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Letting April 27, 2018

Notice to Bidders, Specifications and Proposal

Springfield, Illinois 62764

Contract No. 60C48
COOK County
Section 86S-I-1
Route FAU 3512
Project STP-HPP-KHEE(555)
District 1 Construction Funds

Prepared by

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Checked by

(Printed by authority of the State of Illinois)

Illinois Department of Transportation

NOTICE TO BIDDERS

1. **TIME AND PLACE OF OPENING BIDS.** Electronic bids are to be submitted to the electronic bidding system (iCX-Integrated Contractors Exchange). All bids must be submitted to the iCX system prior to 10:00 a.m. April 27, 2018 at which time the bids will be publicly opened from the iCX SecureVault.

2. **DESCRIPTION OF WORK**. The proposed improvement is identified and advertised for bids in the Invitation for Bids as:

   Contract No. 60C48
   COOK County
   Section 86S-I-1
   Project STP-HPP-KHEE(555)
   Route FAU 3512
   District 1 Construction Funds

Relocation of Pump station 8 on US 14 in the City of Des Plaines.

3. **INSTRUCTIONS TO BIDDERS**. (a) This Notice, the invitation for bids, proposal and letter of award shall, together with all other documents in accordance with Article 101.09 of the Standard Specifications for Road and Bridge Construction, become part of the contract. Bidders are cautioned to read and examine carefully all documents, to make all required inspections, and to inquire or seek explanation of the same prior to submission of a bid.

   (b) State law, and, if the work is to be paid wholly or in part with Federal-aid funds, Federal law requires the bidder to make various certifications as a part of the proposal and contract. By execution and submission of the proposal, the bidder makes the certification contained therein. A false or fraudulent certification shall, in addition to all other remedies provided by law, be a breach of contract and may result in termination of the contract.

4. **AWARD CRITERIA AND REJECTION OF BIDS**. This contract will be awarded to the lowest responsive and responsible bidder considering conformity with the terms and conditions established by the Department in the rules, Invitation for Bids and contract documents. The issuance of plans and proposal forms for bidding based upon a prequalification rating shall not be the sole determinant of responsibility. The Department reserves the right to determine responsibility at the time of award, to reject any or all proposals, to readvertise the proposed improvement, and to waive technicalities.

By Order of the
Illinois Department of Transportation

Randall S. Blankenhorn,
Secretary

INDEX
FOR
SUPPLEMENTAL SPECIFICATIONS
AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2018

This index contains a listing of SUPPLEMENTAL SPECIFICATIONS and frequently used RECURRING SPECIAL PROVISIONS.

ERRATA Standard Specifications for Road and Bridge Construction (Adopted 4-1-16) (Revised 1-1-18)

SUPPLEMENTAL SPECIFICATIONS

RECURRING SPECIAL PROVISIONS

The following RECURRING SPECIAL PROVISIONS indicated by an "X" are applicable to this contract and are included by reference:

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STATE OF ILLINOIS

SPECIAL PROVISIONS

The following Special Provisions supplement the "Standard Specifications for Road and Bridge Construction," adopted April 1, 2016, the latest edition of the “Manual on Uniform Traffic Control Devices” and the “Manual of Test Procedures for Materials” in effect on the date of invitation for bids; and the Supplemental Specifications and Recurring Special Provisions indicated on the Check Sheet included herein which apply to and govern the construction at FAU Route 3512 (US 14), Project STP-HPP-KHEE(555), Section 86 S-I-1, Cook County, Contract No. 60C48, and in case of conflict with any part or parts of said specifications, the said Special Provisions shall take precedence and shall govern.

LOCATION OF IMPROVEMENT

The Project is located along US 14 (Northwest Highway) at the Wisconsin Central LTD Railroad in the City of Des Plaines, Illinois, Cook County.

DESCRIPTION OF IMPROVEMENT

This improvement shall consist of the relocation of the pump station including but not limited to supply of new material, transportation, labor, installation, testing and commissioning, demolition and material removal.

Site work, inlet/outlet discharge mains, concrete work, discharge chamber, reinforcement bars, glass block and masonry work, doors and frame, metal works, single ply roofing, sheet metal work, painting, and maintenance of existing pump station during construction as specified herein.

Further, the improvement shall include the removal of the following equipment from the existing pump station that will be de-commissioned after final acceptance of new pump station: existing pumps including motors, fabricated metal, bowls, impellers and discharge piping, removal of existing heating and ventilation equipment, removal of existing electrical equipment and controls, removal of bubbler system, and demolition of existing superstructure.

The improvement shall also include mechanical work for new submersible wet pit pumps, new heating and ventilating equipment, piping for pump and recirculation system and hoist equipment, electrical and telephone services, and diesel generator set.

The improvement shall also include electric service with metering and connection to the station, telephone service to the station, electrical work for the motor control center (MCC), electrical distribution equipment, control, instrumentation, intrusion AEGIS, fire alarm, lighting, equipment, conduit and wiring, and tagging/labeling, gas detection system, field testing and commissioning, a new Supervisory Control and Data Acquisition (SCADA) System, and verification of SCADA signals at remote end, District 1, IDOT TSC, and Maintenance Contractor’s facility, interfacing, float type level sensing control system, fire alarm panel, control panels, and packaged engine generator systems.

The scope shall include field testing and commissioning of mechanical, heating and ventilation, electrical and SCADA systems.

The Contractor shall furnish, install, maintain and subsequently remove all temporary equipment required to maintain the existing pump station capacity during all work under this contract.

STAGING AND SEQUENCE OF CONSTRUCTION

Construction Staging: The Contractor shall be responsible for and include all work for implementing and maintaining and construction staging as may be required and as described in the Contract Documents and indicated on the Drawings to maintain all pumping capabilities through the relocation work under this Contract. Operation of pumps shall be maintained as described under Division 1, General, Division 15, Mechanical, and Division 16, Electrical, and in order to complete all construction by the completion date specified in the Contract Document and as approved by the Engineer.

The Contractor shall confine his construction operations within the limits of work indicated on the Drawings. In the event the Contractor requires additional area or areas for his constriction operations, he shall be responsible for leasing such additional area or areas. No additional payment will be made for leasing additional area or areas. This expense shall be deemed as included in prices in the Contract.

The Contractor shall obtain all permits, easements or other requirements and shall pay all fees, rent or other expense for easements for access to the work area or for storage of materials, equipment or construction operations. The contractor shall submit shop drawings or proposed access plan and for such additional areas, as he may require, to the Engineer for approval before commencing construction. No separate measurements or payment will be made for providing, maintaining and restoring any areas used for access or other construction operations.

In general, the work described herein and on the Drawings shall not be considered as all-inclusive and will not be listed in order but only to give a brief description of the work required and which shall be executed concurrently under this Contract.

The Contractor shall prepare and submit to the Engineer for approval his proposed sequence of operations for the relocation of the Pump Station. The submittal shall include all details and descriptions for the work under this Contract including, but not limited to, maintenance of electric service to existing pump station; existing pumps; maintenance of pumping capacity as specified in the Contract Documents; protection of existing and new equipment during all relocation work; demolition sequence; reconstruction sequence; the proposed construction schedule indicating critical path the Contractor proposes to pursue on all work under this Contract; and all matters relating to this Contract. The submittal shall be a form acceptable to the State and shall be subject to approval by the State.

COMPLETION DATE

The Contractor shall schedule his operation so as to complete all work for the relocation of Pump Station No. 8 on or before, **August 28, 2020**, except as specified herein.

The Contractor will be allowed to complete all clean-up work and punch list items within ***10 working days*** after the completion date.

This completion is based upon an expedited work schedule.

Article 108.09 or the Special Provision for "Failure to Complete the Work on Time", if included in this contract, shall apply to both the completion date and the number of working days.

FAILURE TO COMPLETE THE WORK ON TIME

Should the Contractor fail to complete the work on or before the specified completion date or within such extended time as may be allowed, the Contractor shall be liable to the Department in the amount as defined in Section 108.09 of the Standard Specifications, not as a penalty but as liquidated damages, for each calendar day or a portion thereof, of overrun in the Contract time or such extended time as may have been allowed.

A calendar day is every day on the calendar and starts at 12:00 midnight and ends at the following 12:00 midnight, twenty-four hours later.

PRE-BID SITE INSPECTION OF PUMP STATION

The existing Pump Station No. 8 site will be open for Contractor's inspection ten (10) days prior to the bid opening. A representative of the State will be on hand during this stated time period. In the event the date or time is not suitable, an alternative inspection date and time can be arranged with Mr. Naser Gholeh of IDOT's Bureau of Electrical Operations, Maintenance Division, at (847) 221-3089.

CONTRACTOR COOPERATION

The attention of the Contractor is directed to the fact that other contracts are or may be in force that adjoins the limits of this project. The Contractor shall cooperate with the other contractors in the phasing and performance of his work so as not to delay, interrupt or hinder the progress or completion of work being performed by the other contractors.

No additional compensation will be allowed this Contractor for compliance with the above requirements, nor for any delays or inconvenience resulting from the activities of the other contractors.

PROGRESS SCHEDULE

Time is of the essence in this Contract. It may be necessary for the Contractor to work longer hours, use additional crews, and work during weekends in order to complete the work within the required time limit. The Contractor shall submit a Critical Path Method (CPM) Progress Schedule for the Engineer's approval before the work can be started.

In the event the Contractor falls more than three (3) days behind the approved progress schedule, the Contractor shall work seven (7) days a week at extended hours in order to meet the specified Completion Date.

The Contractor will not be allowed any extra compensation for working longer hours or using extra shifts; and working on weekends or during holidays; working during winter months, etc., to meet the specified Completion Date.

STATUS OF UTILITIES (D-1)
Effective: June 1, 2016

Utility companies and/or municipal owners located within the construction limits of this project have provided the following information in regard to their facilities and the proposed improvements. The tables below contain a description of specific conflicts to be resolved and/or facilities which will require some action on the part of the Department’s contractor to proceed with work. Each table entry includes an identification of the action necessary and, if applicable, the estimated duration required for the resolution.

UTILITIES TO BE ADJUSTED

Conflicts noted below have been identified by following the suggested staging plan included in the contract. The company has been notified of all conflicts and will be required to obtain the necessary permits to complete their work; in some instances resolution will be a function of the construction staging. The responsible agency must relocate or complete new installations as noted in the action column; this work has been deemed necessary to be complete for the Department’s contractor to then work in the stage under which the item has been listed.

All stationing used in the stage/location column in the tables below correspond to the SW-series of drawings.

STAGE / LOCATION	TYPE	DESCRIPTION	OWNER	ACTION
Area north of US-14 and at US-14 / Railroad crossing	Telephone	The Contractor is alerted that there is an underground telephone line that will be in the immediate area of the proposed inlet sewer manholes and north of US-14 at the forcemain crossing and in the area of the conduits for ComEd primary conductors. Telephone line is in the IDOT ROW and shall be adjusted as no cost to IDOT.	**AT&T**	Relocate telephone line as required to accommodate new forcemain, inlet sewer, sewer manhole construction, and primary conduits for ComEd.

The following contact information is what was used during the preparation of the plans as provided by the owner of the facility.

Agency/Company Responsible to Resolve Conflict	Name of contact	Address	Phone	e-mail address
AT&T	Bruce Robbins	AT&T 1000 Commerce Dr, Oak Brook, Il 60523	630-573-6471 & 815-412-5254	br1831@att.com

UTILITIES TO BE WATCHED AND PROTECTED

The areas of concern noted below have been identified by following the suggested staging plan included for the contract. The information provided is not a comprehensive list of all remaining utilities, but those which during coordination were identified as ones which might require the Department's contractor to take into consideration when making the determination of the means and methods that would be required to construct the proposed improvement. In some instances the contractor will be responsible to notify the owner in advance of the work to take place so necessary staffing on the owners part can be secured.

Pump Station

Area north of the pump station and south of US-14	Gas	The Contractor is alerted that there is an underground gas main that will be in the immediate area of the proposed pump station.	**Nicor**	Nicor gas main shall be protected from damage by the Contractor during construction
US Rte. 14:_Sta. 114+50, 20' RT	Gas Main	The Contractor is alerted that there is an underground gas main that will be in the immediate area of proposed MH #200.	**Nicor Gas**	Nicor gas main shall be protected from damage by the Contractor during construction
Area west of the proposed pump station	Gas	The Contractor is alerted that there is an underground gas main that will be in the immediate area of the generator	**Nicor**	Nicor gas main shall be protected from damage by the Contractor during construction
Area east of the proposed pump station	Gas	The Contractor is alerted that there is an underground gas main that will be in the immediate area of the jacking pits	**North Shore**	North Shore gas main shall be protected from damage by the Contractor during construction
Area east of the proposed pump station	Electric	The Contractor is alerted that there is an underground duct bank that will be in the immediate area of the pump station and jacking pits	**ComEd**	ComEd duct bank shall be protected from damage by the Contractor during construction
Area north of US-14	Water	The Contractor is alerted that there is an underground water main that will be in the immediate area of the forcemain connection to the existing manhole	**City of Des Plaines**	City water main shall be protected from damage by the Contractor during construction
Area north of US-14	Electric	The Contractor is alerted that there is a manhole, underground duct banks, poles and overhead lines that will be in the immediate area of the receiving pits and forcemain	**ComEd**	ComEd manhole, duct banks, poles and overhead lines shall be protected from damage by the Contactor during construction.

Stage 1

STAGE / LOCATION	TYPE	DESCRIPTION	OWNER	ACTION
US Rte. 14 • Sta. 115+50, RT to Sta. 117+80, RT	Overhead Transmission Lines	The Contractor is alerted there are overhead transmission lines across US Rte. 14 as a precaution for Construction Equipment.	**ComEd**	To be watched and protected
US Rte. 14 • Sta. 114+36, 20' RT to Sta. 114+65, 88' RT • Sta. 116+32, 27' RT to Sta. 117+85, 33' RT	Underground Electric Lines	The Contractor is alerted there are underground electric lines along the south side of US Rte. 14 as a precaution for Construction Equipment.	**Unknown**	To be watched and protected
US Rte. 14 • Sta. 114+36, 24' RT to Sta. 117+85, 22' RT	Gas Main	The Contractor is alerted there is an underground gas line as a precaution to be watched and protected.	**Nicor Gas**	To be watched and protected
US Rte. 14 • Sta. 114+95, 39.6' RT	Gas Main	The Contractor is alerted there is an underground gas main as a precaution to be watched and protected.	**North Shore Gas**	To be watched and protected

Stage 2

STAGE / LOCATION	TYPE	DESCRIPTION	OWNER	ACTION
US Rte. 14 • Sta. 117+00, RT to Sta. 118+00, RT	Overhead Transmission Lines	The Contractor is alerted there are overhead Transmission Lines across US Rte. 14 as a precaution for Construction Equipment.	**ComEd**	To be watched and protected
US Rte. 14 • Sta. 117+68, 29' LT to Sta. 118+00, 9' RT	Water main	The Contractor is alerted there is an underground water main as a precaution to be watched and protected	**City of Des Plaines**	To be watched and protected
US Rte. 14 • Sta. 117+00, 22' RT to Sta. 118+00, 22' RT	Gas Main	The Contractor is alerted there is an underground gas main as a precaution to be watched and protected.	**Nicor Gas**	To be watched and protected
US Rte. 14 • Sta. 117+00, 30' RT to Sta. 118+00, 34' RT	Underground Electric Lines	The Contractor is alerted there are underground electric lines as a precaution to be watched and protected.	**Unknown**	To be watched and protected

Stage 3

STAGE / LOCATION	TYPE	DESCRIPTION	OWNER	ACTION
US Rte. 14 • Sta. 117+00, RT to Sta. 118+00, LT	Overhead Transmission Lines	The Contractor is alerted there are overhead Transmission Lines across US Rte. 14 as a precaution for Construction Equipment.	**ComEd**	To be watched and protected
US Rte. 14 • Sta. 117+68, 29' LT to Sta. 118+00, 9'RT	Water main	The Contractor is alerted there is an underground water main as a precaution to be watched and protected	**City of Des Plaines**	To be watched and protected
US Rte. 14 • Sta. 117+47, 22' LT to Sta. 118+15, 25' LT	Underground Telephone line	The Contractor is alerted there is an underground telephone line as a precaution to be watched and protected	**AT&T**	To be watched and protected
US Rte. 14 • Sta. 114+36, 24' RT to 88' RT	Underground Electric Lines	The Contractor is alerted there is an underground electric line along the south side of US Rte. 14 as a precaution for Construction Equipment.	**Unknown**	To be watched and protected
US Rte. 14 • Sta. 113+67, 22' RT to 76' RT • Sta. 113+67, 22' RT to Sta. 114+36, 24' RT	Gas Main	The Contractor is alerted there is an underground gas line as a precaution to be watched and protected.	**Nicor Gas**	To be watched and protected

The following contact information is what was used during the preparation of the plans as provided by the owner of the facility.

Agency/Company Responsible to Resolve Conflict	Name of contact	Address	Phone	e-mail address
AT&T	Bruce Robbins	AT&T 1000 Commerce Dr, Oak Brook, Il 60523	630-573-6471 & 815-412-5254	br1831@att.com
Nicor	Bruce Koppang	Nicor Gas 1844 Ferry Rd. Naperville, IL 60563	630-388-3046 & 708	bkoppan@southernco.com
North Shore Gas	Eric Frank & Jay Hammer	North Shore Gas, 3001 Grand Avenue Waukegan, Illinois 60085	847-263-4680 & 847-263-467	ejfrank@northshoregasdelivery.com & JRHammer@northshoregasdelivery.com
Commonwealth Edison	Joseph Sakanis & Angela Harrell	ComEd, One Lincoln Centre Oakbrook Terrace, IL 60181	630-691-4857 & (224) 422-7142	Joseph.Sakanis@ComEd.com & angela.harrell@ComEd.com
City of Des Plaines	Tim Watkins & Jon Duddles	Public Works and Engineering City of Des Plaines 1420 Miner Street, Des Plaines, IL 60016	847-391-5468 & 847-391-6127	twatkins@desplaines.org & jduddles@desplaines.org

The above represents the best information available to the Department and is included for the convenience of the bidder. The days required for conflict resolution should be taken into account in the bid as this information has also been factored into the timeline identified for the project when setting the completion date. The applicable portions of the Standard Specifications for Road and Bridge Construction shall apply.

Estimated duration of time provided in the action column for the first conflicts identified will begin on the date of the executed contract regardless of the status of the utility relocations. The responsible agencies will be working toward resolving subsequent conflicts in conjunction with contractor activities in the number of days noted.

The estimated relocation dates must be part of the progress schedule submitted by the contractor. A utility kickoff meeting will be scheduled between the Department, the Department's contractor and the utility companies. The Department's contractor is responsible for contacting J.U.L.I.E. prior to any and all excavation work.

EXISTING UTILTIES

The Contractor shall familiarize themselves with the locations of all utilities and structures that may be found in the vicinity of the construction. The Contractor shall conduct his operations to avoid damage to the above-mentioned utilities and structures. Should any damage occur due to the Contractor's negligence, repairs shall be made by the Contractor at their expense in a manner acceptable to the Engineer.

The Contractor shall notify all utility owners of their construction schedule and shall coordinate constructions operations with utility owners so that relocation of utility lines and structures may proceed in an orderly manner. Notification shall be in writing, with copies transmitted to the Engineer.

COORDINATION WITH ADJACENT AND/OR OVERLAPPING CONTRACTS

This contract overlaps with other concurrent and/or future contracts as listed below. The Contractor will be governed by Article 105.08 of the Standard Specifications. The Contractor shall cooperate with the other contractors in the phasing and performance of his work so as not to delay, interrupt or hinder the progress or completion of work being performed by the other contractors.

No additional compensation will be allowed this Contractor for compliance with the above requirements, nor for any delays or inconvenience resulting from the activities of the other contractors.

C**ontract No. 60T49**
Improvement: Resurfacing and Drainage Improvements

Add the following to Article 105.08:

The Contractor shall identify all such activities at the beginning of the contract and coordinate the sequence and timing of their execution and completion with the other Contractors through the Engineer. All of these work items shall be identified as separate line items in the Contractor's proposed Construction Progress Schedule. The Contractor shall submit to the Resident Engineer a daily work schedule for the purpose of coordinating the Contractor's activities for the next working day. The daily work schedule must be submitted by 3:00 p.m. the day prior. This schedule is necessary and shall be used by the Engineer to schedule inspections, material testing and checking of layout as part of the following day's work. Failure to submit a schedule may result in uninspected work and therefore considered unacceptable.

The daily schedule shall include the Contractor's or Sub-Contractor's planned work for that day including the location, description, scheduled work hours and pay items of work to be performed. The schedule shall also include any material testing requests, layout check requests and all traffic control measures to be implemented for that day's work.

Additional compensation or the extension of contract time will not be allowed for work items where progress is affected due to the lack of coordination with other Contractors or failure to submit daily work schedules by the Contractor.

REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES

This work shall be according to Article 669 of the Standard Specifications and the following:

Qualifications. The term environmental firm shall mean an environmental firm with at least five (5) documented leaking underground storage tank (LUST) cleanups or that is pre-qualified in hazardous waste by the Department. Documentation includes but not limited to verifying remediation and special waste operations for sites contaminated with gasoline, diesel, or waste oil in accordance with all Federal, State, or local regulatory requirements and shall be provided to the Engineer for approval. The environmental firm selected shall not be a former or current consultant or have any ties with any of the properties contained within and/or adjacent to this construction project.

General. This **Revised Special Provision** will likely require the Contractor to subcontract for the execution of certain activities.

All contaminated materials shall be managed as either "uncontaminated soil" or non-special waste. This work shall include monitoring and potential sampling, analytical testing, and management of a material contaminated by regulated substances. The Environmental Firm shall continuously monitor all soil excavation for worker protection and soil contamination. **Phase I Preliminary Engineering information is available through the District's Environmental Studies Unit.** Soil samples or analysis without the approval of the Engineer will be at no additional cost to the Department. The lateral distance is measured from centerline and the farthest distance is the offset distance or construction limit whichever is less.

The Contractor shall manage any excavated soils and sediment within the following areas:

Site 3036-4 (Utility Corridor)

- Station 113+30 to 113+95 (CL US Route 14 / Northwest Highway), 0 to 35 feet RT (Utility Corridor, PESA Site 3036-4, 1000 block of Northwest Highway, Des Plaines). This material meets the criteria of Article 669.09(a)(5) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameter: VOCs, Arsenic and Manganese.
- Station 113+95 to 115+20 (CL US Route 14 / Northwest Highway), 0 to 45 feet RT (Utility Corridor, PESA Site 3036-4, 1000 block of Northwest Highway, Des Plaines). This material meets the criteria of Article 669.09(a)(2) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameter: Arsenic and Manganese.
- Station 115+20 to 115+65 (CL US Route 14 / Northwest Highway), 0 to 55 feet RT (Utility Corridor, PESA Site 3036-4, 1000 block of Northwest Highway, Des Plaines). This material meets the criteria of Article 669.09(a)(5) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameter: VOCs and Manganese.
- Station 115+65 to 118+10 (CL US Route 14 / Northwest Highway), 0 to 65 feet RT (Utility Corridor, PESA Site 3036-4, 1000 block of Northwest Highway, Des Plaines). This material meets the criteria of Article 669.09(a)(2) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameter: Manganese.

Site 3036-5 (Union Pacific Railroad)

- Station 118+10 to 118+50 (CL US Route 14 / Northwest Highway), 0 to 65 feet RT (Union Pacific Railroad, PESA Site 3036-5, 1000 block of Northwest Highway, Des Plaines). This material meets the criteria of Article 669.09(a)(2) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameter: Manganese.

GEOTECHNICAL REPORT

Refer to GEOTECHNICAL REPORT in the additional information section of the web site.

SPECIAL PROVISIONS FOR CIVIL AND DRAINAGE
MAINTENANCE OF ROADWAYS

Effective: September 30, 1985 Revised: November 1, 1996

Beginning on the date that work begins on this project, the Contractor shall assume responsibility for normal maintenance of all existing roadways within the limits of the improvement. This normal maintenance shall include all repair work deemed necessary by the Engineer, but shall not include snow removal operations. Traffic control and protection for maintenance of roadways will be provided by the Contractor as required by the Engineer.

If items of work have not been provided in the contract, or otherwise specified for payment, such items, including the accompanying traffic control and protection required by the Engineer, will be paid for in accordance with Article 109.04 of the Standard Specifications.

TRAFFIC CONTROL PLAN
Effective: September 30, 1985 Revised: January 1, 2007

Traffic Control shall be according to the applicable sections of the Standard Specifications, the Supplemental Specifications, the "Illinois Manual on Uniform Traffic Control Devices for Streets and Highways", any special details and Highway Standards contained in the plans, and the Special Provisions contained herein.

Special attention is called to Article 107.09 of the Standard Specifications and the following Highway Standards, Details, Quality Standard for Work Zone Traffic Control Devices, Recurring Special Provisions and Special Provisions contained herein, relating to traffic control.

The Contractor shall contact the District One Bureau of Traffic at least 72 hours in advance of beginning work.

STANDARDS:

701101	Off-Rd Operations, Multi Lane, 15’ (4.5 m) to 24” (600 mm) from Pavement Edge
701427	Lane Closure, Multilane, Intermittent or Moving Operation, for Speeds ≤ 40 MPH
701606	Urban Lane Closure, Multilane 2 Way with Mountable Median
701611	Urban Half Road Closure, Multilane 2 Way with Mountable Median
701901	Traffic Control Devices

DETAILS:

TC-10	Traffic Control and Protection for Side Roads, Intersections and Driveways
TC-11	Raised Reflective Pavement Markers (Snow Plow Resistant)
TC-13	District One Typical Pavement Markings
TC-22	Arterial Road Information Sign
TC-26	Driveway Entrance Signing

SPECIAL PROVISIONS:
Maintenance of Roadways
Traffic Control Plan
Traffic Control and Protection (Arterials)
Keeping Arterial Roadways Open to Traffic (Lane Closures Only)
Temporary Information Signing
Public Convenience and Safety (District-1)
Maintenance of Existing Traffic Signal and Flashing Beacon Installation
Equipment Parking and Storage (BDE)
Lights on Barricades (BDE)
Pavement Marking Removal (BDE)
Temporary Pavement Marking (BDE)

TRAFFIC CONTROL AND PROTECTION (ARTERIALS)
Effective: February 1, 1996 Revised: March 1, 2011

Specific traffic control plan details and Special Provisions have been prepared for this contract. This work shall include all labor, materials, transportation, handling and incidental work necessary to furnish, install, maintain and remove all traffic control devices required as indicated in the plans and as approved by the Engineer.

When traffic is to be directed over a detour route, the Contractor shall furnish, erect, maintain and remove all applicable traffic control devices along the detour route according to the details shown in the plans.

Method of Measurement: All traffic control (except "Traffic Control and Protection (Expressways)" and temporary pavement markings) indicated on the traffic control plan details and specified in the Special Provisions will be measured for payment on a lump sum basis.

Basis of Payment: All traffic control and protection will be paid for at the contract lump sum price for TRAFFIC CONTROL AND PROTECTION (SPECIAL).

Temporary pavement markings will be paid for separately unless shown on a Standard.

KEEPING ARTERIAL ROADWAYS OPEN TO TRAFFIC (LANE CLOSURES ONLY)
Effective: January 22, 2003 Revised: August 10, 2017

The Contractor shall provide the necessary traffic control devices to warn the public and to delineate the work zone as required in these Special Provisions, the Standard Specifications, the State Standards, and the District Details.

Arterial lane closures shall be in accordance with the Standard Specifications, Highway Standards, District Details, and the direction of the Engineer. The Contractor shall request and gain approval from the Engineer seventy–two (72) hours in advance of all long-term (24 hrs. or longer) lane closures.

Arterial lane closures not shown in the staging plans will not be permitted during **peak traffic volume hours**.

Peak traffic volume hours are defined as weekdays (Monday through Friday) from
6:00 AM to 9:00 AM and 3:00 PM to 6:00 PM.

Private vehicles shall not be parked in the work zone. Contractor's equipment and/or vehicles shall not be parked on the shoulders or in the median during non-working hours. The parking of equipment and/or vehicles on State right-of-way will only be permitted at locations approved by the Engineer in accordance with Articles 701.08 and 701.11 of the Standard Specifications.

Should the Contractor fail to completely open and keep open all the traffic lanes to traffic in accordance with the limitations specified above, the Contractor shall be liable to the Department for the amount of:

One lane or ramp blocked = $1,000
Two lanes blocked = $2,500

Not as a penalty but as liquidated and ascertained damages for each and every 15 minute interval or a portion thereof that a lane is blocked outside the allowable time limitations. Such damages may be deducted by the Department from any monies due the Contractor. These damages shall apply during the contract time and during any extensions of the contract time.

TEMPORARY INFORMATION SIGNING
Effective: November 13, 1996 Revised: January 2, 2007

Description.
This work shall consist of furnishing, installing, maintaining, relocating for various states of construction and eventually removing temporary informational signs. Included in this item may be ground mount signs, skid mount signs, truss mount signs, bridge mount signs, and overlay sign panels which cover portions of existing signs.

Materials.
Materials shall be according to the following Articles of Section 1000 - Materials:

	Item	Article/Section
a.)	Sign Base (Notes 1 & 2)	1090
b.)	Sign Face (Note 3)	1091
c.)	Sign Legends	1092
d.)	Sign Supports	1093
e.)	Overlay Panels (Note 4)	1090.02

Note 1. The Contractor may use 5/8 inch (16 mm) instead of 3/4 inch (19 mm) thick plywood.
Note 2. Type A sheeting can be used on the plywood base.
Note 3. All sign faces shall be Type A except all orange signs shall meet the requirements of Article 1106.01.
Note 4. The overlay panels shall be 0.08 inch (2 mm) thick.

GENERAL CONSTRUCTION REQUIRMENTS

Installation.
The sign sizes and legend sizes shall be verified by the Contractor prior to fabrication.

Signs which are placed along the roadway and/or within the construction zone shall be installed according to the requirements of Article 701.14 and Article 720.04. The signs shall be 7 ft (2.1 m) above the near edge of the pavement and shall be a minimum of 2 ft (600 mm) beyond the edge of the paved shoulder. A minimum of two (2) posts shall be used.

The attachment of temporary signs to existing sign structures or sign panels shall be approved by the Engineer. Any damage to the existing signs due to the Contractor's operations shall be repaired or signs replaced, as determined by the Engineer, at the Contractor's expense.

Signs which are placed on overhead bridge structures shall be fastened to the handrail with stainless steel bands. These signs shall rest on the concrete parapet where possible. The Contractor shall furnish mounting details for approval by the Engineer.

Method of Measurement.
This work shall be measured for payment in square feet (square meters) edge to edge (horizontally and vertically).

All hardware, posts or skids, supports, bases for ground mounted signs, connections, which are required for mounting these signs will be included as part of this pay item.

Basis of Payment.
This work shall be paid for at the contract unit price per square foot (square meter) for TEMPORARY INFORMATION SIGNING.

PUBLIC CONVENIENCE AND SAFETY (DIST-1)

Effective: May 1, 2012 Revised: July 15, 2012

Add the following to the end of the fourth paragraph of Article 107.09:

“If the holiday is on a Saturday or Sunday, and is legally observed on a Friday or Monday, the length of Holiday Period for Monday or Friday shall apply.”

Add the following sentence after the Holiday Period table in the fourth paragraph of Article 107.09:

“The Length of Holiday Period for Thanksgiving shall be from 5:00 AM the Wednesday prior to 11:59 PM the Sunday after.”

Delete the fifth paragraph of Article 107.09 of the Standard Specifications:

"On weekends, excluding holidays, roadways with Average Daily Traffic of 25,000 or greater, all lanes shall be open to traffic from 3:00 P.M. Friday to midnight Sunday except where structure construction or major rehabilitation makes it impractical."

MAINTENANCE OF EXISTING TRAFFIC SIGNAL AND FLASHING BEACON INSTALLATION
Effective: May 22, 2002 Revised: July 1, 2015
850.01TS

General.

1. Full maintenance responsibility shall start as soon as the Contractor begins any physical work on the Contract or any portion thereof. If Contract work is started prior to a traffic signal inspection, maintenance of the traffic signal installation(s) will be transferred to the Contractor without an inspection.

2. The Contractor shall have electricians with IMSA Level II certification on staff to provide signal maintenance. A copy of the certification shall be immediately available upon request of the Engineer.

3. This item shall include maintenance of all traffic signal equipment and other connected and related equipment such as flashing beacons, emergency vehicle pre-emption equipment, master controllers, uninterruptable power supply (UPS and batteries), PTZ cameras, vehicle detection, handholes, lighted signs, telephone service installations, communication cables, conduits to adjacent intersections, and other traffic signal equipment.

4. Regional transit, County and other agencies may also have equipment connected to existing traffic signal or peripheral equipment such as PTZ cameras, switches, transit signal priority (TSP and BRT) servers, radios and other devices that shall be included with traffic signal maintenance at no additional cost to the contract.

5. Maintenance shall not include Automatic Traffic Enforcement equipment, such as Red Light Enforcement cameras, detectors, or peripheral equipment. This equipment is operated and maintained by the local municipality and should be de-activated while on contractor maintenance.

6. The energy charges for the operation of the traffic signal installation shall be paid for by the Contractor.

Maintenance.

1. The Contractor shall check all controllers every two (2) weeks, which will include visually inspecting all timing intervals, relays, detectors, and pre-emption equipment to ensure that they are functioning properly. The Contractor shall check signal system communications and phone lines to assure proper operation. This item includes, as routine maintenance, all portions of emergency vehicle pre-emption equipment. The Contractor shall maintain in stock at all times a sufficient amount of materials and equipment to provide effective temporary and permanent repairs. Prior to the traffic signal maintenance transfer, the contractor shall supply a detailed maintenance schedule that includes dates, locations, names of electricians providing the required checks and inspections along with any other information requested by the Engineer.

2. The Contractor is advised that the existing and/or span wire traffic signal installation must remain in operation during all construction stages, except for the most essential down time. Any shutdown of the traffic signal installation, which exceeds fifteen (15) minutes, must have prior approval of the Engineer. Approval to shut down the traffic signal installation will only be granted during the period extending from 10:00 a.m. to 3:00 p.m. on weekdays. Shutdowns shall not be allowed during inclement weather or holiday periods.

3. The Contractor shall provide immediate corrective action when any part or parts of the system fail to function properly. Two far side heads facing each approach shall be considered the minimum acceptable signal operation pending permanent repairs. When repairs at a signalized intersection require that the controller be disconnected or otherwise removed from normal operation, and power is available, the Contractor shall place the traffic signal installation on flashing operation. The signals shall flash RED for all directions unless a different indication has been specified by the Engineer. The Contractor shall be required to place stop signs (R1-1-36) at each approach of the intersection as a temporary means of regulating traffic. When the signals operate in flash, the Contractor shall furnish and equip all their vehicles assigned to the maintenance of traffic signal installations with a sufficient number of stop signs as specified herein. The Contractor shall maintain a sufficient number of spare stop signs in stock at all times to replace stop signs which may be damaged or stolen.

4. The Contractor shall provide the Engineer with 2 (two) 24 hour telephone numbers for the maintenance of the traffic signal installation and for emergency calls by the Engineer.

5. Traffic signal equipment which is lost or not returned to the Department for any reason shall be replaced with new equipment meeting the requirements of the Standard Specifications and these special provisions.

6. The Contractor shall respond to all emergency calls from the Department or others within one (1) hour after notification and provide immediate corrective action. When equipment has been damaged or becomes faulty beyond repair, the Contractor shall replace it with new and identical equipment. The cost of furnishing and installing the replaced equipment shall be borne by the Contractor at no additional charge to the contract. The Contractor may institute action to recover damages from a responsible third party. If at any time the Contractor fails to perform all work as specified herein to keep the traffic signal installation in proper operating condition or if the Engineer cannot contact the Contractor's designated personnel, the Engineer shall have the State's Electrical Maintenance Contractor perform the maintenance work. The Contractor shall be responsible for all of the State's Electrical Maintenance Contractor's costs and liquidated damages of $1000 per day per occurrence. The State's Electrical Maintenance Contractor shall bill the Contractor for the total cost of the work. The Contractor shall pay this bill within thirty (30) days of the date of receipt of the invoice or the cost of such work will be deducted from the amount due the Contractor. The Contractor shall allow the Electrical Maintenance Contractor to make reviews of the Existing Traffic Signal Installation that has been transferred to the Contractor for Maintenance.

7. Any proposed activity in the vicinity of a highway-rail grade crossing must adhere to the guidelines set forth in the current edition of the Manual on Uniform Traffic Control Devices (MUTCD) regarding work in temporary traffic control zones in the vicinity of highway-rail grade crossings which states that lane restrictions, flagging, or other operations shall not create conditions where vehicles can be queued across the railroad tracks. If the queuing of vehicles across the tracks cannot be avoided, a uniformed law enforcement officer or flagger shall be provided at the crossing to prevent vehicles from stopping on the tracks, even if automatic warning devices are in place.

8. Equipment included in this item that is damaged or not operating properly from any cause shall be replaced with new equipment meeting current District One traffic signal specifications and provided by the Contractor at no additional cost to the Contract and/or owner of the traffic signal system, all as approved by the Engineer. Final replacement of damaged equipment must meet the approval of the Engineer prior to or at the time of final inspection otherwise the traffic signal installation will not be accepted. Cable splices outside the controller cabinet shall not be allowed.

9. Automatic Traffic Enforcement equipment, such as Red Light Enforcement cameras, detectors, and peripheral equipment, damaged or not operating properly from any cause, shall be the responsibility of the municipality or the Automatic Traffic Enforcement Company per Permit agreement.

10. The Contractor shall be responsible to clear snow, ice, dirt, debris or other condition that obstructs visibility of any traffic signal display or access to traffic signal equipment.

11. The Contractor shall maintain the traffic signal in normal operation during short or long term loss of utility or battery back-up power at critical locations designated by the Engineer. Critical locations may include traffic signals interconnected to railroad warning devices, expressway ramps, intersection with an SRA route, critical corridors or other locations identified by the Engineer. Temporary power to the traffic signal must meet applicable NEC and OSHA guidelines and may include portable generators and/or replacement batteries. Temporary power to critical locations shall not be paid for separately but shall be included in the contract.

12. Temporary replacement of damaged or knockdown of a mast arm pole assembly shall require construction of a full or partial span wire signal installation or other method approved by the Engineer to assure signal heads are located overhead and over traveled pavement. Temporary replacement of mast arm mount signals with post mount signals will not be permitted.

Basis of Payment.
This work will be paid for at the contract unit price per each for MAINTENANCE OF EXISTING TRAFFIC SIGNAL INSTALLATION. Each intersection will be paid for separately. Maintenance of a standalone and or not connected flashing beacon shall be paid for at the contract unit price for MAINTENANCE OF EXISITNG FLASHING BEACON INSTALLATION. Each flashing beacon will be paid for separately.

AGGREGATE FOR CONCRETE BARRIER (DISTRICT ONE)
Effective: February 11, 2004 Revised: January 24, 2008

Add the following paragraph to Article 637.02 of the Standard Specifications:

"The coarse aggregate to be used in the concrete barrier walls shall conform to the requirement for coarse aggregate used in Class BS concrete according to Article 1004.01(b), paragraph 2."

COARSE AGGREGATE FOR BACKFILL, TRENCH BACKFILL AND BEDDING (D-1)
Effective: November 1, 2011
Revised: November 1, 2013

This work shall be according to Section 1004.05 of the Standard Specifications except for the following:

Reclaimed Asphalt Pavement (RAP) maybe blended with gravel, crushed gravel, crushed stone crushed concrete, crushed slag, chats, crushed sand stone or wet bottom boiler slag. The RAP used shall be according to the current Bureau of Materials and Physical Research Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications". The RAP shall be uniformly graded and shall pass the 1.0 in. (25 mm) screen. When RAP is blended with any of the coarse aggregate listed above, the blending shall be done mechanically with calibrated feeders. The feeders shall have an accuracy of $\pm$ 2.0 percent of the actual quantity of material delivered. The final blended product shall not contain more than 40 percent by weight RAP.

The coarse aggregate listed above shall meet CA 6 and CA 10 gradations prior to being blended with the processed and uniformly graded RAP. Gradation deleterious count shall not exceed 10% of total RAP and 5% of other by total weight.

FRICTION AGGREGATE (D-1)
Effective: January 1, 2011 Revised: April 29, 2016

Revise Article 1004.03(a) of the Standard Specifications to read:

"**1004.03 Coarse Aggregate for Hot-Mix Asphalt (HMA).** The aggregate shall be according to Article 1004.01 and the following.

(a) Description. The coarse aggregate for HMA shall be according to the following table.

Use	Mixture	Aggregates Allowed
Class A	Seal or Cover	Allowed Alone or in Combination [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag Crushed Concrete
HMA Low ESAL	Stabilized Subbase or Shoulders	Allowed Alone or in Combination [5/]: Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[1/] Crushed Concrete
HMA High ESAL Low ESAL	Binder IL-19.0 or IL-19.0L SMA Binder	Allowed Alone or in Combination [5/ 6/]: Crushed Gravel Carbonate Crushed Stone[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Concrete[3/]
HMA High ESAL Low ESAL	C Surface and Leveling Binder IL-9.5 or IL-9.5L SMA Ndesign 50 Surface	Allowed Alone or in Combination [5/]: Crushed Gravel Carbonate Crushed Stone[2/] Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag[4/] Crushed Concrete[3/]

<table>
<tr><th>Use</th><th>Mixture</th><th colspan="2">Aggregates Allowed</th></tr>
<tr><td rowspan="5">HMA
High ESAL</td><td rowspan="5">D Surface and Leveling Binder IL-9.5

SMA
Ndesign 50
Surface</td><td colspan="2"><u>Allowed Alone or in Combination</u> [5/]:

Crushed Gravel
Carbonate Crushed Stone (other than Limestone)[2/]
Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag[4/]
Crushed Concrete[3/]</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed:</u></td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>25% Limestone</td><td>Dolomite</td></tr>
<tr><td>50% Limestone</td><td>Any Mixture D aggregate other than Dolomite</td></tr>
<tr><td>75% Limestone</td><td>Crushed Slag (ACBF) or Crushed Sandstone</td></tr>
<tr><td rowspan="6">HMA
High ESAL</td><td rowspan="6">E Surface
IL-9.5

SMA
Ndesign 80
Surface</td><td colspan="2"><u>Allowed Alone or in Combination</u> [5/ 6/]:

Crystalline Crushed Stone
Crushed Sandstone
Crushed Slag (ACBF)
Crushed Steel Slag

No Limestone.</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed:</u></td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>50% Dolomite[2/]</td><td>Any Mixture E aggregate</td></tr>
<tr><td>75% Dolomite[2/]</td><td>Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone</td></tr>
<tr><td>75% Crushed Gravel[2/] or Crushed Concrete[3/]</td><td>Crushed Sandstone, Crystalline Crushed Stone, Crushed Slag (ACBF), or Crushed Steel Slag</td></tr>
</table>

Use	Mixture	Aggregates Allowed	
HMA High ESAL	F Surface IL-9.5 SMA Ndesign 80 Surface	<u>Allowed Alone or in Combination</u> [5/ 6/]: Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag No Limestone.	
		<u>Other Combinations Allowed</u>:	
		Up to...	*With...*
		50% Crushed Gravel[2/], Crushed Concrete[3/], or Dolomite[2/]	Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone

1/ Crushed steel slag allowed in shoulder surface only.
2/ Carbonate crushed stone (limestone) and/or crushed gravel shall not be used in SMA Ndesign 80. In SMA Ndesign 50, carbonate crushed stone shall not be blended with any of the other aggregates allowed alone in Ndesign 50 SMA binder or Ndesign 50 SMA surface.
3/ Crushed concrete will not be permitted in SMA mixes.
4/ Crushed steel slag shall not be used as leveling binder.
5/ When combinations of aggregates are used, the blend percent measurements shall be by volume."
6/ Combining different types of aggregate will not be permitted in SMA Ndesign 80."

GROUND TIRE RUBBER (GTR) MODIFIED ASPHALT BINDER (D-1)
Effective: June 26, 2006 Revised: April 1, 2016

Add the following to the end of Article 1032.05 of the Standard Specifications:

"(c) Ground Tire Rubber (GTR) Modified Asphalt Binder. A quantity of 10.0 to 14.0 percent GTR (Note 1) shall be blended by dry unit weight with a PG 64-28 to make a GTR 70-28 or a PG 58-28 to make a GTR 64-28. The base PG 64-28 and PG 58-28 asphalt binders shall meet the requirements of Article 1032.05(a). Compatible polymers may be added during production. The GTR modified asphalt binder shall meet the requirements of the following table.

Test	Asphalt Grade GTR 70-28	Asphalt Grade GTR 64-28
Flash Point (C.O.C.), AASHTO T 48, °F (°C), min.	450 (232)	450 (232)
Rotational Viscosity, AASHTO T 316 @ 275 °F (135 °C), Poises, Pa·s, max.	30 (3)	30 (3)
Softening Point, AASHTO T 53, °F (°C), min.	135 (57)	130 (54)
Elastic Recovery, ASTM D 6084, Procedure A (sieve waived) @ 77 °F, (25 °C), aged, ss, 100 mm elongation, 5 cm/min., cut immediately, %, min.	65	65

Note 1. GTR shall be produced from processing automobile and/or light truck tires by the ambient grinding method. GTR shall not exceed 1/16 in. (2 mm) in any dimension and shall contain no free metal particles or other materials. A mineral powder (such as talc) meeting the requirements of AASHTO M 17 may be added, up to a maximum of four percent by weight of GTR to reduce sticking and caking of the GTR particles. When tested in accordance with Illinois modified AASHTO T 27, *a* 50 g sample of the GTR shall conform to the following gradation requirements:

Sieve Size	Percent Passing
No. 16 (1.18 mm)	100
No. 30 (600 μm)	95 ± 5
No. 50 (300 μm)	> 20

Add the following to the end of Note 1. of Article 1030.03 of the Standard Specifications:

"A dedicated storage tank for the Ground Tire Rubber (GTR) modified asphalt binder shall be provided. This tank must be capable of providing continuous mechanical mixing throughout by continuous agitation and recirculation of the asphalt binder to provide a uniform mixture. The tank shall be heated and capable of maintaining the temperature of the asphalt binder at 300 °F to 350 °F (149 °C to 177 °C). The asphalt binder metering systems of dryer drum plants shall be calibrated with the actual GTR modified asphalt binder material with an accuracy of ± 0.40 percent."

Revise 1030.02(c) of the Standard Specifications to read:

"(c) RAP Materials (Note 5) ……..…..1031"

Add the following note to 1030.02 of the Standard Specifications:

Note 5. When using reclaimed asphalt pavement and/or reclaimed asphalt shingles, the maximum asphalt binder replacement percentage shall be according to the most recent special provision for recycled materials.

HMA MIXTURE DESIGN REQUIREMENTS (D-1)
Effective: January 1, 2013 Revised: January 1, 2018

1) Design Composition and Volumetric Requirements

Revise the table in Article 406.06(d) of the Standard Specifications to read:

"MINIMUM COMPACTED LIFT THICKNESS	
Mixture Composition	Thickness, in. (mm)
IL-4.75	3/4 (19)
SMA-9.5, IL-9.5, IL-9.5L	1 1/2 (38)
SMA-12.5	2 (50)
IL-19.0, IL-19.0L	2 1/4 (57)"

Revise the table in Article 1004.03(c) of the Standard Specifications to read:

"Use	Size/Application	Gradation No.
Class A-1, 2, & 3	3/8 in. (10 mm) Seal	CA 16
Class A-1	1/2 in. (13 mm) Seal	CA 15
Class A-2 & 3	Cover	CA 14
HMA High ESAL	IL-19.0 IL-9.5	CA 11 1/ CA 16, CA 13 3/
HMA Low ESAL	IL-19.0L IL-9.5L Stabilized Subbase or Shoulders	CA 11 1/ CA 16
SMA 2/	1/2 in. (12.5mm) Binder & Surface IL 9.5 Surface	CA13 3/, CA14 or CA16 CA16, CA 13 3/

1/ CA 16 or CA 13 may be blended with the gradations listed.
2/ The coarse aggregates used shall be capable of being combined with stone sand, slag sand, or steel slag sand meeting the FA/FM 20 gradation and mineral filler to meet the approved mix design and the mix requirements noted herein.
3/ CA 13 shall be 100 percent passing the 1/2 in. (12.5mm) sieve.

Revise Article 1004.03(e) of the Supplemental Specifications to read:

"(e) Absorption. For SMA the coarse aggregate shall also have water absorption ≤ 2.0 percent."

Revise the last paragraph of Article 1102.01 (a) (5) of the Standard Specifications to read:

"IL-4.75 and Stone Matrix Asphalt (SMA) mixtures which contain aggregate having absorptions greater than or equal to 2.0 percent, or which contain steal slag sand, shall have minimum surge bin storage plus haul time of 1.5 hours."

Revise the nomenclature table in Article 1030.01 of the Standard Specifications to read:

"High ESAL	IL-19.0 binder; IL-9.5 surface; IL-4.75; SMA-12.5, SMA-9.5
Low ESAL	IL-19.0L binder; IL-9.5L surface; Stabilized Subbase (HMA) 1/; HMA Shoulders 2/

1/ Uses 19.0L binder mix.

2/ Uses 19.0L for lower lifts and 9.5L for surface lift."

Revise Article 1030.02 of the Standard Specifications and Supplemental Specifications to read:

"**1030.02 Materials.** Materials shall be according to the following.

Item	Article/Section
(a) Coarse Aggregate	1004.03
(b) Fine Aggregate	1003.03
(c) RAP Material	1031
(d) Mineral Filler	1011
(e) Hydrated Lime	1012.01
(f) Slaked Quicklime (Note 1)	
(g) Performance Graded Asphalt Binder (Note 2)	1032
(h) Fibers (Note 3)	
(i) Warm Mix Asphalt (WMA) Technologies (Note 4)	

Note 1. Slaked quicklime shall be according to ASTM C 5.

Note 2. The asphalt binder shall be an SBS PG 76-28 when the SMA is used on a full-depth asphalt pavement and SBS PG 76-22 when used as an overlay, except where modified herein. The asphalt binder shall be an Elvaloy or SBS PG 76-22 for IL-4.75, except where modified herein. The elastic recovery shall be a minimum of 80.

Note 3. A stabilizing additive such as cellulose or mineral fiber shall be added to the SMA mixture according to Illinois Modified AASHTO M 325. The stabilizing additive shall meet the Fiber Quality Requirements listed in Illinois Modified AASHTO M 325. Prior to approval and use of fibers, the Contractor shall submit a notarized certification by the producer of these materials stating they meet these requirements. Reclaimed Asphalt Shingles (RAS) may be used in Stone Matrix Asphalt (SMA) mixtures designed with an SBA polymer modifier as a fiber additive if the mix design with RAS included meets AASHTO T305 requirements. The RAS shall be from a certified source that produces either Type I or Type 2. Material shall meet requirements noted herein and the actual dosage rate will be determined by the Engineer.

Note 4. Warm mix additives or foaming processes shall be selected from the current Bureau of Materials and Physical Research Approved List, "Warm Mix Asphalt Technologies"."

Revise Article 1030.04(a)(1) of the Standard Specifications and the Supplemental Specifications to read:

"(1) High ESAL Mixtures. The Job Mix Formula (JMF) shall fall within the following limits.

High ESAL, MIXTURE COMPOSITION (% PASSING) 1/										
Sieve Size	IL-19.0 mm		SMA 4/ IL-12.5 mm		SMA 4/ IL-9.5 mm		IL-9.5 mm		IL-4.75 mm	
	min	max	min	max	min	max	min	max	min	max
1 1/2 in (37.5 mm)										
1 in. (25 mm)		100								
3/4 in. (19 mm)	90	100		100						
1/2 in. (12.5 mm)	75	89	80	100		100		100		100
3/8 in. (9.5 mm)				65	90	100	90	100		100
#4 (4.75 mm)	40	60	20	30	36	50	34	69	90	100
#8 (2.36 mm)	20	42	16	24 5/	16	32 5/	34 6/	52 2/	70	90
#16 (1.18 mm)	15	30					10	32	50	65
#30 (600 μm)			12	16	12	18				
#50 (300 μm)	6	15					4	15	15	30
#100 (150 μm)	4	9					3	10	10	18
#200 (75 μm)	3	6	7.0	9.0 3/	7.5	9.5 3/	4	6	7	9 3/
Ratio Dust/Asphalt Binder		1.0		1.5		1.5		1.0		1.0

1/ Based on percent of total aggregate weight.

2/ The mixture composition shall not exceed 44 percent passing the #8 (2.36 mm) sieve for surface courses with Ndesign = 90.

3/ Additional minus No. 200 (0.075 mm) material required by the mix design shall be mineral filler, unless otherwise approved by the Engineer.

4/ The maximum percent passing the #635 (20 μm) sieve shall be ≤ 3 percent.

5/ When establishing the Adjusted Job Mix Formula (AJMF) the percent passing the #8 (2.36 mm) sieve shall not be adjusted above the percentage stated on the table.

6/ When establishing the Adjusted Job Mix Formula (AJMF) the percent passing the #8 (2.36 mm) sieve shall not be adjusted below 34 percent.

Revise Article 1030.04(b)(1) of the Standard Specifications to read:

"(1) High ESAL Mixtures. The target value for the air voids of the HMA shall be 4.0 percent and for IL-4.75 it shall be 3.5 percent at the design number of gyrations. The VMA and VFA of the HMA design shall be based on the nominal maximum size of the aggregate in the mix, and shall conform to the following requirements.

VOLUMETRIC REQUIREMENTS High ESAL				
	Voids in the Mineral Aggregate (VMA), % minimum			Voids Filled with Asphalt Binder (VFA), %
Ndesign	IL-19.0	IL-9.5	IL-4.75 1/	
50	13.5	15.0	18.5	65 – 78 2/
70				65 - 75
90				

1/ Maximum Draindown for IL-4.75 shall be 0.3 percent

2/ VFA for IL-4.75 shall be 72-85 percent"

Replace Article 1030.04(b)(3) of the Standard Specifications with the following:

"(3) SMA Mixtures.

Volumetric Requirements SMA 1/			
Ndesign	Design Air Voids Target %	Voids in the Mineral Aggregate (VMA), % min.	Voids Filled with Asphalt (VFA), %
80 4/	3.5	17.0 2/ 16.0 3/	75 - 83

1/ Maximum draindown shall be 0.3 percent. The draindown shall be determined at the JMF asphalt binder content at the mixing temperature plus 30 °F.

2/ Applies when specific gravity of coarse aggregate is ≥ 2.760.

3/ Applies when specific gravity of coarse aggregate is < 2.760.

4/ Blending of different types of aggregate will not be permitted.
For surface course, the coarse aggregate can be crushed steel slag, crystalline crushed stone or crushed sandstone. For binder course, coarse aggregate shall be crushed stone (dolomite), crushed gravel, crystalline crushed stone, or crushed sandstone.

Add to the end of Article 1030.05 (d) (2) a. of the Standard Specifications:

"During production, the Contractor shall test SMA mixtures for draindown according to AASHTO T305 at a frequency of 1 per day of production."

Delete last sentence of the second paragraph of Article 1102.01(a) (4) b. 2.

Add to the end of Article 1102.01 (a) (4) b. 2.:

"As an option, collected dust (baghouse) may be used in lieu of manufactured mineral filler according to the following:

(a.) Sufficient collected dust (baghouse) is available for production of the SMA mix for the entire project.

(b.) A mix design was prepared based on collected dust (baghouse).

2) Design Verification and Production

Revise Article 1030.04 (d) of the Standard Specifications to read:

"(d) Verification Testing. High ESAL, IL-4.75, and SMA mix designs submitted for verification will be tested to ensure that the resulting mix designs will pass the required criteria for the Hamburg Wheel Test (IL mod AASHTO T-324) and the Tensile Strength Test (IL mod AASHTO T-283). The Department will perform a verification test on gyratory specimens compacted by the Contractor. If the mix fails the Department's verification test, the Contractor shall make the necessary changes to the mix and resubmit compacted specimens to the Department for verification. If the mix fails again, the mix design will be rejected.

All new and renewal mix designs will be required to be tested, prior to submittal for Department verification and shall meet the following requirements:

(1)Hamburg Wheel Test criteria. The maximum allowable rut depth shall be 0.5 in. (12.5 mm). The minimum number of wheel passes at the 0.5 in. (12.5 mm) rut depth criteria shall be based on the high temperature binder grade of the mix as specified in the mix requirements table of the plans.

Illinois Modified AASHTO T 324 Requirements [1/]

Asphalt Binder Grade	# Repetitions	Max Rut Depth (mm)
PG 70 -XX (or higher)	20,000	12.5
PG 64 -XX (or lower)	10,000	12.5

1/ When produced at temperatures of 275 ± 5 °F (135 ± 3 °C) or less, loose Warm Mix Asphalt shall be oven aged at 270 ± 5 °F (132 ± 3 °C) for two hours prior to gyratory compaction of Hamburg Wheel specimens.

Note: For SMA Designs (N-80) the maximum rut depth is 6.0 mm at 20,000 repetitions.
For IL 4.75mm Designs (N-50) the maximum rut depth is 9.0mm at 15,000 repetitions.

(2) Tensile Strength Criteria. The minimum allowable conditioned tensile strength shall be 60 psi (415 kPa) for non-polymer modified performance graded (PG) asphalt binder and 80 psi (550 kPa) for polymer modified PG asphalt binder. The maximum allowable unconditioned tensile strength shall be 200 psi (1380 kPa)."

Production Testing. Revise first paragraph of Article 1030.06(a) of the Standard Specifications to read:

"(a) High ESAL, IL-4.75, WMA, and SMA Mixtures. For each contract, a 300 ton (275 metric tons) test strip, except for SMA mixtures it will be 400 ton (363 metric ton), will be required at the beginning of HMA production for each mixture at the beginning of each construction year according to the Manual of Test Procedures for Materials "Hot Mix Asphalt Test Strip Procedures". At the request of the Producer, the Engineer may waive the test strip if previous construction during the current construction year has demonstrated the constructability of the mix using Department test results."

Add the following after the sixth paragraph in Article 1030.06 (a) of the Standard Specifications:

"The Hamburg Wheel test shall also be conducted on all HMA mixtures from a sample taken within the first 500 tons (450 metric tons) on the first day of production or during start up with a split reserved for the Department. The mix sample shall be tested according to the Illinois Modified AASHTO T 324 and shall meet the requirements specified herein. Mix production shall not exceed 1500 tons (1350 metric tons) or one day's production, whichever comes first, until the testing is completed and the mixture is found to be in conformance. The requirement to cease mix production may be waived if the plant produced mixture demonstrates conformance prior to start of mix production for a contract.

If the mixture fails to meet the Hamburg Wheel criteria, no further mixture will be accepted until the Contractor takes such action as is necessary to furnish a mixture meeting the criteria"

Method of Measurement:

Add the following after the fourth paragraph of Article 406.13 (b):

"The plan quantities of SMA mixtures shall be adjusted using the actual approved binder and surface Mix Design's G_{mb}."

Basis of Payment.

Replace the fourth paragraph of Article 406.14 of the Standard Specifications with the following:

"Stone matrix asphalt will be paid for at the contract unit price per ton (metric ton) for POLYMERIZED HOT-MIX ASPHALT SURFACE COURSE, STONE MATRIX ASPHALT, of the mixture composition and Ndesign specified; and POLYMERIZED HOT-MIX ASPHALT BINDER COURSE, STONE MATRIX ASPHALT, of the mixture composition and Ndesign specified."

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (D-1)
Effective: November 1, 2012 Revise: January 1, 2018

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

1031.01 Description. Reclaimed asphalt pavement and reclaimed asphalt shingles shall be according to the following.

(a) Reclaimed Asphalt Pavement (RAP). RAP is the material resulting from cold milling or crushing an existing hot-mix asphalt (HMA) pavement. RAP will be considered processed FRAP after completion of both crushing and screening to size. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.

(b) Reclaimed Asphalt Shingles (RAS). Reclaimed asphalt shingles (RAS). RAS is from the processing and grinding of preconsumer or post-consumer shingles. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable material, as defined in Central Bureau of Materials Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Sources", by weight of RAS. All RAS used shall come from a Central Bureau of Materials approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 90 percent passing the #4 (4.75 mm) sieve. RAS shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.

(1) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.

(2) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

1031.02 Stockpiles. RAP and RAS stockpiles shall be according to the following.

(a) RAP Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. Additional processed RAP (FRAP) shall be stockpiled in a separate working pile, as designated in the QC Plan, and only added to the sealed stockpile when test results for the working pile are complete and are found to meet tolerances specified herein for the original sealed FRAP stockpile. Stockpiles shall be sufficiently separated to prevent intermingling at the base. All stockpiles (including unprocessed RAP and FRAP) shall be identified by signs indicating the type as listed below (i.e. “Non- Quality, FRAP -#4 or Type 2 RAS”, etc…).

(1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in FRAP shall be crushed aggregate and may represent more than one aggregate type and/or quality, but shall be at least C quality. All FRAP shall be processed prior to testing and sized into fractions with the separation occurring on or between the #4 (4.75 mm) and 1/2 in. (12.5 mm) sieves. Agglomerations shall be minimized such that 100 percent of the RAP in the coarse fraction shall pass the maximum sieve size specified for the mix the FRAP will be used in.

(2) Restricted FRAP (B quality) stockpiles shall consist of RAP from Class I, HMA (High ESAL), or HMA (High ESAL). If approved by the Engineer, the aggregate from a maximum 3.0 in. (75 mm) single combined pass of surface/binder milling will be classified as B quality. All millings from this application will be processed into FRAP as described previously.

(3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in this RAP shall be crushed aggregate and may represent more than one aggregate type and/or quality, but shall be at least C quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate RAP shall be processed (FRAP) prior to testing. Conglomerate RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(4) Conglomerate “D” Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from HMA shoulders, bituminous stabilized subbases or HMA (Low ESAL)/HMA (Low ESAL) IL-19.0L binder mixture. The coarse aggregate in this RAP may be crushed or round but shall be at least D quality. This RAP may have an inconsistent gradation and/or asphalt binder content. Conglomerate DQ RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(5) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as “Non-Quality”.

RAP or FRAP containing contaminants, such as earth, brick, sand, concrete, sheet asphalt, bituminous surface treatment (i.e. chip seal), pavement fabric, joint sealants, plant cleanout etc., will be unacceptable unless the contaminants are removed to the satisfaction of the Engineer. Sheet asphalt shall be stockpiled separately.

(b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall be sufficiently separated to prevent intermingling at the base. Each stockpile shall be signed indicating what type of RAS is present.

However, a RAS source may submit a written request to the Department for approval to blend mechanically a specified ratio of Type 1 RAS with Type 2 RAS. The source will not be permitted to change the ratio of the blend without the Department prior written approval. The Engineer's written approval will be required, to mechanically blend RAS with any fine aggregate produced under the AGCS, up to an equal weight of RAS, to improve workability. The fine aggregate shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The fine aggregate shall be one that is approved for use in the HMA mixture and accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type, and lot number shall be maintained by project contract number and kept for a minimum of three years.

1031.03 Testing. FRAP and RAS testing shall be according to the following.

(a) FRAP Testing. When used in HMA, the FRAP shall be sampled and tested either during processing or after stockpiling. It shall also be sampled during HMA production.

(1) During Stockpiling. For testing during stockpiling, washed extraction samples shall be run at the minimum frequency of one sample per 500 tons (450 metric tons) for the first 2000 tons (1800 metric tons) and one sample per 2000 tons (1800 metric tons) thereafter. A minimum of five tests shall be required for stockpiles less than 4000 tons (3600 metric tons).

(2) Incoming Material. For testing as incoming material, washed extraction samples shall be run at a minimum frequency of one sample per 2000 tons (1800 metric tons) or once per week, whichever comes first.

(3) After Stockpiling. For testing after stockpiling, the Contractor shall submit a plan for approval to the District proposing a satisfactory method of sampling and testing the RAP/FRAP pile either in-situ or by restockpiling. The sampling plan shall meet the minimum frequency required above and detail the procedure used to obtain representative samples throughout the pile for testing.

Before extraction, each field sample of FRAP, shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedure. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

(b) RAS Testing. RAS shall be sampled and tested during stockpiling according to Central Bureau of Materials Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Sources". The Contractor shall also sample as incoming material at the HMA plant.

(1) During Stockpiling. Washed extraction and testing for unacceptable materials shall be run at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 1000 tons (900 metric tons) thereafter. A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-sample/test stockpile has been established it shall be sealed. Additional incoming RAS shall be in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

(2) Incoming Material. For testing as incoming material at the HMA plant, washed extraction shall be run at the minimum frequency of one sample per 250 tons (227 metric tons). A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). The incoming material test results shall meet the tolerances specified herein.

The Contractor shall obtain and make available all test results from start of the initial stockpile sampled and tested at the shingle processing facility in accordance with the facility's QC Plan.

Before extraction, each field sample shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

1031.04 Evaluation of Tests. Evaluation of test results shall be according to the following.

(a) Evaluation of FRAP Test Results. All test results shall be compiled to include asphalt binder content, gradation and, when applicable (for slag), G_{mm}. A five test average of results from the original pile will be used in the mix designs. Individual extraction test results run thereafter, shall be compared to the average used for the mix design, and will be accepted if within the tolerances listed below.

Parameter	FRAP
No. 4 (4.75 mm)	± 6 %
No. 8 (2.36 mm)	± 5 %
No. 30 (600 μm)	± 5 %
No. 200 (75 μm)	± 2.0 %
Asphalt Binder	± 0.3 %
G_{mm}	± 0.03 1/

1/ For stockpile with slag or steel slag present as determined in the current Manual of Test Procedures Appendix B 21, "Determination of Reclaimed Asphalt Pavement Aggregate Bulk Specific Gravity".

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the FRAP stockpile shall not be used in Hot-Mix Asphalt unless the FRAP representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

The Contractor shall maintain a representative moving average of five tests to be used for Hot-Mix Asphalt production.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the ITP, "Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)" or Illinois Modified AASHTO T-164-11, Test Method A.

(b) Evaluation of RAS Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. A five test average of results from the original pile will be used in the mix designs. Individual test results run thereafter, when compared to the average used for the mix design, will be accepted if within the tolerances listed below.

Parameter	RAS
No. 8 (2.36 mm)	± 5 %
No. 16 (1.18 mm)	± 5 %
No. 30 (600 µm)	± 4 %
No. 200 (75 µm)	± 2.5 %
Asphalt Binder Content	± 2.0 %

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the RAS shall not be used in Hot-Mix Asphalt unless the RAS representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

(c) Quality Assurance by the Engineer. The Engineer may witness the sampling and splitting conduct assurance tests on split samples taken by the Contractor for quality control testing a minimum of once a month.

The overall testing frequency will be performed over the entire range of Contractor samples for asphalt binder content and gradation. The Engineer may select any or all split samples for assurance testing. The test results will be made available to the Contractor as soon as they become available.

The Engineer will notify the Contractor of observed deficiencies.

Differences between the Contractor's and the Engineer's split sample test results will be considered acceptable if within the following limits.

Test Parameter	Acceptable Limits of Precision	
% Passing:[1/]	FRAP	RAS
1/2 in.	5.0%	
No. 4	5.0%	
No. 8	3.0%	4.0%
No. 30	2.0%	4.0%
No. 200	2.2%	4.0%
Asphalt Binder Content	0.3%	3.0%
G_{mm}	0.030	

1/ Based on washed extraction.

In the event comparisons are outside the above acceptable limits of precision, the Engineer will immediately investigate.

(d) Acceptance by the Engineer. Acceptable of the material will be based on the validation of the Contractor's quality control by the assurance process.

1031.05 Quality Designation of Aggregate in RAP and FRAP.

(a) RAP. The aggregate quality of the RAP for homogeneous, conglomerate, and conglomerate "D" quality stockpiles shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

(1) RAP from Class I, HMA (High ESAL), or (Low ESAL) IL-9.5L surface mixtures are designated as containing Class B quality coarse aggregate.

(2) RAP from HMA (Low ESAL) IL-19.0L binder mixture is designated as Class D quality coarse aggregate.

(3) RAP from Class I, HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.

(4) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

(b) FRAP. If the Engineer has documentation of the quality of the FRAP aggregate, the Contractor shall use the assigned quality provided by the Engineer.

If the quality is not known, the quality shall be determined as follows. Fractionated RAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5,000 tons (4,500 metric tons). The Contractor shall obtain a representative sample witnessed by the Engineer. The sample shall be a minimum of 50 lb (25 kg). The sample shall be extracted according to Illinois Modified AASHTO T 164 by a consultant laboratory prequalified by the Department for the specified testing. The consultant laboratory shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid by the Contractor. The District will forward the sample to the Central Bureau of Materials Aggregate Lab for MicroDeval Testing, according to ITP 327. A maximum loss of 15.0 percent will be applied for all HMA applications. The fine aggregate portion of the fractionated RAP shall not be used in any HMA mixtures that require a minimum of "B" quality aggregate or better, until the coarse aggregate fraction has been determined to be acceptable thru a MicroDeval Testing.

1031.06 Use of FRAP and/or RAS in HMA. The use of FRAP and/or RAS shall be the Contractor's option when constructing HMA in all contracts.

(a) FRAP. The use of FRAP in HMA shall be as follows.

(1) Coarse Aggregate Size (after extraction). The coarse aggregate in all FRAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

(2) Steel Slag Stockpiles. FRAP stockpiles containing steel slag or other expansive material, as determined by the Department, shall be homogeneous and will be approved for use in HMA (High ESAL and Low ESAL) mixtures regardless of lift or mix type.

(3) Use in HMA Surface Mixtures (High and Low ESAL). FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall have coarse aggregate that is Class B quality or better. FRAP shall be considered equivalent to limestone for frictional considerations unless produced/screened to minus 3/8 inch.

(4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP in which the coarse aggregate is Class C quality or better.

(5) Use in Shoulders and Subbase. FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, Restricted FRAP, conglomerate, or conglomerate DQ.

(b) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.

(c) FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with FRAP in HMA mixtures up to a maximum of 5.0 percent by weight of the total mix.

When FRAP is used alone or FRAP is used in conjunction with RAS, the percent of virgin asphalt binder replacement (ABR) shall not exceed the amounts indicated in the table below for a given N Design.

Max Asphalt Binder Replacement for FRAP with RAS Combination

HMA Mixtures 1/ 2/ 4/	Maximum % ABR		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified 3/
30L	50	40	30
50	40	35	30
70	40	30	30
90	40	30	30
4.75 mm N-50			40
SMA N-80			30

1/ For Low ESAL HMA shoulder and stabilized subbase, the percent asphalt binder replacement shall not exceed 50 % of the total asphalt binder in the mixture.

2/ When the binder replacement exceeds 15 % for all mixes, except for SMA and IL-4.75, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 % binder replacement using a virgin asphalt binder grade of PG64-22 will be reduced to a PG58-28). When constructing full depth HMA and the ABR is less than 15 %, the required virgin asphalt binder grade shall be PG64-28.

3/ When the ABR for SMA or IL-4.75 is 15 % or less, the required virgin asphalt binder shall be SBS PG76-22 and the elastic recovery shall be a minimum of 80. When the ABR for SMA or IL-4.75 exceeds 15%, the virgin asphalt binder grade shall be SBS PG70-28 and the elastic recovery shall be a minimum of 80.

4/ When FRAP or RAS is used alone, the maximum percent asphalt binder replacement designated on the table shall be reduced by 10 %.

1031.07 HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the detailed requirements specified herein.

(a) FRAP and/or RAS. FRAP and /or RAS mix designs shall be submitted for verification. If additional FRAP or RAS stockpiles are tested and found to be within tolerance, as defined under "Evaluation of Tests" herein, and meet all requirements herein, the additional FRAP or RAS stockpiles may be used in the original design at the percent previously verified.

(b) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design.

The RAP, FRAP and RAS stone specific gravities (G_{sb}) shall be according to the "Determination of Aggregate Bulk (Dry) Specific Gravity (G_{sb}) or Reclaimed Asphalt Pavement (RAP) and Reclaimed Asphalt Shingles (RAS)" procedure in the Department's Manual of Test Procedures for Materials.

1031.08 HMA Production. HMA production utilizing FRAP and/or RAS shall be as follows.

To remove or reduce agglomerated material, a scalping screen, gator, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAS and FRAP feed system to remove or reduce oversized material. .

If during mix production, corrective actions fail to maintain FRAP, RAS or QC/QA test results within control tolerances or the requirements listed herein the Contractor shall cease production of the mixture containing FRAP or RAS and conduct an investigation that may require a new mix design.

(a) RAS. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

(b) HMA Plant Requirements. HMA plants utilizing FRAP and/or RAS shall be capable of automatically recording and printing the following information.

(1) Dryer Drum Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

d. Accumulated dry weight of RAS and FRAP in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

e. Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.

f. Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

g. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

h. Aggregate RAS and FRAP moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS and FRAP are printed in wet condition.)

i. When producing mixtures with FRAP and/or RAS, a positive dust control system shall be utilized.

j. Accumulated mixture tonnage.

k. Dust Removed (accumulated to the nearest 0.1 ton (0.1 metric ton))

(2) Batch Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).

d. Mineral filler weight to the nearest pound (kilogram).

f. RAS and FRAP weight to the nearest pound (kilogram).

g. Virgin asphalt binder weight to the nearest pound (kilogram).

h. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

1031.09 RAP in Aggregate Surface Course and Aggregate Wedge Shoulders, Type B. The use of RAP or FRAP in aggregate surface course and aggregate shoulders shall be as follows.

(a) Stockpiles and Testing. RAP stockpiles may be any of those listed in Article 1031.02, except "Non-Quality" and "FRAP". The testing requirements of Article 1031.03 shall not apply. RAP used shall be according to the current Central Bureau of Materials Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications".

(c) Gradation. The RAP material shall meet the gradation requirements for CA 6 according to Article 1004.01(c), except the requirements for the minus No. 200 (75 µm) sieve shall not apply. The sample for the RAP material shall be air dried to constant weight prior to being tested for gradation."

STORM SEWER ADJACENT TO OR CROSSING WATER MAIN
Effective: February 1, 1996 Revised: January 1, 2007

This work consists of constructing storm sewer adjacent to or crossing a water main, at the locations shown on the plans. The material and installation requirements shall be according to the latest edition of the "Standard Specifications for Water and Sewer Main Construction in Illinois", and the applicable portions of Section 550 of the Standard Specifications; which may include concrete collars and encasing pipe with seals if required.

Pipe materials shall meet the requirements of Sections 40 and 41-2.01 of the "Standard Specifications for Water and Sewer Main Construction in Illinois", except PVC pipe will not be allowed. Ductile-Iron pipe shall meet the minimum requirements for Thickness Class 50.

Encasing of standard type storm sewer, according to the details for "Water and Sewer Separation Requirements (Vertical Separation)" in the "STANDARD DRAWINGS" Division of the "Standard Specifications for Water and Sewer Main Construction in Illinois", may be used for storm sewers crossing water mains.

Basis of Payment.
This work will be paid according to Article 550.10 of the Standard Specifications, except the pay item shall be STORM SEWER (WATER MAIN REQUIREMENTS), of the diameter specified.

STORM SEWER, DUCTILE IRON

Description.
This item includes furnishing all labor and materials necessary to furnish and install ductile iron storm sewers in accordance with Section 550 of the Standard Specification and a specified herein.

Materials.
Ductile Iron pipe shall be class 52, centrifugally cast, cement lined, meeting the requirements of AWWA C 150, C 151 and C 104.Joints shall meet the requirements of AWWA C 111.

Joints for Ductile Iron pipe shall be mechanical joints (AWWA C 111 and C 600) or push-on joints (AWWA C 111 and C 600)

Method and Measurement.
This work shall be measured for payment per foot at the location shown on the plans.

Basis of Payment.
This work will be paid for at the contract unit price per foot for STORM SEWERS, DUCTILE IRON of the type and diameter specified which price shall include all excavation, sheeting or shoring, backfill, thrust blocking, valves, repair couplings, tees, labor, materials, equipment and incidentals necessary to complete the installation as herein specified.

MANHOLES, STORM SEWER (SPECIAL)

Description.
This work shall consist of furnishing and installing new storm sewer manholes as indicated on the plans in accordance with Section 602 of the Standard Specifications and the details in the project plans.

Method and Measurement.
This work shall be measured for payment per EACH for MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1 FRAME, CLOSED LID (SPECIAL) at the location shown on the plans.

Basis of Payment.
Storm sewer will be paid for at the contract unit price per EACH for MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1 FRAME, CLOSED LID (SPECIAL). The price shall include the costs of excavation and disposal of unsuitable material, sheeting and bracing, control of water, bedding course, backfilling, compaction of backfill, grade adjustments, rings, and furnishing and placement of new manhole, frame and lid.

STABILIZED CONSTRUCTION ENTRANCE

Description.
This work shall consist of constructing, maintaining and removing the STABILIZED CONSTRUCTION ENTRANCE at work site entrances. This work shall be done in accordance with the details shown on the plans, and in accordance with the Natural Resource Conservation Services Illinois Urban Manual. Wash racks and sediment trapping devices are not required.

STABILIZED CONSTRUCTION ENTRANCE shall include all labor, equipment and materials required to construct and maintain an operating system and to remove and dispose of the entrance materials when the entrance is no longer required. Filter Fabrics, aggregate and excavations will not be paid for separately, but are included in the contract unit price for STABILIZED CONSTRUCTION ENTRANCE.

Method of Measurements.
STABILIZED CONSTRUCTION ENTRANCE will be measured for payment in place and the area computed in square yards.

Basis of Payment.
This work shall be paid for at the contract unit price per square yard for STABILIZED CONSTRUCTION ENTRANCE.

BARRIER WALL REMOVAL

Description.
This work shall be performed in compliance with Section 440 of the Standard Specifications.

Method and Measurement.
This work shall be measured for payment per foot at the location shown on the plans.

Basis of Payment.
This work shall be paid for at the contract unit price per foot for BARRIER WALL REMOVAL, and shall include all labor, equipment and other materials necessary for construction as specified herein. If backfill is required to fill the excavation, it shall be paid for as TRENCH BACKFILL.

GUTTERS TO BE CLEANED

Description.
This work consists of cleaning gutters behind the existing barrier wall. The extent of cleaning of the gutter and related work items, are herein described.

CONSTRUCTION REQUIREMENTS

General.
All soil/aggregate build-up, trash, debris, and any other foreign material must be removed, including any material loged inside the gutters. If foreign material must be removed, including any material lodged inside the gutters. If water does not suffice, the Contractor is to use compressed air, hand tools or whatever appropriate means necessary, subject to approval of the Engineer, to remove accumulated foreign material.

The contractor shall properly dispose of all accumulated materials according to Article 203.03. Runoff water will not be allowed to constitute a hazard on adjacent or underlying roadways, waterways, drainage areas or railroads nor be allowed to erode existing slopes.

The Contractor shall take caution not to damage the existing gutters or surrounding barrier or timber walls. Any damaged materials shall be repaired or replaced by the contractor. No additional payment will be made for such damages.

Method and Measurement.
Gutters to be cleaned will be measured for payment in feet along the flow line of the gutter cleaned.

Basis of Payment.
This work will be paid for at the contract unit price per foot for GUTTERS TO BE CLEANED, which price shall include all equipment, material and labor to satisfactorily complete the work.

TIMBER RETAINING WALL REMOVAL

Description.
This work shall consist of removing and disposing of an existing structural timber retaining wall at the location shown in the plans.

CONSTRUCTION REQUIREMENTS

General.
Designated timber retaining walls (planks) shall be removed and existing anchorage devices, when encountered, shall be removed as directed by the Engineer.

Method of Measurement.
This work will be measured for payment as follows:

(a) Contract Quantities. The requirement for use of contract quantities shall be according to Article 202.07(a) of the Standard Specifications.

(b) Measured Quantities. This work will be measured for payment per foot as measured along the top of the retaining wall.

Basis of Payment.
This work will be paid for at the contract unit price per foot for TIMBER RETAINING WALL REMOVAL which price shall be payment in full to complete this work.

TIMBER RETAINING WALL

Description.
This work shall consist of furnishing and constructing a treated timber retaining wall according to the dimensions shown on the plans and in the approved design submittal.

Materials.
Materials shall be according to the following:

Item	Article/Section
(a) Structural Timber	1007.03
(b) Preservative Treatment	1007.12
(c) Fastenings for Timber Structures	1006.17

CONSTRUCTION REQUIREMENTS

General.
The timber retaining wall shall be designed by the Contractor as a minimum, to retain the exposed surface area as specified in the plans or as directed by the Engineer.

The design calculations and details for the timber retaining wall proposed by the Contractor shall be submitted to the Engineer for approval. The calculations shall be prepared and sealed by an Illinois Licensed Structural Engineer. This approval will not relieve the Contractor of responsibility for the safety of the excavation. Approval shall be contingent upon acceptance by all involved utilities and/or railroad. Required excavations for the purpose of removing and installing the timber retaining wall shall be done in a neat and workmanlike manner. Excavated materials shall be stored and re-incorporated into the new construction, graded and compacted to the satisfaction of the Engineer.

The Contractor shall restore the work area as specified in Article 104.06 of the Standard Specifications. Area disturbed for retaining wall construction will be permanently seeded as specified in Section 250 of the Standard Specifications.

Construction.
If unable to install the timber retaining wall as specified in the approved design, the Contractor shall have the adequacy of the design re-evaluated. Any reevaluation shall be submitted to the Engineer for approval prior to commencing the excavation adjacent to the area in question.

When an obstruction is encountered, the Contractor shall notify the Engineer and upon concurrence of the Engineer, the Contractor shall begin working to break up, push aside, or remove the obstruction. An obstruction shall be defined as any object (such as but not limited to, boulders, logs, old foundations etc.) where its presence was not obvious or specifically noted on the plans prior to bidding, that cannot be installed through or around with normal installation procedures, but requires additional excavation or other procedures to remove or miss the obstruction.

Treated Timber.
All cutting, framing and boring of treated timber shall be done before treatment insofar as is practicable.

a) Handling. Treated timber shall be handled carefully without sudden dropping, bruising, breaking of outer fibers or penetrating the surface with tools. It shall be handled with rope slings. Cant hooks, peaveys, pikes, or hooks shall not be used.

b) Cuts, Abrasions, and Holes. All cuts, abrasions, and holes made after treatment shall be repaired according to Article 1007.13. Each coat shall be allowed to dry before the next coat is applied. Any unfilled holes, after being treated with preservative, shall be plugged with treated plugs.

c) Temporary Attachments. Forms or temporary braces may be attached to treated timber with nails or spikes only when approved by the Engineer. Upon their removal, the holes shall be filled by driving galvanized nails or spikes flush with the surface, or by plugging as required for holes.

Countersinking.
Countersinking shall be done wherever smooth faces are required. Recesses formed in treated timber for countersinking shall be treated as required for cuts and abrasions, except as specified for plank floors.

Hardware.
The term hardware shall include all metal fastenings required for timber connections. The following items will be considered as hardware: bolts, tie rods, turnbuckles, washers, nuts, drift bolts, steel dowels, nails, spikes, and lag screws for timber connections.

All hardware for treated timber construction, except cast iron ogee washers, malleable iron washers and timber connectors, shall be stainless steel or galvanized.

a) Rods. Rods connecting only sawed timbers shall be threaded sufficiently at each end to provide tight connections, allowing for permissible variations in dimensions of material. All rods shall extend entirely through the nut at each end and, after being drawn tight, all ends that project more than 1 in. beyond the nut shall be cut off about 1/2 in. beyond the nut.

b) Bolts. The length specified shall be the length measured under the head. Bolts may be substituted for rods for timber connections where the length of threaded portion provided by the bolt is sufficient. Bolt ends projecting more than 1 in. beyond the nut shall be cut off as specified for rods. Machine bolts with square heads and nuts shall be used for connections.

c) Lag Screws. Lag screws shall be installed by turning them into place. They may be driven sufficiently to start them into the holes and hold them firmly in place for turning, but shall not be driven beyond the depth that will be occupied by the shank.

d) Nuts and Washers. Washers shall be used under all nuts and bolt heads that would otherwise come in contact with wood. Ogee or malleable iron washers shall be used for all tie rods. Standard wrought washers shall be used at all locations, except where washers of other types are required. All nuts shall be standard square nuts. They shall be tightened sufficiently to prevent the rods or bolts from becoming loose during service and, after being tightened, they shall be effectively secured against backing off by burring of the rod or bolt threads.

e) Nails and Spikes. Nails shall not extend through all material into which they pass. The size of nails and spikes, when not otherwise shown, shall be according to the following.

Size of Nails and Spikes		
Actual Thickness of Piece Nailed (in.)	Actual Thickness of Piece Nailed to (in.)	Size of Nails and Spikes
1 5/8	1 5/8	10d
1 5/8	2	16d
1 5/8	2 5/8 or more	20d
2	2	16d
2	2 5/8 or more	20d
2 5/8	2 5/8 or 3	40d
2 5/8	3 5/8 or more	60d
3	3	50d
3	3 5/8 or more	60d
3 5/8	3 Spikes	
4	3 or more	7 in. spikes

Holes for Bolts, Dowels, Rods, and Lag Screws.
Holes for round drift bolts and dowels shall be bored with a bit 1/16 in. less in diameter than the bolt or dowel to be used. The diameter of holes for square drift bolts or dowels shall be equal to the least dimension of the bolt or dowels. Holes for bolts shall be bored with a bit of the same diameter as the bolt. Holes for rods shall be bored with a bit 1/16 in. greater in diameter than the rod. Holes for lag screws shall be bored with a bit not larger than the body of the screw at the root of the thread. If required to prevent splitting, the hole for the shank shall be bored the same diameter as the shank. The depth of holes for lag screws shall be a minimum of 1 in. less than the length under the head.

Method of Measurement.
This work will be measured for payment as follows:

(a) Contract Quantities. The requirement for use of contract quantities shall be according to Article 202.07(a) of the Standard Specifications.

(b) Measured Quantities. Timber retaining wall installed according to the Contractor's approved design or as directed by the Engineer shall be measured for payment and the area computed in square feet of the exposed face of the retaining wall.

Any timber retaining wall installed beyond those dimensions shown on the contract plans or the approved contractor's design without the written permission of the Engineer, shall not be measured for payment but shall be done at the Contractor's own expense.

Basis of Payment.
This work will be paid for at the contract unit price per square foot for TIMBER RETAINING WALL which price shall be payment in full to complete this work. Necessary excavations and all items classified as hardware will not be paid for separately, but shall be included in the cost of the Timber Retaining Wall.

Obstruction mitigation shall be paid for according to Article 109.04 of the Standard Specifications.

CLASS D PATCHES (SPECIAL)

Description.
This work shall consist of patching Class D Patches at a location shown on the plans. The work shall be performed according to Section 442 of the Standard Specifications, except as modified herein.

Delete Note 2 from Article 442.02 of the Standard Specification and replace with the following:

Note 2. The mixture composition of the HMA used shall be binder course and surface course as specified in the Hot-Mix Asphalt Mixtures Requirements table in the plans.

Basis of Payment.
This work shall be paid for at the contract unit price per square yard of CLASS D PATCHES, of the type and thickness specified, (SPECIAL), which price shall include all labor, materials and equipment necessary to perform the work as described.

RAISED REFLECTIVE PAVEMENT MARKER, REFLECTOR REMOVAL

Description. This work shall consist of removing the reflector unit from existing raised reflector pavement markers that will remain in place at the end of construction activities. Existing reflectors that conflict with revised traffic patterns shall be removed immediately to facilitate a change in lane assignment. If darkness or inclement weather prohibits the removal operations, such operations shall be resumed the next morning or when weather permits.

The base casting shall remain in place in areas where no pavement rehabilitation is required, therefore only the reflector shall be removed. Debris from the removal operations shall be removed from the pavement prior to opening the roadway to traffic.

Basis of Payment. This work will be measured for payment at the contract unit price per each for RAISED REFLECTIVE PAVEMENT MARKER, REFLECTOR REMOVAL.

IMPORTANT NOTICE

CORPORATIONS

License must be signed by the President or a Vice President of the Corporation or Company, or be accompanied by a certified resolution of the Board of Directors authorizing execution by a lesser official.

PARTNERSHIP

License must be signed by all of the partners.

MUNICIPALITIES OR GOVERNMENTAL AGENCIES

License must be accompanied by a certified resolution authorizing the official signing the License to execute on behalf of the Governmental Body. The resolution should not be certified by the same official who executed the License.

RIGHT OF ENTRY LICENSE AGREEMENT

Wisconsin Central Ltd. (hereinafter called Railroad Company) hereby grants pursuant to this Right of Entry License Agreement (hereinafter called License) to _____ (hereinafter called Licensee) license and permission, at Licensee's sole cost, risk and expense, to enter Railroad Company's property in the vicinity of _____, Railroad Milepost _____, _____ Subdivision for purposes related to _____ near _____, IL on, over and near Railroad Company's tracks and right-of-way, as generally shown on Location Exhibit, attached hereto and made a part hereof.

Licensee shall pay to Railroad Company upon execution of this License the sum of **$750.00** for the privileges granted by this License. The aforesaid sum is not refundable in the event Licensee elects not to enter upon Railroad Company's property or in the event Railroad Company elects to terminate this License for any reason whatsoever.

Licensee shall not enter Railroad Company's premises for the purpose as set forth above without having first given Railroad Company's Engineering Manager or their authorized representative at least five (5) working days advance notice of the date Licensee plans to commence the work.

Railroad Company shall have the right, but not the duty, to require Licensee to furnish detailed plans prior to entry upon the premises and to view and inspect any activity or work on or above Railroad Company's property. If in the sole opinion of the authorized representative of Railroad Company any said activity or work is undesirable for any reason, Railroad Company shall have the right to terminate this License at once.

Railroad Company shall have the right, but not the duty, to restrict Licensee's activity on Railroad Company's property in any way that Railroad Company may, in its sole opinion, deem necessary from time to time and shall also have the right, but not the duty, to require Licensee to adopt and take any safety precautions that Railroad Company may, in its sole opinion, deem necessary from time to time. No work shall be performed or equipment located within twenty-five feet (25') of the centerline of the nearest railroad track without the expressed permission of Railroad Company's Engineering Manager or their duly authorized representative and then only when either the track has been removed from service or Railroad Company flag protection is provided.

Railroad Company may, at Licensee's sole cost, risk and expense, furnish whatever protective services it considers necessary, including, but not limited to, flag protection, and inspectors.

Licensee shall at all times conduct its work in accordance with any and all "Special Provisions" which may be appended hereto which, by reference hereto, are hereby made a part hereof.

As a consideration and as a condition, without which this license would not have been granted, Licensee agrees to indemnify and save harmless Railroad Company, its parentS, affiliates, and their directors, officers, employees and agents and to assume all liability for death or injury to any persons, including, but not limited to, officers, employees, agents, patrons and licensees of the parties hereto, and for all loss, damage or injury to any property, including, but not limited to, that belonging to the parties hereto, together with all expenses, attorneys' fees and costs incurred or sustained by Railroad Company, whether in defense of any such claims, demands, actions and causes of action or in the enforcement of the indemnification rights hereby conferred, in any manner or degree caused by, attributable to or resulting from the exercise of the rights herein granted, or the failure of Licensee to conform to conditions of this license, work performed by Railroad Company for Licensee under the terms of this license or the construction, maintenance, repair, renewal, alteration, change, relocation, existence, presence, use, operation or removal of any

structure incident thereto, or from any activity conducted on or occurrence originating on the area covered by this license, regardless of any negligence of Railroad Company, its officers, employees and agents. Said Licensee agrees also to release, indemnify and save harmless Railroad Company, its officers, employees and agents from all liability to Licensee, its officers, employees, agents or patrons, resulting from railroad operations at or near the area in which License is to be exercised, whether or not the death, injury or damage resulting therefrom may be due to whole or in part to the negligence of Railroad Company, its officers, employees or agents. At the election of Railroad Company, Licensee, upon notice to that effect, shall assume or join in the defense of any claim based upon allegations purporting to bring said claim within the coverage of this section.

Before commencing work and until this License shall be terminated, Licensee shall provide and maintain the following insurance in form and amount with companies satisfactory to and as approved by Railroad Company.

a. Statutory Workers Compensation and Employer's Liability insurance.

b. Automobile Liability in an amount not less than $1,000,000 dollars combined single limit.

c. Comprehensive General Liability (occurrence form) in an amount not less than $5,000,000 dollars per occurrence, with an aggregate limit of not less than $10,000,000 dollars. The Policy must name Railroad Company and its Parents as additional insureds in the following form:

Railroad Company name and its Parents
Attn: Paul Chojenski
17641 South Ashland Avenue
Homewood, IL 60430
708.332.3557 (office)
Paul.Chojenski@cn.ca

If the commercial general liability policy required herein contains any exclusions related to doing business or undertaking construction or demolition on, near, or adjacent to railroad facilities; such exclusion must be removed through issuance of endorsement CG 24 17, or a similar endorsement approved by Railroad Company in its sole discretion prior to the commencement of work hereunder.

d. In the event the privileges provided herein to Licensee involve any work that could result in the discharge, spillage, disposal, release or escape of any Hazardous Material or petroleum product onto the Railroad Company's property, Licensee shall purchase and maintain in effect at all times during the term of this License a Contractor's Pollution Liability policy in an amount not less than two million dollars ($2,000,000) combined single limit (and with a deductible not to exceed $50,000) insuring Railroad against any and all damages, costs, liabilities and expenses resulting from on- or off-site bodily injury (including death to any person), on or off-site loss, damage or destruction of property (including that belonging to the parties hereto), and on-or off-site cleanup costs (including expenses incurred in the investigation, removal, remediation, neutralization, or immobilization of contaminated soils, surface water, groundwater or any other contamination) growing out of or incidental to any discharge, spillage, disposal, release, or escape of any Hazardous Material or petroleum product arising therefrom. For purposes of this Agreement , the term "Hazardous Material" shall include, without limit, any flammable explosives, radioactive materials, hazardous materials, hazardous wastes, hazardous or toxic substances, or related materials defined in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 U.S.C. §§ 9601, et seq.), the Hazardous Material Transportation Act, as amended (49 U.S.C. §§

1801, et seq.), the Resource Conservation and Recovery Act, as amended (42 U.S.C. §§ 6901 et seq.), the Toxic Substances Control Act, as amended (15 U.S.C. §§ 2601, et seq.), similar laws or ordinances enacted by any state, county or municipality in which the Property is located, or in the regulations adopted and publications promulgated pursuant to any of the above, as such laws or regulations now exist or may exist in the future.

Licensee is required to advise Railroad Company by thirty (30) day advance written notice when any work to be performed under this License may require Pollution Liability Insurance pursuant to the previous paragraph.

Before commencing work, Licensee shall deliver to Railroad Company a certificate of insurance evidencing the foregoing coverage, and upon request, Licensee shall deliver a certified, true and complete copy of the policy or policies at its sole cost and expense. The policies shall provide for not less than thirty (30) days prior written notice to Railroad Company of cancellation of or any material change in, the policies, and shall contain the waiver of right of subrogation.

It is understood and agreed that the foregoing insurance coverage is not intended to, and shall not, relieve Licensee from or serve to limit Licensee's liability under the indemnity provisions of this License or any applicable agreement.

It is further understood and agreed that, so long as this License shall remain in force or until the Licensee's work is complete and Licensee shall have vacated the Railroad Company's property (whichever shall be later), Railroad Company shall have the right, from time to time, to revise the amount or form of insurance coverage provided as circumstances or changing economic conditions may require. Railroad Company shall give Licensee written notice of any such requested change at least thirty (30) days prior to the date of expiration of the then existing policy or policies; and Licensee agrees to, and shall, thereupon provide Railroad Company with certificates reflecting such revised policy or policies thereof.

If a contractor is to be employed by Licensee, then, before any work is commenced hereunder, Licensee shall establish, to the reasonable satisfaction of Railroad Company, that either (i) the contractor has in place insurance policies covering its own work that comply with the required insurance coverages, limits and terms applicable to Licensee, or (ii) the contractor is fully covered under Licensee's insurance policies.

Railroad Company's exercise or failure to exercise any rights under this License shall not relieve Licensee of any responsibility under this License, including, but not limited to, the obligation to indemnify Railroad Company as herein provided.

Cost and expense for work performed by Railroad Company, as referred to in this License, shall consist of the actual cost of labor, materials, equipment and other plus Railroad Company's standard additives in effect at the time the work is performed.

This License is revocable at the option and discretion of Railroad Company upon notice to Licensee, and shall not be transferred or assigned. Unless sooner revoked by Railroad Company, extended at request of Licensee and granted by Railroad Company in writing, or relinquished by act of Licensee, this License shall terminate on _____.

Upon termination of this License, Licensee shall remove all of its property, leaving Railroad Company's premises in a neat and safe condition satisfactory to Railroad Company's Engineering Manager or their authorized representative, failing which Railroad Company may remove said materials from its premises at Licensee's sole cost, risk and expense, or at its option, may deem such property as abandoned and henceforth owned by Railroad Company, with no compensation for Licensee whatsoever.

WISCONSIN CENTRAL LTD.

By: _____

Print Name: _____

Title: _____

ACCEPTED:

_____

By: _____

Print Name: _____

Title: _____

SPECIAL PROVISIONS

RELATIVE TO FLAGGING AND OTHER PROTECTION OF RAILROAD COMPANY TRAFFIC AND FACILITIES DURING CONSTRUCTION ADJACENT AND ABOVE, ON OR ACROSS, THE PROPERTY OF, OR ON, ABOVE AND BENEATH THE TRACKS OF THE WISCONSIN CENTRAL LTD.

The Licensee shall, before entering upon the property of Railroad Company for performance of any work, secure a fully executed right of entry license from Railroad Company's Engineering Manager or their authorized representative for the occupancy and use of Railroad Company's property. Licensee shall confer with Railroad Company relative to requirements for railroad clearances, operation and general safety regulations.

Prior to any entry onto Railroad Company's property, employees and/or contractor(s) of Licensee doing work shall determine by the guidelines hereinafter provided and by the work to be performed the level of safety training to be required.

All employees and/or contractor(s) of Licensee not hired by Railroad Company that will work on CN property are required to have minimum www.contractororientation.com.

a. EXCEPTION: Railroad Company has exempted those it classifies as "Delivery Persons" from this training. This will include contractors such as UPS, FedEx, trucking companies, etc. who merely access the property to supply materials or equipment.

All employees and/or contractor(s) of Licensee hired by Railroad Company which will work on Railroad Company property are required to have minimum CN Safety and Security Awareness training, in addition to undergoing a background check. This training and background check must be obtained through the eRailSafe.com website. If not done before, the contractor must contact CN Special Agent James Conroy at 708-332-5947 or James.Conroy@cn.ca to be issued a vendor number prior to accessing the noted website. Minimum information required of the Licensee and/or their contractor when contacting either Special Agent James Conroy or e-RailSafe is Name, Address, Telephone, Contact Person for State Projects, DOT Contract Number, and the AAR/DOT Number. This training is good for a period of two years.

a. EXCEPTION: Railroad Company has exempted those employees of contractors providing paving services at a road crossing under construction or repair from this requirement.

b. EXCEPTION: Railroad Company has exempted those it classifies as "Delivery Persons" from this training. This will include contractors such as UPS, FedEx, trucking companies, etc. who merely access the property to supply materials or equipment.

All employees and/or contractor(s) of Licensee hired by Railroad Company, whose duties include and who are engaged in the inspection, construction, maintenance, or repair of railroad track, bridges, roadway, signal and communication systems, roadway facilities, or roadway machinery that will work foul of or have the potential to foul a live track are considered Roadway Workers under FRA regulations and CN Policy. They must complete the On-Track Safety Training course approved by Railroad Company and provided by R.R. Safety – AMR, P.O. Box 75, Lomira, WI 53048, telephone (920) 517-1677, email rrsafetytraining@yahoo.com. This training must be repeated at least once each calendar year.

a. EXCEPTION: Railroad Company has exempted those employees of contractors providing paving services at a road crossing under construction or repair from this requirement.

b. EXCEPTION: Railroad Company has exempted those it classifies as "Delivery Persons" from this training. This will include contractors such as UPS, FedEx, trucking companies, etc. who merely access the property to supply materials or equipment.

c. All the employees and/or contractor(s) of Licensee who will operate on-track machinery or those who will provide protection for other employees and/or contractor(s) of Licensee must also be trained on CN US Operating Rules pertaining to their duties. They must take and pass the required examination. This training is good for a period of two years.

d. "Potential to foul a live track" is considered, at a minimum, to be working within twenty-five feet of the track; or as otherwise to be determined by CN Design & Construction Department.

The employees, contractor(s) , and/or agents of the Licensee and/or its contractor shall qualify for, and make available for inspection to Railroad Company's employees or other authorized personnel at all times while on Railroad Company property, a photo identification issued by www.e-railsafe.com, along with at least one other government-issued form of identification. Licensee and/or their contractor shall bear all costs of compliance with the requirements of this Section. Railroad Company reserves the right to bar any of employees or agents of Licensee and/or their contractor from Railroad Company's property at any time for any reason.

Licensee and/or any contractor engaged on their behalf, shall at all times conduct work in a manner satisfactory to the Engineering Manager of Railroad Company, or their authorized representative, and shall exercise care so as to not damage the property of Railroad Company, or that belonging to any other grantees, licensees, permittees or tenants of Railroad Company, or to interfere with railroad operations.

Engineering Manager of Railroad Company, or their authorized representative, will at all times have jurisdiction over the safety of railroad operations., The decision of the Engineering Manager or their authorized representative as to procedures which may affect the safety of railroad operations shall be final, and Licensee and/or their contractor shall be governed by such decision.

All work shall be conducted in such a manner as will assure the safety of Railroad Company. Railroad Company's authorized representative shall have the right, but not the duty, to require certain procedures to be used or to supervise the work on Railroad Company's property.

Should any damage occur to Railroad Company property as a result of the authorized or unauthorized operations of Licensee and/or their contractor and Railroad Company deems it necessary to repair such damage or perform any work for the protection of its property or operations, the Licensee and/or their contractor, as the case may be, shall promptly reimburse Railroad Company for the actual cost of such repairs or work. For the purpose of these Special Provisions, actual cost shall be deemed to include the direct cost of any labor, materials, equipment, or contract expense plus Railroad Company's current standard additives in each instance.

If the work requires the construction of a temporary grade crossing across the track(s) of Railroad Company, Licensee and/or their contractor shall make the necessary arrangements and execute Railroad Company's temporary grade crossing agreement for the construction, protection, maintenance, and later removal of such temporary grade crossing. The cost of such temporary grade crossing construction and later removal shall be prepaid to Railroad Company. Additional costs for repairs, maintenance or protection will be paid within thirty (30) days upon receipt of bill(s) therefor.

Licensee and/or their contractor shall at no time cross Railroad Company's property or tracks with vehicles or equipment of any kind or character, except at such temporary grade crossing as may be constructed as outlined herein, or at any existing and open public grade crossing. Operation over such crossing shall be at the direction and method of Railroad Company's Engineering Manager or their authorized representative.

Railroad Company may, at Licensee's and/or their contractor's sole cost, risk and expense, furnish whatever protective services it considers necessary, including, but not limited to, flagger(s), inspector(s), and stand-by personnel. Flagging protection, inspection services, or standby personnel required by

Railroad Company for the safety of railroad operations because of work being conducted by Licensee and/or their contractor, or in connection therewith, will be provided by Railroad Company and the cost of Licensee and shall be prepaid to Railroad Company by Licensee and/or their contractor. Flagging protection, inspection services, or standby personnel, necessary or provided in excess of prepayment amounts will be billed at the proper rates and will be promptly paid by overnight delivery.

In the event Railroad Company is unable to furnish protective services at the desired time or on the desired date(s), or if Licensee's prepayment for such services is exhausted and not replenished by Licensee and/or their contractor, Licensee and/or their contractor shall not perform any work on Railroad Company's property until such time and date(s) that appropriate Railroad Company services can be made available and/or appropriate prepayment is received. It is understood that Railroad Company shall not be liable for any delay or increased costs incurred by Licensee and/or their contractor owing to Railroad Company's inability or failure to have appropriate protective services available at the time or on the date requested.

Licensee and/or their contractor shall request and secure flagging protection by written notice to Railroad Company using CN's "Request for Flagging Services" form. This form must be submitted at least ten (10) working days in advance of proposed performance of any work or access to Railroad Company's property.

Flagging protection will be required during any operation involving direct and potential interference with Railroad Company's tracks or traffic. This may include but is not limited to fouling of railroad operating clearances, reasonable proximity of accidental hazard to railroad traffic, work within twenty-five (25) feet horizontally of the nearest centerline of any railroad track, any work over any railroad track, or in any other condition that Railroad Company deems protective services necessary, which may include work on or off Railroad Company's property more than twenty-five (25) feet from the nearest centerline of any railroad track, such as any equipment extension (including but not limited to a crane boom) that will reach or has the potential to reach within twenty-five (25) feet of any track.

Licensee and/or their contractor shall request, prepay, and secure Railroad Company signal facility locates by written notice to Railroad Company along with submission of CN's "Request for Flagging Services" form at least ten (10) working days in advance of proposed performance of any work or access to Railroad Company property. Notice to Railroad Company does not fulfill or satisfy any other notification requirements for utility locates for non-railroad facilities.

Railroad Company may require that prior to digging, trenching, or boring activities on or near Railroad Company property, or beneath any railroad track, an on-site meeting be conducted with Railroad Company's Signal Department representative. No digging, trenching or boring activities shall be conducted in the proximity of any known buried Railroad Company signal cables without Railroad Company's Signal Department representative being present.

The rate of pay for Railroad Company employees will be the prevailing hourly rate for not less than eight (8) hours for the class of labor at regular rates during regularly assigned work hours, and at overtime rates outside of regular hours and in accordance with Labor Agreements or Schedules plus Railroad Company's current standard additives in each instance.

Wage rates are subject to change, at any time, by law or agreement between Railroad Company and employees, and may be retroactive because of negotiations or a ruling by an authorized Governmental Agent. If the wage rates are changed, Licensee and/or their contractor shall pay on the basis of the new rates and/or additives.

No digging, trenching, or boring on Railroad Company property shall be conducted without Railroad Company's written approval of the plans that were furnished to Railroad Company's Engineering Manager at least thirty (30) in advance of the excavation.

The following temporary clearances are the minimum that must be maintained at all times during any operation on or adjacent to Railroad Company property:

Vertical: 22'-0" (7.00 m) above top of highest rail within 12'-0" (3.81 m) of the centerline of any track

Horizontal: 12'-0" (3.81 m) from centerline of the nearest track, measured at right angles thereto

If lesser clearances than the above are required for any part of the work, Licensee and/or their contractor shall secure written authorization from Railroad Company's Engineering Manager for such lesser clearances in advance of the start of that portion of the work.

No materials, supplies, or equipment will be stored within twenty-five (25) feet from the centerline of any railroad track, measured at right angles thereto.

Licensee and/or their contractor will be required upon the completion of the work to remove from within the limits of Railroad Company's property all machinery, equipment, surplus materials, false work, rubbish or temporary buildings, and to leave said property in a condition satisfactory to the Engineering Manager of Railroad Company or their authorized representative.

Nothing in these Special Provisions shall be construed to place any responsibility on Railroad Company for the quality or conduct of the work performed by Licensee and/or their contractor hereunder. Any approval given or supervision exercised by Railroad Company hereunder, or failure of Railroad Company to object to any work done, material used, or method of operation shall not be construed to relieve Licensee and/or their contractor of any obligations pursuant hereto or under the License these Special Provisions are appended to.

Accepted: _____

Print Name: _____

Request for Flagging Services
Southern Region

TO: **CN** **Date submitted:** _____
Attn: Mary Ellen Carmody, Audit Officer
2800 Livernois, Suite 220
Troy, Michigan 48083
(248) 740-6227
(248) 740-6036 fax
maryellen.carmody@cn.ca

FROM: _____
(Name)

I am requesting a flagman for the following project. All blanks below must be completely filled in before any flagman request will be honored. Proof of Insurance must accompany this form. Flagman will be provided within five (5) business days, at your cost, depending on availability. Direct your calls concerning availability and problems to (248) 740-6227.

Project Location: _____
RR milepost, Street, etc. _____
Company: _____
Billing Address: _____
City: _____ State: _____ Zip: _____
Company Phone: _____ Company Fax: _____
**Agreement or Authorization No.: _____ Dated: _____
With: _____
Contractor's Contact Person: _____ Phone: _____
Date(s) Flagging needed: _____
Starting time: _____ Ending Time: _____
Location for flagman to report: _____

Prepayment for WEEKDAY flagman protection is required, and must be submitted by over-night delivery to the address shown at the top of this page. The prepayment amount will be based on the number of weekdays a flagman is required, at the base rate of $1000.00 per weekday (1-8 hour continuous period). Prepayment for WEEKEND flagman protection will be at the rate of $150.00 per hour, with an eight hour (8) minimum of $1,200.00. Any hours in excess of eight (8) continuous hours per flagman on either WEEKDAY or WEEKEND days are to be prepaid at the rate of $150.00 per hour. Hours of flagman protection provided in excess of prepayment amounts will be billed at the proper rate and will be promptly paid by over-night delivery.

If project will run longer than originally anticipated, MaryEllen Carmody must be contacted in advance, and an additional check for the overrun submitted by over-night delivery.

Cost for a railroad S&C cable locate is $250.00, and is to be prepaid by over-night delivery.
*** You must have an agreement with CN railroad subsidiary, such as a Right of Entry Permit, Formal Agreement or State, County, City Project Number and proof of insurance before you can enter the property.*

Description of work to be performed: _____
_____
_____

Will you receive State or Federal Funds as reimbursement for this project? Yes____ No____

I agree to pay for flagging services as requested: _____
Attach map or other location info and fax completed form with cover letter on your company's letterhead and proof of insurance to MaryEllen Carmody (248) 740-6036

[INSERT JPEG IMAGE FOR EXHIBIT A]

Paul Chojenski
Manager Public Works
17641 South Ashland Avenue
Homewood, IL 60430
T 708.332.3557
F 708.332.3514
Email: Paul.Chojenski@cn.ca

RIGHT OF ENTRY (ROE) LICENSE AGREEMENT INFORMATION

Cost is $750.00* for application

Railroad Company requires everyone (contractor, consultants, etc.) working on Railroad Company property to have a Right-of-Entry (ROE) License Agreement. ROE license agreement applications are handled by email. Once Railroad Company receives the information requested below, and if application is approved, Railroad Company will draw up a ROE License Agreement, and will forward electronic copy by email for applicant's execution. Applicant must return one (1) executed original copy, a check for $750.00*, and proof of insurance, together in one package to the address above. Application and ROE License Agreement will be delayed if Railroad Company receives the required documents separately, incomplete, or inaccurate. Railroad Company will return a fully executed digital copy of the ROE License Agreement by email for Applicant's files and records. No work may occur on Railroad Company property nor will flagging protection be provided until ROE License Agreement has been fully executed by both parties and returned.
* Fee may be increased for special handling.

Please use this form and return by email to submit application request for a Right of Entry agreement.

Contact name –

Name of Applicant/contractor -

Street Address –

City, State, Zip –

Telephone –

Reason for ROE –

Duration of ROE –

Public Agency's Project No. –

Public agency Easement No. (if known) –

Location of project –

FRA/AAR/DOT Crossing No. –

If unable to locate this number at jobsite, please use following links to obtain:
http://safetydata.fra.dot.gov/officeofsafety/publicsite/crossing/xingqryloc.aspx

In Illinois
http://www.icc.illinois.gov/railroad/advanced.aspx?

If project job site does not have a FRA/AAR/DOT Crossing Number, please attach an aerial snapshot to help identify specific location.

ROE may take up to 4+ weeks to obtain

FAQ

What are the insurance requirements?

Railroad Company allows outside parties to come onto Railroad Company property to perform work, such as survey or inspection work, installation of pipelines and wirelines, and other work for projects necessitating the occupancy of Railroad Company. Before commencing work, and until the license of allowing such occupancy ends or is terminated, outside parties shall provide and maintain the following insurance in form and amount with companies satisfactory to and as approved by Railroad Company.

1. Minimum insurance required of outside party:

A. Statutory Workers Compensation and Employer's Liability Insurance.

B. Automobile Liability Insurance in an amount not less than $1,000,000 combined single limit.

C. Commercial General Liability Insurance (Occurrence Form) in an amount not less than $5,000,000 per occurrence, with an aggregate limit of not less than $10,000,000. The policy must name Railroad Company and its Parents as additional insureds in the following form:

Railroad Company name and its Parents
Attn: Rob Glass
17641 South Ashland Avenue
Homewood, IL 60430
708.332.6673 (office)
Rob.Glass@cn.ca

The policy must remove any provisions excluding coverage for injury, loss or damage arising out of or resulting from doing business or undertaking construction or demolition on, near, or adjacent to railroad track or facilities using endorsement CG 2417 10 01 or equivalent approved by Railroad Company.

D. When outside party is required by Railroad Company or Governing Authority to purchase Railroad Protective Liability Insurance to cover work on, near or adjacent to railroad track or facilities, and outside party is not being hired for this project by Railroad Company, outside party must procure Railroad Protective Liability Insurance in the following form;

This coverage shall be written on an Occurrence Form with limits of not less than $5,000,000 per occurrence for Bodily Injury, Personal Injury and Physical Damage to Property, with an aggregate limit of not less than $10,000,000. The policy must name:

Railroad Company name and its Parents
Attn: Rob Glass
17641 South Ashland Avenue
Homewood, IL 60430

708.332.6673 (office)
Rob.Glass@cn.ca

E. In the event the privileges provided herein to Applicant involve any work that could result in the discharge, spillage, disposal, release or escape of any Hazardous Material or petroleum product onto the Railroad Company's property, Applicant shall purchase and maintain in effect at all times during the term of this License a Contractor's Pollution Liability policy in an amount not less than two million dollars ($2,000,000) combined single limit (and with a deductible not to exceed $50,000) insuring Railroad against any and all damages, costs, liabilities and expenses resulting from on- or off-site bodily injury (including death to any person), on or off-site loss, damage or destruction of property (including that belonging to the parties hereto), and on-or off-site cleanup costs (including expenses incurred in the investigation, removal, remediation, neutralization, or immobilization of contaminated soils, surface water, groundwater or any other contamination) growing out of or incidental to any discharge, spillage, disposal, release, or escape of any Hazardous Material or petroleum product arising therefrom. For purposes of this Agreement, the term "Hazardous Material" shall include, without limit, any flammable explosives, radioactive materials, hazardous materials, hazardous wastes, hazardous or toxic substances, or related materials defined in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 U.S.C. §§ 9601, et seq.), the Hazardous Material Transportation Act, as amended (49 U.S.C. §§ 1801, et seq.), the Resource Conservation and Recovery Act, as amended (42 U.S.C. §§ 6901 et seq.), the Toxic Substances Control Act, as amended (15 U.S.C. §§ 2601, et seq.), similar laws or ordinances enacted by any state, county or municipality in which the Property is located, or in the regulations adopted and publications promulgated pursuant to any of the above, as such laws or regulations now exist or may exist in the future.

Applicant is required to advise Railroad Company by thirty (30) day advance written notice when any work to be performed under this License may require Pollution Liability Insurance pursuant to the previous paragraph.

F. All policies described above must include description of operations, Railroad Company milepost, highway or street name, city and state of location, project number, and Railroad Company contact person on the certificate.

2. Before commencing work, outside party shall deliver to Railroad Company a certificate of insurance evidencing the foregoing coverages and, if requested by Railroad Company, true and complete copies of the policies described above. If the policy is being issued in conjunction with, or as a result of, a city, county or state contract, the policy should be initially submitted to the respective city, county or state agency that will review it first and then forward it to Railroad Company.

3. Common Policy Provisions. Each policy described in paragraph 1, parts A through E above, must include the following provisions:

A. Each policy shall include a waiver by the insurer of any right of subrogation against any recovery by or on behalf of any insured.

B. Each policy shall provide for not less than thirty (30) days prior written notice to Railroad Company at the address listed above of cancellation of or any material change in that policy.

4. It is understood and agreed that the foregoing insurance coverage requirements, and outside party's compliance with those requirements, is not intended to, and shall not, relieve outside party from, or serve to limit, outside party's liability and indemnity obligations under the provisions herein.

5. Railroad Company shall have the right, from time to time, to revise the amount or form of insurance coverage required as circumstances or changing economic conditions may require. Railroad Company shall give outside party written notice of any such requested change at least thirty (30) days before the date of expiration of the then-existing policy or policies, outside party agrees to, and shall, thereupon provide Railroad Company with such revised policy or policies.

6. Insurance required of SUBCONTRACTOR:

A. If a SUBCONTRACTOR is to be employed by outside party to perform work on Railroad Company under or by the permission for occupancy granted to outside party by Railroad Company, before commencing work, the SUBCONTRACTOR shall provide and thereafter maintain all of the insurance described in paragraph 1, parts A through E, above, in the same forms and amounts as provided for above and subject to the other terms and conditions provided for in paragraphs 2 through 4 above.

B. In the alternative, before the SUBCONTRACTOR commences work for outside party on Railroad Company, outside party may provide and thereafter maintain all of the insurance described in paragraph 1, parts A through E, above, in the same forms and amounts as provided for above and subject to the other terms and conditions provided for in paragraphs 2 through 5 above, provided that all such insurance names SUBCONTRACTOR as an additional insured and all such insurance provides coverage to all additional insureds, including Railroad Company, for any liability arising out of work performed by all other additional insureds, including SUBCONTRACTOR.

Is safety training required?

Prior to any entry onto Railroad Company's property, the employees and/or subcontractors of a Contractor, Grantee, Licensee, or Permittee shall determine by the guidelines hereinafter provided and by the work to be performed the level of safety training to be required.

All employees and/or subcontractors of a Contractor, Grantee, Licensee, or Permittee not hired by Railroad Company that will work on CN property are required to have minimum www.contractororientation.com.

b. EXCEPTION: Railroad Company has exempted those it classifies as "Delivery Persons" from this training. This will include contractors such as UPS, FedEx, trucking companies, etc. who merely access the property to supply materials or equipment.

All employees and/or subcontractors of a Contractor, Grantee, Licensee, or Permittee hired by Railroad Company which will work on Railroad Company property are required to have minimum CN Safety and Security Awareness training, in addition to undergoing a background check. This training and

background check must be obtained through the eRailSafe.com website. If not done before, the contractor must contact CN Special Agent James Conroy at 708-332-5947 or James.Conroy@cn.ca to be issued a vendor number prior to accessing the noted website. Minimum information required of of a Contractor, Grantee, Licensee, or Permittee and/or their contractor when contacting either Special Agent James Conroy or e-RailSafe is Name, Address, Telephone, Contact Person for State Projects, DOT Contract Number, and the AAR/DOT Number. This training is good for a period of two years.

c. EXCEPTION: Railroad Company has exempted those employees of contractors providing paving services at a road crossing under construction or repair from this requirement.

d. EXCEPTION: Railroad Company has exempted those it classifies as "Delivery Persons" from this training. This will include contractors such as UPS, FedEx, trucking companies, etc. who merely access the property to supply materials or equipment.

All employees and/or subcontractors of a Contractor, Grantee, Licensee, or Permittee hired by Railroad Company, whose duties include and who are engaged in the inspection, construction, maintenance, or repair of railroad track, bridges, roadway, signal and communication systems, roadway facilities, or roadway machinery that will work foul of or have the potential to foul a live track are considered Roadway Workers under FRA regulations and CN Policy. They must complete the On-Track Safety Training course approved by Railroad Company and provided by R.R. Safety – AMR, P.O. Box 75, Lomira, WI 53048, telephone (920) 517-1677, email rrsafetytraining@yahoo.com. This training must be repeated at least once each calendar year.

e. EXCEPTION: Railroad Company has exempted those employees of contractors providing paving services at a road crossing under construction or repair from this requirement.

f. EXCEPTION: Railroad Company has exempted those it classifies as "Delivery Persons" from this training. This will include contractors such as UPS, FedEx, trucking companies, etc. who merely access the property to supply materials or equipment.

g. All the employees and/or subcontractors of a Contractor, Grantee, Licensee, or Permittee who will operate on-track machinery or those who will provide protection for other employees and/or subcontractors of a Contractor, Grantee, Licensee, or Permittee must also be trained on CN US Operating Rules pertaining to their duties. They must take and pass the required examination. This training is good for a period of two years.

h. "Potential to foul a live track" is considered, at a minimum, to be working within twenty-five (25) feet of the track; or as otherwise to be determined by CN Design & Construction Department.

The employees, subcontractors, and/or agents of the Licensee and/or its contractor shall qualify for, and make available for inspection to Railroad Company's employees or other authorized personnel at all times while on Railroad Company property, a photo identification issued by www.e-railsafe.com, along with at least one other government-issued form of identification. Licensee and/or their contractor shall bear all costs of compliance with the requirements of this Section. Railroad Company reserves the right to bar any of employees or agents of a Contractor, Grantee, Licensee, or Permittee and/or their contractor from Railroad Company's property at any time for any reason.

What are the flagging protection rates?

Flagging protection Rates:

Basic rate - 8 hour minimum = $1,000.00 – Monday thru Friday regular business hours

Overtime rate - hours in excess of 8 hours = $150.00/hr non regular business hours

Weekend or holiday rate = $150.00 per hour with a 8 hour minimum or $1,200.00

Email the above back to Paul.Chojenski.@cn.ca

Revised 07-24-2013

RAILROAD FLAGGING (WCL RR)

Description.
This work shall be performed as in accordance with Sections 107.12 and 109.05 of the Standard Specifications.

General Requirements.
The flagging costs incurred for the work associated at the location of the US 14 and the Wisconsin Central Ltd. (WCL) grade crossing will be reimbursed by IDOT in accordance with Section 109.05 of the Standard Specifications. The Contractor is responsible for prepaying the CN in advance for flagging services provided. The Contractor shall deposit the cost of flagging services for thirty (30) days with the CN. If the Contractor uses less than 30 days, then the Contractor will be charged for the days used and the balance will be reimbursed back to the Contractor. The Contractor will then be reimbursed by IDOT for the actual number of flagging days used. The Contractor is required to conduct operations at all times in full compliance with the rules, regulations and requirements of the WCL Special Provisions contained in the Contract Specifications and as described below.

The Contractor shall give thirty (30) days advance written notice to the Engineering Superintendent of the Railroad or his authorized representative prior to commencement of any construction work on the Improvement affecting the railroad property. The Contractor shall notify the Railroad sufficiently in advance of when the protective services are required. The Contractor shall make every effort to notify the Railroad in advance if a previously requested flagger will not be needed for any reason. Any costs for flagging protection provided by the Railroad at the Contractor's request for those days when the Contractor does not work shall be borne by the Contractor.

Basis of Payment.
RAILROAD FLAGGING (WCL RR) will be paid for according to Article 109.05 of the Standard Specifications.

RAILROAD PROTECTIVE LIABILITY INSURANCE (5 AND 10) (BDE)
Effective: January 1, 2006

Description.
Railroad Protective Liability and Property Damage Liability Insurance shall be carried according to Article 107.11 of the Standard Specifications, except the limits shall be a minimum of $5,000,000 combined single limit per occurrence for bodily injury liability and property damage liability with an aggregate limit of $10,000,000 over the life of the policy. A separate policy is required for each railroad unless otherwise noted.

NAMED INSURED & ADDRESS	NUMBER & SPEED OF PASSENGER TRAINS	NUMBER & SPEED OF FREIGHT TRAINS
Wisconsin Central, LTD and its parents 17641 South Ashland Ave. Homewood, IL 60430	22 trains/day @ 60 mph	10 trains/day @ 40 mph

DOT/AAR No.:	689 661Y	RR Mile Post:	23.44
RR Division:	Chicago	RR Sub-Division:	Waukesha

For Freight/Passenger Information Contact:	Paul Chojenski	Phone:	708-332-3557
For Insurance Information Contact:	Rob Glass	Phone:	708-332-6673

Approval of Insurance.
The original and one certified copy of each required policy shall be submitted to the following address for approval:

Illinois Department of Transportation
Bureau of Design and Environment
2300 South Dirksen Parkway, Room 326
Springfield, Illinois 62764

The Contractor will be advised when the Department has received approval of the insurance from the railroad(s). Before any work begins on railroad right-of-way, the Contractor shall submit to the Engineer evidence that the required insurance has been approved by the railroad(s). The Contractor shall also provide the Engineer with the expiration date of each required policy.

Basis of Payment.
Providing Railroad Protective Liability and Property Damage Liability Insurance will be paid for at the contract unit price per Lump Sum for RAILROAD PROTECTIVE LIABILITY INSURANCE.

COMPENSABLE DELAY COSTS (BDE)
Effective: June 2, 2017

Revise Article 107.40(b) of the Standard Specifications to read:

"(b) Compensation. Compensation will not be allowed for delays, inconveniences, or damages sustained by the Contractor from conflicts with facilities not meeting the above definition; or if a conflict with a utility in an unanticipated location does not cause a shutdown of the work or a documentable reduction in the rate of progress exceeding the limits set herein. The provisions of Article 104.03 notwithstanding, compensation for delays caused by a utility in an unanticipated location will be paid according to the provisions of this Article governing minor and major delays or reduced rate of production which are defined as follows.

(1) Minor Delay. A minor delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two hours, but not to exceed two weeks.

(2) Major Delay. A major delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two weeks.

(3) Reduced Rate of Production Delay. A reduced rate of production delay occurs when the rate of production on the work in conflict with the utility in an unanticipated location decreases by more than 25 percent and lasts longer than seven calendar days."

Revise Article 107.40(c) of the Standard Specifications to read:

"(c) Payment. Payment for Minor, Major, and Reduced Rate of Production Delays will be made as follows.

(1) Minor Delay. Labor idled which cannot be used on other work will be paid for according to Article 109.04(b)(1) and (2) for the time between start of the delay and the minimum remaining hours in the work shift required by the prevailing practice in the area.

Equipment idled which cannot be used on other work, and which is authorized to standby on the project site by the Engineer, will be paid for according to Article 109.04(b)(4).

(2) Major Delay. Labor will be the same as for a minor delay.

Equipment will be the same as for a minor delay, except Contractor-owned equipment will be limited to two weeks plus the cost of move-out to either the Contractor's yard or another job and the cost to re-mobilize, whichever is less. Rental equipment may be paid for longer than two weeks provided the Contractor presents adequate support to the Department (including lease agreement) to show retaining equipment on the job is the most economical course to follow and in the public interest.

(3) Reduced Rate of Production Delay. The Contractor will be compensated for the reduced productivity for labor and equipment time in excess of the 25 percent threshold for that portion of the delay in excess of seven calendar days. Determination of compensation will be in accordance with Article 104.02, except labor and material additives will not be permitted.

Payment for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be determined according to Article 109.13."

Revise Article 108.04(b) of the Standard Specifications to read:

"(b) No working day will be charged under the following conditions.

(1) When adverse weather prevents work on the controlling item.

(2) When job conditions due to recent weather prevent work on the controlling item.

(3) When conduct or lack of conduct by the Department or its consultants, representatives, officers, agents, or employees; delay by the Department in making the site available; or delay in furnishing any items required to be furnished to the Contractor by the Department prevents work on the controlling item.

(4) When delays caused by utility or railroad adjustments prevent work on the controlling item.

(5) When strikes, lock-outs, extraordinary delays in transportation, or inability to procure critical materials prevent work on the controlling item, as long as these delays are not due to any fault of the Contractor.

(6) When any condition over which the Contractor has no control prevents work on the controlling item."

Revise Article 109.09(f) of the Standard Specifications to read:

"(f) Basis of Payment. After resolution of a claim in favor of the Contractor, any adjustment in time required for the work will be made according to Section 108. Any adjustment in the costs to be paid will be made for direct labor, direct materials, direct equipment, direct jobsite overhead, direct offsite overhead, and other direct costs allowed by the resolution. Adjustments in costs will not be made for interest charges, loss of anticipated profit, undocumented loss of efficiency, home office overhead and unabsorbed overhead other than as allowed by Article 109.13, lost opportunity, preparation of claim expenses and other consequential indirect costs regardless of method of calculation.

The above Basis of Payment is an essential element of the contract and the claim cost recovery of the Contractor shall be so limited."

Add the following to Section 109 of the Standard Specifications.

"**109.13 Payment for Contract Delay.** Compensation for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be allowed when such costs result from a delay meeting the criteria in the following table.

Contract Type	Cause of Delay	Length of Delay
Working Days	Article 108.04(b)(3) or Article 108.04(b)(4)	No working days have been charged for two consecutive weeks.
Completion Date	Article 108.08(b)(1) or Article 108.08(b)(7)	The Contractor has been granted a minimum two week extension of contract time, according to Article 108.08.

Payment for each of the various costs will be according to the following.

(a) Escalated Material and/or Labor Costs. When the delay causes work, which would have otherwise been completed, to be done after material and/or labor costs have increased, such increases will be paid. Payment for escalated material costs will be limited to the increased costs substantiated by documentation furnished by the Contractor. Payment for escalated labor costs will be limited to those items in Article 109.04(b)(1) and (2), except the 35 percent and 10 percent additives will not be permitted.

(b) Extended Project Overhead. For the duration of the delay, payment for extended project overhead will be paid as follows.

(1) Direct Jobsite and Offsite Overhead. Payment for documented direct jobsite overhead and documented direct offsite overhead, including onsite supervisory and administrative personnel, will be allowed according to the following table.

Original Contract Amount	Supervisory and Administrative Personnel
Up to $5,000,000	One Project Superintendent
Over $ 5,000,000 - up to $25,000,000	One Project Manager, One Project Superintendent or Engineer, and One Clerk
Over $25,000,000 - up to $50,000,000	One Project Manager, One Project Superintendent, One Engineer, and One Clerk
Over $50,000,000	One Project Manager, Two Project Superintendents, One Engineer, and One Clerk

(2) Home Office and Unabsorbed Overhead. Payment for home office and unabsorbed overhead will be calculated as 8 percent of the total delay cost.

(c) Extended Traffic Control. Traffic control required for an extended period of time due to the delay will be paid. For working day contracts the payment will be made according to Article 109.04. For completion date contracts, an adjustment will be determined as follows.

Extended Traffic Control occurs between April 1 and November 30:

ETCP Adjustment ($) = TE x (%/100 x CUP / OCT)

Extended Traffic Control occurs between December 1 and March 31:

ETCP Adjustment ($) = TE x 1.5 (%/100 x CUP / OCT)

Where: TE = Duration of approved time extension in calendar days.
% = Percent maintenance for the traffic control, % (see table below).
CUP = Contract unit price for the traffic control pay item in place during the delay.
OCT = Original contract time in calendar days.

Original Contract Amount	Percent Maintenance
Up to $2,000,000	65%
$2,000,000 to $10,000,000	75%
$10,000,000 to $20,000,000	85%
Over $20,000,000	90%

When an ETCP adjustment is paid under this provision, an adjusted unit price as provided for in Article 701.20(a) for increase or decrease in the value of work by more than ten percent will not be paid.

Upon payment for a contract delay under this provision, the Contractor shall assign subrogation rights to the Department for the Department's efforts of recovery from any other party for monies paid by the Department as a result of any claim under this provision. The Contractor shall fully cooperate with the Department in its efforts to recover from another party any money paid to the Contractor for delay damages under this provision."

CONSTRUCTION AIR QUALITY – DIESEL RETROFIT (BDE)
Effective: June 1, 2010 Revised: November 1, 2014

The reduction of emissions of particulate matter (PM) for off-road equipment shall be accomplished by installing retrofit emission control devices. The term "equipment" refers to diesel fuel powered devices rated at 50 hp and above, to be used on the jobsite in excess of seven calendar days over the course of the construction period on the jobsite (including rental equipment).

Contractor and subcontractor diesel powered off-road equipment assigned to the contract shall be retrofitted using the phased in approach shown below. Equipment that is of a model year older than the year given for that equipment's respective horsepower range shall be retrofitted:

Effective Dates	Horsepower Range	Model Year
June 1, 2010 1/	600-749	2002
	750 and up	2006
June 1, 2011 2/	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006
June 1, 2012 2/	50-99	2004
	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006

1/ Effective dates apply to Contractor diesel powered off-road equipment assigned to the contract.
2/ Effective dates apply to Contractor and subcontractor diesel powered off-road equipment assigned to the contract.

The retrofit emission control devices shall achieve a minimum PM emission reduction of 50 percent and shall be:

a) Included on the U.S. Environmental Protection Agency (USEPA) *Verified Retrofit Technology List* (http://www.epa.gov/cleandiesel/verification/verif-list.htm), or verified by the California Air Resources Board (CARB) (http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm); or

b) Retrofitted with a non-verified diesel retrofit emission control device if verified retrofit emission control devices are not available for equipment proposed to be used on the project, and if the Contractor has obtained a performance certification from the retrofit device manufacturer that the emission control device provides a minimum PM emission reduction of 50 percent.

Note: Large cranes (Crawler mounted cranes) which are responsible for critical lift operations are exempt from installing retrofit emission control devices if such devices adversely affect equipment operation.

Diesel powered off-road equipment with engine ratings of 50 hp and above, which are unable to be retrofitted with verified emission control devices or if performance certifications are not available which will achieve a minimum 50 percent PM reduction, may be granted a waiver by the Department if documentation is provided showing good faith efforts were made by the Contractor to retrofit the equipment.

Construction shall not proceed until the Contractor submits a certified list of the diesel powered off-road equipment that will be used, and as necessary, retrofitted with emission control devices. The list(s) shall include (1) the equipment number, type, make, Contractor/rental company name; and (2) the emission control devices make, model, USEPA or CARB verification number, or performance certification from the retrofit device manufacturer. Equipment reported as fitted with emissions control devices shall be made available to the Engineer for visual inspection of the device installation, prior to being used on the jobsite.

The Contractor shall submit an updated list of retrofitted off-road construction equipment as retrofitted equipment changes or comes on to the jobsite. The addition or deletion of any diesel powered equipment shall be included on the updated list.

If any diesel powered off-road equipment is found to be in non-compliance with any portion of this special provision, the Engineer will issue the Contractor a diesel retrofit deficiency deduction.

Any costs associated with retrofitting any diesel powered off-road equipment with emission control devices shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed. The Contractor's compliance with this notice and any associated regulations shall not be grounds for a claim.

Diesel Retrofit Deficiency Deduction

When the Engineer determines that a diesel retrofit deficiency exists, a daily monetary deduction will be imposed for each calendar day or fraction thereof the deficiency continues to exist. The calendar day(s) will begin when the time period for correction is exceeded and end with the Engineer's written acceptance of the correction. The daily monetary deduction will be $1,000.00 for each deficiency identified.

The deficiency will be based on lack of diesel retrofit emissions control.

If a Contractor accumulates three diesel retrofit deficiency deductions for the same piece of equipment in a contract period, the Contractor will be shutdown until the deficiency is corrected. Such a shutdown will not be grounds for any extension of the contract time, waiver of penalties, or be grounds for any claim.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION (BDE)
Effective: September 1, 2000 Revised: April 2, 2018

FEDERAL OBLIGATION. The Department of Transportation, as a recipient of federal financial assistance, is required to take all necessary and reasonable steps to ensure nondiscrimination in the award and administration of contracts. Consequently, the federal regulatory provisions of 49 CFR Part 26 apply to this contract concerning the utilization of disadvantaged business enterprises. For the purposes of this Special Provision, a disadvantaged business enterprise (DBE) means a business certified by the Department in accordance with the requirements of 49 CFR Part 26 and listed in the Illinois Unified Certification Program (IL UCP) DBE Directory.

STATE OBLIGATION. This Special Provision will also be used by the Department to satisfy the requirements of the Business Enterprise for Minorities, Females, and Persons with Disabilities Act, 30 ILCS 575. When this Special Provision is used to satisfy state law requirements on 100 percent state-funded contracts, the federal government has no involvement in such contracts (not a federal-aid contract) and no responsibility to oversee the implementation of this Special Provision by the Department on those contracts. DBE participation on 100 percent state-funded contracts will not be credited toward fulfilling the Department’s annual overall DBE goal required by the US Department of Transportation to comply with the federal DBE program requirements.

CONTRACTOR ASSURANCE. The Contractor makes the following assurance and agrees to include the assurance in each subcontract that the Contractor signs with a subcontractor.

The Contractor, subrecipient, or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of contracts funded in whole or in part with federal or state funds. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:

(a) Withholding progress payments;

(b) Assessing sanctions;

(c) Liquidated damages; and/or

(d) Disqualifying the Contractor from future bidding as non-responsible.

OVERALL GOAL SET FOR THE DEPARTMENT. As a requirement of compliance with 49 CFR Part 26, the Department has set an overall goal for DBE participation in its federally assisted contracts. That goal applies to all federal-aid funds the Department will expend in its federally assisted contracts for the subject reporting fiscal year. The Department is required to make a good faith effort to achieve the overall goal. The dollar amount paid to all approved DBE companies performing work called for in this contract is eligible to be credited toward fulfillment of the Department's overall goal.

CONTRACT GOAL TO BE ACHIEVED BY THE CONTRACTOR. This contract includes a specific DBE utilization goal established by the Department. The goal has been included because the Department has determined that the work of this contract has subcontracting opportunities that may be suitable for performance by DBE companies. The determination is based on an assessment of the type of work, the location of the work, and the availability of DBE companies to do a part of the work. The assessment indicates that, in the absence of unlawful discrimination, and in an arena of fair and open competition, DBE companies can be expected to perform **15.00%** of the work. This percentage is set as the DBE participation goal for this contract. Consequently, in addition to the other award criteria established for this contract, the Department will only award this contract to a bidder who makes a good faith effort to meet this goal of DBE participation in the performance of the work. A bidder makes a good faith effort for award consideration if either of the following is done in accordance with the procedures set for in this Special Provision:

(a) The bidder documents that enough DBE participation has been obtained to meet the goal or,

(b) The bidder documents that a good faith effort has been made to meet the goal, even though the effort did not succeed in obtaining enough DBE participation to meet the goal.

DBE LOCATOR REFERENCES. Bidders shall consult the IL UCP DBE Directory as a reference source for DBE-certified companies. In addition, the Department maintains a letting and item specific DBE locator information system whereby DBE companies can register their interest in providing quotes on particular bid items advertised for letting. Information concerning DBE companies willing to quote work for particular contracts may be obtained by contacting the Department's Bureau of Small Business Enterprises at telephone number (217) 785-4611, or by visiting the Department's website at:
http://www.idot.illinois.gov/doing-business/certifications/disadvantaged-business-enterprise-certification/il-ucp-directory/index.

BIDDING PROCEDURES. Compliance with this Special Provision is required prior to the award of the contract and the failure of the low bidder to comply will render the bid not responsive.

In order to assure the timely award of the contract, the low bidder shall submit:

(a) The bidder shall submit a DBE Utilization Plan on completed Department forms SBE 2025 and 2026.

(1) The final Utilization Plan must be submitted within five calendar days after the date of the letting in accordance with subsection (a)(2) of Bidding Procedures herein.

(2) To meet the five day requirement, the bidder may send the Utilization Plan electronically by scanning and sending to **DOT.DBE.UP@illinois.gov** or faxing to (217) 785-1524. The subject line must include the bid Item Number and the Letting date. The Utilization Plan should be sent as one .pdf file, rather than multiple files and emails for the same Item Number. It is the responsibility of the bidder to obtain confirmation of email or fax delivery.

Alternatively, the Utilization Plan may be sent by certified mail or delivery service within the five calendar day period. If a question arises concerning the mailing date of a Utilization Plan, the mailing date will be established by the U.S. Postal Service postmark on the certified mail receipt from the U.S. Postal Service or the receipt issued by a delivery service when the Utilization Plan is received by the Department. It is the responsibility of the bidder to ensure the postmark or receipt date is affixed within the five days if the bidder intends to rely upon mailing or delivery to satisfy the submission day requirement. The Utilization Plan is to be submitted to:

Illinois Department of Transportation
Bureau of Small Business Enterprises
Contract Compliance Section
2300 South Dirksen Parkway, Room 319
Springfield, Illinois 62764

The Department will not accept a Utilization Plan if it does not meet the five day submittal requirement and the bid will be declared not responsive. In the event the bid is declared not responsive due to a failure to submit a Utilization Plan or failure to comply with the bidding procedures set forth herein, the Department may elect to cause the forfeiture of the penal sum of the bidder's proposal guaranty, and may deny authorization to bid the project if re-advertised for bids. The Department reserves the right to invite any other bidder to submit a Utilization Plan at any time for award consideration.

(b) The Utilization Plan shall indicate that the bidder either has obtained sufficient DBE participation commitments to meet the contract goal or has not obtained enough DBE participation commitments in spite of a good faith effort to meet the goal. The Utilization Plan shall further provide the name, telephone number, and telefax number of a responsible official of the bidder designated for purposes of notification of Utilization Plan approval or disapproval under the procedures of this Special Provision.

(c) The Utilization Plan shall include a DBE Participation Commitment Statement, Department form SBE 2025, for each DBE proposed for the performance of work to achieve the contract goal. For bidding purposes, submission of the completed SBE 2025 forms, signed by the DBEs and scanned or faxed to the bidder will be acceptable as long as the original is available and provided upon request. All elements of information indicated on the said form shall be provided, including but not limited to the following:

(1) The names and addresses of DBE firms that will participate in the contract;

(2) A description, including pay item numbers, of the work each DBE will perform;

(3) The dollar amount of the participation of each DBE firm participating. The dollar amount of participation for identified work shall specifically state the quantity, unit price, and total subcontract price for the work to be completed by the DBE. If partial pay items are to be performed by the DBE, indicate the portion of each item, a unit price where appropriate and the subcontract price amount;

(4) DBE Participation Commitment Statements, form SBE 2025, signed by the bidder and each participating DBE firm documenting the commitment to use the DBE subcontractors whose participation is submitted to meet the contract goal;

(5) If the bidder is a joint venture comprised of DBE companies and non-DBE companies, the Utilization Plan must also include a clear identification of the portion of the work to be performed by the DBE partner(s); and,

(6) If the contract goal is not met, evidence of good faith efforts; the documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor is selected over a DBE for work on the contract.

GOOD FAITH EFFORT PROCEDURES. The contract will not be awarded until the Utilization Plan submitted by the apparent successful bidder is approved. All information submitted by the bidder must be complete, accurate and adequately document that enough DBE participation has been obtained or document that good faith efforts of the bidder, in the event enough DBE participation has not been obtained, before the Department will commit to the performance of the contract by the bidder. The Utilization Plan will be approved by the Department if the Utilization Plan documents sufficient commercially useful DBE work to meet the contract goal or the bidder submits sufficient documentation of a good faith effort to meet the contract goal pursuant to 49 CFR Part 26, Appendix A. The Utilization Plan will not be approved by the Department if the Utilization Plan does not document sufficient DBE participation to meet the contract goal unless the apparent successful bidder documented in the Utilization Plan that it made a good faith effort to meet the goal. This means that the bidder must show that all necessary and reasonable steps were taken to achieve the contract goal. Necessary and reasonable steps are those which, by their scope, intensity and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if they were not successful. The Department will consider the quality, quantity, and intensity of the kinds of efforts that the bidder has made. Mere *pro forma* efforts, in other words, efforts done as a matter of form, are not good faith efforts; rather, the bidder is expected to have taken genuine efforts that would be reasonably expected of a bidder actively and aggressively trying to obtain DBE participation sufficient to meet the contract goal.

(a) The following is a list of types of action that the Department will consider as part of the evaluation of the bidder's good faith efforts to obtain participation. These listed factors are not intended to be a mandatory checklist and are not intended to be exhaustive. Other factors or efforts brought to the attention of the Department may be relevant in appropriate cases, and will be considered by the Department.

(1) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBE companies that have the capability to perform the work of the contract. The bidder must solicit this interest within sufficient time to allow the DBE companies to respond to the solicitation. The bidder must determine with certainty if the DBE companies are interested by taking appropriate steps to follow up initial solicitations.

(2) Selecting portions of the work to be performed by DBE companies in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the prime Contractor might otherwise prefer to perform these work items with its own forces.

(3) Providing interested DBE companies with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(4) a. Negotiating in good faith with interested DBE companies. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBE companies that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBE companies to perform the work.

b. A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBE companies is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also the ability or desire of a bidder to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidders are not, however, required to accept higher quotes from DBE companies if the price difference is excessive or unreasonable. In accordance with subsection (c)(6) of the above Bidding Procedures, the documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract.

(5) Not rejecting DBE companies as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

(6) Making efforts to assist interested DBE companies in obtaining bonding, lines of credit, or insurance as required by the recipient or Contractor.

(7) Making efforts to assist interested DBE companies in obtaining necessary equipment, supplies, materials, or related assistance or services.

(8) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBE companies.

(b) If the Department determines that the apparent successful bidder has made a good faith effort to secure the work commitment of DBE companies to meet the contract goal, the Department will award the contract provided that it is otherwise eligible for award. If the Department determines that the bidder has failed to meet the requirements of this Special Provision or that a good faith effort has not been made, the Department will notify the responsible company official designated in the Utilization Plan that the bid is not responsive. The notification shall include a statement of reasons for the determination. If the Utilization Plan is not approved because it is deficient as a technical matter, unless waived by the Department, the bidder will be notified and will be allowed no more than a five calendar day period in order to cure the deficiency.

(c) The bidder may request administrative reconsideration of a determination adverse to the bidder within the five working days after the receipt of the notification date of the determination by delivering the request to the Department of Transportation, Bureau of Small Business Enterprises, Contract Compliance Section, 2300 South Dirksen Parkway, Room 319, Springfield, Illinois 62764 (Telefax: (217) 785-1524). Deposit of the request in the United States mail on or before the fifth business day shall not be deemed delivery. The determination shall become final if a request is not made and delivered. A request may provide additional written documentation or argument concerning the issues raised in the determination statement of reasons, provided the documentation and arguments address efforts made prior to submitting the bid. The request will be forwarded to the Department's Reconsideration Officer. The Reconsideration Officer will extend an opportunity to the bidder to meet in person in order to consider all issues of documentation and whether the bidder made a good faith effort to meet the goal. After the review by the Reconsideration Officer, the bidder will be sent a written decision within ten working days after receipt of the request for reconsideration, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. A final decision by the Reconsideration Officer that a good faith effort was made shall approve the Utilization Plan submitted by the bidder and shall clear the contract for award. A final decision that a good faith effort was not made shall render the bid not responsive.

CALCULATING DBE PARTICIPATION. The Utilization Plan values represent work anticipated to be performed and paid for upon satisfactory completion. The Department is only able to count toward the achievement of the overall goal and the contract goal the value of payments made for the work actually performed by DBE companies. In addition, a DBE must perform a commercially useful function on the contract to be counted. A commercially useful function is generally performed when the DBE is responsible for the work and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. The Department and Contractor are governed by the provisions of 49 CFR Part 26.55(c) on questions of commercially useful functions as it affects the work. Specific counting guidelines are provided in 49 CFR Part 26.55, the provisions of which govern over the summary contained herein.

(a) DBE as the Contractor: 100 percent goal credit for that portion of the work performed by the DBE's own forces, including the cost of materials and supplies. Work that a DBE subcontracts to a non-DBE does not count toward the DBE goals.

(b) DBE as a joint venture Contractor: 100 percent goal credit for that portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work performed by the DBE's own forces.

(c) DBE as a subcontractor: 100 percent goal credit for the work of the subcontract performed by the DBE's own forces, including the cost of materials and supplies, excluding the purchase of materials and supplies or the lease of equipment by the DBE subcontractor from the prime Contractor or its affiliates. Work that a DBE subcontractor in turn subcontracts to a non-DBE does not count toward the DBE goal.

(d) DBE as a trucker: 100 percent goal credit for trucking participation provided the DBE is responsible for the management and supervision of the entire trucking operation for which it is responsible. At least one truck owned, operated, licensed, and insured by the DBE must be used on the contract. Credit will be given for the following:

(1) The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.

(2) The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission is receives as a result of the lease arrangement.

(e) DBE as a material supplier:

(1) 60 percent goal credit for the cost of the materials or supplies purchased from a DBE regular dealer.

(2) 100 percent goal credit for the cost of materials of supplies obtained from a DBE manufacturer.

(3) 100 percent credit for the value of reasonable fees and commissions for the procurement of materials and supplies if not a DBE regular dealer or DBE manufacturer.

CONTRACT COMPLIANCE. Compliance with this Special Provision is an essential part of the contract. The Department is prohibited by federal regulations from crediting the participation of a DBE included in the Utilization Plan toward either the contract goal or the Department's overall goal until the amount to be applied toward the goals has been paid to the DBE. The following administrative procedures and remedies govern the compliance by the Contractor with the contractual obligations established by the Utilization Plan. After approval of the Utilization Plan and award of the contract, the Utilization Plan and individual DBE Participation Statements become part of the contract. If the Contractor did not succeed in obtaining enough DBE participation to achieve the advertised contract goal, and the Utilization Plan was approved and contract awarded based upon a determination of good faith, the total dollar value of DBE work calculated in the approved Utilization Plan as a percentage of the awarded contract value shall become the amended contract goal. All work indicated for performance by an approved DBE shall be performed, managed, and supervised by the DBE executing the DBE Participation Commitment Statement.

(a) NO AMENDMENT. No amendment to the Utilization Plan may be made without prior written approval from the Department's Bureau of Small Business Enterprises. All requests for amendment to the Utilization Plan shall be submitted to the Department of Transportation, Bureau of Small Business Enterprises, Contract Compliance Section, 2300 South Dirksen Parkway, Room 319, Springfield, Illinois 62764. Telephone number (217) 785-4611. Telefax number (217) 785-1524.

(b) CHANGES TO WORK. Any deviation from the DBE condition-of-award or contract plans, specifications, or special provisions must be approved, in writing, by the Department as provided elsewhere in the Contract. The Contractor shall notify affected DBEs in writing of any changes in the scope of work which result in a reduction in the dollar amount condition-of-award to the contract. Where the revision includes work committed to a new DBE subcontractor, not previously involved in the project, then a Request for Approval of Subcontractor, Department form BC 260A or AER 260A, must be signed and submitted. If the commitment of work is in the form of additional tasks assigned to an existing subcontract, than a new Request for Approval of Subcontractor shall not be required. However, the Contractor must document efforts to assure that the existing DBE subcontractor is capable of performing the additional work and has agreed in writing to the change.

(c) SUBCONTRACT. The Contractor must provide DBE subcontracts to IDOT upon request. Subcontractors shall ensure that all lower tier subcontracts or agreements with DBEs to supply labor or materials be performed in accordance with this Special Provision.

(d) ALTERNATIVE WORK METHODS. In addition to the above requirements for reductions in the condition of award, additional requirements apply to the two cases of Contractor-initiated work substitution proposals. Where the contract allows alternate work methods which serve to delete or create underruns in condition of award DBE work, and the Contractor selects that alternate method or, where the Contractor proposes a substitute work method or material that serves to diminish or delete work committed to a DBE and replace it with other work, then the Contractor must demonstrate one of the following:

(1) That the replacement work will be performed by the same DBE (as long as the DBE is certified in the respective item of work) in a modification of the condition of award; or

(2) That the DBE is aware that its work will be deleted or will experience underruns and has agreed in writing to the change. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so; or

(3) That the DBE is not capable of performing the replacement work or has declined to perform the work at a reasonable competitive price. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so.

(e) TERMINATION AND REPLACEMENT PROCEDURES. The Contractor shall not terminate or replace a DBE listed on the approved Utilization Plan, or perform with other forces work designated for a listed DBE except as provided in this Special Provision. The Contractor shall utilize the specific DBEs listed to perform the work and supply the materials for which each is listed unless the Contractor obtains the Department's written consent as provided in subsection (a) of this part. Unless Department consent is provided for termination of a DBE subcontractor, the Contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the DBE in the Utilization Plan.

As stated above, the Contractor shall not terminate or replace a DBE subcontractor listed in the approved Utilization Plan without prior written consent. This includes, but is not limited to, instances in which the Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. Written consent will be granted only if the Bureau of Small Business Enterprises agrees, for reasons stated in its concurrence document, that the Contractor has good cause to terminate or replace the DBE firm. Before transmitting to the Bureau of Small Business Enterprises any request to terminate and/or substitute a DBE subcontractor, the Contractor shall give notice in writing to the DBE subcontractor, with a copy to the Bureau, of its intent to request to terminate and/or substitute, and the reason for the request. The Contractor shall give the DBE five days to respond to the Contractor's notice. The DBE so notified shall advise the Bureau and the Contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Bureau should not approve the Contractor's action. If required in a particular case as a matter of public necessity, the Bureau may provide a response period shorter than five days.

For purposes of this paragraph, good cause includes the following circumstances:

(1) The listed DBE subcontractor fails or refuses to execute a written contract;

(2) The listed DBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the prime contractor;

(3) The listed DBE subcontractor fails or refuses to meet the prime Contractor's reasonable, nondiscriminatory bond requirements;

(4) The listed DBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;

(5) The listed DBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215 and 1200 or applicable state law.

(6) You have determined that the listed DBE subcontractor is not a responsible contractor;

(7) The listed DBE subcontractor voluntarily withdraws from the projects and provides to you written notice of its withdrawal;

(8) The listed DBE is ineligible to receive DBE credit for the type of work required;

(9) A DBE owner dies or becomes disabled with the result that the listed DBE subcontractor is unable to complete its work on the contract;

(10) Other documented good cause that compels the termination of the DBE subcontractor. Provided, that good cause does not exist if the prime Contractor seeks to terminate a DBE it relied upon to obtain the contract so that the prime Contractor can self-perform the work for which the DBE contractor was engaged or so that the prime Contractor can substitute another DBE or non-DBE contractor after contract award.

When a DBE is terminated, or fails to complete its work on the Contract for any reason the Contractor shall make a good faith effort to find another DBE to substitute for the original DBE to perform at least the same amount of work under the contract as the terminated DBE to the extent needed to meet the established Contract goal. The good faith efforts shall be documented by the Contractor. If the Department requests documentation under this provision, the Contractor shall submit the documentation within seven days, which may be extended for an additional seven days if necessary at the request of the Contractor. The Department shall provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated.

(f) FINAL PAYMENT. After the performance of the final item of work or delivery of material by a DBE and final payment therefore to the DBE by the Contractor, but not later than thirty calendar days after payment has been made by the Department to the Contractor for such work or material, the Contractor shall submit a DBE Payment Agreement on Department form SBE 2115 to the Resident Engineer. If full and final payment has not been made to the DBE, the DBE Payment Agreement shall indicate whether a disagreement as to the payment required exists between the Contractor and the DBE or if the Contractor believes that the work has not been satisfactorily completed. If the Contractor does not have the full amount of work indicated in the Utilization Plan performed by the DBE companies indicated in the Utilization Plan and after good faith efforts are reviewed, the Department may deduct from contract payments to the Contractor the amount of the goal not achieved as liquidated and ascertained damages. The Contractor may request an administrative reconsideration of any amount deducted as damages pursuant to subsection (h) of this part.

(g) ENFORCEMENT. The Department reserves the right to withhold payment to the Contractor to enforce the provisions of this Special Provision. Final payment shall not be made on the contract until such time as the Contractor submits sufficient documentation demonstrating achievement of the goal in accordance with this Special Provision or after liquidated damages have been determined and collected.

(h) RECONSIDERATION. Notwithstanding any other provision of the contract, including but not limited to Article 109.09 of the Standard Specifications, the Contractor my request administrative reconsideration of a decision to deduct the amount of the goal not achieved as liquidated damages. A request to reconsider shall be delivered to the Contract Compliance Section and shall be handled and considered in the same manner as set forth in paragraph (c) of "Good Faith Effort Procedures" of this Special Provision, except a final decision that a good faith effort was not made during contract performance to achieve the goal agreed to in the Utilization Plan shall be the final administrative decision of the Department. The result of the reconsideration process is not administratively appealable to the U.S. Department of Transportation.

EQUIPMENT PARKING AND STORAGE (BDE)
Effective: November 1, 2017

Replace the first paragraph of Article 701.11 of the Standard Specifications with the following.

"**701.11 Equipment Parking and Storage.** During working hours, all vehicles and/or nonoperating equipment which are parked, two hours or less, shall be parked at least 8 ft (2.5 m) from the open traffic lane. For other periods of time during working and for all nonworking hours, all vehicles, materials, and equipment shall be parked or stored as follows.

(a) When the project has adequate right-of-way, vehicles, materials, and equipment shall be located a minimum of 30 ft (9 m) from the pavement.

(b) When adequate right-of-way does not exist, vehicles, materials, and equipment shall be located a minimum of 15 ft (4.5 m) from the edge of any pavement open to traffic.

(c) Behind temporary concrete barrier, vehicles, materials, and equipment shall be located a minimum of 24 in. (600 mm) behind free standing barrier or a minimum of 6 in. (150 mm) behind barrier that is either pinned or restrained according to Article 704.04. The 24 in. or 6 in. measurement shall be from the base of the non-traffic side of the barrier.

(d) Behind other man-made or natural barriers meeting the approval of the Engineer."

HOT-MIX ASPHALT - DENSITY TESTING OF LONGITUDINAL JOINTS (BDE)
Effective: January 1, 2010 Revised: April 1, 2016

Description. This work shall consist of testing the density of longitudinal joints as part of the quality control/quality assurance (QC/QA) of hot-mix asphalt (HMA). Work shall be according to Section 1030 of the Standard Specifications except as follows.

Quality Control/Quality Assurance (QC/QA). Delete the second and third sentence of the third paragraph of Article 1030.05(d)(3) of the Standard Specifications.

Add the following paragraphs to the end of Article 1030.05(d)(3) of the Standard Specifications:

"Longitudinal joint density testing shall be performed at each random density test location. Longitudinal joint testing shall be located at a distance equal to the lift thickness or a minimum of 4 in. (100 mm), from each pavement edge. (i.e. for a 5 in. (125 mm) lift the near edge of the density gauge or core barrel shall be within 5 in. (125 mm) from the edge of pavement.) Longitudinal joint density testing shall be performed using either a correlated nuclear gauge or cores.

a. Confined Edge. Each confined edge density shall be represented by a one-minute nuclear density reading or a core density and shall be included in the average of density readings or core densities taken across the mat which represents the Individual Test.

b. Unconfined Edge. Each unconfined edge joint density shall be represented by an average of three one-minute density readings or a single core density at the given density test location and shall meet the density requirements specified herein. The three one-minute readings shall be spaced 10 ft (3 m) apart longitudinally along the unconfined pavement edge and centered at the random density test location."

Revise the Density Control Limits table in Article 1030.05(d)(4) of the Standard Specifications to read:

"Mixture Composition	Parameter	Individual Test (includes confined edges)	Unconfined Edge Joint Density Minimum
IL-4.75	Ndesign = 50	93.0 – 97.4% 1/	91.0%
IL-9.5	Ndesign = 90	92.0 – 96.0%	90.0%
IL-9.5,IL-9.5L	Ndesign < 90	92.5 – 97.4%	90.0%
IL-19.0	Ndesign = 90	93.0 – 96.0%	90.0%
IL-19.0, IL-19.0L	Ndesign < 90	93.0 2/– 97.4%	90.0%
SMA	Ndesign = 50 & 80	93.5 – 97.4%	91.0%"

HOT-MIX ASPHALT – TACK COAT (BDE)
Effective: November 1, 2016

Revise Article 1032.06(a) of the Standard Specifications to read:

"(a) Anionic Emulsified Asphalt. Anionic emulsified asphalts shall be according to AASHTO M 140. SS-1h emulsions used as a tack coat shall have the cement mixing test waived."

LIGHTS ON BARRICADES (BDE)
Effective: January 1, 2018

Revise Article 701.16 of the Standard Specifications to read:

"**701.16 Lights.** Lights shall be used on devices as required in the plans, the traffic control plan, and the following table.

Circumstance	Lights Required
Daylight operations	None
First two warning signs on each approach to the work involving a nighttime lane closure and "ROUGH GROOVED SURFACE" (W8-I107) signs	Flashing mono-directional lights
Devices delineating isolated obstacles, excavations, or hazards at night (Does not apply to patching)	Flashing bi-directional lights
Devices delineating obstacles, excavations, or hazards exceeding 100 ft (30 m) in length at night (Does not apply to widening)	Steady burn bi-directional lights
Channelizing devices for nighttime lane closures on two-lane roads	None
Channelizing devices for nighttime lane closures on multi-lane roads	None
Channelizing devices for nighttime lane closures on multi-lane roads separating opposing directions of traffic	None
Channelizing devices for nighttime along lane shifts on multilane roads	Steady burn mono-directional lights
Channelizing devices for night time along lane shifts on two lane roads	Steady burn bi-directional lights
Devices in nighttime lane closure tapers on Standards 701316 and 701321	Steady burn bi-directional lights
Devices in nighttime lane closure tapers	Steady burn mono-directional lights
Devices delineating a widening trench	None
Devices delineating patches at night on roadways with an ADT less than 25,000	None
Devices delineating patches at night on roadways with an ADT of 25,000 or more	None

Batteries for the lights shall be replaced on a group basis at such times as may be specified by the Engineer."

Delete the fourth sentence of the first paragraph of Article 701.17(c)(2) of the Standard Specifications.

Revise the first paragraph of Article 603.07 of the Standard Specifications to read:

"**603.07 Protection Under Traffic.** After the casting has been adjusted and Class SI concrete has been placed, the work shall be protected by a barricade for at least 72 hours."

MANHOLES, VALVE VAULTS, AND FLAT SLAB TOPS (BDE)
Effective: January 1, 2018 Revised: March 2, 2018

Description. Manholes, valve vaults, and flat slab tops manufactured according to the current or previous Highway Standards listed below will be accepted on this contract:

Product	Current Standard	Previous Standard
Precast Manhole Type A, 4' (1.22 m) Diameter	602401-04	602401-03
Precast Manhole Type A, 5' (1.52 m) Diameter	602402	602401-03
Precast Manhole Type A, 6' (1.83 m) Diameter	602406-08	602406-07
Precast Manhole Type A, 7' (2.13 m) Diameter	602411-06	602411-05
Precast Manhole Type A, 8' (2.44 m) Diameter	602416-06	602416-05
Precast Manhole Type A, 9' (2.74 m) Diameter	602421-06	602421-05
Precast Manhole Type A, 10' (3.05 m) Diameter	602426	n/a
Precast Valve Vault Type A, 4' (1.22 m) Diameter	602501-03	602501-02
Precast Valve Vault Type A, 5' (1.52 m) Diameter	602506	602501-02
Precast Reinforced Concrete Flat Slab Top	602601-05	602601-04

When manufacturing to the current standards, the following revisions to the Standard Specifications shall apply:

Revise Article 602.02(g) of the Standard Specifications to read:

"(g) Structural Steel (Note 4)..... 1006.04

Note 4. All components of the manhole joint splice shall be galvanized according to the requirements of AASHTO M 111 or M 232 as applicable."

Add the following to Article 602.02 of the Standard Specifications:

"(s) Anchor Bolts and Rods (Note 5) 1006.09

Note 5. The threaded rods for the manhole joint splice shall be according to the requirements of ASTM F 1554, Grade 55, (Grade 380)."

Add the following paragraph after the first paragraph of Article 602.07 of the Standard Specifications:

"Threaded rods connecting precast sections shall be brought to a snug tight condition."

Revise the second paragraph of Article 1042.10 of the Standard Specifications to read:

"Catch basin Types A, B, C, and D; Manhole Type A; Inlet Types A and B; Drainage Structures Types 1, 2, 3, 4, 5, and 6; Valve Vault Type A; and reinforced concrete flat slab top (Highway Standard 602601) shall be according to AASHTO M 199 (M 199M), except the minimum wall thickness shall be 3 in. (75 mm). Additionally, catch basins, inlets, and drainage structures shall have a minimum concrete compressive strength of 4500 psi (31,000 kPa) at 28 days and manholes, valve vaults, and reinforced concrete flat slab tops shall have a minimum concrete compressive strength of 5000 psi (34,500 kPa) at 28 days."

PAVEMENT MARKING REMOVAL (BDE)
Effective: July 1, 2016

Revise Article 783.02 of the Standard Specifications to read:

"**783.02 Equipment.** Equipment shall be according to the following.

Item	Article/Section
(a) Grinders (Note 1)	
(b) Water Blaster with Vacuum Recovery	1101.12

Note 1. Grinding equipment shall be approved by the Engineer."

Revise the first paragraph of Article 783.03 of the Standard Specifications to read:

"**783.03 Removal of Conflicting Markings.** Existing pavement markings that conflict with revised traffic patterns shall be removed. If darkness or inclement weather prohibits the removal operations, such operations shall be resumed the next morning or when weather permits. In the event of removal equipment failure, such equipment shall be repaired, replaced, or leased so removal operations can be resumed within 24 hours."

Revise the first and second sentences of the first paragraph of Article 783.03(a) of the Standard Specifications to read:

"The existing pavement markings shall be removed by the method specified and in a manner that does not materially damage the surface or texture of the pavement or surfacing. Small particles of tightly adhering existing markings may remain in place, if in the opinion of the Engineer, complete removal of the small particles will result in pavement surface damage."

Revise the first paragraph of Article 783.04 of the Standard Specifications to read:

"**783.04 Cleaning.** The roadway surface shall be cleaned of debris or any other deleterious material by the use of compressed air or water blast."

Revise the first paragraph of Article 783.06 of the Standard Specifications to read:

"**783.06 Basis of Payment.** This work will be paid for at the contract unit price per each for RAISED REFLECTIVE PAVEMENT MARKER REMOVAL, or at the contract unit price per square foot (square meter) for PAVEMENT MARKING REMOVAL – GRINDING and/or PAVEMENT MARKING REMOVAL – WATER BLASTING."

Delete Article 1101.13 from the Standard Specifications.

PAYMENTS TO SUBCONTRACTORS (BDE)
Effective: November 2, 2017

Add the following to the end of the fourth paragraph of Article 109.11 of the Standard Specifications:

"If reasonable cause is asserted, written notice shall be provided to the applicable subcontractor and/or material supplier and the Engineer within five days of the Contractor receiving payment. The written notice shall identify the contract number, the subcontract or material purchase agreement, a detailed reason for refusal, the value of payment being withheld, and the specific remedial actions required of the subcontractor and/or material supplier so that payment can be made."

PORTABLE CHANGEABLE MESSAGE SIGNS (BDE)
Effective: November 1, 2016 Revised: April 1, 2017

Revise the second paragraph of Article 701.20(h) of the Standard Specifications to read:

"For all other portable changeable message signs, this work will be paid for at the contract unit price per calendar day for each sign as CHANGEABLE MESSAGE SIGN."

Revise this second sentence of the first paragraph of Article 1106.02(i) of the Standard Specifications to read:

"The message panel shall be a minimum of 7 ft (2.1 m) above the edge of pavement in urban areas and a minimum of 5 ft (1.5 m) above the edge of pavement in rural areas, present a level appearance, and be capable of displaying up to eight characters in each of three lines at a time."

PORTLAND CEMENT CONCRETE (BDE)
Effective: November 1, 2017

Revise the Air Content % of Class PP Concrete in Table 1 Classes of Concrete and Mix Design Criteria in Article 1020.04 of the Standard Specifications to read:

"TABLE 1. CLASSES OF CONCRETE AND MIX DESIGN CRITERIA		
Class of Conc.	Use	Air Content %
PP	Pavement Patching Bridge Deck Patching (10)	
	PP-1	4.0 - 8.0"
	PP-2	
	PP-3	
	PP-4	
	PP-5	

Revise Note (4) at the end of Table 1 Classes of Concrete and Mix Design Criteria in Article 1020.04 of the Standard Specifications to read:

"(4) For all classes of concrete, the maximum slump may be increased to 7 in (175 mm) when a high range water-reducing admixture is used. For Class SC, the maximum slump may be increased to 8 in. (200 mm). For Class PS, the maximum slump may be increased to 8 1/2 in. (215 mm) if the high range water-reducing admixture is the polycarboxylate type."

PROGRESS PAYMENTS (BDE)
Effective: November 2, 2013

Revise Article 109.07(a) of the Standard Specifications to read:

"(a) Progress Payments. At least once each month, the Engineer will make a written estimate of the quantity of work performed in accordance with the contract, and the value thereof at the contract unit prices. The amount of the estimate approved as due for payment will be vouchered by the Department and presented to the State Comptroller for payment. No amount less than $1000.00 will be approved for payment other than the final payment.

Progress payments may be reduced by liens filed pursuant to Section 23(c) of the Mechanics' Lien Act, 770 ILCS 60/23(c).

If a Contractor or subcontractor has defaulted on a loan issued under the Department's Disadvantaged Business Revolving Loan Program (20 ILCS 2705/2705-610), progress payments may be reduced pursuant to the terms of that loan agreement. In such cases, the amount of the estimate related to the work performed by the Contractor or subcontractor, in default of the loan agreement, will be offset, in whole or in part, and vouchered by the Department to the Working Capital Revolving Fund or designated escrow account. Payment for the work shall be considered as issued and received by the Contractor or subcontractor on the date of the offset voucher. Further, the amount of the offset voucher shall be a credit against the Department's obligation to pay the Contractor, the Contractor's obligation to pay the subcontractor, and the Contractor's or subcontractor's total loan indebtedness to the Department. The offset shall continue until such time as the entire loan indebtedness is satisfied. The Department will notify the Contractor and Fund Control Agent in a timely manner of such offset. The Contractor or subcontractor shall not be entitled to additional payment in consideration of the offset.

The failure to perform any requirement, obligation, or term of the contract by the Contractor shall be reason for withholding any progress payments until the Department determines that compliance has been achieved."

SPEED DISPLAY TRAILER (BDE)
Effective: April 2, 2014 Revised: January 1, 2017

Revise the third paragraph of Article 701.11 of the Standard Specifications to read:

"When not being utilized to inform and direct traffic, sign trailers, speed display trailers, arrow boards, and portable changeable message boards shall be treated as nonoperating equipment."

Add the following to Article 701.15 of the Standard Specifications:

"(m) Speed Display Trailer. A speed display trailer is used to enhance safety of the traveling public and workers in work zones by alerting drivers of their speed, thus deterring them from driving above the posted work zone speed limit."

Add the following to Article 701.20 of the Standard Specifications:

"(k) When speed display trailers are shown on the Standard, this work will not be paid for separately but shall be considered as included in the cost of the Standard.

For all other speed display trailers, this work will be paid for at the contract unit price per calendar month or fraction thereof for each trailer as SPEED DISPLAY TRAILER."

Add the following to Article 1106.02 of the Standard Specifications:

"(o) Speed Display Trailer. The speed display trailer shall consist of a LED speed indicator display with self-contained, one-direction radar mounted on an orange see-through trailer. The height of the display and radar shall be such that it will function and be visible when located behind concrete barrier.

The speed measurement shall be by radar and provide a minimum detection distance of 1000 ft (300 m). The radar shall have an accuracy of ±1 mile per hour.

The speed indicator display shall face approaching traffic and shall have a sign legend of "YOUR SPEED" immediately above or below the speed display. The sign letters shall be between 5 and 8 in. (125 and 200 mm) in height. The digital speed display shall show two digits (00 to 99) in mph. The color of the changeable message legend shall be a yellow legend on a black background. The minimum height of the numerals shall be 18 in. (450 mm), and the nominal legibility distance shall be at least 750 ft (250 m).

The speed indicator display shall be equipped with a violation alert that flashes the displayed detected speed when the work zone posted speed limit is exceeded. The speed indicator shall have a maximum speed cutoff. On roadway facilities with a normal posted speed limit greater than or equal to 45 mph, the detected speeds of vehicles traveling more than 25 mph over the work zone speed limit shall not be displayed. On facilities with normal posted speed limit of less than 45 mph, the detected speeds of vehicles traveling more than 15 mph over the work zone speeds limit shall not be displayed. On any roadway facility if detected speeds are less than 25 mph, they shall not be displayed. The display shall include automatic dimming for nighttime operation.

The speed indicator measurement and display functions shall be equipped with the power supply capable of providing 24 hours of uninterrupted service."

SUBCONTRACTOR AND DBE PAYMENT REPORTING (BDE)
Effective: April 2, 2018

Add the following to Section 109 of the Standard Specifications.

"**109.14 Subcontractor and Disadvantaged Business Enterprise Payment Reporting.** The Contractor shall report all payments made to the following parties:

(a) first tier subcontractors;

(b) lower tier subcontractors affecting disadvantaged business enterprise (DBE) goal credit;

(c) material suppliers or trucking firms that are part of the Contractor's submitted DBE utilization plan.

The report shall be made through the Department's on-line subcontractor payment reporting system within 21 days of making the payment."

SUBCONTRACTOR MOBILIZATION PAYMENTS (BDE)
Effective: November 2, 2017

Replace the second paragraph of Article 109.12 of the Standard Specifications with the following:

"This mobilization payment shall be made at least 14 days prior to the subcontractor starting work. The amount paid shall be at the following percentage of the amount of the subcontract reported on form BC 260A submitted for the approval of the subcontractor's work.

Value of Subcontract Reported on Form BC 260A	Mobilization Percentage
Less than $10,000	25%
$10,000 to less than $20,000	20%
$20,000 to less than $40,000	18%
$40,000 to less than $60,000	16%
$60,000 to less than $80,000	14%
$80,000 to less than $100,000	12%
$100,000 to less than $250,000	10%
$250,000 to less than $500,000	9%
$500,000 to $750,000	8%
Over $750,000	7%"

TEMPORARY PAVEMENT MARKING (BDE)
Effective: April 1, 2012 Revised: April 1, 2017

Revise Article 703.02 of the Standard Specifications to read:

"**703.02 Materials.** Materials shall be according to the following.

(a) Pavement Marking Tape, Type I and Type III 1095.06
(b) Paint Pavement Markings 1095.02
(c) Pavement Marking Tape, Type IV ..... 1095.11"

Revise the second paragraph of Article 703.05 of the Standard Specifications to read:

"Type I marking tape or paint shall be used at the option of the Contractor, except paint shall not be applied to the final wearing surface unless authorized by the Engineer for late season applications where tape adhesion would be a problem. Type III or Type IV marking tape shall be used on the final wearing surface when the temporary pavement marking will conflict with the permanent pavement marking such as on tapers, crossovers and lane shifts."

Revise Article 703.07 of the Standard Specifications to read:

"**703.07 Basis of Payment.** This work will be paid for as follows.

a) Short Term Pavement Marking. Short term pavement marking will be paid for at the contract unit price per foot (meter) for SHORT TERM PAVEMENT MARKING. Removal of short term pavement markings will be paid for at the contract unit price per square foot (square meter) for SHORT TERM PAVEMENT MARKING REMOVAL.

b) Temporary Pavement Marking. Where the Contractor has the option of material type, temporary pavement marking will be paid for at the contract unit price per foot (meter) for TEMPORARY PAVEMENT MARKING of the line width specified, and at the contract unit price per square foot (square meter) for TEMPORARY PAVEMENT MARKING LETTERS AND SYMBOLS.

Where the Department specifies the use of pavement marking tape, the Type III or Type IV temporary pavement marking will be paid for at the contract unit price per foot (meter) for PAVEMENT MARKING TAPE, TYPE III or PAVEMENT MARKING TAPE, TYPE IV of the line width specified and at the contract unit price per square feet (square meter) for PAVEMENT MARKING TAPE, TYPE III - LETTERS AND SYMBOLS or PAVEMENT MARKING TAPE, TYPE IV – LETTERS AND SYMBOLS.

Removal of temporary pavement markings will be paid for at the contract unit price per square foot (square meter) for TEMPORARY PAVEMENT MARKING REMOVAL.

When temporary pavement marking is shown on the Standard, the cost of the temporary pavement marking and its removal will be included in the cost of the Standard."

Add the following to Section 1095 of the Standard Specifications:

"**1095.11 Pavement Marking Tape, Type IV.** The temporary, preformed, patterned markings shall consist of a white or yellow tape with wet retroreflective media incorporated to provide immediate and continuing retroreflection during both wet and dry conditions. The tape shall be manufactured without the use of heavy metals including lead chromate pigments or other similar, lead-containing chemicals.

The white and yellow Type IV marking tape shall meet the Type III requirements of Article 1095.06 and the following.

(a) Composition. The retroreflective pliant polymer pavement markings shall consist of a mixture of high-quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a layer of wet retroreflective media bonded to a durable polyurethane topcoat surface. The patterned surface shall have approximately 40% ± 10% of the surface area raised and presenting a near vertical face to traffic from any direction. The channels between the raised areas shall be substantially free of exposed beads or particles.

(b) Retroreflectance. The white and yellow markings shall meet the following for initial dry and wet retroreflectance.

(1) Dry Retroreflectance. Dry retroreflectance shall be measured under dry conditions according to ASTM D 4061 and meet the values described in Article 1095.06 for Type III tape.

(2) Wet Retroreflectance. Wet retroreflectance shall be measured under wet conditions according to ASTM E 2177 and meet the values shown in the following table.

Wet Retroreflectance, Initial R_L

Color	R_L 1.05/88.76
White	300
Yellow	200

(c) Color. The material shall meet the following requirements for daylight reflectance and color, when tested, using a color spectrophotometer with 45 degrees circumferential/zero degree geometry, illuminant D65, and a two degree observer angle. The color instrument shall measure the visible spectrum from 380 to 720 nm with a wavelength measurement interval and spectral bandpass of 10 nm.

Color	Daylight Reflectance %Y
White	65 minimum
*Yellow	36-59

*Shall match Federal 595 Color No. 33538 and the chromaticity limits as follows.

x	0.490	0.475	0.485	0.530
y	0.470	0.438	0.425	0.456

(d) Skid Resistance. The surface of the markings shall provide an average minimum skid resistance of 50 BPN when tested according to ASTM E 303.

(e) Sampling, Testing, Acceptance, and Certification. Prior to approval and use of the wet reflective, temporary, removable pavement marking tape, the manufacturer shall submit a notarized certification from an independent laboratory, together with the results of all tests, stating that the material meets the requirements as set forth herein. The certification test report shall state the lot tested, manufacturer's name, and date of manufacture.

After approval by the Department, samples and certification by the manufacturer shall be submitted for each batch used. The manufacturer shall submit a certification stating that the material meets the requirements as set forth herein and is essentially identical to the material sent for qualification. The certification shall state the lot tested, manufacturer's name, and date of manufacture.

All costs of testing (other than tests conducted by the Department) shall be borne by the manufacturer."

TRAINING SPECIAL PROVISIONS (BDE)
Effective: October 15, 1975

This Training Special Provision supersedes Section 7b of the Special Provision entitled "Specific Equal Employment Opportunity Responsibilities," and is in implementation of 23 U.S.C. 140(a).

As part of the Contractor's equal employment opportunity affirmative action program, training shall be provided as follows:

The Contractor shall provide on-the-job training aimed at developing full journeyman in the type of trade or job classification involved. The number of trainees to be trained under this contract will be **5**. In the event the Contractor subcontracts a portion of the contract work, he shall determine how many, if any, of the trainees are to be trained by the subcontractor, provided however, that the Contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The Contractor shall also insure that this Training Special Provision is made applicable to such subcontract. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training.

The number of trainees shall be distributed among the work classifications on the basis of the Contractor's needs and the availability of journeymen in the various classifications within the reasonable area of recruitment. Prior to commencing construction, the Contractor shall submit to the Illinois Department of Transportation for approval the number of trainees to be trained in each selected classification and training program to be used. Furthermore, the Contractor shall specify the starting time for training in each of the classifications. The Contractor will be credited for each trainee employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter.

Training and upgrading of minorities and women toward journeyman status is a primary objective of this Training Special Provision. Accordingly, the Contractor shall make every effort to enroll minority trainees and women (e.g. by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent such persons are available within a reasonable area of recruitment. The Contractor will be responsible for demonstrating the steps that he has taken in pursuance thereof, prior to a determination as to whether the Contractor is in compliance with this Training Special Provision. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

No employee shall be employed as a trainee in any classification in which he has successfully completed a training course leading to journeyman status or in which he has been employed as a journeyman. The Contractor should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used, the Contractor's records should document the findings in each case.

The minimum length and type of training for each classification will be as established in the training program selected by the Contractor and approved by the Illinois Department of Transportation and the Federal Highway Administration. The Illinois Department of Transportation and the Federal Highway Administration shall approve a program, if it is reasonably calculated to meet the equal employment opportunity obligations of the Contractor and to qualify the average trainee for journeyman status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau and training programs approved by not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training shall also be considered acceptable provided it is being administered in a manner consistent with the equal employment obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from the State prior to commencing work on the classification covered by the program. It is the intention of these provisions that training is to be provided in the construction crafts rather then clerk-typists or secretarial-type positions. Training is permissible in lower level management positions such as office engineers, estimators, timekeepers, etc., where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the Illinois Department of Transportation and the Federal Highway Administration. Some offsite training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

Except as otherwise noted below, the Contractor will be reimbursed 80 cents per hour of training given an employee on this contract in accordance with an approved training program. As approved by the Engineer, reimbursement will be made for training of persons in excess of the number specified herein. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the Contractor from receiving other reimbursement. Reimbursement for offsite training indicated above may only be made to the Contractor where he does one or more of the following and the trainees are concurrently employed on a Federal-aid project; contributes to the cost of the training, provides the instruction to the trainee or pays the trainee's wages during the offsite training period.

No payment shall be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyman, is caused by the Contractor and evidences a lack of good faith on the part of the Contractor in meeting the requirement of this Training Special Provision. It is normally expected that a trainee will begin his training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training opportunities exist in his work classification or until he has completed his training program.

It is not required that all trainees be on board for the entire length of the contract. A Contractor will have fulfilled his responsibilities under this Training Special Provision if he has provided acceptable training to the number of trainees specified. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period.

Trainees will be paid at least 60 percent of the appropriate minimum journeyman's rate specified in the contract for the first half of the training period, 75 percent for the third quarter of the training period, and 90 percent for the last quarter of the training period, unless apprentices or trainees in an approved existing program are enrolled as trainees on this project. In that case, the appropriate rates approved by the Departments of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification who are covered by this Training Special Provision.

The Contractor shall furnish the trainee a copy of the program he will follow in providing the training. The Contractor shall provide each trainee with a certification showing the type and length of training satisfactorily complete.

The Contractor shall provide for the maintenance of records and furnish periodic reports documenting his performance under this Training Special Provision.

Method of Measurement. The unit of measurement is in hours.

Basis of Payment. This work will be paid for at the contract unit price of 80 cents per hour for TRAINEES. The estimated total number of hours, unit price, and total price have been included in the schedule of prices.

IDOT TRAINING PROGRAM GRADUATE ON-THE-JOB TRAINING SPECIAL PROVISION
Effective: August 1, 2012 Revised: February 2, 2017

In addition to the Contractor's equal employment opportunity (EEO) affirmative action efforts undertaken as required by this Contract, the Contractor is encouraged to participate in the incentive program described below to provide additional on-the-job training to certified graduates of the IDOT pre-apprenticeship training program, as outlined in this Special Provision.

IDOT funds, and various Illinois community colleges operate, pre-apprenticeship training programs throughout the State to provide training and skill-improvement opportunities to promote the increased employment of minority groups, disadvantaged persons and women in all aspects of the highway construction industry. The intent of this IDOT Pre-Apprenticeship Training Program Graduate (TPG) special provision (Special Provision) is to place these certified program graduates on the project site for this Contract in order to provide the graduates with meaningful on-the-job training. Pursuant to this Special Provision, the Contractor must make every reasonable effort to recruit and employ certified TPG trainees to the extent such individuals are available within a practicable distance of the project site.

Specifically, participation of the Contractor or its subcontractor in the Program entitles the participant to reimbursement for graduates' hourly wages at $15.00 per hour per utilized TPG trainee, subject to the terms of this Special Provision. Reimbursement payment will be made even though the Contractor or subcontractor may also receive additional training program funds from other non-IDOT sources for other non-TPG trainees on the Contract, provided such other source does not specifically prohibit the Contractor or subcontractor from receiving reimbursement from another entity through another program, such as IDOT through the TPG program. With regard to any IDOT funded construction training program other than TPG, however, additional reimbursement for other IDOT programs will not be made beyond the TPG Program described in this Special Provision when the TPG Program is utilized.

No payment will be made to the Contractor if the Contractor or subcontractor fails to provide the required on-site training to TPG trainees, as solely determined by IDOT. A TPG trainee must begin training on the project as soon as the start of work that utilizes the relevant trade skill and the TPG trainee must remain on the project site through completion of the Contract, so long as training opportunities continue to exist in the relevant work classification. Should a TPG trainee's employment end in advance of the completion of the Contract, the Contractor must promptly notify the IDOT District EEO Officer for the Contract that the TPG's involvement in the Contract has ended. The Contractor must supply a written report for the reason the TPG trainee involvement terminated, the hours completed by the TPG trainee on the Contract, and the number of hours for which the incentive payment provided under this Special Provision will be, or has been claimed for the separated TPG trainee.

Finally, the Contractor must maintain all records it creates as a result of participation in the Program on the Contract, and furnish periodic written reports to the IDOT District EEO Officer that document its contractual performance under and compliance with this Special Provision. Finally, through participation in the Program and reimbursement of wages, the Contractor is not relieved of, and IDOT has not waived, the requirements of any federal or state labor or employment law applicable to TPG workers, including compliance with the Illinois Prevailing Wage Act.

Method Of Measurement: The unit of measurement is in hours.

Basis Of Payment: This work will be paid for at the contract unit price of $15.00 per hour for each utilized certified TPG Program trainee (TRAINEES TRAINING PROGRAM GRADUATE). The estimated total number of hours, unit price, and total price must be included in the schedule of prices for the Contract submitted by Contractor prior to beginning work. The initial number of TPG trainees for which the incentive is available for this contract is **5.**

The Department has contracted with several educational institutions to provide screening, tutoring and pre-training to individuals interested in working as a TPG trainee in various areas of common construction trade work. Only individuals who have successfully completed a Pre-Apprenticeship Training Program at these IDOT approved institutions are eligible to be TPG trainees. To obtain a list of institutions that can connect the Contractor with eligible TPG trainees, the Contractor may contact: HCCTP TPG Program Coordinator, Office of Business and Workforce Diversity (IDOT OBWD), Room 319, Illinois Department of Transportation, 2300 S. Dirksen Parkway, Springfield, Illinois 62764. Prior to commencing construction with the utilization of a TPG trainee, the Contractor must submit documentation to the IDOT District EEO Officer for the Contract that provides the names and contact information of the TPG trainee(s) to be trained in each selected work classification, proof that that the TPG trainee(s) has successfully completed a Pre-Apprenticeship Training Program, proof that the TPG is in an Apprenticeship Training Program approved by the U.S. Department of Labor Bureau of Apprenticeship Training, and the start date for training in each of the applicable work classifications.

To receive payment, the Contractor must provide training opportunities aimed at developing a full journeyworker in the type of trade or job classification involved. During the course of performance of the Contract, the Contractor may seek approval from the IDOT District EEO Officer to employ additional eligible TPG trainees. In the event the Contractor subcontracts a portion of the contracted work, it must determine how many, if any, of the TPGs will be trained by the subcontractor. Though a subcontractor may conduct training, the Contractor retains the responsibility for meeting all requirements imposed by this Special Provision. The Contractor must also include this Special Provision in any subcontract where payment for contracted work performed by a TPG trainee will be passed on to a subcontractor.

Training through the Program is intended to move TPGs toward journeyman status, which is the primary objective of this Special Provision. Accordingly, the Contractor must make every effort to enroll TPG trainees by recruitment through the Program participant educational institutions to the extent eligible TPGs are available within a reasonable geographic area of the project. The Contractor is responsible for demonstrating, through documentation, the recruitment efforts it has undertaken prior to the determination by IDOT whether the Contractor is in compliance with this Special Provision, and therefore, entitled to the Training Program Graduate reimbursement of $15.00 per hour.

Notwithstanding the on-the-job training requirement of this TPG Special Provision, some minimal off-site training is permissible as long as the offsite training is an integral part of the work of the contract, and does not compromise or conflict with the required on-site training that is central to the purpose of the Program. No individual may be employed as a TPG trainee in any work classification in which he/she has previously successfully completed a training program leading to journeyman status in any trade, or in which he/she has worked at a journeyman level or higher.

WARM MIX ASPHALT (BDE)
Effective: January 1, 2012 Revised: April 1, 2016

Description. This work shall consist of designing, producing and constructing Warm Mix Asphalt (WMA) in lieu of Hot Mix Asphalt (HMA) at the Contractor's option. Work shall be according to Sections 406, 407, 408, 1030, and 1102 of the Standard Specifications, except as modified herein. In addition, any references to HMA in the Standard Specifications, or the special provisions shall be construed to include WMA.

WMA is an asphalt mixture which can be produced at temperatures lower than allowed for HMA utilizing approved WMA technologies. WMA technologies are defined as the use of additives or processes which allow a reduction in the temperatures at which HMA mixes are produced and placed. WMA is produced by the use of additives, a water foaming process, or combination of both. Additives include minerals, chemicals or organics incorporated into the asphalt binder stream in a dedicated delivery system. The process of foaming injects water into the asphalt binder stream, just prior to incorporation of the asphalt binder with the aggregate.

Approved WMA technologies may also be used in HMA provided all the requirements specified herein, with the exception of temperature, are met. However, asphalt mixtures produced at temperatures in excess of 275 °F (135 °C) will not be considered WMA when determining the grade reduction of the virgin asphalt binder grade.

Equipment.

Revise the first paragraph of Article 1102.01 of the Standard Specifications to read:

"**1102.01 Hot-Mix Asphalt Plant.** The hot-mix asphalt (HMA) plant shall be the batch-type, continuous-type, or dryer drum plant. The plants shall be evaluated for prequalification rating and approval to produce HMA according to the current Bureau of Materials and Physical Research Policy Memorandum, "Approval of Hot-Mix Asphalt Plants and Equipment". Once approved, the Contractor shall notify the Bureau of Materials and Physical Research to obtain approval of all plant modifications. The plants shall not be used to produce mixtures concurrently for more than one project or for private work unless permission is granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce HMA having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements."

Add the following to Article 1102.01(a) of the Standard Specifications.

"(11) Equipment for Warm Mix Technologies.

a. Foaming. Metering equipment for foamed asphalt shall have an accuracy of ± 2 percent of the actual water metered. The foaming control system shall be electronically interfaced with the asphalt binder meter.

b. Additives. Additives shall be introduced into the plant according to the supplier's recommendations and shall be approved by the Engineer. The system for introducing the WMA additive shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes."

Mix Design Verification.

Add the following to Article 1030.04 of the Standard Specifications.

"(e) Warm Mix Technologies.

(1) Foaming. WMA mix design verification will not be required when foaming technology is used alone (without WMA additives). However, the foaming technology shall only be used on HMA designs previously approved by the Department.

(2) Additives. WMA mix designs utilizing additives shall be submitted to the Engineer for mix design verification."

Construction Requirements.

Revise the second paragraph of Article 406.06(b)(1) of the Standard Specifications to read:

"The HMA shall be delivered at a temperature of 250 to 350 °F (120 to 175 °C). WMA shall be delivered at a minimum temperature of 215 °F (102 °C)."

Basis of Payment.

This work will be paid at the contract unit price bid for the HMA pay items involved. Anti-strip will not be paid for separately, but shall be considered as included in the cost of the work.

WEEKLY DBE TRUCKING REPORTS (BDE)
Effective: June 2, 2012 Revised: April 2, 2015

The Contractor shall submit a weekly report of Disadvantaged Business Enterprise (DBE) trucks hired by the Contractor or subcontractors (i.e. not owned by the Contractor or subcontractors) that are used for DBE goal credit.

The report shall be submitted to the Engineer on Department form "SBE 723" within ten business days following the reporting period. The reporting period shall be Monday through Sunday for each week reportable trucking activities occur.

Any costs associated with providing weekly DBE trucking reports shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed.

STEEL COST ADJUSTMENT (BDE)
Effective: April 2, 2004 Revised: August 1, 2017

Description. Steel cost adjustments will be made to provide additional compensation to the Contractor, or a credit to the Department, for fluctuations in steel prices when optioned by the Contractor. The bidder shall indicate with their bid whether or not this special provision will be part of the contract. Failure to indicate "Yes" for any item of work will make that item of steel exempt from steel cost adjustment.

Types of Steel Products. An adjustment will be made for fluctuations in the cost of steel used in the manufacture of the following items:

Metal Piling (excluding temporary sheet piling)
Structural Steel
Reinforcing Steel

Other steel materials such as dowel bars, tie bars, mesh reinforcement, guardrail, steel traffic signal and light poles, towers and mast arms, metal railings (excluding wire fence), and frames and grates will be subject to a steel cost adjustment when the pay items they are used in have a contract value of $10,000 or greater.

The adjustments shall apply to the above items when they are part of the original proposed construction, or added as extra work and paid for by agreed unit prices. The adjustments shall not apply when the item is added as extra work and paid for at a lump sum price or by force account.

Documentation. Sufficient documentation shall be furnished to the Engineer to verify the following:

(a) The dates and quantity of steel, in lb (kg), shipped from the mill to the fabricator.

(b) The quantity of steel, in lb (kg), incorporated into the various items of work covered by this special provision. The Department reserves the right to verify submitted quantities.

Method of Adjustment. Steel cost adjustments will be computed as follows:

SCA = Q X D

Where: SCA = steel cost adjustment, in dollars
Q = quantity of steel incorporated into the work, in lb (kg)
D = price factor, in dollars per lb (kg)

$D = MPI_M - MPI_L$

Where: MPI_M = The Materials Cost Index for steel as published by the Engineering News-Record for the month the steel is shipped from the mill. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

MPI_L = The Materials Cost Index for steel as published by the Engineering News-Record for the month prior to the letting for work paid for at the contract price; or for the month the agreed unit price letter is submitted by the Contractor for extra work paid for by agreed unit price,. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

The unit weights (masses) of steel that will be used to calculate the steel cost adjustment for the various items are shown in the attached table.

No steel cost adjustment will be made for any products manufactured from steel having a mill shipping date prior to the letting date.

If the Contractor fails to provide the required documentation, the method of adjustment will be calculated as described above; however, the MPI_M will be based on the date the steel arrives at the job site. In this case, an adjustment will only be made when there is a decrease in steel costs.

Basis of Payment. Steel cost adjustments may be positive or negative but will only be made when there is a difference between the MPI_L and MPI_M in excess of five percent, as calculated by:

Percent Difference = $\{(MPI_L - MPI_M) \div MPI_L\} \times 100$

Steel cost adjustments will be calculated by the Engineer and will be paid or deducted when all other contract requirements for the items of work are satisfied. Adjustments will only be made for fluctuations in the cost of the steel as described herein. No adjustment will be made for changes in the cost of manufacturing, fabrication, shipping, storage, etc.

The adjustments shall not apply during contract time subject to liquidated damages for completion of the entire contract.

Attachment

Item	Unit Mass (Weight)
Metal Piling (excluding temporary sheet piling)	
Furnishing Metal Pile Shells 12 in. (305 mm), 0.179 in. (3.80 mm) wall thickness)	23 lb/ft (34 kg/m)
Furnishing Metal Pile Shells 12 in. (305 mm), 0.250 in. (6.35 mm) wall thickness)	32 lb/ft (48 kg/m)
Furnishing Metal Pile Shells 14 in. (356 mm), 0.250 in. (6.35 mm) wall thickness)	37 lb/ft (55 kg/m)
Other piling	See plans
Structural Steel	See plans for weights (masses)
Reinforcing Steel	See plans for weights (masses)
Dowel Bars and Tie Bars	6 lb (3 kg) each
Mesh Reinforcement	63 lb/100 sq ft (310 kg/sq m)
Guardrail	
Steel Plate Beam Guardrail, Type A w/steel posts	20 lb/ft (30 kg/m)
Steel Plate Beam Guardrail, Type B w/steel posts	30 lb/ft (45 kg/m)
Steel Plate Beam Guardrail, Types A and B w/wood posts	8 lb/ft (12 kg/m)
Steel Plate Beam Guardrail, Type 2	305 lb (140 kg) each
Steel Plate Beam Guardrail, Type 6	1260 lb (570 kg) each
Traffic Barrier Terminal, Type 1 Special (Tangent)	730 lb (330 kg) each
Traffic Barrier Terminal, Type 1 Special (Flared)	410 lb (185 kg) each
Steel Traffic Signal and Light Poles, Towers and Mast Arms	
Traffic Signal Post	11 lb/ft (16 kg/m)
Light Pole, Tenon Mount and Twin Mount, 30 - 40 ft (9 – 12 m)	14 lb/ft (21 kg/m)
Light Pole, Tenon Mount and Twin Mount, 45 - 55 ft (13.5 – 16.5 m)	21 lb/ft (31 kg/m)
Light Pole w/Mast Arm, 30 - 50 ft (9 – 15.2 m)	13 lb/ft (19 kg/m)
Light Pole w/Mast Arm, 55 - 60 ft (16.5 – 18 m)	19 lb/ft (28 kg/m)
Light Tower w/Luminaire Mount, 80 - 110 ft (24 – 33.5 m)	31 lb/ft (46 kg/m)
Light Tower w/Luminaire Mount, 120 - 140 ft (36.5 – 42.5 m)	65 lb/ft (97 kg/m)
Light Tower w/Luminaire Mount, 150 - 160 ft (45.5 – 48.5 m)	80 lb/ft (119 kg/m)
Metal Railings (excluding wire fence)	
Steel Railing, Type SM	64 lb/ft (95 kg/m)
Steel Railing, Type S-1	39 lb/ft (58 kg/m)
Steel Railing, Type T-1	53 lb/ft (79 kg/m)
Steel Bridge Rail	52 lb/ft (77 kg/m)
Frames and Grates	
Frame	250 lb (115 kg)
Lids and Grates	150 lb (70 kg)

DIVISION 1 – GENERAL REQUIREMENTS

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 1A - SUMMARY OF WORK

1. GENERAL:

1.1 General Work

1.1.1 The requirements of Division 1, General Requirements, shall apply to all Pump Station General Work. Any pay items that are not included in this Division shall be in accordance with the Standard Specifications.

1.1.2 The Pump Station General Work shall include, but not be limited to, the following and shall be paid under pay item PUMP STATION GENERAL WORK:

(a) All site work as indicated on the Drawings and as specified in Section 2A, Site Work.

(b) All grout as indicated on the Drawings and as specified in Section 3B, Grout.

(d) All unit masonry work consisting of concrete block work, glass block work and faced brickwork as indicated on the Drawings and as specified in Section 4A, Unit Masonry.

(e) All miscellaneous metal work as indicated on the Drawings and as specified in Division 5, Metals.

(f) All carpentry work as indicated on the Drawings and as specified in Section 6A, Rough Carpentry.

(g) All roofing work as indicated on the Drawings and as specified in Section 7A, Elastomeric Sheet Roofing- Fully Adhered/Ballasted Cover.

(h) All sheet metal work as indicated on the Drawings and as specified in Section 7B, Sheet Metal Flashing and Trim.

(i) All sealant work as indicated on the Drawings and as specified in Section 7C, Joint Sealers.

(j) All board insulation work as indicated on the Drawings and as specified in Section 7D, Board Insulation.

(k) All doors and hardware as indicated on the Drawings and as specified in Division 8, Doors and Windows.

(l) All painting as indicated on the Drawings and as specified in Section 9A, Painting.

(m) The station identification plate, shop desk, pump dolly, bulletin board, staff gauges, first aid kit, fire extinguishers, electric clock, metal shelf and trash

can as indicated on the Drawings and as specified in Section 10A, Specialties.

(n) Fiberglass railing as specified in Section 10B, Fiberglass Reinforced Plastic Products and Fabrications

1.1.3 The following items of general work at the Pump Station are indicated on the drawings and as specified under the respective Sections of the Standard Specifications with separate pay items included in the Contract.

(a)	Tree Removal	Section 201
(b)	Earth Excavation	Section 202
(c)	Trench Backfill	Section 208
(d)	Porous Granular Backfill	Section 209
(e)	Perimeter Erosion Control	Section 280
(f)	Aggregate Base Course	Section 351
(g)	Bituminous Materials	Section 403
(h)	Hot-mix Asphalt	Section 406
(i)	PCC Driveway	Section 423
(j)	Curb and Gutter Removal	Section 440
(k)	Concrete Structures	Section 503
(l)	Reinforcement Bars	Section 508
(m)	Drilled Shaft	Section 516
(n)	Storm Sewer	Section 550
(o)	Manholes	Section 602
(p)	Concrete Curb and Gutter	Section 606
(q)	Engineer's Field Office, Type A	Section 670
(r)	Mobilization	Section 671

1.1.4 Work related with concrete shall be paid for under pay item CONCRETE STRUCTURES and shall be in accordance with Section 3A, Cast-in-place concrete and the Standard Specifications.

1.1.5 Work related with reinforcing shall be paid for under pay item REINFORCEMENT BARS, EPOXY COATED and shall be in accordance with Section 3A, Cast-in-place concrete and the Standard Specifications.

1.1.6 CHAIN LINK GATES, 8'X3' SINGLE shall be in accordance with Section 2B, Chain Link Fence and Gate.

1.1.7 CHAIN LINK GATES, 8'X20' DOUBLE shall be in accordance with Section 2B, Chain Link Fence and Gate.

1.1.8 Work related with the fence shall be paid for under pay item CHAIN LINK FENCE, 8' (SPECIAL) shall be in accordance with Section 2B, Chain Link Fence and Gate.

1.1.9 Work related with excavation of the pump station shall be paid for under pay item BRACED EXCAVATION shall be in accordance with Section 2A, Site Work.

1.1.10 Work related with the bollards shall be paid for under pay item BOLLARDS and shall be in accordance with Section 2A, Site Work.

1.1.11 Work related with the demolition of the existing pump station shall be paid for under pay item DEMOLITION OF EXISTING PUMP STATION and shall be in accordance with Section 2C, Demolition.

1.1.12 Maintenance of existing pump station during construction shall be paid under pay item MAINTENANCE OF EXISTING PUMP STATION DURING CONSTRUCTION and shall be in accordance with Division 1, General Requirements.

1.1.13 Work related with the outfall forcemain shall be paid for under pay item FORCEMAIN, DIP, 16" CLASS 250 and shall be in accordance with Section 2A, Site Work.

1.1.14 Work related with the outfall forcemain installed in casing pipe shall be paid for under pay item FORCEMAIN, DIP, 16" CLASS 250, INSTALL IN A 30" STEEL CASING and shall be in accordance with Section 2A, Site Work.

1.1.15 Work related with the directional drilling of the conduits for ComEd primary feeder shall be paid for under pay item ELECTRICAL CONDUIT, HDD METHOD and shall be in accordance with Section 2A, Site Work.

1.2 Description: Mechanical

1.2.1 The requirements of Division 1, General Requirements, shall apply to all Pump Station Mechanical Work.

1.2.2 The Pump Station Mechanical Work shall be as shown on the Drawings and as specified and include, but not be limited to, furnishing and installing the following and shall be paid under pay item PUMP STATION MECHANICAL WORK:

(a) Piping and appurtenances as indicated on the Drawings and as specified in all Contract Documents.

(b) Gates and valves with all appurtenances.

(c) Flow recirculation system including, but not limited to, knife gate, piping, actuator and all appurtenances.

(d) Miscellaneous mechanical items consisting of cable support, stilling well and pump dolly.

(e) See Division 15.

1.2.3 The heating and ventilation system shall be paid under pay item HEATING AND VENTILATION and shall be in accordance with Section 15E, Ventilation.

1.2.4 The storm water main pumps shall be paid under pay item MAIN PUMPS and shall be in accordance with Section 15D, Pumping Equipment.

1.2.5 The storm water low flow pump shall be paid under pay item LOW FLOW PUMP and shall be in accordance with Section 15D, Pumping Equipment.

1.2.6 Complete spare main pump assembly shall be paid under pay item COMPLETE SPARE MAIN PUMP ASSEMBLY and shall be in accordance with Section 15D, Pumping Equipment.

1.2.7 Complete spare low flow pump assembly shall be paid under pay item COMPLETE SPARE LOW FLOW PUMP ASSEMBLY and shall be in accordance with Section 15D, Pumping Equipment.

1.3 Description: Electrical

1.3.1 The requirements of Division 1, General Requirements, shall apply to all Pump Station Electrical Work.

1.3.2 The pump Station Electrical Work shall include, but not be limited to, furnishing and installing the following and shall be paid under pay item PUMP STATION ELECTRICAL WORK:

(a) Disconnect switches and motor starters.

(b) Electrical Power System Studies.

(c) Lighting fixtures, lighting panel board, lighting transformer and wiring devices.

(d) Power, lighting, control and signal wires and cables.

(e) Conduit and raceway system.

(f) Float type level sensing control system.

(g) Branch wiring and conduit for main pumps, low flow pumps, unit heaters, slide gate actuators, ventilation system, SCADA panel and other electrical equipment as shown on the Drawings.

(h) Testing.

(i) See Division 16.

1.3.3 Packaged engine generator systems shall be paid under pay item PUMP STATION PACKAGED ENGINE GENERATOR SYSTEMS and shall be in accordance with Section 16E, Packaged Engine Generator Systems.

1.3.4 Motor control center with misc. controls, breaker and automatic transfer switch shall be paid under pay item PUMP STATION MOTOR CONTROL CENTER and shall be in accordance with Section 16F, Motor Control Center.

1.3.5 SCADA equipment and panel shall be paid under pay item PUMP STATION SCADA EQUIPMENT (AND PROGRAMMING) and shall be in accordance with Section 16D, Supervisory Control and Data Acquisition (SCADA) Equipment. Systems Integrator shall be in accordance with Section 16D.

1.3.6 Electric service connection shall be paid under pay item ELECTRICAL SERVICE CONNECTION and shall be in accordance with Section 16A, General Electrical Provisions.

1.3.7 Electric service connection shall be paid under pay item ELECTRICAL SERVICE INSTALLATION and shall be in accordance with Section 16A, General Electrical Provisions.

1.3.8 Telephone service installation and connection shall be paid under pay item TELEPHONE SERVICE INSTALLATION AND CONNECTION and shall be in accordance with Section 16A, General Electrical Provisions.

1.3.9 AEGIS panel shall be paid under pay item AEGIS PANEL and shall be in accordance with Section 16H, Major Electrical Equipment.

1.3.10 Fire detection panel shall be paid under pay item FIRE DETECTION PANEL and shall be in accordance with Section 16H, Major Electrical Equipment.

1.3.11 Gas detection panel shall be paid under pay item GAS DETECTION PANEL and shall be in accordance with Section 16H, Major Electrical Equipment.

1.4 Scope of Work

1.4.1 It is the intent of the Contract Documents and referenced Standard Specifications, to define the work required for the construction of the new Pump Station 8 and to maintain operations of the existing pump station facility during construction. No portion of the work required to provide a coordinated complete installation shall be omitted even though not expressly specified or indicated.

1.4.2 These Contract Specifications for work on Pump Station 8 are presented as various listed Divisions. In general, these Divisions address the requirements for work items which are listed as pay items and as described under the various Divisions.

1.5 Existing Pump Station Maintenance during Construction

1.5.1 From the day of transferring the maintenance of the existing pump station to the Contractor until the day of final acceptance by the Engineer, the Contractor shall be fully responsible for maintenance of the existing Pump Station 8. Maintenance shall be in full compliance with the District 1 Electrical Maintenance Contract, Contract 62A12 from September 2015 letting or the most recent contract from the date of BID.

1.5.2 If the project is not complete, the existing pump station shall remain in operation.

1.5.3 Once the new pump station is commissioned to the satisfaction of the Engineer, the existing pump station shall be abandoned and demolished. The Contractor shall transfer the maintenance of the new Pump Station 8 to the Department at the day of final acceptance by the Engineer.

1.5.4 The Contractor shall transfer the maintenance of the new Pump Station 8 to the Department at the day of final acceptance by the Engineer and IDOT Maintenance. The Contractor shall be responsible for maintaining the equipment installed in the new Pump Station 8 in accordance with the equipment manufacturer's written instructions and maintenance recommendations. The Contractor shall be responsible for maintaining the new Pump Station 8 including but not limited to, removal of silt and debris from wet well, remove of debris from screen and exercising of generator until maintenance has been transferred to the Department. Contractor shall clean wet well and screen at intervals not to exceed three months. The wet well shall be cleaned and free of debris at the final acceptance day.

1.5.5 Prior to the starting of work, the Contractor shall notify the Engineer and arrange for a pre-construction inspection. At the pre-construction inspection, the facility and its equipment shall be examined and defective or missing items shall be repaired by the State's Electrical Maintenance Contractor or shall otherwise be noted. A record of inspection shall be furnished to the Engineer.

1.5.6 Emergency Service Requirements:

The Contractor shall be responsible for providing 24-hour, 7 days a week emergency response to existing pumping station alarms. Upon notification of a pump station alarm, the Contractor shall dispatch emergency service personnel to the station immediately and shall arrive at the station within one (1) hour of the receipt of the alarm. All necessary emergency repairs required to restore the pump station to its normal operating condition shall be done by the Contractor immediately. Emergency service personnel shall remain at the station to monitor the situation until the alarm(s) are cleared or otherwise notified by the IDOT engineer.

(a) The IDOT COMCENTER shall be immediately notified by the Contractor whenever an "Entry Alarm", or "Water on Pavement Alarm" are received, the IDOT COMCENTER shall be notified with the following information: number of pumps running, water depth in wet well, depth of water on pavement and if the drainage inlets are clogged.

(b) Failure to respond or meet the emergency service requirements of a pumping station alarm, the Contractor shall be liable to the Department in the amount paid to other subcontractors hired by the State to perform the necessary alarm response.

1.5.7 Routine Maintenance Requirements:

Ongoing maintenance activities are required to maintain the existing Pump Station 8 for proper roadway drainage. Routine maintenance inspections of all equipment shall be conducted by the Contractor. Routine maintenance items shall

be done at intervals and as outlined in the District 1 Electrical Maintenance Contract, Article 15.0 "Routine Patrol Requirements".

(a) Failure to meet the routine maintenance requirements of the pumping station, the Contractor shall be liable to the Department in the amount paid to other subcontractors hired by the State to perform the necessary routing maintenance.

1.5.8 The Contractor shall ensure that two sets of construction lock and entry keys for all construction facilities are provided to the Engineer.

1.5.9 All surrounding landscaping of the existing Pump Station 8 shall be maintained by the Contractor during construction. All grass areas shall be mowed and maintained at a maximum two (2) inch height. Snow plowing of the facility shall be provided no more than two working days after a snow fall of one (1) inch or more.

1.5.10 Should it become necessary to perform maintenance work beyond the scope of the Contract or routine maintenance/patrol, as outlined in the Electrical Maintenance Contract, the Contractor shall be reimbursed per Article 109.04 (B) and 109.05.

1.5.11 This work shall be paid for at the Contract lump sum price for MAINTENANCE OF EXISTING PUMP STATION DURING CONSTRUCTION, which shall be payment in full for the work described herein.

1.6 Continuous Operation

1.6.1 The existing Pump Station 8 shall remain in continuous operation during construction. Brief shut-down periods may be permitted to facilitate construction needs when approved by the Engineer. The Contractor shall submit, to the Engineer, all requests for a brief shut-down indicating detailed written description of all particulars such as date, time of day, length of shut-down and all related details. The work required to meet this requirement shall be included at no additional cost to the Department. The Contractor is responsible for maintaining the full existing pump station capacity at all times until transferring the maintenance of the new pump station to the Department.

1.6.2 Continuous operation may require that some of the existing electrical equipment be disconnected, relocated and reconnected as temporary systems.

1.6.3 Continuous operation may require temporary pumping arrangements. Existing station specified firm pumping capacity 3,000 gpm shall be maintained. All necessary temporary pumping provisions and arrangements shall be made to maintain the above specified pumping capacity of the pumping station. There are (2) existing 1,500 gpm main pumps.

1.6.4 This work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK, which shall be payment in full for the work described herein.

1.7 Protection of Drainage Facilities during Construction

1.7.1 Unless otherwise noted in the Contract Drawings, the existing drainage facilities shall remain in use during the period of the new pump station construction.

1.7.2 Locations of existing drainage structures and sewers as indicated on the Contract Drawings are approximate. Prior to commencing work, the Contractor, at his own expense, shall determine the exact location of the existing structures which are within the proposed construction site.

1.7.3 All drainage structures are to be kept free from any debris resulting from construction operations. All work and material necessary to prevent accumulation of debris in the drainage structures will be considered as incidental to the Contract. Any accumulation of debris in the drainage structure resulting from construction operations shall be removed at the Contractor's expense and no extra compensation will be allowed.

1.8 Submittals

1.8.1 Except as specified elsewhere herein, materials and equipment shall be in conformance with the requirements of Section 106 of the Standard Specifications.

1.8.2 Materials and equipment shall be the products of established and reputable manufacturers and shall be suitable for the service required. Unless otherwise specifically indicated, all materials and equipment shall be new. The Contractor is obligated to conduct his own search into the timely availability of the specified equipment and materials to ensure that they are in strict conformance with the contract documents and that delivery schedules are compatible with project time constraints. Materials or equipment items which are similar or identical shall be the product of the same manufacturer. The cost of submittals, certifications, any required samples, and similar costs shall not be separately paid for but shall be included in the pay item bid price for the respective material or work.

1.8.3 All equipment, products and materials incorporated in the work shall be submitted for approval.

1.8.4 Specific submittals required for individual elements of work are specified in the individual Specification sections. Except as otherwise indicated in Specification sections, requirements specified herein shall be complied with for each indicated type of submittal. Procedures concerning items such as listing of manufacturers, suppliers, subcontractors, construction progress schedule, schedule of Shop Drawing submissions, bonds, payment applications, insurance certificates, and schedule of values are specified elsewhere.

1.8.5 Work-Related Submittals

(a) Substitution or "Or Equal" Items include material or equipment Contractor requests Engineer to approve, after Bids are received, as substitute for items specified or described in Specifications by using name of a proprietary item or name of particular supplier.

(b) Shop Drawings include technical data and drawings specially prepared for this Project, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports, instructions, design mix formulas, measurements, and similar information not in standard printed form. Standard information prepared without specific reference to the Project is not considered a Shop Drawing.

(c) Product Data include standard printed information on manufactured products and systems that has not been specially prepared for this Project, including manufacturer's product specifications and installation instructions, catalog cuts, standard wiring diagrams, printed performance curves, mill reports, and standard color charts.

(d) Samples include both fabricated and manufactured physical examples of materials, products, and units of work, partial cuts of manufactured or fabricated work, swatches showing color, texture, and pattern, and units of work to be used for independent inspection and testing. Mock-ups are special forms of samples which are too large or otherwise inconvenient for handling in manner specified for transmittal of sample submittals.

(e) Miscellaneous Submittals are work-related submittals that do not fit in the previous categories, such as guarantees, warranties, certifications, experience records, maintenance agreements, Operating and Maintenance Manuals, workmanship bonds, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, and similar information, devices, and materials applicable to the Work.

1.8.6 The contractor shall thoroughly review submittal and ensure that the submittal complete and meets contract documents. Any shop drawing submitted more than two times requires the contractor to be charged for all costs incurred by the Department.

1.8.7 Scheduling

(a) A preliminary schedule of shop drawings and samples submittals shall be submitted for approval, in duplicate.

(b) Each submittal shall be prepared and transmitted to Engineer sufficiently in advance of scheduled performance of related work and other applicable activities.

(c) Within 60 days of the contract award, the Contractor shall submit, for approval, complete manufacturer's product data (for standard products and components) and detailed shop drawings (for fabricated equipment). Submittals need not include all project equipment and materials in one submittal, however, the submittals for the equipment and materials for each individual pay item shall be complete in every respect. Partial submittals may be returned without review. The Contractor may request, in writing, permission to make a partial submittal; the Engineer will evaluate the

circumstances of the request and may accept to review such partial submittal. However, no additional compensation or extension of time will be allowed for extra costs or delays incurred due to partial or late submittals.

1.8.8 Each submittal shall be accompanied by a transmittal containing the following information:

(a) Contractor's Name
(b) Supplier's Name
(c) Manufacturer's Name
(d) Date of submittal and dates of previous submittals containing the same material
(e) Project Route/Name
(f) Section
(g) Submittal and transmittal number
(h) Contract identification
(i) Identification of equipment and material with equipment identification numbers, motor numbers, and Specification section number Variations from Contract Documents and any limitations which may impact the Work Drawing sheet and detail number as appropriate
(j) Variations from Contract Documents and any limitations which may impact the Work.
(k) Drawing sheet and detail number as appropriate.
Multi-part submittal forms will be provided by the department to the Contractor to facilitate the submittal and review process. The Contractor shall complete all submittal information on the form and shall sign the submittal as indicated.
(l) The resubmittal shall be complete in all respect and shall supersede earlier submittal in entirety and should not require referring to earlier multiple piece meal submittals.
(m) Each submittal shall be dedicated for each subject. The different subjects and or systems associated with different engineering disciplines shall not be combined or mixed up together in one package of submittal.

1.8.9 Exceptions, Deviations, and Substitutions

(a) In general, exceptions to and deviations from the requirements of the Contract Documents will not be allowed. It is the Contractor's responsibility to note any deviations from Contract requirements at the time of submittal and to make any requests for deviations in writing. In general, substitutions must demonstrate that the proposed substitution is superior to the equipment or material required by the Contract Documents. No exceptions, deviations, or substitutions will be permitted without approval.

(b) Data for items to be submitted for review as substitution shall be collected into one submittal for each item of material or equipment.

(c) Request shall be submitted with other scheduled submittals for the material or equipment allowing time for Engineer to evaluate the additional information required to be submitted. If Contractor requests to substitute for material or equipment specified but not identified in Specifications as

requiring submittals, substitution submittal request shall be included in Submittal schedule and submitted as scheduled.

1.8.10 Shop Drawings

(a) Shop drawing information shall be newly prepared and submitted with graphic information at accurate scale. The name of manufacturer or supplier (firm name) shall be indicated. Dimensions shall be shown and clearly noted which are based on field measurement; materials and products which are included in the Work shall be identified; revision shall be identified. Compliance with standards and notation of coordination requirements with other work shall be indicated. Variations from Contract Documents or previous submittals shall be highlighted, encircled or otherwise indicated.

(b) The catalog cuts shall be highlighted identifying all selected options and project specific details. Generic catalog cuts shall be unacceptable.

(c) Any deviation hidden in the submittals shall be unacceptable. The deviations if any shall be highlighted and contractor shall provide cost analysis justifying equal or better product. The Engineer shall be the sole authority for the acceptance or rejection without any justification.

(d) List all shop drawings that are required for each discipline.

(e) Each major equipment submittal shall have a detailed bill of material list.

(f) The following information shall be included on each drawing or page:

1) Submittal date and revision dates.
2) Project name, division number and descriptions.
3) Detailed specifications section number and page number.
4) Identification of equipment, product or material.
5) Name of Contractor and Subcontractor.
6) Name of Supplier and Manufacturer.
7) Relation to adjacent structure or material.
8) Field dimensions, clearly identified.
9) Standards or Industry Specification references.
10) Identification of deviations from the Contract Documents.
11) Contractor's stamp, initialed or signed, dated and certifying to review of submittal, certification of field measurements and compliance with Contract.
12) Physical location and location relative to other connected or attached material at which the equipment or materials are to be installed.

(g) An 8-inch by 3-inch blank space shall be provided for Contractor and Engineer stamps.

(h) Five submittal copies shall be submitted to the Engineer for review. Contractor will be responsible for distribution and pick-up of submittals as directed by the Engineer. One approved copy will be returned to the Contractor.

(i) Materials, products or systems shall not be installed until copy of applicable product data showing only approved information is in possession of installer. One set of product data (for each submittal) shall be maintained at Project site.

(j) Shop drawing submittal shall include pump control schematics, SCADA panel drawings, and detailed control system descriptions for auto/manual controls and operation and monitoring and monitoring of main and low flow pumps from the SCADA Panel and from the float control mode and also remote monitoring system descriptions.

1.8.11 Product Data

(a) Required product data shall be collected into a single submittal for each element of work or system. Where product data has been printed to include information on several similar products, some of which are not required for use on Project or are not included in submittal, copies shall be marked to clearly identify not applicable and project specific information.

(b) Where product data must be specially prepared for required products, materials or systems, because standard printed data are not suitable for use, data shall be submitted as a Shop Drawing and not as product data.

(c) Submittal shall be final when returned by Engineer marked "Approved".

(d) Four submittal copies shall be submitted to the Engineer.

(e) Materials, products or systems shall not be installed until copy of applicable product data showing only approval information is in possession of installer. One set of product data (for each submittal) shall be maintained at Project site, available for reference by Engineer and others.

1.8.12 Samples

(a) Where possible, samples shall be physically identical with proposed materials or products to be incorporated into the Work. Where variations in color, pattern or texture are inherent in material or product represented by sample, multiple units (not less than 3 units) shall be submitted showing approximate limits of variations.

(b) A full set of optional samples shall be provided where Engineer's selection required. Samples shall be prepared to match Engineer's selection where so indicated.

(c) Each sample shall include generic description, source or product name and manufacturer, limitations, and compliance with standards.

(d) Samples for Engineer's visual review and final check of coordination of these characteristics with other related elements of work shall be of general generic kind, color, pattern, texture.

(e) At Contractor's option, and depending upon nature of anticipated response from Engineer, initial submittal of samples may be either preliminary or final submittal.

A preliminary submittal, consisting of a single set of samples, is required where specifications indicate Engineer's selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with Engineer's "Action" marking.

Three sets of samples shall be submitted in final submittal, 1 set will be returned.

(f) The returned final set of samples shall be maintained at Project site, in suitable condition and available for quality control comparisons throughout course of performing work.

Returned samples intended or permitted to be incorporated in the Work are indicated in Specification sections, and shall be in undamaged condition at time of use.

1.8.13 Mock-ups and similar samples specified in Specification sections are recognized as special type of samples. Requirements for samples submittal shall be complied with to greatest extent possible. Transmittal forms shall be processed to provide record of activity.

1.8.14 Miscellaneous Submittals

(a) Inspection and Test Reports

1) Inspection and factory test reports shall be submitted for pumps, SCADA panel, generator and MCC.

(b) Submittals for detailed factory and field test procedures for pumps. Submittals for detailed field test procedures for SCADA, generator and MCC.

(c) Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds

1) Refer to Specification sections and section Guarantees and Warranties of this Division for specific requirements. Submittal is final when returned by Engineer marked "Approved" or "Approved as Noted".

2) In addition to copies desired for Contractor's use, 2 executed copies shall be furnished. Two additional copies shall be provided where required for maintenance data.

(d) Certifications

1) Refer to Specification sections for specific requirements on submittal of certifications. Seven copies shall be submitted. Certifications are submitted for review of conformance with specified requirements and information. Submittal shall be final when returned by Engineer marked "Approved".

2) Where certifications are specified, the information submitted for approval shall incorporate certification information. When a certification can be made prior to manufacture, the certification shall be included with initial submittal information. When certification is possible only after manufacture, the initial submittal information shall include a statement of intent to furnish the certification after equipment approval and manufacture.

3) Certifications involving inspections and/or tests shall be complete with all test data presented in a neat, descriptive format, with all test data, applicable dates, times, and persons responsible.

4) There should be a section in the report analyzing results and test data that meets the requirements of the contract and also list the items that fall short of contract requirements with conclusive remarks for acceptance/rejection of the equipment.

(d) Tools

1) Spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units shall be submitted.

2) Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for maintenance of particular equipment.

3) For each type of equipment provided under this Contract, a complete set of all special tools shall be furnished including grease guns and other lubricating devices, which may be needed for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be of high grade, smooth forged alloy tool steel. Grease guns shall be of the lever type.

1.8.15 Contractor's Stamp

(a) Prior to submittal, the Contractor shall review the submittal material and shall affix his stamp of approval, with comments as applicable, signed by a responsible representative, to each appropriate submittal item. In the case of Subcontractor's submittals, both the Sub- contractor and the General Contractor shall review and stamp the submittal. Submittals which are not approved or approved-as-noted by the Contractor shall not be submitted to the Engineer. The Contractor shall not give an approved-as-noted status to submittals having incompleteness or major corrective notations as this will only delay the ultimate approval process.

(b) The receipt of submittal information from the Contractor will be construed as the Contractor's assurance that he has reviewed the submittal information and attests to the submittal's accuracy and conformance to the requirements of the contract documents. Submitted information shall be complete and in sufficient detail to demonstrate compliance with all requirement of the contract documents, including fitting in the space provided and meeting all salient features of the specifications.

1.8.16 Submittal information must be particularly detailed in every respect. Product data shall present information to demonstrate the complete nature of the product, including dimensions, wiring diagrams, operating information, and the like. Shop drawings shall be extremely detailed and shall include all appropriate dimensions, fabrication details, component bill of material, information relative to mounting, detailed wiring, finish, and the like. Wiring diagrams shall include both schematic and point-to-point representations, complete with references to circuiting as indicated on the Contract Drawings as well as terminal points of component devices.

1.8.17 Unless required elsewhere, submittals shall be distributed to subcontractors, suppliers, governing authorities, and others as necessary for proper performance of work.

1.8.18 Except for submittals for record and similar purposes, where action and return on submittals are required or requested, Engineer will review each submittal, mark with appropriate action, and return. Where submittal must be held for coordination, Engineer will also advise Contractor without delay. Engineer will stamp each submittal with uniform, self-explanatory action stamp, appropriately marked with submittal action.

1.8.19 Where submittals are marked "Approved", Work covered by submittal may proceed PROVIDED IT COMPLIES WITH CONTRACT DOCUMENTS. Acceptance of Work will depend upon that compliance.

1.8.20 When submittals are marked "Approved as Noted", Work covered by submittal may proceed provided it complies with both Engineer's notations or corrections on submittal and with Contract Documents. Acceptance of Work will depend on that compliance. The complete re-submittal shall be required for the "Approved as Noted" until the submittal attain "Approved" status, unless the reviewer's remarks indicate "Re-submittal is not required" which shall only be exercised for minor comments.

1.8.21 When submittals are marked "Examined and Returned for Correction or disapproved", Work covered by submittal shall not proceed. Work covered by submittal shall not be used at Project site or elsewhere where Work is in progress. The submittal shall be revised or a new submittal shall be prepared in accordance with Engineer's notations in accordance with Re-submittal Preparation procedures specified in this section. The submittal shall be resubmitted without delay and repeated if necessary to obtain different action marking.

1.8.22 Any need for more than one resubmission, or any other delay in Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time.

1.8.23 Coordination

(a) Preparation and processing of submittals shall be coordinated with performance of the work, other submittals and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.

(b) Submission of different units of interrelated work shall be coordinated so that one submittal will not be delayed by Engineer's need to review a related submittal. Engineer may withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

1.8.24 Unless otherwise indicated, guarantees as specified herein shall be included with the submittal information of all applicable equipment and materials. Incompleteness, inaccuracy, or lack of coordination shall be grounds for rejection. The Contractor shall clearly understand no equipment or material shall be installed prior to approval and that any equipment or material installed prior to approval is subject to removal from the right-of-way solely at the Contractor's expense.

1.9. Re-submittal Preparation

1.9.1 Re-submittal Preparation shall comply with the requirements described in subsection 1.8, Submittal, of this section. In addition, it shall be identified on the transmittal form that the submittal is a resubmission. Re-submittal shall have previous comments and detailed point by point response to each previous comments.

1.9.2 Any corrections or changes in submittals required by Engineer's notations shall be made on returned submittal.

1.9.3 On the transmittal or on a separate page attached to Contractor's resubmission transmittal, all notations or questions indicated by Engineer on Engineer's transmittal form shall be answered or acknowledged in writing. Each response shall be identified by question or notation number established by Engineer. If Contractor does not respond to each notation or question, resubmission will be returned without action by Engineer until Contractor provides a written response to all Engineer's notations or questions.

1.9.4 Variations or revisions from previously reviewed submittal, other than those called for by Engineer, shall be identified on transmittal form.

1.10 Record Drawings

1.10.1 One record copy of all Contract Documents, reference documents and all technical documents submitted in good order shall be kept and maintained at the site. On bond media, and using drafting symbols and standards consistent with the original documents, Contract Drawings shall be annotated in red to show all changes made during the construction period. Annotated drawings are to be made available to Engineer for reference at all times.

1.10.2 At completion of the Contract and before final payment is made, three (3) sets of clearly legible 11"x 17" bond media Contract Drawings reflecting all changes made during construction shall be delivered to the Engineer. The drawings shall each be stamped "Record Drawings", and shall be marked with the contractor's stamp, the date, and the signature of the contractor's representative.

1.10.3 Record Drawings shall reflect the actual field installed equipment, locations, nameplates, electrical control logic, conduit locations with corresponding labeling, and wiring changes etc. Any deletions of the design drawings shall cross reference to the replaced drawings.

1.10.4 The Record Drawings must be submitted and must be acceptable to the Engineer prior to final acceptance.

1.10.5 The record drawings shall be submitted in PDF format on CDROM as well as hardcopy for review and approval. In addition to the record drawings, copies of the final catalog cuts which have been Approved or Approved as Noted shall be submitted in PDF format along with the record drawings. The PDF files shall clearly indicate either by filename or PDF table of contents the respective pay item number. Specific part or model numbers of items which have been selected shall be clearly visible.

1.10.6 In addition to the specified record drawings, the Contactor shall record GPS coordinates of the following electrical components:

- Last light pole on each circuit
- Handholes
- Conduit crossings
- Controllers
- Buildings
- Structures with electrical connections, i.e. DMS, lighted signs.
- Electric Service locations"

1.11 Guarantees and Warranties

1.11.1 All equipment shall be furnished complete with the manufacturer's standard trade guarantee or warranty, applicable to the Illinois Department of Transportation, from the date of final acceptance. Such guarantee shall accompany submittal shop drawings and product data.

1.11.2 Prior to final payment, the original and one copy of all bonds, warranties, guarantees and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period shall be delivered to the Engineer.

1.11.3 The warranties shall include parts and labor and shall begin from the date of final acceptance.

1.12 Operation and Maintenance Manuals

1.12.1 Four copies of an Operation and Maintenance Manual shall be furnished to the Engineer for all equipment and associated control systems furnished and installed for review and approval. Four hard copies of approved O&M manuals and four scanned O&M Manuals CD's shall be submitted for Engineer's use.

1.12.2 The contractor shall submit three manuals for engineer, IDOT O&M and IDOT engineer's independent review when construction is at 75% complete stage. Based on the consolidated review comments and compliance, the contractor shall organize and compile required number of sets of O&M manuals and resubmit for review and approval along with point to point response to the previous comments. If it is determined by the Engineer that the manuals does not contain required details and are not revised per the previous comments, then all manuals shall be returned back to the contractor for corrective action until the manuals are approved by the Engineer.

1.12.3 The manual shall consist of the following and shall be prepared and arranged subject wise and chronological order as follows:

(a) Table of Contents broken down per discipline.
(b) A section of a pump station data sheet (see sample form at end of section.
(c) A section of an equipment data summary (see sample form at end of section) for each item of equipment.
(d) A section of an equipment preventive maintenance data summary (see sample form at end of section) for each item of equipment.
(e) A section of the equipment manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.
(f) Approved power systems study including list of electrical relay settings and control, alarm contact, an timer settings with applicable ranges.
(g) Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.
(h) One valve schedule giving valve number and location for each valve installed.
(i) All O&M Manual material and catalog pages shall be on 8-1/2 inch by 11 inch commercially printed or typed forms or an acceptable alternative format.
(j) Comprehensive equipment technical data sheets for pumps , motors, equipment within switchgear, MCC, switchgear, transformers, breakers, valves, SCADA and control panel.
(k) Details of equipment nameplates and technical ratings.
(l) Detailed summary of quantities and bill of material with technical descriptions for major equipment such as MCC, switchgear, SCADA, and control panels, etc.
(m) The manuals shall contain catalog cuts highlighting features and selected options of the equipment.
(n) Legible 11 inch x 17 inch shop drawing and each shop drawing shall have "Record" stamp, signatures and date.

(o) The catalog cuts of each device/equipment shall have engineer's "Approved" stamp, signature and date.
(p) The manual shall include shop drawings of SCADA, control panels, MCC, switchgear, front and internal views, internal wiring and field interconnection termination details/terminal schedules.
(q) The manual shall have CAD produced contract drawings having changes identified by red ink and contract documents shall have "Record" stamp, signature and date.
(r) The manual shall include control schematic shop drawings for pumps and discharge/recirculation gate valves.
(s) Mechanical and HVAC equipment schedules.
(t) The manual shall contain a section for detailed system description of sequence of pump operations during rising and falling wet well water level through SCADA primary and backup level controls, float mode control, manual and auto operation of various level systems, remote monitoring of pump station signals and communications method.
(u) All documents shall be legible.
(v) The manual shall include shop drawings having engineer's approved stamp, signature and date.
(w) The manual shall include section for field test reports for all major equipment including the MCC, generator, grounding system, SCADA, and all other monitoring and control equipment.
(x) Four copies of Record Drawings shall be submitted to the Engineer for review.
(y) Successful bidder will be provided with MicroStation drawings upon receipt of acceptable release.

1.12.4 Each manual shall be organized into sections paralleling the equipment specifications. Each section shall be identified using heavy section dividers with reinforced holes and numbered plastic index tabs. The data shall be compiled in high-quality heavy-weight, hard cover binders with piano style metal hinges or in an alternate approved format. 11"x17" reduced size legible drawings and other materials which would be opened or removed for reading shall be provided with heavy clear plastic pouches within the binders. The number of binders shall be as required to hold all required material without over-filling. Various sections, as appropriate shall have suitable dividers. All volumes shall be labeled. All loose data shall be punched for binding. Composition and printing shall be arranged so that punching does not obliterate any data. The project title, and manual title, as furnished and approved by the Engineer shall be printed on the cover and binding edge of each manual.

1.12.5 All operating and maintenance material that comes bound by the equipment manufacturer shall be left in its original bound state. The appropriate sections of the Contractor's O&M manual shall be cross-referenced to the manufacturers' bound manuals.

1.12.6 The O&M Manuals must be submitted and must be acceptable to the Engineer prior to equipment start-up. Substantial completion is not achieved until O&M Manuals are approved by the Engineer.

Pump Station # 8 Data Sheet

Location: Describe Location and Address

Telephone:
Voice & AEGIS Phone #:
SCADA Phone #:

Main Pumps: Total 2@ 1,500 GPM
Standby Pump: 1@1,500 GPM
Pump: Describe complete model # and manufacturer's name
Motor: Describe complete model #, motor HP, amps, voltage and manufacturer's name

Low Flow Pumps: 1@ 500 GPM.
Pump: Describe complete model # and manufacturer's name
Motor: Describe complete model #, motor HP, amps, voltage and manufacturer's name

Pump Station Capacity: 3,000 GPM

Pit Type: Wet Pit

Outlet: 16" Diameter Force Main

Electrical Service:
1) Normal Power: Describe amps, cable and conduit size

2) Emergency Power: Describe amps, cable and conduit size

Generator: Describe complete model # and manufacturer's name, and technical rating

MCC:
1) MCC: Describe tech ratings, model # and manufacturer's name

Pump Station #8 Control Elevations

Pumping Operation Ranges With Rising Water			
SCADA Function	Level Above Wet Pit Floor	Level EL.	Float Function
	(FT)	(EL)	
High Water Alarm	11	612.00	High Water Alarm
No Function	10	611.00	Start Main Pump 3 (If 1 or 2 has failed)
Start Lag Main Pump	7	608.00	Start Main Pump 2
Start Lead Main pump and Stop Low Flow Pump	6	607.00	Start Main Pump 1 Stop Low Flow Pump
Start Low Flow Pump	4	605.00	Start Low Flow Pump
Pavement Flood Alarm	27.3	627.3	Pavement Flood Alarm

Pumping Operation Ranges With Falling Water			
SCADA Function	Level Above Wet Pit Floor	Level EL.	Float Function
	(FT)	(EL)	
Stop Main Pumps & Start Low Flow Pump	5	606.00	Stop main pumps and Start Low Flow Pump
Stop Low Flow Pump	3.5	604.50	Stop Low Flow Pump
Low Water Alarm	2.5	603.50	Low Water Alarm

Maps, Photos, and Driving Directions

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

STORMWATER PUMP STATION NO. 8

Operation and Maintenance Manual

Equipment Data Summary

Equipment Name: | Specification Reference:

Manufacturer
Name:

Address:

Telephone:

Number Supplied: | Location / Service:

Model No.: | Serial No.:

Type:

Size / Speed / Capacity / Range (as applicable):

Power Requirement (Phase / Volts / Hertz):

Local Representative
Name:

Address:

Telephone:

NOTES:

STORMWATER PUMP STATION NO. 8

Operation and Maintenance Manual

Preventive Maintenance Summary

Equipment Name: Location:

Manufacturer

Name:

Address:

Telephone:

Model No.: Serial No.:

Maintenance Task	Lubricant/Part	D W M Q S A A

NOTES:

1.12.7 Binders shall be labeled Volume 1 of X, 2 of X, and so on, where more than one binder is required. The table of contents for the entire set, identified by volume number, shall be included in each binder.

1.13 Storage of Equipment and Materials

1.13.1 All materials and equipment shall be protected from wear and damage both before and after delivery to the job site.

1.13.2 Unless specifically permitted by the Engineer, all equipment such as pumps, fans, electrical apparatus, valve operators, SCADA equipment, and the like shall be stored indoors out of exposure to the weather. Items having electrical parts, such as motors, electronic panels, and the like, shall be kept in heated storage, at a temperature to prohibit the accumulation of condensation on the equipment. Where equipment is provided with integral space/strip heaters, (such as the motor control center), these heaters shall be energized as soon as the equipment is present at the job site and they shall remain energized from temporary circuits until final permanent energization is attained.

1.13.3 Unless otherwise specifically permitted by these specifications or as allowed by the Engineer, all materials for use on the project shall be stored indoors out of exposure to the weather. Such materials would include ductwork, doors and frames, louvers, grating, slate roofing, building hardware, windows and glass block, wire and cable, conduit, and piping. Certain materials such as building steel, exterior hatch covers, fencing, and the like which will be applied exposed to the weather, may be stored outdoors in a safe manner as approved. Note the specified requirements for the storage of building masonry in Section 4A.

1.14 Protection of the Work

1.14.1 All work shall be protected from damage by vandals, the weather, or other sources until final acceptance by the Engineer. Such protection shall include temporary fencing or other barriers, if necessary, to restrict access to the work. Open pits, doors, hatches, etc. shall be covered, closed and locked. No additional compensation will be granted and no additional time will be allowed due to delays caused by failure to adequately protect the work from damage. In addition, the Contractor shall make the worksite safe at the end of each work day, leaving no attractive nuisance hazards and no open electrical boxes and the like.

1.14.2 Clean-Up and Public Safety
The work site shall be maintained in a clean condition, free of hazards to the work force and the public, all in conformance with the requirements of Article 107 of the Standard Specifications. Special care shall be taken to see that electrical systems are not left in an exposed or otherwise hazardous condition. All electrical boxes, cabinets, pole handholes, etc., which contain wiring, either energized or non-energized, shall be closed or have their cover in place and shall be locked when possible, during off-work hours.

1.15 Standards of Workmanship

1.15.1 All work shall be performed to the highest standard of each respective trade. The work shall demonstrate all due care and attention so that all specified requirements are met and that the end product is a first-rate installation.

1.15.2 The Contractor shall comply with the requirements of Sections 105 and 108 of the Standard Specifications, and any Supplements thereto shall, in addition, comply with the requirements for control of work specified herein.

1.16 Quality Control

1.16.1 Submittals

All submittals, including the following, shall be provided as specified in this Section.

Authoritative evidence in the form of Certificates of Manufacture shall be furnished to the Engineer to show that the materials and equipment to be used in the Work have been manufactured and tested in conformity with the Contract Documents. Copies of the results of physical tests that have been made directly on the product or on similar products of the manufacturer shall be included where necessary.

1.16.2 At all times during the progress of the Work and until the date of final completion, afford the Engineer every reasonable, safe, and proper facility for inspecting the Work at the site. The observation and inspection of any work will not relieve the Contractor of any obligations to perform proper and satisfactory work as specified. Work rejected due to faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, shall be replaced with satisfactory work at no additional cost to the Department. Finished or unfinished work found not to be in strict accordance with the Contract shall be replaced as directed even though such work may have been previously approved and payment made therefore.

1.16.3 Failure or neglect on the part of the Engineer to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring the Engineer at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the Work in which inferior work or improper materials were used.

1.16.4 Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or IEEE, except as may otherwise be stated herein.

1.16.5 Personnel shall be provided to assist the Engineer in performing the following periodic observation and associated services.

(a) Soils: Observe and test excavations, placement and compaction of soils. Determine suitability of excavated material. Observe sub-grade soils and foundations.

(b) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by Engineer.

(c) Masonry: Sample and test mortar, bricks, blocks and grout; inspect brick and block samples and sample panels; inspect placement of reinforcement and grouting.

1.16.6 When specified in Divisions 2 through 16 of the Contract Documents, an independent laboratory testing facility shall be provided to perform required testing. The laboratory shall be qualified as having performed previous satisfactory work. Prior to use, such qualifications shall be submitted to the Engineer for approval.

1.16.7 Cooperate with the Engineer and laboratory testing representatives. At least fifteen (15) working days notice shall be given prior to when specified testing is required. Labor and materials, and necessary facilities shall be provided by the Contractor at the site as required by the Engineer and the testing laboratory.

1.16.8 Equipment test procedures shall be coordinated and demonstrated as specified in the Contract Documents or as otherwise required during the formal tests.

1.16.9 Where transcripts or certified test reports are required by the Contract Documents, the following requirements shall be met:

For all required transcripts, certified test reports, certified copies of the reports of all tests required in referenced specifications or specified in the Contract Documents, submit and obtain approval of the Engineer before delivery of materials or equipment. All testing shall be performed in an approved independent laboratory or the manufacturer's laboratory. Reports of shop equipment tests shall be submitted for approval within thirty days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type, quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.

1.16.10 At the option of the Engineer, or where not otherwise specified, a notarized Certificate of Compliance shall be submitted for approval. The Certificates may be in the form of a letter stating the following:

(a) Manufacturer has performed all required tests
(b) Materials to be supplied meet all test requirements
(c) Tests were performed not more than one year prior to submittal of the certificate
(d) Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified
(e) Identification of the materials

1.16.11 Except as expressly provided elsewhere herein, all the costs of shop and field tests of equipment and other tests specifically called for in the Contract Documents shall be included in the Contract Price.

1.16.12 Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the Engineer for compliance. The Engineer shall be reimbursed for expenditures incurred in making such tests on materials and equipment which are rejected for noncompliance.

1.16.13 The Contractor shall coordinate work such that inspections are not required outside of the hours of 7:00 a.m. and 5:00 a.m. Monday-Friday, non-holiday.

1.16.14 The Contractor shall provide transportation and reasonable expenses including lodging and meals to and from all factory motor control center and pump testing for two Engineer representatives. The Contractor shall notify the Engineer of a scheduled test date two months prior to said date and shall arrange an exact suitable date not less than two weeks prior to the test.

1.16.15 As soon as conditions permit, all labor and materials and services to perform preliminary field tests of all equipment shall be furnished as provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, all changes, adjustments and replacements required shall be made prior to the acceptance tests.

1.16.16 Upon completion of the Work and prior to final payment, all equipment, piping and appliances installed under this Contract shall be subjected to specified acceptance tests to demonstrate compliance with the Contract Documents.

1.16.17 All labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests shall be furnished by the Contractor.

1.16.18 Field tests shall be conducted in the presence of the Engineer. The field tests shall demonstrate that under all conditions of operation each equipment item:

(a) Has not been damaged by transportation or installation
(b) Has been properly installed
(c) Has no mechanical defects
(d) Is in proper alignment
(e) Has been properly connected
(f) Is free of overheating of any parts
(g) Is free of all objectionable vibration
(h) Is free of overloading of any parts
(i) Operates as intended

1.16.19 Each pump and generator shall be operated for a minimum of 30 minutes continuous service.

1.16.20 If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, such deficiencies shall be promptly corrected. Failure or refusal to

correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the Engineer, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the Contractor to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

1.17 Cutting and Patching

1.17.1 No structural members shall be removed, cut or otherwise modified without approval and any such work shall be done in a manner as directed by the Engineer.

1.17.2 Cutting of concrete slabs, walls and members shall be performed without over-cutting at corners or elsewhere.

1.17.3 Cutting and patching shall be performed in a neat and workmanlike manner, consistent with the best practices of the appropriate trade. All patching shall be done in a manner consistent with the building material being patched.

1.17.4 All cutting, fitting or patching of the Work that may be required to make the several parts thereof join shall be provided in accordance with the Contract Documents. Restoration shall be performed by competent workmen skilled in the trade.

1.17.5 All cutting and patching required to install improperly timed work or to remove samples of installed materials for testing shall be provided.

1.17.6 Except when the cutting or removal of existing construction is specified or indicated, any cutting or demolition which may affect the structural stability of the Work or existing facilities shall not be undertaken without the Engineer's concurrence.

1.17.7 Shoring, bracing, supports, and protective devices necessary to safeguard all work during cutting and patching operations shall be provided.

1.17.8 All materials shall be cut and removed to the extent shown or as required to complete the Work. Materials shall be removed in a careful manner with no damage to adjacent facilities. Materials which are not salvageable from the site shall be removed.

1.17.9 All work affected by demolition, cutting operations, and equipment removal shall be patched, repaired or restored with new materials or with salvaged materials acceptable to the Engineer to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished. Affected surfaces shall match adjacent surfaces and provide uniform appearance. Unnecessary gaps, holes, openings and depressions shall be filled with suitable patching material.

1.18 Definition of Terms

1.18.1 Abbreviations

Wherever the following abbreviations are used in these Special Provisions or on the Plans, they are to be construed the same as the respective expressions represented:

AASHTO	American Association of State Highways and Transportation Officials
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
ICEA	Insulated Power Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society of North America
IBC	International Building Code
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NETA ATS	International Electrical Testing Agency, Acceptance Testing Specifications
UL	Underwriter's Laboratories
ACI	American Concrete Institute
FM	Factory Mutual
SSPC	Steel Structures Painting Council
HI	Hydraulic Institute Standard
NFPA 72	National fire Alarm and Signaling Code
NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities
OSHA	Confined Space Regulations and Electrical Systems Code Regulations

IDOT Drainage Manuals

IDOT General Guidelines for Pump Station Design

IDOT Bureau of Design and Environment BDE Manuals

Illinois Professional Engineering Practice Act

1.18.2 Standard Specifications

Where used in these Special Provisions, this term shall mean the latest "Standard Specifications for Road and Bridge Construction, Adopted April 1, 2016", published by the Illinois Department of Transportation.

1.18.3 Specifications

Where used in these Special Provisions, this term shall mean the complete body of specifications, including the Standard Specifications, these Special Provisions, and referenced specifications and standards. See also latest IDOT "Standard Specifications for Road and Bridge Construction" for definition of terms.

1.18.4 Supplements

Where used in these Special Provisions, this term shall mean the latest "Supplemental Specifications and Recurring Special Provisions" published by the Illinois Department of Transportation.

1.18.5 Contract Documents

The complete body of agreements, specifications and drawings which define the contract work.

1.18.6 Provide

Where used in these Special Provisions, this term shall mean "furnish and install, complete functional, including any required connection and testing".

1.19 Referenced Specifications and Standards

1.19.1 The referenced specifications and standards shall be latest version and are incorporated, by reference, in these Special Provisions and shall apply to the work as though fully written herein:

(a) *STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION*, a publication of the Illinois Department of Transportation.

(b) *SUPPLEMENTAL SPECIFICATIONS AND RECURRING SPECIAL PROVISIONS*, a publication of the Illinois Department of Transportation.

(c) NATIONAL ELECTRICAL SAFETY CODE, a publication of American National Standards Institute.

(d) SAFETY CODE, a publication of the Illinois Department of Transportation.

(e) *AMERICAN NATIONAL STANDARD PRACTICE FOR ROADWAY LIGHTING, ANSI/IES RP-8*, published by Illuminating Engineering Society, approved by National Standards Institute.

(f) *ELECTRICAL MAINTENANCE CONTRACT*, State of Illinois. Department of Transportation, Division of Highways, District 1.

1.20 Schedule of Values, Payment and Invoices

1.20.1 A Schedule of Values and invoices shall be submitted as payment basis for each pay item of Pump Station General Work, Pump Station Electrical Work, and Pump Station Mechanical Work.

1.20.2 The Contractor shall submit a Schedule of Values, as specified herein, at least fifteen (15) days prior to submitting the first payment estimate and shall provide information as requested to substantiate the prices included in the Schedule of Values.

1.20.3 The Schedule of Values shall be approved by the Engineer prior to any project payments.

1.20.4 Complete Schedule of Values

(a) The Schedule of Values shall be typewritten on 8-1/2 inch by 11 inch paper in a format approved by the Engineer.

(b) The Schedule of Values shall be used to determine the value of work completed for payment purposes. After review by the Engineer, the Contractor shall revise and resubmit the Schedule of Values as required.

(c) The Schedule of Values shall have each pay item further itemized by Specification Division as listed in the Specification index.

(d) For the item Pump Station General Work, Pump Station Electrical Work and Pump Station Mechanical Work, each pay item which has an installed value of over $10,000, a list of the costs for the major products or operations shall be indicated under each pay item. Round off figures to the nearest ten (10) dollars. The "value" for each pay item listed shall be the supplied, installed and operational start-up cost incurred to the Contractor for that pay item (overhead and profit included). The sum total of all pay items in the Schedule shall be equal to the payment reflecting total contract value.

1.20.5 Unit Price for Change Order

(a) If there is no bid unit prices for change order, the contractor shall use the unit price based on the previous IDOT PTB bid unit prices if applicable for the change order.

1.21 Start-Up

1.21.1 Items to be checked on start-up include, but not limited to, the following:

(a) Field test procedures shall be approved by the Engineer prior to field testing. Pump Station shall be operational for a minimum of 30 days prior to final acceptance within which cumulative major component remains active without down time, consisting of the pumps, HVAC system and electrical system. Control system down time shall not exceed 4 hours, see Section 16D.
(b) Demonstration of back-up float controls.
(c) Gas detection calibration kit shall be always stored on site.
(d) Demonstration of generator and transfer switch operation and maintenance.
(e) Check pump operation in manual, bump and auto mode.
(f) Check alarm operation SCADA and AEGIS system and verify at remote location (EMC contractor's facility, District 1, and IDOT TSC).
(g) SCADA panel operation
(h) Network Equipment Rack operation
(i) Level system operation
(j) Fire alarm system operation
(k) HVAC system operation
(l) Discharge slide gate and recirculation valve operation

1.21.2 The contractor shall prepare to demonstrate operation and maintenance procedures for all equipment installed.

1.22 Method of Measurement

1.22.1 Progress payments will be accordance with Section 109 of the Standard Specifications.

1.22.2 Mechanical equipment specified under Section 15D and electrical equipment specified under Sections 16D, 16E, 16F will be considered 80% complete once substantially complete and corresponding O&M Manuals have been approved by the Engineer, training has been provided to the Department, and O&M Manuals have been delivered for each corresponding pay item. Substantial completion is defined as the time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of the Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. Equipment will not be considered 100% complete for each corresponding pay item until the Final Acceptance by the Engineer, all incomplete works have been addressed, spare parts have been delivered, Record Drawings have been approved and delivered, and all outstanding issues have been completed.

2. PRODUCTS:

Not Used

3. EXECUTION:

Not Used

END OF THIS SECTION

SECTION 1B - MEASUREMENT AND PAYMENT

1. GENERAL:

1.1 Description

1.1.1 The work under this Contract for the construction of Pump Station 8 shall include all labor, materials, tools, equipment and incidentals and for performing all work required for the construction of a new pump station for a complete operational facility, as included in all Contract Documents and shall be as measured and paid for as described hereinafter.

1.1.2 TREE REMOVAL (6 TO 15 UNITS DIAMETER) shall be paid for at the contract unit price per unit diameter in accordance with the Standard Specifications.

1.1.3 TREE REMOVAL (OVER 15 UNITS DIAMETER) shall be paid for at the contract unit price per unit diameter in accordance with the Standard Specifications.

1.1.4 EARTH EXCAVATION shall be paid for at the unit contract unit price per cubic yard in accordance with the Standard Specifications.

1.1.5 TRENCH BACKFILL shall be paid for at the unit contract unit price per cubic yard in accordance with the Standard Specifications.

1.1.6 POROUS GRANULAR BACKFILL shall be paid for at the unit contract unit price per cubic yard in accordance with the Standard Specifications.

1.1.7 PERIMETER ERROSION BARRIER shall be paid for at the contract unit price per lineal foot in accordance with the Standard Specifications.

1.1.8 AGGREGATE BASE COURSE, TYPE B, 6" shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.1.9 AGGREGATE BASE COURSE, TYPE B, 12" shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.1.10 BITUMINOUS MATERIAL (PRIME COAT) POUND BIT MATLS PR CT shall be paid for at the contract unit price per pound in accordance with the Standard Specifications.

1.1.11 HOT-MIX ASPHALT BINDER COURSE, IL-19.0, N50 shall be paid for at the contract unit price per ton in accordance with the Standard Specifications.

1.1.12 HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50 shall be paid for at the contract unit price per ton in accordance with the Standard Specifications.

1.1.13 PORTLAND CEMENT CONCRETE DRIVEWAY PAVEMENT, 8-INCH shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.1.14 COMBINATION CURB AND GUTTER REMOVAL shall be paid for at the contract unit price per lineal foot in accordance with the Standard Specifications.

1.1.15 CONCRETE STRUCTURES shall be paid for at the contract unit price per cubic yard in accordance with the Standard Specifications and as specified in Section 3A, Cast-In-Place Concrete.

1.1.16 REINFORCED BARS, EPOXY COATED shall be paid for at the contract unit price per pound in accordance with the Standard Specifications and as specified in Section 3A, Cast-In-Place Concrete.

1.1.17 DRILLED SHAFT IN SOIL shall be paid for at the contract unit per cubic yard in accordance with the Standard Specifications.

1.1.18 STORM SEWERS, CLASS A, TYPE 2 36" shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.1.19 STORM SEWERS, CLASS A, TYPE 6 60" shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.1.20 CONCRETE CURB, TYPE B shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.1.21 COMBINATION CONCRETE CURB AND GUTTER, TYPE B-6.24 (MODIFIED) shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.1.22 CHAIN LINK GATES, 8'X3' SINGLE shall be paid for at the contract unit price per each as specified in Section 2B, Chain Link Fence and Gate.

1.1.23 CHAIN LINK GATES, 8'X20' DOUBLE shall be paid for at the contract unit price per each as specified in Section 2B, Chain Link Fence and Gate.

1.1.24 ENGINEER'S FIELD OFFICE, TYPE A shall be paid for at the contract unit price per calendar month and shall be in accordance with the Standard Specifications.

1.1.25 MOBILIZATION shall be paid for at the contract lump sum price and shall be in accordance with the Standard Specifications.

1.1.26 ELECTRICAL SERVICE INSTALLATION shall be paid for at the contract lump sum price as specified in Section 16A, General Electrical Provisions.

1.1.27 BRACED EXCAVATION shall be paid for at the contract unit price per cubic yard as specified in Section 2A, Site Work.

1.1.28 PUMP STATION SCADA EQUIPMENT (AND PROGRAMMING) shall be paid for at the contract lump sum price as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 16, Electrical.

1.1.29 COMPLETE SPARE MAIN PUMP ASSEMBLY shall be paid for at the contract unit price lump sum as specified in the applicable requirements Division 1, General Requirements and Division 15, Mechanical.

1.1.30 COMPLETE SPARE LOW FLOW PUMP ASSEMBLY shall be paid for at the contract unit price lump sum as specified in the applicable requirements Division 1, General Requirements and Division 15, Mechanical.

1.1.31 PUMP STATION, GENERAL WORK shall include all work which is not listed as a specific pay item but which is required for compliance with the specifications and for a complete operational facility and will be paid for at the contract lump sum price as specified in the Special Provisions; Division 1, General Requirements; and the applicable requirements under the following: Division 2, Site Work; Section 3B, Grout; Division 4, Masonry; Division 5, Metals, Division 6, Carpentry; Division 7, Thermal and Moisture Protection; Division 8, Doors and Windows; Division 9A, Painting; and Division 10, Specialties.

1.1.32 PUMP STATION, ELECTRICAL WORK will be paid for at the contract lump sum as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements Under Division 16, Electrical.

1.1.33 PUMP STATION, MECHANICAL WORK will be paid for at the contract lump sum as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 14, Conveying Systems and Division 15, Mechanical.

1.1.34 CHAIN LINK FENCE 8' (SPECIAL) shall be paid for at the contract unit price per lineal foot as specified in Section 2B, Chain Link Fence and Gate.

1.1.35 ELECTRIC SERVICE CONNECTION shall consist of charges of the electric utility for both the temporary service during construction and permanent electrical service. The Contractor shall be paid for at the contract lump sum as specified in Section 16A, General Electrical Provisions.

1.1.36 SIGNAL HEAD, LED, 1-FACE, 1-SECTION, BRACKET MOUNTED shall be paid for at the contract unit price per each and shall be in accordance with the Standard Specifications.

1.1.37 REMOVE EXISTING TRAFFIC SIGNAL EQUIPMENT shall be paid for for at the contract unit price per each and shall be in accordance with the Standard Specifications.

1.1.38 NON-SPECIAL WASTE DISPOSAL shall be paid for at the contract unit price per cubic yard and shall be in accordance with the Standard Specifications.

1.1.39 SPECIAL WASTE PLANS AND REPORTS shall be paid for at the contract unit price lump sum and shall be in accordance with the Standard Specifications.

1.1.40 SOIL DISPOSAL ANALYSIS shall be paid for at the contract unit price per each and shall be in accordance with the Standard Specifications.

1.1.41 BOLLARDS shall be paid for at the contract unit price per each as specified in Section 2A, Site Work.

1.1.42 TELEPHONE SERVICE INSTALLATION AND CONNECTION shall be paid for at the contract lump sum as specified in Section 16A, General Electrical Provisions.

1.1.43 DEMOLITION OF EXISTING PUMP STATION shall be paid for at the contract lump sum as specified in Section 2C, Demolition.

1.1.44 MAINTENANCE OF EXISTING PUMP STATION DURING CONSTRUCTION shall be paid for at the contract unit price per calendar month as specified in Division 1, General Requirements. No additional monthly payment shall be paid to Contractor beyond contractual date due to the contractor's inability to complete the relocation of the pump station in a timely manner and as stipulated in the contract documents.

1.1.45 PUMP STATION PACKAGED ENGINE GENERATOR SYSTEMS shall be paid for at the contract lump sum as specified in Section 16E, Packaged Engine Generator Systems.

1.1.46 PUMP STATION MOTOR CONTROL CENTER shall be paid for at the contract lump sum as specified in Section 16F, Motor Control Center.

1.1.47 HEATING AND VENTILATION shall be paid for at the contract lump sum as specified in Section 15E, Ventilation.

1.1.48 MAIN PUMPS shall be paid for at the contract unit price per each as specified in Section 15D, Pumping Equipment.

1.1.49 LOW FLOW PUMP shall be paid for at the contract unit price per each as specified in Section 15D, Pumping Equipment.

1.1.50 AEGIS PANEL shall be paid for at the contract lump sum as specified in Section 16H, Major Electrical Equipment.

1.1.51 FIRE DETECTION PANEL shall be paid for at the contract lump sum as specified in Section 16H, Major Electrical Equipment.

1.1.52 GAS DETECTION PANEL shall be paid for at the contract lump sum as specified in Section 16D, Supervisory Control and Data Acquisition (SCADA) Equipment.

1.1.53 FORCE MAIN, 16" DIP, CLASS 250 shall be paid for at the contract unit price per foot as specified in Section 2A.

1.1.54 FORCE MAIN, 16" DIP CLASS 250, INSTALL IN A 30" STEEL CASING PIPE shall be paid for at the contract unit price per foot as specified in Section 2A, Site Work.

1.1.55 ELECTRICAL CONDUIT, HDD METHOD shall be paid for at the contract unit price per foot as specified in Section 2A, Site Work.

1.2 Description: Civil and Drainage

1.2.1 TEMPORARY FENCE shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.2 TRENCH BACKFILL shall be paid for at the contract unit price per cubic yard in accordance with the Standard Specifications.

1.2.3 TOPSOIL EXCAVATION AND PLACEMENT shall be paid for at the contract unit price per cubic yard in accordance with the Standard Specifications.

1.2.4 COMPOST FURNISH AND PLACE, 2" shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.2.5 SEEDING, CLASS 3 shall be paid for at the contract unit price per acre in accordance with the Standard Specifications.

1.2.6 NITROGEN FERTILIZER NUTRIENT shall be paid for at the contract unit price per pound in accordance with the Standard Specifications.

1.2.7 PHOSPHORUS FERTILIZER NUTRIENT shall be paid for at the contract unit price per pound in accordance with the Standard Specifications.

1.2.8 POTASSIUM FERTILIZER NUTRIENT shall be paid for at the contract unit price per pound in accordance with the Standard Specifications.

1.2.9 MULCH, METHOD 2 shall be paid for at the contract unit price per acre in accordance with the Standard Specifications.

1.2.10 EROSION CONTROL BLANKET shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.2.11 TEMPORARY EROSION CONTROL SEEDING shall be paid for at the contract unit price per pound in accordance with the Standard Specifications.

1.2.12 PERIMETER EROSION BARRIER shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.13 INLET FILTERS shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.14 AGGREGATE BASE COURSE, TYPE B 6" shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.2.15 BITUMINOUS MATERIALS (TACK COAT) shall be paid for at the contract unit price per pound in accordance with the Standard Specifications.

1.2.16 PROTECTIVE COAT shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.2.17 PAVEMENT REMOVAL shall be paid for at the contract unit price per square yard in accordance with the Standard Specifications.

1.2.18 GUTTER REMOVAL shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.19 COMBINATION CURB AND GUTTER REMOVAL shall be paid for at the contract unit price of per foot in accordance with the Standard Specifications.

1.2.20 STORM SEWERS, CLASS A, TYPE 2 18" shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.21 STORM SEWERS, CLASS A, TYPE 4 60" shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.22 STORM SEWERS, CLASS A, TYPE 5 60" shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.23 MANHOLES, TYPE A, 4'-DIAMETER, TYPE 1 FRAME, CLOSED LID shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.24 MANHOLES, TYPE A, 7'-DIAMETER, TYPE 1 FRAME, CLOSED LID shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.25 MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1 FRAME, CLOSED LID shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.26 CONCRETE GUTTER, TYPE A shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.27 COMBINATION CONCRETE CURB AND GUTTER, TYPE B-6.24 shall be paid for at the contract unit per foot in accordance with the Standard Specifications.

1.2.28 CONCRETE BARRIER, SINGLE FACE, 32 INCH HEIGHT shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.29 CONCRETE BARRIER, DOUBLE FACE, 32 INCH HEIGHT shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.30 CONCRETE BARRIER BASE shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.31 TEMPORARY CONCRETE BARRIER shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.32 IMPACT ATTENUATORS, TEMPORARY (FULLY REDIRECT, NARROW), TEST LEVEL 3 shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.33 THERMOPLASTIC PAVEMENT MARKING - LINE 4" shall be paid for at the contract unit price per foot in accordance with the Standard Specifications.

1.2.34 RAISED REFLECTIVE PAVEMENT MARKER shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.35 BARRIER WALL REFLECTORS, TYPE C shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.36 MAINTENANCE OF EXISTING FLASHING BEACON INSTALLATION shall be paid for at the contract unit price per each in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.37 GUTTERS TO BE CLEANED shall be paid for at the contract unit price per foot in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.38 BARRIER WALL REMOVAL shall be paid for at the contract unit price per foot in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.39 STORM SEWERS, DUCTILE IRON, TYPE 2 24" shall be paid for at the contract unit price per foot in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.40 TRAFFIC CONTROL AND PROTECTION, (SPECIAL) shall be paid for at the contract unit lump sum price in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.41 CHANGEABLE MESSAGE SIGN shall be paid for at the contract unit price per calendar day in accordance with the Standard Specifications.

1.2.42 PINNING TEMPORARY CONCRETE BARRIER shall be paid for at the contract unit price per each in accordance with the Standard Specifications.

1.2.43 STABILIZED CONSTRUCTION ENTRANCE shall be paid for at the contract unit price per square yard in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.44 CONSTRUCTION LAYOUT shall be paid for at the contract lump sum unit price in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.45 TEMPORARY INFORMATION SIGNING shall be paid for at the contract unit price per square foot in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.46 RAILROAD PROTECTIVE LIABILITY INSURANCE shall be paid for at the contract lump sum price per in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.47 STORM SEWER (WATER MAIN REQUIREMENTS) 48 INCH shall be paid for at the contract unit price per foot in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.48 TIMBER RETAINING WALL shall be paid for at the contract unit price per square foot in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.49 TIMBER RETAINING WALL REMOVAL shall be paid for at the contract unit price per foot in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.50 CLASS D PATCHES, TYPE IV, 10 INCH (SPECIAL) shall be paid for at the contract unit price per square yard in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

1.2.51 MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1 FRAME, CLOSED LID (SPECIAL) shall be paid for at the contract unit price per each in accordance with the special provision listed under the section for "Special provisions for Civil and Drainage".

2. PRODUCTS:
Not used.

3. EXECATION:
Not used.

END OF THIS SECTION

DIVISION 2 – SITE WORK

DIVISION 2 - SITE WORK

SECTION 2A - SITE WORK

1. GENERAL:

1.1 Description

1.1.1 This Section shall include all work required for the furnishing and completing all site work as indicated on the Contract Drawings and as specified herein.

1.1.2 The work included under this Section shall include, but not be limited to, the following:

(a) Braced support system for excavation.
(b) Storm sewer system and discharge force main.
(c) Bollards
(d) ComEd transformer foundation.

1.1.3 Refer to Division 1 for additional requirements.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.

1.3 Warranty

1.3.1 Provide warranty under provisions of Section 1A.

1.4 Submittals

1.4.1 Submit product data under provisions of Section 1A.

1.5 Braced Excavation General Requirements

1.5.1 This work shall consist of furnishing all labor, equipment, and materials necessary to install, maintain and remove a braced support system for excavation to protect the adjacent roadway during the construction of as shown on the plans and as specified herein.

1.5.2 The design of the braced support system for excavation is the responsibility of the Contractor. The Contractor shall submit drawings and design for the braced excavation to the Engineer for approval. The braced excavation design and drawings shall be signed and sealed by an Illinois licensed Structural Engineer, submitted and reviewed prior to the start of any work. The Engineer's review shall not relieve the Contractor from the sole responsibility of the structural integrity of the braced excavation system.

1.5.3 The braced support system for excavation shall be capable of restraining earth pressures and surcharges imposed by construction equipment, trucks and

vehicular traffic on the adjacent roadway. The braced excavation shall include all sheeting, walers, struts, and bracing, backfill, coarse aggregate base, material, dewatering, concrete fill hardware and all appurtenant and collateral materials and work required to construct the structure and protect the adjacent roadway where the braced excavation is utilized.

1.5.4 It shall be the Contractor's responsibility to verify all existing conditions, including geotechnical conditions, utilities, and access to the site prior to construction or ordering of materials.

1.5.5 All materials, equipment and construction methods shall be in accordance with the requirements of Section 505 and 512 of the Standard Specifications except as herein modified.

1.5.6 At the option of the Contractor, the materials may be new or used. If used, the materials shall be in good condition and acceptable to the Engineer. The Contractor shall provide all temporary or permanent materials required for the proper execution of the work on this Item.

1.6 Basis of Payment

1.6.1 This work will be paid for at the contract unit price per cubic yard for BRACED EXCAVATION. The price shall be payment in full for all work, equipment, and materials necessary for designing, installing, maintaining, removing the braced excavation support system and all necessary excavation for structure as shown on the plans and as specified herein. This work will be measured for payment as a computed volume in cubic yards as described in Section 502 of the Standard specifications.

1.6.2 Site clearing shall be included for payment under the Item, PUMP STATION GENERAL WORK

1.6.3 Force main system consists of 16" diameter force main and 30" casing pipe shall be paid per contract unit price per foot for FORCE MAIN, 16" DIP, CLASS 250 and FORCE MAIN, 16" DIP, CLASS 250, INSTALL IN A 30" STEEL CASING PIPE in accordance with this Section.

1.6.4 ComEd transformer foundation consists of gravel fill and base course shall be included for payment under the Item, PUMP STATION GENERAL WORK. Concrete and reinforcement bars required shall be paid under separate pay items.

1.6.5 Conduits to be directionally drilled as shown on the contract plans shall be paid per contract unit price per foot for ELECTRICAL CONDUIT, HDD METHOD in accordance with this Section.

1.6.6 Bollards as shown on the contract plans shall be paid per contract unit price each for BOLLARDS in accordance with this Section.

1.6.7 Tumbling basin as shown on the contract plans shall be included in the contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.6.8 All remaining site work as specified herein or as required shall be included in the contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.6.9 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Force Main

2.1.1 Force main shall be 16" DIP Class 250 in accordance with AWWA C151.

2.1.2 Joint shall be restrained joint (American fastite or flex ring bell joint).

2.1.3 Steel casing shall be 30" steel pipe meeting the requirements of ASTM A 139 and AWWA M11. Steel casing pipe shall have minimum yield strength of 35,000 psi and a minimum wall thickness of 0.3125 inch Steel casing sections shall be jointed by butt welding. Pipe shall be beveled for field welding. Field welding shall conform to AWWA C206.

2.1.4 The void between outside of the force main pipe and the casing pipe shall be filled with Controlled Low Strength Material (CLSM) in accordance to the Standard Specification for Road and Bridge Construction, Section 593.

2.2 Bollards

2.2.1 Provide bollards (guard posts) as detailed on Drawings.

2.3 Directional Drilling

2.3.1 This work shall be in accordance with the "Standard Specifications for Water and Sewer Main Construction in Illinois" and the detail(s) provided in the plans, except as modified herein.

2.3.2 This work shall consist of the furnishing and installation of 5" electrical conduits by using Horizontal Directional Drilling (HDD) method, of interior as indicated on the plans or as determined by the Engineer. The Contractor performing the HDD shall have five (5) years experience installing HDD pressure piping systems and shall be able to provide work history of completed projects.

2.3.3 Exploration and determination of location of existing utilities shall be performed as necessary. It is contractor's responsibility to verify on the jobsite, the exact locations and elevations of existing utilities and sewer services before commencing with any installation/drilling work and coordinate with the Engineer any changes to the proposed layout and/or elevation. Existing utility exploration work shall be considered included in Electrical Conduit – HDD Method" unit price item and will not be paid separately.

2.3.4 Certa-Lok C900/RJ restrained joint PVC Pipe, or approved equal, shall be used for this project.

3. EXECUTION:

3.1 Site Clearing

3.1.1 Unless otherwise specifically indicated, this work shall consist of clearing, grubbing, removal and disposal off site of the tree branches, stumps and construction debris within the project site.

3.2 Pump Station Discharge Force Main to be installed in a Casing Pipe

3.2.1 The boring and jacking operations shall be done simultaneously, with continuous installation, until the casing pipe is in final position. Correct line and grade shall be carefully maintained. Add on sections of casing pipe shall be full-ring welded to the preceding length, developing watertight total pipe strength joints. The casing installation shall produce no upheaval, settlement, cracking, movement, or distortion of the existing roadbed or other facilities. Following placement of the carrier pipe within the pipe casing, 12" minimum brick and mortar shall be used to seal each end.

3.2.2 Casing pipe holes shall be mechanically bored through the soil by a cutting head on a continuous auger mounted inside the pipe. The auger shall extend a minimum distance beyond the end of the casing pipe to preclude formation of voids outside of the pipe shell.

3.2.3 The casing pipe shall be adequately protected to prevent crushing or other damage under jacking pressures. Backstops shall be provided for adequately distributing the jack thrust without causing deformation of the soil or other damage. Should the casing pipe be damaged, such damaged portion, if not in the hole, shall be replaced. However, if inserted, the encasement pipe shall be abandoned in place, grouted full, and suitably plugged, and an alternate installation made.

3.2.4 Required boring and jacking pits or shafts shall be excavated and maintained to the minimum dimension necessary to perform the operation. Said excavations shall be adequately barricaded, sheeted, braced and dewatered as required.

3.2.5 Bored and jacked installation shall have a bore hole essentially the same as the outside diameter of the casing pipe. Grout any voids that develop. Also grout around the casing pipe when the bore hole diameter is greater than the outside diameter of the pipe by more than 1 inch.

3.3 Directional Drilling Construction Requirements

3.3.1 The work specified in this section consists of furnishing and installing new PVC pipes using the horizontal directional drilling (HDD) method of installation, also commonly referred to as directional boring or guided horizontal boring. This work shall consist of the complete furnishing and installation of conduit, with appropriate retaining joints and tracer wires, directionally bored and placed as herein specified and/or determined by the engineer. This work shall be constructed in accordance with all applicable sections of the IDOT "Standard Specifications for Road and Bridge Construction", OSHA, all Local Codes and Ordinances and as specified herein.

3.3.2 Drilling fluid shall be composed of a carrier fluid (water) and drilling fluid additives (bentonite and/or polymers). Bentonite is a naturally occurring clay mineral (montmorillinite) that forms a mud when mixed with water.

3.3.3 All drilling fluids and loose cuttings shall be contained; no fluids shall be allowed to enter any unapproved areas, storm and sanitary sewers systems or natural waterways. The Contractor at all times shall be in compliance with NPDES requirement and permitting. Upon completion of the directional drill project, all excess drilling fluid and material shall be removed by the Contractor.

3.3.4 Directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing, delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system.

3.3.5 All utility supports, pit excavation, dewatering, sheeting, bracing, shoring, and other materials necessary for the complete installation of the directional bore shall be of sufficient strength to support the loads that are imposed on them.

3.3.6 If boring operations cause surface disruptions or damage to existing pavement, sidewalks, driveways, lawns, or any other surface appurtenances, the contractor shall halt operations and adjust procedures to ensure damage is not caused to surface appurtenances.

3.3.7 Any surface disruption or damage to existing pavement created by the directional bore shall be the contractor's responsibility to repair. All cost associated to repair surface disruptions shall be the contractors to incur.

3.3.8 Backfilling and compaction of trench backfill, excavation of material, dewatering, removal and disposal of any material and disturbed area restoration with topsoil and sod shall be considered included in "Electrical Conduit – HDD Method" unit price item.

END OF THIS SECTION

SECTION 2B – CHAIN LINK FENCE AND GATE

1. GENERAL:

1.1 Description

1.1.1 This Section shall include all work required for the furnishing and completing all fence and gate work. In addition to the work specified herein, work shall be in accordance with the details shown on the plans and the applicable portions of Section 664 of the Standard Specifications.

1.1.2 Refer to Division 1 for additional requirements.

1.2 Basis of Payment

1.2.1 The Contract unit price for CHAIN LINK FENCE, 8' (SPECIAL) shall be paid for at the contract unit price per linear foot.

1.2.2 CHAIN LINK GATES, 8'X3' SINGLE shall be paid for at the contract unit price per each.

1.2.3 CHAIN LINK GATES, 8'X20' DOUBLE shall be paid for at the contract unit price per each.

2. PRODUCTS:

2.2 Barbed Wire

2.1.1 Barbed wire supporting arms shall meet the requirements of ASTM F626. Metal and finish shall match the framework, with provision for anchorage to posts and attaching the rows of barbed wire and coil of barbed tape to each arm. Support arms shall be either attached to posts and be capable of withstanding 250 pound downward pull at outmost end, except as otherwise required. Provide a single 45-degree arm for three stands of barbed wire, one for each post.

2.1.2 Steel barbed wire shall be ASTM A121, Chain Link Fence Grade, Class 3 coating, three stands 0.099 inch minimum diameter (12-1/2 gage) steel wire with 0.080 minimum diameter (14 gage), four-point barbs spaced at 5 inches maximum centers. Ends of barbs shall be cut on bias.

3. EXECUTION:

3.1 Site Clearing

1.1.47 Unless otherwise specifically indicated, this work shall consist of clearing, grubbing, removal and disposal off site of the tree branches, stumps and construction debris within the project site.

END OF THIS SECTION

SECTION 2C - DEMOLITION

1. GENERAL:

1.1 Description

1.1.1 The extent and location of the Demolition works shall be as indicated on the Drawings and as specified herein. The work consists of the removal and disposal of the existing pump station building to extents shown on drawings, filling of the below grade structure with sand, and all incidental and collateral work necessary to complete the removal of the building in a manner approved by the Engineer.

1.1.2 The Contractor shall arrange for the discontinuance of all utility services and the removal of the metering devices that serve the building according to the respective requirements and regulations of the City, County, or utility companies involved. The Contractor shall disconnect and seal, in an approved manner, all service outlets that serve any building is to remove.

1.1.3 Demolition shall not commence, nor shall the existing pump station be decommissioned until written authorization has been obtained from the Engineer to proceed. The pumps, SCADA panel and all other items identified by the Engineer to be salvaged shall be removed from the building and delivered to a location determined by the Engineer. All remaining items shall be removed and properly disposed.

1.1.4 There is no access Right-Of-Way to the existing pump station. The Contractor shall obtain access permission from the Dayton Freight property owner to perform the required demolition work.

1.1.5 The demolition work is included in the Drawing s for guidance only to indicate typical general construction features of various types of construction and shall not be construed as definitive or adequate to supplement the actual on-site inspection by the Contractor.

1.2 Job Conditions

1.2.1 The Contractor represents that it has visited the site to become familiar with the quantity and character of all materials to be demolished. The Contractor agrees that the premises were made available prior to deadline for submission of Bids for whatever inspection and tests the Contractor deemed appropriate. The Contractor assumes full responsibility for the proper disposal of all demolition materials.

1.3 Related Sections

1.3.1 Section 3A - Cast-In-Place Concrete

1.4 Submittal

1.4.1 Submit under provisions of Section 1A.

1.4.2 Shop drawings: Indicate demolition and removal sequence.

1.5 Basis of Payment

1.5.1 Measurement

(a) The demolition work for mechanical work and electrical work shall not be measured for payment.

1.5.2 Payment

(a) The work as required for all mechanical demolition work shall be included in the contract lump sum for the Item, PUMP STATION MECHANICAL WORK.

(b) The work as required for all electrical demolition work shall be included in the Contract lump sum for the Item, PUMP STATION ELECTRICAL WORK.

(c) This work will be paid for at the contract lump sum unit price for DEMOLITION OF EXISTING PUMP STATION, which price shall be payment in full for complete removal of the building as specified herein and as indicated on the drawing. The lump sum unit price for this work shall represent the cost of demolition. Any salvage value shall be reflected in the contract unit price for this item.

2. PRODUCTS:

2.1 Material for backfilling the remaining foundation to be filled with IDOT fine aggregate FA 6 sand.

3. EXECUTION:

3.1 Demolition

3.1.1 Demolition work to be included under the Item shall include the removal and disposal of designated materials in areas as indicated on the Drawings and shall include, but not be limited to, the following:

(a) Concrete walls and roof
(b) Built-up roofing
(c) Miscellaneous metals and structural steel
(d) Louvers and dampers
(e) Miscellaneous mechanical and piping
(f) Plugging the abandoned pipes with concrete grout as indicated on the plans.

3.1.5 The contractor shall maintain the existing Pump Station during construction as specified under Division 1, General Requirements. All demolition shall be subject to approval of the Engineer.

3.1.6 The Contractor shall protect adjacent materials, equipment, areas and related construction during all demolition operations from all dirt, dust, debris or damage of any kind.

3.1.7 The demolition operations shall be coordinated with the Contractor's proposed sequence of construction and maintenance of pumping of storm water at the Pump Station.

3.1.8 The existing Modine unit heater and ABS submersible main pumps shall be salvaged. The salvaged items shall be removed carefully, not damaged, protected and returned to IDOT designated storage facility at no additional cost.

3.2 Notifications

3.2.1 The "Demolition/Renovation Notice" form, which can be obtained from the IEPA office, shall be completed and submitted to the address listed below at least ten days prior to commencement of any demolition activity.

Asbestos Demolition/Renovation Coordinator
Illinois Environmental Protection Agency
Division of Air Pollution Control
P. O. Box 19276
Springfield, Illinois 62794-9276
(217)785-1743

3.2.2 Notices shall be updated if there is a change in the starting date.

3.2.3 Prior to starting work, the Contractor shall submit proof of written notification and compliance with the "Notifications" paragraph.

3.3 Disposal

3.3.1 General: All materials, except those indicated to be salvaged upon their demolition, shall become the property of the Contractor and shall be removed and promptly disposed of in a lawful manner away from the site.

3.2.2 Cleanup: After removal of designated areas of structure, clean and grade the area. There shall be no debris, rubble, or litter left at the site from any of the demolition operations, and the site shall be clean.

END OF THIS SECTION

DIVISION 3 - CONCRETE

DIVISION 3 - CONCRETE

SECTION 3A - CAST-IN-PLACE CONCRETE

1 GENERAL:

1.1 Description

1.1.1 The work shall include requirements for all Cast-In-Place Concrete, as shown and specified herein. The work shall also include requirements for Concrete Form work for structural concrete, Concrete Reinforcement and Concrete Accessories.

1.1.2 Unless otherwise indicated, concrete material and work shall be in conformance with the requirements of the Standard Specifications for Road and Bridge Construction, adopted April 1, 2016, a publication of the Illinois Department of Transportation. Refer to Division 1 for additional requirements.

1.2 Submittals

1.2.1 Submit under provisions of Section 1A and Standard Specifications.

1.3 Quality Assurance

1.3.1 Under provisions of Standard Specifications.

1.4 Basis of Payment

1.4.1 Measurement

(a) The work specified for concrete shall be measured as specified in Article 503.21 of the Standard Specifications.

1.4.2 Payment

(a) The work specified under this Section excluding concrete reinforcements shall be paid for at the contract unit price per cubic yard for CONCRETE STRUCTURES, which price shall be considered as payment in full for this Item.

(b) The work specified under this Section for concrete reinforcements shall be paid for at the contract unit price per pound for REINFORCEMENT BARS, EPOXY COATED, which price shall be considered as payment in full for this item.

(c) Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Concrete Form Work

2.1.1 Forms shall be of wood or metal, as required, and supplied in sufficient quantities so that work can be properly accomplished.

2.1.2 Forms shall be constructed to slopes, lines and dimensions shown, plumb, straight and sufficiently tight to prevent leakage and so braced that no distortion or settling can take place during or after placing of concrete.

2.1.3 Forms shall conform to the requirements of Section 503 "Concrete Structures" of the Standard Specifications.

2.2 Concrete Reinforcing

2.2.1 General

(a) All steel reinforcement bars shall be epoxy coated deformed bars.

(b) All steel reinforcement bars shall be deformed bars conforming to the requirements of ASTM A706, Grade 60 ksi, and the applicable portions of the Standard Specifications. Epoxy coated bars shall conform to the requirement of AASHTO M284. Submit one sample of 12 inch long steel reinforcement bars and one sample each reinforcement accessories. Materials shall meet the requirements of Section 508 and Section 1006 of the Standard Specifications.

(c) Minimum clearances for reinforcement bars shall be as shown on the Plans. Where clearances are not shown on the Plans, the minimum clearances shall be as specified in ACI-318 (Building Code Requirements for Reinforced Concrete).

2.3 Cast-In-Place Concrete

2.3.1 General

(a) Unless otherwise indicated, all regular concrete shall be Class SI with 14 days Compressive Strength of 3,500 psi in accordance with Section 1020 of the Standard Specifications.

Fly ash shall be stored at the concrete mixing plant separately from the cement. Fly ash and cement shall not be intermixed prior to being added to the concrete mix.

(b) Unless otherwise indicated, all cement shall be Portland Cement type I or II.

(c) The coarse aggregate gradations for all regular concrete (Class SI) shall be CA7 or CA 11.

(d) Concrete Proportions: Concrete proportions shall be selected to provide the required strength and durability and to provide work ability and consistency so that the concrete can be worked into forms and around reinforcement without segregation or excessive bleeding.

Establish concrete proportions including the water-cementitious material ratio on the basis of field experience or trial mixtures with the materials to be used in accordance with ACI 318.

(e) The concrete mix design slumps shall be within the following limits:

Concrete Placement (Class SI)

Normal	2 in. to 4 in.
Pumped	4 in. to 6 in.

2.3.2 Fiber Reinforcement Concrete

(a) Fiber Reinforcement Manufacturers:

1) W.R. Grace & Co.
2) Fibermesh Co.
3) Euclid Chemical Co.
4) Or approved equal.

(b) Dosage Rate: 1-1/2 lbs/cu yd min.

(c) Use in strict accordance with manufacturer's written recommendation and ASTM C94.

2.4 Waterstop

2.4.1 Virgin polyvinyl chloride (PVC) waterstop conforming to CRD C572, with hog rings or grommets at 12 to 18 in. oc.

2.4.2 Construction Joints: Dumbbell or serrated type, 6 in. wide by 3/8 in. thick, at center.

2.4.3 Provide prefabricated tees, crosses, and other configurations as required.

2.4.4 Gasket Type Waterstop: 1" by ¾" Waterstop-Rx by CETCO, SikaSwell S-2 by Sika Corp, or approved equal.

2.5 Mechanical Splicer

2.5.1 Develop minimum 125% of yield capacity of bars spliced in tension when tested as assembly in accordance with ASTM A370 and ASTM A615.

3. EXECUTION:

3.1 Form

3.1.1 Form Installation

Form surfaces shall be smooth and free from any imperfections which would cause objectionable roughness on the finished surface of the concrete.

(a) All forms for concrete shall be tied with rods or patented ties where the concrete is to be exposed. Ties within the forms shall be constructed so as to permit their removal in accordance with the requirements of Section 503.06 of the Standard Specifications. Ties which are left in place within water containing structures shall be provided with swaged washers or other suitable devices to prevent seepage or moisture along the ties. Use lugs, cones, washers or other devices which do not leave holes or depressions greater than 7/8-inch in diameter.

(b) All necessary inserts in form work such as rods, bolts, anchorages, fillets, and other devices shall be installed as required.

(c) Forms shall not be treated with material that will adhere to or discolor the concrete.

(d) All sheeting, bracing and timbering shall be placed entirely outside of the neat lines of the structure, except that flanges or projections of steel shapes may extend into the concrete a distance not exceeding 2 inches. All sheeting shall be closely fitted to the excavation and no timber shall be left within the finished lines of the structure. The bracing shall be so arranged that no stress will be placed on any part of the substructure concrete until the concrete has developed sufficient strength to support safely the load thereon.

(e) For all exposed concrete edges a 3/4 inch chamfer strip shall be provided.

3.2 Concrete Reinforcing

3.2.1 Reinforcing Installation

(a) Placing and fastening of reinforcement shall be as per Article 508 of Standard Specifications.

(b) The Contractor shall furnish to the Engineer complete bar bending details, bar lists, weights and detail drawings for the fabricating and placing of all reinforcement to be furnished under this contract. Such lists and drawings shall be prepared in accordance with the American Concrete Institute ACI 315, SP66 (Details and Detailing of Concrete Reinforcement), except as otherwise shown on the plans or ordered by the Engineer.

(c) Bar bending details, bar lists, weights and detail drawings furnished by the Contractor will be examined by the Engineer and it shall be understood by the Contractor that a responsible amount of time will be necessary for their examination before they can be approved or returned for correction. No reinforcement shall be fabricated until the bar bending details and detail drawings have been approved by the Engineer. The Contractor shall furnish

to the Engineer, without extra charge therefore, copies of the approved bar bending details, bar lists and detail drawings in such number as the Engineer may require.

(d) Mechanical connections shall develop at least 125 percent of the Specified Yield Strength of the bar in tension.

3.3 Cast-In-Place Concrete

3.3.1 Placing Concrete

(a) Concrete placement and consolidation shall comply with provisions of Section 503 of the Standard Specifications.

(b) Once concreting is started it shall be carried on as a continuous operation until the placing of the section between construction joints is completed. Sections containing "cold joints" will not be accepted and shall be removed and replaced at the Contractor's expense.

(c) Temperature control for concrete placement shall comply with the provisions of Section 1020 of the Standard Specifications.

(d) Old concrete surfaces that will be in contact with the new concrete shall be coated with an epoxy bonding agent, Sika Chemical Co. Sikadur 32 Hi-Mod by Sika Corp, Sure Bond J-58 by Dayton Superior, or approved equal. Application shall be in strict conformity with the manufacturer's recommendations. This work will not be paid for separately, but shall be incidental to the contract unit price for Class SI Concrete, and no additional compensation will be allowed.

(e) The concrete surface for Wet Well and Discharge Chamber bottom shall be screeded and wood floated.

(f) All top slab surfaces exposed to the weather shall be finished to a true and even surface with floats and trowels. The final troweling shall be done with a steel trowel, leaving a smooth even surface. After the water sheen has disappeared, the surface shall be given a final finish by brushing with a whitewash brush. The brush shall be drawn across the slab with adjacent strokes slightly overlapping, producing a uniform, slightly roughened surface with parallel brush marks. All edges shall be rounded with an edging tool.

(g) Concrete floor slab of building shall have a smooth steel troweled finish and all edges of finished surfaces shall be rounded or leveled with edging tools. The pumping station floor slab shall be treated with an approved floor hardener and sealer.

(h) All concrete shall be cured for a minimum of 7 days in accordance with Section 1020.13, "Curing and Protection" of Portland Cement Concrete.

3.4 Embedded Items

3.4.1 Cast pipe and other embedded items into concrete as placement progresses. Do not provide blockouts.

3.4.2 Following restrictions shall be adhered to, unless otherwise noted.

(a) No duct, conduit, pipe, or fitting placed vertically shall be larger in cross-sectional area than 4% of column into which it is placed.
(b) Duct, conduit, pipe, and fittings, when placed within slabs or walls

1) Shall not be larger than 1/3 thickness of slab or wall.
2) Shall be placed within the middle 1/3 thickness of slab or wall where possible.
3) Shall not be placed closer than 3 outside diameter clear from each other when parallel.
4) Shall cross each other at right angles.
5) Shall be secured to prevent shifting or "floating" during concrete placement.
6) Multiple conduits shall not cross each other at the same location.
7) Except for conduits that must run up a column, keep conduits a minimum of 2 to 3 feet away from columns.
8) Where conditions require conduit to be tied to the inside face of the reinforcing mat, the conduit shall be galvanized steel or PVC, shall not be tied directly adjacent to a parallel reinforcement bar, and shall be placed 3 outside diameter clear away from the parallel reinforcement bar.

(c) Reinforcing steel shall be in place before embedded items placed and reinforcing cut or removed shall be replaced with additional reinforcing as indicated.
(d) Do not pass sleeves through columns without Engineer's approval.

3.4.3 Do not place ducts, conduit, and pipes in slabs on grade. Place minimum 4 inches below slab.

3.4.4 Set items such as bolts, anchors, piping, and frames in concrete as shown.

3.4.5 Place items constructed of dissimilar metals to avoid physical contact with reinforcing. Secure item and reinforcing to ensure they will not shift and come into contact during concrete placement. Contact between reinforcing steel and other metal, other than bare, coated, or plated carbon steel not permitted.

3.5 Repair of Surface defects

3.5.1 General:

(a) Prior to starting repair work, obtain Engineer's approval of proposed repair techniques and materials.
(b) Method of repair shall not adversely affect the appearance of the finished structure.
(c) Develop repair techniques on portion of as-cast surface selected by Engineer. Surface of repair remaining exposed to view shall match color and texture of adjacent surfaces.

(d) Prepare surfaces, apply and install materials, and cure as recommended by material manufacturers.

3.5.2 Tie Holes: Fill plastic cone snap tie holes with Patching Mortar. Fill taper tie through-bolt form tie holes with Non-Shrink Grout.

3.5.3 Defective Areas:

(a) Remove honeycombing, stone pockets, spalls, and other defective concrete down to sound concrete. If chipping required, make edges perpendicular to surface. Do not feather edges.
(b) Fill defective area with Patching Mortar.

3.5.4 Leaks or Wet Spots:

(a) Inject, patch and repair areas where leaks or wet spots have occurred inside dry structures.
(b) Inject, patch and repair areas where leaks or wet spots have occurred.

3.6 Finishing Slabs and Flatwork

3.6.1 Slab Finishes:

DESCRIPTION	CONCRETE FINISH
Surfaces to Receive Grout or Topping	Float
Submerged and Buried Slabs	Float
Slabs with Floor Coverings	1 Troweling
Sealer Applied Floors and Slabs	3 Trowelings
Exterior Exposed Slabs	Float and Broom Finish
Exterior Stairs and Walks	Float and Broom Finish
Interior Stairs	I Troweling and Broom Finish

3.6.2 After placement, screed concrete with straightedges, power strike-offs or vibrating screeds.

3.6.3 After screeding, bull float or darby surfaces to eliminate ridges and to fill in voids left by screeding.

3.6.4 Float:

(a) Use magnesium or aluminum hand floats or power floats with slip on float shoes.
(b) Float finish shall result in uniform smooth granular texture.

3.6.5 Trowel:

(a) Use steel trowels.
(b) Use power or hand troweling.

(c) Final troweling shall be by hand and continue until concrete surface consolidated to uniform, smooth, dense surface free of trowel marks and irregularities.

3.6.6 Broom Finish: Use fine, soft-bristled broom and broom at right angles to direction of traffic to give nonskid finish approved by Engineer.

3.6.7 Clear Floor Hardener: Apply according to manufacturer's written instructions where shown in room finish schedule.

3.6.8 Floor Sealer:

(a) Apply in accordance with manufacturer's written instructions.
(b) Apply first cost after final troweling, surface water glaze has dissipated, and when surface is hard enough to sustain foot traffic on same day as pour.
(c) When floor has been water cured, apply first coat after curing has been completed. Apply within one day of floor being dry enough for application.
(d) Apply second coat after Work completed and ready for occupancy.

3.6.9 For special coatings or finishes, see room finish schedule.

3.6.10 Tolerances:

(a) Concrete slabs shall be within 3/16 inch of 10 foot straightedge in all directions except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 inch.
(b) Pitch floor to floor drains minimum 1/8 inch per foot or as shown. Pitch bottom of slab or beam to match top slope to maintain thickness or depth indicated. As an alternate, bottom of slab or beam may be placed level provided that min thickness or depth is maintained.

3.7 Finishing Formed Concrete

3.7.1 As-Formed Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water, or subsequent construction.

(a) Repair surface defects as specified herein.
(b) Where joint marks or fins on submerged surfaces exceed 1/4 inch, grind smooth.

3.7.2 Smooth Finish: Interior concrete surfaces permanently exposed to view and concrete surfaces scheduled to be painted.

(a) Repair surface defects as specified herein.
(b) Grind joint marks and fins smooth with adjacent surface. Remove stains and rinse.
(c) Dampen concrete and paint entire surface with Cement Grout. Work grout into surface with suitable float. When grout has set to where it will not be pulled out of holes or depressions, brush off surface with burlap or carpet.
(d) Prepare surface to be painted in accordance with Section 9A and paint manufacturer's recommendations.

3.7.3 Rubbed Finish: Exterior concrete surfaces permanently exposed to view extending to 6 inch below finished grade or liquid level.

(a) Repair surface defects as specified herein.
(b) Grind joint marks and fins smooth with adjacent surface. Remove stains and rinse.
(c) Apply heavy coat of Finishing Grout. After first coat has set, apply second coat. When second coat has set, float to uniform texture.
(d) Follow manufacturer's written recommendations.

3.8 Removal of Forming and Shoring

3.8.1 Do not remove forming or shoring until member supported has acquired sufficient strength to safely support own weight and any imposed loads. Forming shall remain in place for at least min time recommended by ACI 347R. In addition, forming for horizontal members shall remain in place minimum 7 days. In no case shall forming for horizontal members be removed before concrete has reached 70% of specified design strength.

3.8.2 Reshore areas as required to carry additional imposed loads.

3.8.3 Removal of forms shall conform to Section 503.06 of the Standard Specifications.

END OF THIS SECTION

SECTION 3B - GROUT

1. GENERAL:

1.1 Section Includes

1.1.1 Grout for equipment bases.

1.1.2 Grout for pipe and conduit penetrations.

1.1.3 Grout for anchor bolts.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.

1.2.2 Section 5B – Bolts, Anchor Bolts, Concrete Anchors, and Concrete Inserts.

1.2.3 Section 15C – Piping and Appurtenances.

1.3 References

1.3.1 ASTM C109 - Compressive Strength of Hydraulic Cement Mortars (using 2" or 50 mm. Cube Specimens).

1.3.2 ASTM C150 - Portland Cement.

1.3.3 ASTM C191 - Time of Setting of Hydraulic Cement by Vicat Needle.

1.3.4 ASTM C827 - Early Volume Change of Cementitious Mixtures.

1.3.5 CRD-C-588 - Specifications for Non-Shrink Grout.

1.3.6 CRD-C-619 - Specification for Grout Fluidifier.

1.3.7 CRD-C-621 - Specification for Non-Shrink Grout.

1.4 Submittals

1.4.1 Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

1.4.2 Submit manufacturer's installation instructions under provisions of Division 1.

1.5 Tests

1.5.1 Testing of grout will be performed under provisions of Division 1.

1.6 Delivery, Storage and Handling

1.6.1 Grout materials from manufacturers shall be delivered in unopened containers.

1.6.2 Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.

1.7 Environmental Requirements

1.7.1 Maintain materials and surrounding air temperatures to a minimum of 50°F prior to, during and 48 hours after completion of the Work.

1.7.2 If manufacturer's requirements are more stringent, such requirements shall govern.

1.8 Basis of Payment

1.8.1 The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

1.8.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Materials

2.1.1 Each required material shall have one manufacturer throughout the use of that material on the Work.

2.2 Manufacturers - Non-Shrink, Non-Metallic, 100% Solid, High Strength Epoxy Grout

2.2.1 Sikadur 42, Grout-Pak by Sika Chemical Company.

2.2.2 DP Epoxy Grout by Five Star Products, Inc.

2.2.3 Substitutions: Under provisions of Division 1.

2.3 Materials- Non-Shrink, Non-Metallic, Cementitious Grout

2.3.1 Pre-mixed, non-staining, cementitious grout requiring only the addition of water at the job site; conforming to the following:

(a) Non-shrink: No shrinkage (0.0%) and a maximum of 0.2% expansion in the hardened state when tested in accordance with CRD-C-621.

(b) Compressive Strength: A minimum 28-day compressive strength of 7,000 psi when tested in accordance with ASTM C109.

(c) Setting Time: A minimum initial set time of 60 minutes when tested in accordance with ASTM C191.

(d) Composition: Shall not contain metallic particles, chlorides or expansive cement.

2.3.2 Manufacturers - Non-Shrink, Non-Metallic, Cementitious Grout

(a) Sika Grout 212 by Sika Chemical Company.

(b) Masterflow 928 by BASF Corporation.

(c) Sealtight 588-10K grout by W. R. Meadows, Inc.

(d) Substitutions: Under provisions of Division 1.

2.4 Materials - Cement-Sand Grout

2.4.1 Use 1 part cement to 3 parts sand. Keep the water cement ratio below 0.45 and achieve a minimum 28-day compressive strength of 4,000 psi.

2.4.2 Cement: ASTM C150, Type I or Type II.

2.4.3 Sand: ASTM C33.

2.4.4 Water: Clean, fresh, potable water free from injurious amounts of vegetable matter and mineral salts.

3. EXECUTION:

3.1 Inspection

3.1.1 Examine conditions under which grout is to be installed and notify Engineer in writing of unsatisfactory conditions or deficiencies that have been corrected.

3.2 Installation

3.2.1 Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications, do not proceed until Engineer provides clarification.

3.2.2 Drypacking for vertical grouting behind vertical base plates.

3.2.3 Manufacturers of proprietary products shall make available upon 72 hours' notification the services of a qualified, full-time employee to aid in assuring proper use of the product under job conditions.

3.2.4 Placing grout shall conform to temperature and weather limitations in Section 3A.

3.2.5 Equipment Bases

(a) After shimming and equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates allowing sufficient room around

the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with grout. Use non-metallic cementitious grout unless another type of grout is recommended by equipment manufacturer.

(b) Non-shrink, non-metallic epoxy grout may be used with Engineer's specific review.

3.3 Schedule

3.3.1 Non-Shrink, Non-Metallic Cementitious Grout: anchor bolts, equipment bases, pipe supports, pipe and conduit penetration, slide gate frame, and pipe thrust support structures.

3.3.2 Cement-Sand Grout: Pipe and conduit penetrations for non-water containing structure, and repair of exposed concrete.

END OF THIS SECTION

DIVISION 4 – MASONRY SYSTEM

DIVISION 4 - MASONRY SYSTEM

SECTION 4A - UNIT MASONRY

1. GENERAL:

1.1 Description

1.1.1 The scope of work under this Division shall include the furnishing and installing of all masonry units, bond beams, grout and mortar, reinforcing steel, wall ties, flashing, and appurtenant work required to complete the masonry walls and partitions as shown on the Drawings and as specified herein. Refer to Division 1 for additional requirements.

1.1.2 The Contractor shall be responsible for ascertaining the extent of work by other trades which require coordination with this work and shall be responsible for the coordination thereof.

1.1.3 This work shall include the setting and incorporating into the masonry of all bolts, anchors, inserts, nailers, metal attachments, etc. as indicated on the Drawings, as specified herein, as furnished by others, and as located by others.

1.1.4 This work shall include the building in of all door and window frames, vents, louvers, conduits, pipes, etc. as shown on the Drawings and as furnished by and set by others.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.

1.2.2 Section 5A – Metal Fabrications.

1.2.3 Section 5B – Bolts, Anchor Bolts, Concrete Anchors, and Concrete Inserts.

1.2.4 Section 6A – Rough Carpentry.

1.2.5 Section 7A – Elastomeric Membrane Roofing

1.2.6 Section 7B - Sheet Metal Flashing and Trim.

1.2.7 Section 7C - Joint Sealers.

1.2.8 Section 7D - Board Insulation.

1.2.9 Section 8A – Stainless Steel Doors and Frames.

1.2.10 Section 8B - Door Hardware.

1.2.11 Section 9A - Painting

1.2.12 Section 10A – Specialties.

1.2.13 Divisions 11, 12, 13 & 15.

1.3. Reference Standards

1.3.1 This work is subject to the requirements of the applicable portions of the following standards:

General:

(a) ACI 530: Building Code Requirements for Concrete Masonry Structures.

(b) ACI 530.1: Specifications for Masonry Structures.

(c) IBC 2012: International Building Code.

Mortar:

(a) ASTM C5: Quicklime for Structural Purposes.

(b) ASTM C144: Aggregate for Masonry Mortar.

(c) ASTM C150: Portland Cement.

(d) ASTM C207: Hydrated Lime for Masonry Purposes.

(e) ASTM C270: Mortar for Unit Masonry.

(f) ASTM C404: Aggregates for Masonry Grout.

(g) ASTM C476: Grout for Masonry.

(h) ASTM C780: Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

(i) ASTM C1019: Method of Sampling and Testing Grout.

Unit Masonry:

(a) ASTM A123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

(b) ASTM A525: Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.

(c) ASTM B370: Copper Sheet and Strip for Building Construction.

(d) ASTM C90: Hollow Load Bearing Concrete Masonry Units.

(e) ASTM C216: Facing Brick (Solid Masonry Units Made From Clay or Shale).

1.4 Submittals

1.4.1 Samples of glass block, brick and block per the type, size, color and texture shall be submitted. As a minimum, samples shall include 3 blocks of the following:

(a) Glass Block.
(b) Glazed single face block.
(c) Glazed double face block.
(d) Brick unit.
(e) Concrete masonry unit.

1.4.2 Material submittals shall include manufacturer's certification of compliance for the type and grade of masonry units supplied.

1.4.3 Include design mix, indicate proportion or property method used, required environmental conditions, and admixture limitations.

1.4.4 Submit test reports on mortar indicating conformance with ASTM C270.

1.4.5 Submit test reports on grout indicating conformance with ASTM C476 and C1019.

1.4.6 Submit manufacturer's certificate indicating that products meet or exceed specified requirements.

1.5 Delivery and Storage

1.5.1 Deliver cements and lime to the site in unopened containers. Use one manufacturer's product for each type of material throughout the work. Do not use material that has, in the opinion of the Engineer, become unstable for good construction.

1.5.2 Store cementitious materials off the ground and completely cover with a wind safe waterproof covering.

1.5.3 Take special precautions during transit and storage of masonry units to protect them from staining or discoloration from any cause whatsoever and replace permanently discolored units, whether set in place or not. Stains which cannot be removed with clean water and fiber brushes shall be considered defects and pieces so stained shall not be used.

1.5.4 Stack masonry units on platforms and cover, or store in other approved manner that will protect them from contact with soil and from weather exposure.

1.6 Environmental Requirements

1.6.1 Maintain materials and surrounding air temperatures to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.

1.7 Mix Tests

1.7.1 Testing of Mortar Mix: In accordance with ASTM C780.

1.7.2 Test mortar mix for compressive strength, slump, consistency, mortar aggregate ratio, water content, air content and splitting tensile strength.

1.7.3 Testing of Grout Mix: In accordance with ASTM C1019.

1.8 Field Measurements

1.8.1 Verify that field measurements are as indicated on the Drawings.

1.9 Basis of Payment

1.9.1 The work shall be paid as part of the Contract lump sum price for

PUMP STATION GENERAL WORK

which shall be payment in full for the work described herein.

2. PRODUCTS:

2.1 Brick Units

2.1.1 Manufacturers:

(a) Belden.
(b) General Shale.
(c) Glen-Gery.
(d) Substitutions: Approved equal.

2.1.2 Brick masonry units shall be face brick in accordance with ASTM C216, Type FBS, Grade SW (severe weathering/exposure), zero efflorescence.

2.1.3 Brick masonry units shall be nominal modular size of 4"x4"x8". Provide special solid brick units for corners, lintels, headers, bases and other special conditions as required.

2.1.4 Color shall be red with smooth texture. Contractor shall submit the sample brick for Engineer's approval. Do not start Work until Engineer has accepted sample. The Engineer's brick chosen shall be provided by the Contractor at no additional cost to Department.

2.2 Concrete Block (Standard and Glazed Type CMU)

2.2.1 Manufacturers:

(a) Each type of masonry unit shall have a single source of supply through completion of the Work. Substitutions will not be allowed without written approval of the Engineer.

2.2.2 Glazed concrete masonry units shall be subject to requirements, provide factory glazed concrete masonry units from one of the followings or approved equal.

(a) The Spectra Group, Spectra glazed II CMU.

(b) Trenwyth, Astra-glazed CMU.
(c) Or approved equal.

2.2.3 Hollow normal weight concrete block units shall conform to ASTM C 90.

2.2.4 Solid normal weight concrete block units shall conform to ASTM C 90.

2.2.5 Provide special units for 90 degree corners, bond beams, lintels, jambs, bullnose, wall base (cove-type), and other special conditions as required.

2.2.6 Glazed face block color shall be as follows (based on Trenwyth Astra-glazed CMU):

(a) Base: Cool Cream
(b) Walls: Whitman White.

Contractor shall submit the sample block for Engineer's approval. Do not start Work until Engineer has accepted sample. The Engineer's block chosen shall be provided by the Contractor at no additional cost to Department.

2.2.7 Glazed face block shall be provided in (1) single glazed face and (2) double glazed face units at locations indicated on drawings.

2.3 Glass Block

2.3.1 Manufacturer - Subject to compliance with requirements, provide glass block of one of the following, or approved equal:

(a) Seves Glass Block Inc: Vistabrick Stipple

2.3.2 The glass block shall be solid, colorless glass with manufacturer's standard coating factory-applied on edge surfaces. Sizes shall be 3 inch thick by 7-3/4 inch square actual size. See the drawings for the locations of different size glass block.

2.3.3 Accessories: Panel reinforcing shall be formed of two parallel wires with cross wires at regular intervals. Expansion strips shall be dense glass fiber matting 3/8" thick x 3" wide. Asphalt emulsion shall be water based.

2.3.4 Aluminum angles, plates and tube sections are to be provided with an anodic R1-A1 finish. Interior and exterior color to be selected by Engineer.

2.4 Mortar

2.4.1 Materials:

(a)	Portland Cement:	ASTM C150, Type I, gray color.
(b)	Masonry Cement:	Not permitted for use.
(c)	Mortar Aggregate:	ASTM C144, standard masonry type. Grading and color suitable for type of masonry, one source for entire project.
(d)	Hydrated Lime:	ASTM C207. Type S
(e)	Quicklime:	ASTM C5, non-hydraulic type.
(f)	Grout Aggregate:	ASTM C404

(g) Grout Fine Aggregate: Sand, 50 percent by volume.
(h) Water: Clean and potable.

2.4.2 Pre-Mix Mortar:

Ready mix mortar may be used on this project per the following mortar type listed below:

(a) Ready Mixed Mortar for all load bearing and non loading bearing walls and partitions: ASTM C1142, Type RS with an average compressive strength of 1800 psi at 28 day strength.

2.4.3 Mortar Mixes:

(a) Mortar for Load, Non-Load Bearing Walls and Partitions, and Reinforced Masonry: Mortar shall be Type S and shall conform to ASTM C 270, with a minimum compressive strength of 1800 psi utilitzing the Proportion Method.
(b) Pointing Mortar: Mortar shall be Type N and shall conform to ASTM C270, using the Property Method.
(c) The mortar shall have proportions of 1 part Portland cement, 1/2 part hydrated lime and 4 parts sand by volume. A measuring box shall be used to attain the specified mix. Sand shall be measured in a loose, damp condition.
(d) Mortar shall be freshly prepared and uniformly mixed and shall be of spreadable, workable consistency.
(e) The mortar shall be re-tempered with water as required to maintain high plasticity. Re-tempering on mortar boards shall be done only by adding water within a basin formed with the mortar and the mortar worked into the water. Any mortar which has stiffened or which is unused after one and one-half hours from the initial mixing shall not be used.
(f) The mortar ingredients shall be mixed in a batch mixer for not less than three minutes.
(g) The use of fire clay, rock dust, dirt and other deleterious materials is prohibited.

2.5 Grout

2.5.1 Grout shall conform to ASTM C476 and shall have a minimum strength of 3,000 psi at 28 days.

2.5.2 Grout shall have proportions of 1 part Portland cement 0.10 parts hydrated lime and 3 parts sand by volume.

2.5.3 Bond Beams: Lintels: 3000 psi strength at 28 days, 7-8 inches slump, mixed in accordance with ASTM C476 Course Grout.

2.5.4 Engineered Masonry: 3000 psi strength at 28 days, 7-8 inches slump, mixed in accordance with ASTM C476 Course Grout.

2.6 Cement

Cement shall be Type 1 Portland cement conforming to ASTM C150. Plastic cement shall not be used.

2.7 Lime

Hydrated lime shall conform to ASTM C207.

2.8 Aggregates

2.8.1 All aggregate for mortar and grout shall be sharp, clean, and well graded and free of injurious amounts of dust, lumps, shale, alkali, surface coatings and organic matter.

2.8.2 Aggregate for mortar shall conform to ASTM C144.

2.8.3 Aggregate for grout shall conform to ASTM C404 Size No. 2.

2.9 Water

2.9.1 Water shall be free of deleterious quantities of acids, alkalis and organic materials and shall come from a domestic supply.

2.10 Reinforcing Steel

2.10.1 Steel reinforcement bars shall conform to the requirements of AASHTO M-53 Grade 60 Ksi, or ASTM A615 Grade 60 Ksi, uncoated, deformed billet bars and the applicable portions of the Standard Specifications.

2.10.2 Reinforcement shall be clean and free from loose rust, scale, dirt, and any coatings that reduce bond.

2.10.3 Mechanical splice anchors for reinforcing bars: submit product data and information for review.

2.11 Horizontal Joint Reinforcement and Metal Accessories

2.11.1 Wire for joint reinforcement shall be truss type, with moisture drip, hot dip galvanized after fabrication, cold-drawn steel and shall conform to ASTM A82 and ASTM A153, Class B2. As a minimum, longitudinal wires shall be 3/16" side rods with gage cross ties.

2.11.2 Manufacturer - Subject to compliance with requirements, provide horizontal joint reinforcement of one of the following, or an approved equal:

(a) "Dur-O-Wall" A Hohmann and Bernard Company
(b) Blok-Lok, A Hohmann and Bernard Company
(c) Wire-Bond.
(d) Or approved equal.

2.11.3 Horizontal Joint Reinforcement and Metal Accessories shall be as follows:

(a) The width of the horizontal reinforcing shall be 2 inches less than the actual thickness of the wall or partition in which it is to be placed. Splicing of

horizontal reinforcing, including corner and partition reinforcing, shall be done by providing a 8-inch overlapping of side rods.

(b) Corners shall be reinforced with standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R. Intersection between walls and partitions shall be reinforced horizontally with standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R, spaced at 16-inch centers vertically, in the same course as the wall reinforcing.

(c) Solid and hollow interior or exterior masonry walls shall be reinforced horizontally with Standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R or equal, spaced at 16-inch centers vertically.

2.12 Flashing

2.12.1 Rubberized asphalt sheet flashing with metal drip edge.

2.12.2 Sheet Flashing:

(a) "Perm-A-Barrier" as manufactured by W. R. Grace & Co.
(b) "Textroflash Flashing" as manufacturered by Hohmann & Bernard, Inc.
(c) Or approved equal.
(c) A self-sealing, self-healing, fully adhered composite flexible, self-adhesive, cold applied sheet consisting of a minimum of 32 mils of rubberized asphalt bonded to an 8 mil high density cross laminated polyethylene film.
(d) Metal drip edge shall be 26 gauge 304 stainless steel sheet. Drip edge shall be minimum 2 ½ inches wide with 5/8 inch 135 degree drip and minimum ¼ inch hem along outside edge.
(e) Accessories: Primer, conditioner, adhesive, and mastic compatible with the sheet flashing as recommended by the sheet flashing manufacturer.

2.13 Accessories

2.13.1 Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials per the following:

(a) Cleaners for red and light colored brick not subject to metallic staining with mortar not subject to bleaching.

1. Cleaning solution as recommended by brick manufacturer. Submit product information for review.

(b) Cleaners for brick subject to metallic staining:

1. Cleaning solution as recommended by brick manufacturer. Submit product information for review.

(c) Cleaners for glazed concrete masonry units

1. Cleaning solution as recommended by glazed block manufacturer. Submit cleaning solution and manufacturer's instructions and recommends for review.

2.13.2 Cavity Drainage Material: 1 inch thick, free draining mesh; made from polyethylene, polypropelene, or other polymer strands and shaped to avoid being clogged by mortar droppings per the following:

(a) Mortar Trap by Hohmann & Bernard, Inc.
(b) Mortar Net By Mortar Net Solutions.
(c) Or approved equal.

2.13.3 Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142 inch steel wire, hot-dip galvanized after fabrication.

2.14 Dovetail Anchor Slots and Anchors

2.14.1 20 gauge galvanized dovetail foam filled anchor slots compatible with anchors.

2.14.2 16 gauge by 1 in. galvanized corrugated, dovetailed metal anchor straps.

2.14.3 Zinc coated in accordance with ASTM A153, Class B2.

2.15 Weephole Material

2.15.1 Vertical Cell Vent: 3/8 in. W x 2-1/2 in. H x 3-3/8 in. L; gray polypropylene, multi-cell construction.

2.16 Limestone Sill

2.16.1 Furnish Indiana (oolitic) limestone complying with ASTM C568, Category II (medium density), and as follows.

2.16.2 Minimum Compressive Strength: 4,000 psi (ASTM C170) and maximum absorption of 7.5% (ASTM C97).

3. EXECUTION:

3.1 General

3.1.1 Masonry work shall not be started when the horizontal and vertical alignment of the foundation is out of plumb or line one inch or more.

3.1.2 Masonry The top surface of the concrete foundation shall be clean and free of laitance and the aggregate exposed before starting the masonry.

3.1.3 All masonry shall be laid true, level and plumb in accordance with the Drawings.

3.1.4 Proper masonry units shall be used to provide for all windows, doors, vents, bond beams, lintels, etc. as shown on the Drawings or otherwise required to provide a minimum of unit cutting.

3.1.5 Where masonry unit cutting is necessary, all cuts shall be neat and true and made by a masonry saw. Openings for other trades shall be neatly patched.

3.1.6 Unless otherwise indicated, the masonry units shall be laid in a running bond pattern. All bond patterns and special details shown on the drawings shall be accurately and uniformly executed.

3.1.7 All masonry units shall be sound, free of cracks or other defects that would interfere with the proper placing of the unit or impair the strength of construction.

3.1.8 The starting joint on foundations shall be laid with full mortar coverage on the bed joints, except that area where the grout occurs shall be free from mortar, so that the grout will be in contact with the foundation. The starter coarse shall be laid out dry to determine the extent to which they must be cut, or joint sizes varied, to accomplish accurate horizontal coursing.

3.1.9 Mortar joints shall be straight, clean, and uniform in thickness and shall be tooled joints. Unless otherwise indicated, both horizontal and vertical masonry joints shall be 3/8-inch nominal thickness.

3.1.10 Unless otherwise indicated, all face joints shall be tooled to provide a concave joint. Tooling shall be done when the mortar is partially set and still sufficiently plastic to bond. The tooling shall be done in a matter to provide strength and weather resistance. Unless otherwise indicated all concrete block joints shall be tooled. Where tooled joints are not possible, the joints shall be troweled flush.

3.1.11 Care shall be taken to prevent visible mortar and grout stains on all sides that will be exposed to view. In general, the walls shall be kept continually clean. Grout run over shall be cleaned immediately.

3.1.12 All surfaces, including sills, ledges, finished concrete, etc., shall be protected from mortar droppings or other damage during construction.

3.1.13 Horizontal reinforcing shall be laid on the webs of bond beam units.

3.1.14 Wire reinforcement shall be completely embedded in mortar or grout. Mortar joints with wire reinforcement shall be at least twice the thickness of the wire.

3.1.15 Install horizontal joint reinforcement 16 inches o.c. Place joint reinforcement in first horizontal joints above and below openings. Extend minimum 16 inches each side of opening. Place joint reinforcement continuous in first joint below top of walls.

3.1.16 As a minimum, wire reinforcement shall be lapped 8 inches at splices and shall contain at least one cross wire of each piece of reinforcement in the lap distance.

3.1.17 Reinforcement shall be in place before grouting starts. The grouting space shall be free from mortar droppings. All grout shall be puddled or vibrated in place.

3.1.18 Grouting at beams over openings shall be done in one continuous operation.

3.1.19 All cells containing reinforcement, anchor bolts, inserts, etc. shall be grouted solidly. Spaces around metal door frames and other built-in items shall be filled solidly with grout.

3.1.20 Beams and other structural members shall be anchored to the wall with anchor bolts or their equivalent. Anchors shall be fully, solidly embedded in place. Embedment shall not be less than 2/3 of wall thickness unless otherwise noted. Bearing pads shall be furnished below beams to prevent spalling of the masonry, if required.

3.1.21 Masonry shall not be erected when the ambient temperature is below 0 degrees C (32 degrees F) with a rising temperature, or below 4 degrees C (40 degrees F) with a falling temperature, or when there is a probability of such a condition existing within 48 hours, unless special provisions are made for heating the materials and protecting the work from freezing. Protection shall consist of heating and maintaining the temperature of the masonry materials at not less than 4 degrees C (40 degrees F) but not more than 71 degrees C (160 degrees F), and maintaining an air temperature above 4 degrees C (40 degrees F) on both sides of the masonry for not less than 72 hours. Work will not be permitted with or on frozen materials. Masonry work which has frozen before the mortar has set shall be removed and replaced. No brick or other units having a film of frost on their surfaces shall be laid in the walls.

3.1.22 One section of the walls shall not be carried up in advance of the others, unless specifically approved. Heights of masonry shall be checked with an instrument at each floor, and at sills and heads of openings, to maintain the level of the walls. Partitions shall extend from the floor to the bottom of the floor or roof construction above, unless otherwise indicated. Walls and partitions shall be structurally bonded or anchored to each other and to concrete walls, beams and columns. Nonload-bearing partitions and interior walls shall be securely anchored to the construction above and in a manner that provides lateral stability.

3.1.23 Unfinished work shall be stepped back for jointing with new work; toothing will not be permitted, except where specified. All loose mortar shall be removed and the exposed jointing thoroughly wetted for not less than 12 hours before laying new work.

3.1.24 Surfaces of masonry not being worked on shall be properly protected at all times during the construction operation. When rain or snow is imminent and the work is discontinued, the tops of exposed masonry walls and similar surfaces shall be covered with a strong waterproof membrane, well secured in place.

3.1.25 Concrete masonry units shall be cut and fit for placement of monorail and support beam. Coordinate with other sections of work to provide correct size, shape, and location.

3.2 Cavity Wall Construction

3.2.1 Do not permit mortar to drop or accumulate into cavity air space or to plug weep.

3.2.2 Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor barrier sheet/adhesive.

3.3 Concrete Masonry Units

3.3.1 All concrete masonry units shall be true, plumb and built to the thickness and bond pattern indicated. Special units shall be furnished and used where indicated and as specified. Cutting of units shall be avoided insofar as possible. Cutting at the site shall be done with a power-driven carborundum saw. Units shall not be wetted prior to use.

3.3.2 The first course of concrete masonry units shall be laid in a full bed of mortar for the full width of the unit. Bed joints of a concrete masonry unit shall be formed by applying the mortar to the entire top surfaces of the inner and outer face shells, and the head joints shall be formed by applying the mortar for a width of about 1 inch to the ends of the adjoining units laid previously. Mortar for joints shall be smooth, not furrowed, and of such thickness that it will be forced out of the joints as the units are being placed in position. Where anchors, bolts, reinforcing and ties occur within the cells of the units, such cells shall be filled with mortar or grout as the work progresses. Concrete brick shall be used for topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as indicated.

3.3.3 Concrete masonry lintels shall be installed over openings where steel or precast concrete lintels are not scheduled. Place reinforcing bars 1 inch from bottom web. Use single piece reinforcing bars only; do not splice reinforcing bars. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position. Place and consolidate grout fill without displacing reinforcing. Grout minimum 1 course solid (8 inches high) or higher as shown on Contract Drawings. Allow masonry lintels to attain specified strength before removing temporary supports. Refer to the following bond beam lintel schedule below:

(a) Openings up to 78 inches wide: Place two (2) No. 5 bars 1 inch from bottom web.
(b) Openings over 78 inches wide: Reinforce openings as detailed.

3.3.4 Grouted Components (general)

(a) Reinforce bond beam (where required and as indicated on drawings) with two (2) No. 5 bars, placed continuous bottom reinforcement.
(b) Reinforce other grouted components as shown on Contract Drawings.
(c) Lap splices minimum 48 bar diameters.
(d) Support and secure reinforcing bars from displacement. Maintain position within ½ inch of dimensioned position.
(e) Place and consolidate grout fill without displacing reinforcing.
(f) At bearing locations, fill masonry cores with grout for a minimum 16 inches either side of opening.

3.3.5 Control Joints:

(a) Do not continue horizontal joint reinforcement through control joints.
(b) Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

(c) Size control joint in accordance with Section 7C for sealant performance.

3.3.6 Built-In Work

(a) As work progresses, build in steel frames at door openings, anchor bolts, embed bearing plates, lintels and other items furnished by other Sections.
(b) Build in items plumb and level.
(c) Bed anchors of steel frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
(d) Do not build in organic materials subject to deterioration.

3.3.7 Tolerances

(a) Maximum variation from unit to adjacent unit: 1/32 inch.
(b) Maximum variation from plane of wall: 1/4 inch in 10 feet, and ½ inch in 20 feet or more.
(c) Maximum variation from plumb: 1/4 inch per story non-cumulative; ½ inch in two stories or more.
(d) Maximum variation from level coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; ½ inch in 30 feet.
(e) Maximum variation of joint thickness: 1/8 inch in 3 feet.
(f) Maximum variation from cross sectional thickness of walls: 1/4 inch.

3.3.8 Cutting and Fitting

(a) Cut and fit for chases, pipes, conduit, sleeves and other components. Coordinate with other Sections of work to provide correct size, shape, and location.
(b) Obtain Engineer approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.4 Glass Block

3.4.1 Glass block including reinforcing, expansion strips, coatings, anchors and sealants shall be installed in accordance with the manufacturer's recommendations.

3.4.2 Clean glass units of substances that may impair bond with mortar or sealant. Coat sill under units with asphalt emulsion as a bond breaker, and allow to dry. Set panel anchors in mortar bed directly over coating. Provide full mortar joints. Furrowing not permitted. Remove excess mortar. Maintain uniform joint width of 3/8 inch.

3.4.3 Place panel reinforcement at every second horizontal joint in full mortar bed and at first course above and below openings within the glass unit panel. Discontinue reinforcement at expansion strips.

3.5 Flashing:

3.5.1 Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing.

3.5.2 Install in accordance with manufacturer's recommendations to provide continuous flashing system.

3.5.3 Provide end dam at each end of flashing to funnel flow out of wall.

3.5.4 Turn up sheet flashing a minimum of 8 inches and fully adhere to substrate.

3.5.5 Fully adhere sheet flashing to top of metal drip edge and cut off sheet flashing ½ inch back from exterior face.

3.5.6 In cold or wet weather when flashing will not fully adhere to substrate, provide termination bar mechanically anchored to substrate at top of flashing to secure flashing in place.

3.6 Clean-Up

3.6.1 All surplus material and debris shall be removed from the job site when the masonry work is completed. Any items defaced from the masonry work shall be cleaned.

3.6.2 Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units where intended. Provide new units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

3.6.3 After mortar is thoroughly set and cured, remove large mortar particles by hand with wooden paddles and non-metallic scrape holes or chisels.

3.6.4 Use bucket and brush hand cleaning method as described in BIA "Technical Note No. 20 Revised" to clean brick masonry made from clay or shale, except use detergent type masonry cleaner.

END OF THIS SECTION

DIVISION 5 - METALS

DIVISION 5 - METALS

SECTION 5A - METAL FABRICATIONS

1. GENERAL:

1.1 Section Includes

1.1.1 Provide miscellaneous metal work shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

(a) Lintels.
(b) Metal frames.
(c) Floor access hatches.
(d) Roof access hatches.
(e) Aluminum handrails and railings.
(f) Monorail Hoist Beam.
(g) Bar Screen.
(h) Miscellaneous items.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.
1.2.2 Section 4A - Unit Masonry System.
1.2.3 Section 5B - Bolts, Anchor Bolts, Expansion Anchors and Concrete Inserts.
1.2.4 Section 9A - Painting.

1.3 References

All reference standards shall be the latest edition.

1.3.1 ASTM A36 - Structural Steel.

1.3.2 ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

1.3.3 ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.

1.3.4 ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.3.5 ASTM A276, Type 316L - Stainless Steel.

1.3.6 ASTM A283 - Carbon Steel Plates, Shapes, and Bars.

1.3.7 ASTM A325 - High Strength Bolts for Structural Steel Joints.

1.3.8 ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.

1.3.9 ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

1.3.10 ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

1.3.11 ASTM A992 – Structural Steel Shapes.

1.3.12 AWS A2.0 - Standard Welding Symbols.

1.3.13 AWS D1.1 - Structural Welding Code.

1.3.14 AISI - Standard for Stainless Steel.

1.3.15 SSPC - Steel Structures Painting Council.

1.3.16 ANSI A14.3: Safety requirements for fixed ladders.

1.3.17 Specifications for Aluminum Structures, The Aluminum Association.

1.4 Submittals

1.4.1 Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1.4.2 Submit Product Data.

1.4.3 Shop drawings shall be approved prior to fabrication.

1.4.4 Indicate all revisions on resubmissions.

1.5 Quality Assurance

1.5.1 Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society (AWS).

1.5.2 Conform to AISC and AA standards.

1.6 Field Measurements

1.6.1 Verify that field measurements are as indicated on shop drawings and in accordance with manufacturers' recommendations.

1.7 Basis of Payment

1.7.1 The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

1.7.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Materials

2.1.1 In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, and roughness.

2.1.2 Comply with following standards, as pertinent.

(a) Steel plates and shapes: ASTM A36 or A992.
(b) Square or rectangular tubing: ASTM A500, Grade B.
(c) Round tubing or pipe: ASTM A53, Type E or S, Grade B.
(d) Stainless Steel:
1) Exterior and submerged uses: AISI, Type 316.
2) Interior uses: AISI, Type 304 or Type 316.
(e) Aluminum shapes and plates: Alloy 6061-T6 or 6063-T6.
(f) Floor Plate: Checkered surface aluminum plate.
(g) Connection Bolts:
1) For steel members: ASTM A325.
2) For aluminum members: Stainless steel.
(h) Cast-in-place Anchor Bolts:
1) 1/2 in. min dia.
2) Nonsubmerged: ASTM A307, galvanized.
3) Submerged: Stainless steel.
(i) Malleable Iron: ASTM A47.
1) Cast Iron: ASTM A48, Class 35B.
2) Ductile Iron: ASTM A536, Grade 65-45-12.
3) Cast Aluminum: ASTM B26.

2.2 Fabrication

2.2.1 Except as otherwise shown on the Drawings or the approved Shop Drawings, use materials of size, thickness, and type required to produce reasonable strength and durability in the work of this Section.

2.2.2 Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

2.2.3 Fabricate with accurate angles and surfaces which are true to the required lines and levels, with projecting corners clipped, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.

2.2.4 Weld shop connections and bolt or weld field connections.

2.2.5 Use AISC standard 2-angle web connections or single plate framing connections capable of supporting min of 50% of total uniform load capacity of member.

2.2.6 Connections shall consist of min two 3/4 in. dia bolts or welds developing min of 10,000 lbs capacity.

2.2.7 Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the item. Conform to Section 9A.

(a) Steel plates and
(b) Do not coat ferrous metal surfaces embedded in concrete.
(c) Coating of cast iron or ductile iron floor access hatches and pressure relief valves not required.
(d) On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from the first.
(e) Coat aluminum surfaces in contact with concrete with bituminous coating. Under no circumstances shall aluminum contact dissimilar metal.

2.2.8 Galvanizing:

(a) Galvanize after fabrication.
(b) Galvanize by hot-dip process conforming to ASTM A123 and AHDGA specifications.

2.3 Finishes

2.3.1 Prepare structural component surfaces in accordance with SSPC-SP6 - Commercial Blast Cleaning.

2.3.2 Shop prime structural steel members except members to be galvanized. Do not prime surfaces that will be field welded, contact surface for friction bolts, welded studs, deformed bar anchors and steel encased in concrete.

2.3.3 Zinc used for hot-dip galvanizing coating shall conform to the Standard Specifications for Slab Zinc (Spelter) ASTM Designation B6 and shall be at least equal to the grade designated as "Prime Western". Thickness of coatings shall conform to ASTM Specifications A123, A153, and A385, as applicable for items coated.

2.3.4 Quality of galvanizing shall be rigidly controlled and it shall be understood that any defects as mentioned below shall be just grounds for rejection.

2.3.5 Galvanized steel shall have no bare spots unless small and suitable for patching, pimples showing excessive contamination, flux, ash inclusions, or blisters.

2.3.6 Where cutting existing galvanized metal Work or attaching to existing galvanized metal Work, such as by welding, the connection or bore edges shall be cold galvanized.

2.3.7 Structural and miscellaneous metal Work shall be galvanized when located on the exterior and on the interior where so indicated and/or specified.

2.3.8 Prime paint items in accordance with finish coat requirements.

2.3.9 Repair all damage to field-primed surfaces.

2.4 Lintels

2.4.1 Provide steel lintels over openings in masonry walls as noted and wherever reinforced masonry or concrete lintels are not provided.

2.4.2 Fabricate lintels from structural steel shapes as detailed, selected for straightness of section, with minimum of 8 in bearing each side of opening.

2.4.3 Openings 4 ft and less in width without lintel scheduled, shall have double steel angle lintels or reinforced masonry lintels. Total width of horizontal legs shall be 1 in. less than nominal thickness of wall. Weld angles together. Masonry lintels shall conform to requirements of Section 4A.

2.4.4 Hot-dip galvanize after fabrication.

2.5 Metal Frames

2.5.1 Provide door, hatch, grille, louver, and other frames fabricated from structural shapes or plates.

2.5.2 Select sections for trueness of web and flange. Straighten members so finished frames are uniform, square, and true throughout length and depth of assembled units.

2.5.3 Miter or cope and join members with continuous welds.

2.5.4 Provide temporary spreader bars to prevent springing frames out of shape prior to and during erection.

2.6 Floor Access Hatches

2.6.1 Prefabricated Standard Type:

(a) Manufacturers:

1) Bilco Type K or KD.
2) Halliday Type S1S or S2S.
3) Or approved equal.

(b) Provide access hatches and frames of material, type, and size as shown on Drawings.
(c) Door leaves shall be 1/4 in. min diamond pattern plate with reinforcing on underside to withstand live load of 150 lbs/sq ft with max deflection of 1/150 span.
(d) Frames shall be 1/4 in. min thick with strap anchors around perimeter.

(e) Equip hatches with stainless steel hinges bolted to underside and pivot on torsion bars that counterbalance leaf for easy operation.
(f) Equip hatches with hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.
(g) Provide 316 stainless steel snap lock mounted on underside of leaf with removable topside handle and socket recessed in cover.
(h) Hardware shall be stainless steel.
(i) Factory finish on aluminum surfaces shall be mill finish with bituminous coating applied to surfaces in contact with concrete.
(j) Manufacturer shall warranty in writing against defects in material and workmanship for 5 yrs. Warranty shall commence from the Final Acceptance of the Pump Station.

2.6.2 Prefabricated Drainage Channel Type:

(a) Manufacturers:

1) Bilco Type J or JD.
2) Halliday Type W1S or W2S.
3) Or approved equal.

(b) Provide access hatches and frames of material, type, and size as shown on Drawings.
(c) Door leaves shall be 1/4 in. min diamond pattern plate with reinforcing on underside to withstand live load of 300 lbs/sq ft with max deflection of 1/150 span.
(d) Frames shall be 1/4 in. min thick channel to allow for adequate water drainage with anchor flange around perimeter.
(e) Equip hatches with heavy stainless steel hinges with 3/8 in. min stainless steel pins bolted to underside and pivot so cover does not protrude into channel frame.
(f) Provide compression spring operators enclosed in telescoping tubes for smooth, easy and controlled door operation.
(g) Equip hatches with hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.
(h) Provide 316 stainless steel snap lock mounted on underside of leaf with removable topside handle and socket recessed in cover.
(i) Provide drainage channel coupling.
(j) Hardware shall be 316 stainless steel.
(k) Provide continuous neoprene gasket on the frame.
(l) Factory finish on aluminum surfaces shall be mill finish with bituminous coating applied to surfaces in contact with concrete.
(m) Manufacturer shall warranty in writing against defects in material and workmanship for 5 yrs. Warranty shall commence from the Final Acceptance of the Pump Station.

2.7 Safety Grate

2.7.1 Where noted on Drawings provide retractable safety grate across access hatch openings.

2.7.2 Metal Grating Type:

(a) Aluminum construction with safety orange powder coat.
(b) Spring loaded lifting handle.
(c) Stainless steel hold open arm with aluminum latch.
(d) Stainless steel hardware through out.
(e) Load rated at 300 psf.

2.8 Roof Access Hatches

2.8.1 Prefabricated Ladder Access:

(a) Manufacturers:
1. Bilco Type S.
2. Nystrom RHP Series.
3. Or approved equal.

(b) Provide access hatches with integral curbs where noted.
(c) Door leaves shall be 11 ga. aluminum plate with neatly welded 3 in. beaded flange.
(d) Curbs shall be 11 ga. aluminum plate with 3 ½ in. flange for anchoring to roof deck.
(e) Curbs shall be a minimum of 12 in. high above adjacent roofing.
(f) Curbs shall be equipped with integral cap flashing matching curb material and thickness, welded at corners for watertightness.
(g) Door leaves and curbs shall be insulated with 1 in. rigid glass fiber insulation. Insulation shall be covered with 18 ga. aluminum plate.
(h) Equip hatches with heavy pintel hinges and compression springs in telescoping tubes.
(i) Equip hatches with hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.
(j) Provide snap lock mounted on underside of leaf with underside and topside handle.
(k) All hardware shall be stainless steel.
(l) Provide Bilco Ladder UP safety post where noted. Device shall be hot dipped galvanized steel. It shall be designed with telescoping tubular section that locks automatically when extended. Movement shall be controlled by stainless steel spring mechanism. Device shall be secured to ladder rungs.
(m) Factory finish on aluminum surfaces shall be mill finish with bituminous coating applied to surfaces in contact with concrete.
(n) Manufacturer shall warranty in writing against defects in material and workmanship for 5 yrs. Warranty shall commence from the Final Acceptance of the Pump Station.

2.8.2 Prefabricated Double Leaf Scuttle:

(a) Manufacturers:
1. Bilco Type D.
2. Nystrom RHE-D Series.
3. Or approved equal.

(b) Provide access hatches with integral curbs of the size noted.

(c) Door leaves shall be 3/16 in. aluminum plate with neatly welded 3 in. beaded flange.
(d) Curbs shall be 3/16 in. aluminum plate extended 1 in. beyond concrete curb support with integral 2 in. apron.
(e) Curbs shall be a minimum of 12 in. high above adjacent concrete curb.
(f) Curbs shall be equipped with integral 11 ga. aluminum cap flashing, welded at corners for watertightness.
(g) Door leaves and curbs shall be insulated with 1 in. rigid glass fiber insulation. Insulation shall be covered with 14 ga. aluminum plate.
(h) Equip hatches with heavy pintel hinges and compression springs in telescoping tubes.
(i) Equip hatches with hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.
(j) Provide snap lock mounted on underside of leaf with underside and topside handle.
(k) All hardware shall be stainless steel.
(l) Factory finish on aluminum surfaces shall be mill finish with bituminous coating applied to surfaces in contact with concrete.
(m) Manufacturer shall warranty in writing against defects in material and workmanship for 5 yrs. Warranty shall commence from the Final Acceptance of the Pump Station.

2.9 Aluminum Handrails and Railings

2.9.1 Manufacturers:

(a) ConnectoRail by Julius Blum Co., Inc.
(b) Wesrail by Moultrie Manufacturing Co.
(c) Series 500 by Superior Aluminum Products, Inc.
(d) Or approved equal.

2.9.2 Pipe handrail and railing shall conform to OSHA and local building code requirements.

2.9.3 Rails, Posts, and Formed Elbows: 1-1/2 in. dia schedule 40 aluminum pipe (1.90 in. OD, 0.145 in. wall thickness) alloy 6063-T6.

2.9.4 Fittings:

(a) Riveted type fabricated from material similar to rails and posts.
(b) Connections shall be continuous type to permit sliding of hands.
(c) Fittings for open railing extensions shall be welded construction and welded to posts to comply with OSHA loading requirements. Welds shall be ground smooth and finished to match adjacent finish.
(d) Base plates and side mounted flanges shall be aluminum or stainless steel.

2.9.5 Chain gates shall be 3/16 in. stainless steel link chain with stainless steel clasp capable of withstanding 250 lbs load.

2.9.6 Mechanical fasteners shall be stainless steel.

2.9.7 Clear satin anodized finish:

(a) Extruded Components: 0.7 mil.
(b) Cast Components: 0.4 mil.

2.9.8 Use materials of size, thickness, and type required to produce required strength and durability.

2.9.9 Form connections and changes in direction by using prefabricated fittings or radius bends.

2.9.10 Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces.

2.9.11 Close pipe ends using prefabricated fittings.

2.9.12 Fabricate joints of exterior units to exclude water or provide weep holes where water may accumulate.

2.9.13 Provide base flange or side mounted base plate.

2.9.14 Coat surfaces to be in contact with concrete with bituminous paint.

2.10 Monorail Hoist Beam

2.10.1 Fabricate member from structural steel shapes as detailed, selected for straightness of section.

2.10.2 Hot-dip galvanize after fabrication.

2.11 Bar Screen

2.11.1 Fabricate bar screen from heavy duty stainless steel grating with 1" diameter stainless steel ladder rungs welded to the grating bearing bars.

2.11.2 Grating bearing bars: 3" x 1/2" @ 2" on center. Cross bars: 1" x 1/4" bar @ 4" on center. Provide trim banding or load carrying banding on edges welded to grating.

2.12 Miscellaneous Items

2.12.1 Fabricate miscellaneous framing, supports, and items of structural shapes, plates, bars, and tubing of sizes and arrangements indicated and as required.

3. EXECUTION:

3.1 Examination

3.1.1 Verify that field conditions are acceptable and are ready to receive Work.

3.1.2 Preparation

(a) Clean and strip primed steel items to bare metal where site welding is required.

(b) Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate Sections.

3.2 Installation

3.2.1 Install items plumb and level, accurately fitted, free from distortion or defects.

3.2.2 Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

3.2.3 Perform field welding in accordance with AWS D1.1.

3.2.4 Obtain Engineer approval prior to site cutting or making adjustments not scheduled.

3.2.5 Perform cutting, drilling, and fitting required for installation of metal fabrications. Set the work accurately. Provide temporary bracing and anchors in formwork for items to be built into masonry or concrete. Field weld joints not shop welded because of size limitations. Grind welds smooth and touch-up shop paint coat. Do not weld, cut or abrade surfaces that have been galvanized.

3.2.6 Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2.7 Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

3.2.8 Protect aluminum in contact with dissimilar material with asphalt paint to provide 2 mil dry thickness. Paint miscellaneous metal work which is to be in contact with but not fully embedded in concrete or masonry with a heavy coat of asphalt paint. Coating shall not extend onto surfaces which will be exposed.

3.2.9 Install hatches and manufactured items in accordance with manufacturer's instruction.

3.2.10 Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

3.2.11 Touch up damaged galvanizing with cold galvanizing compound.

END OF THIS SECTION

SECTION 5B - BOLTS, ANCHOR BOLTS, CONCRETE ANCHORS, AND CONCRETE INSERTS

1. GENERAL:

1.1 Section Includes

1.1.1 Furnishing and installing all bolts, anchors and inserts, anchor bolts, expansion anchors and concrete inserts for:

Piping.
Hangers and brackets.
Equipment.
Electrical, plumbing and HVAC work.
Pump base.
Miscellaneous fasteners.

1.2 Related Sections

1.2.1 Section 4A - Unit Masonry.
1.2.2 Section 5A - Metal Fabrication.
1.2.3 Section 15C - Piping and Appurtenances.

1.3 References

1.3.1 Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified.
1.3.2 ACI 349 - Appendix B - Code Requirements for Nuclear Safety Related Concrete Structures.
1.3.3 AISC - American Institute of Steel Construction, Structural Steel Detailing.
1.3.4 ANSI B1.1 - Screw Threads, Coarse Thread Series.
1.3.5 ANSI B18.2 - Square and Hex Bolts and Nuts.
1.3.6 ASTM A36 - Structural Steel.
1.3.7 ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
1.3.8 ASTM A193 - Alloy-Steel & Stainless Steel Bolting Materials for High-Temperature Service.
1.3.9 ASTM A194 - Carbon & Alloy Steel Nuts for Bolts for High Pressure & High Temp. Service.
1.3.10 ASTM A242 - High Strength Low-Alloy Structural Steel.
1.3.11 ASTM A307 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
1.3.12 ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum tensile Strength.
1.3.13 ASTM A354 - Quenched & Tempered Alloy Steel Bolts, Studs & Other Externally Threaded Fasteners.
1.3.14 ASTM A563 - Carbon and Alloy Steel Nuts.
1.3.15 ASTM A588 - High Strength Low-Alloy Structural Steel With 50 KSI Minimum Yield Point.
1.3.16 ASTM B98 - Copper Silicon Alloy Rods, Bars, and Shapes.
1.3.17 AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

1.4 Submittals

1.4.1 Samples: Submit for approval the following:

(a) Representative samples of bolts, anchors and inserts as may be requested by the Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of Contractor.

1.4.2 Shop Drawings: Submit for approval the following:

(a) Setting drawings and templates for location and installation of anchorage devices.
(b) Copies of manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.

1.4.3 Contractor shall submit calculations stamped by a professional engineer.

1.5 Quality Assurance

1.5.1 Bolts, anchor bolts, expansion anchors and concrete inserts shall conform to applicable Section 1006, METALS, of the Standard Specifications.

1.6 Basis of Payment

1.6.1 The work shall be paid as part of the Contract lump sum price for "PUMP STATION GENERAL WORK" which shall be payment in full for the work described herein.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Design Criteria

2.1.1 All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, "Screw Threads", Coarse Thread Series, Class 2 Fit, unless otherwise specified.

2.1.2 Bolt heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, "Wrench-head Bolts and Nuts and Wrench Openings", Heavy Series, unless otherwise specified. Nut dimensions shall conform to ANSI Standard B18.2.2 for heavy hex nuts.

2.1.3 Allowable tensile design stress for threaded fasteners shall not be greater than 0.33 times minimum tensile strength of threaded fastener on tensile stress area.

2.1.4 Concrete Fasteners: When the size, length and load carrying capacity of concrete fasteners is not Specified or shown on the Drawings, provide the size, length and capacity required to satisfy all of the following. Concrete fasteners include anchor bolts, expansion anchors, or concrete inserts:

(a) Working load shall be a minimum of the design load times a safety factor of four, and shall be based on a concrete compressive strength not exceeding 3000 psi.

(b) Shall satisfy all requirements and recommendations of ACI 349, Appendix B.

(c) Shall satisfy all minimum recommendations and requirements of Manufacturer.

(d) Allowances for vibration are not included in the safety factor specified above.

2.1.5 Determine design loads as follows:

(a) For equipment anchors, use the design load recommended by the manufacturer and approved by the Engineer.

(b) For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides. Load shall be increased where required to allow for thrust and temperature induced forces.

2.1.6 Anchors and inserts shall be located and sized so as not to impair the integrity of the supporting structure.

2.2 Materials

2.2.1 Bolts and Anchor Bolts:

(a) Galvanized Steel Bolts and Nuts:

1) Steel anchor bolts, studs, nuts and washers for interior installation shall be in conformity with the current ASTM Designation: A307 "Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength", Grade B, A36 or approved equal. All steel bolts, studs, nuts and washers shall be hot-dip galvanized in conformance with Class C of ASTM A153. Nuts shall conform to requirements of ASTM A563, heavy hex style.

(b) Stainless Steel Bolts and Nuts:

1) In buried, outdoor, high humidity or submerged locations, provide stainless steel bolts, nuts and washers. Stainless steel bolts and nuts shall be in conformity with the current ASTM A193, Grade B8 (AISI 304) 75 KSI Min. Tensile Strength), Class 1 and ASTM A194, Grade 8 (AISI 304), AISI 316 or approved equal.

2) For high strength applications, stainless steel bolts and nuts shall be in conformity with the current ASTM A193, Grade B8 (AISI 304) (Tensile Strength 100/125 KSI, Class 2 and ASTM A194, Grade 8 Strained Hardened (AISI 304) or approved equal.

(c) Bronze Bolts and Nuts:

1) Where shown on Drawings or specified under other Sections, bronze anchor bolts, flange bolts, studs, and nuts shall be in conformity with the current ASTM Designation B98, "Copper-Silicon Alloy Rods, Bars, and Shapes." made of Alloy B12, Hard. Bolts, studs, and nuts machined from bar stock shall be made of Alloy A7, Hard.

(d) Other types, if shown on drawings or specified under other Sections.

2.3 Pipe Joints

2.3.1 Galvanized Bolts and Nuts (For EXPOSED Piping Installations):

(a) Steel anchor bolts, flange bolts, studs and nuts shall be in conformity with the current ASTM A307 "Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength", Grade B or approved equal.

(b) All steel bolts, studs and nuts, shall be hot-dip galvanized in accordance with ASTM A153.

(c) At joint harnesses and restrained harnesses connected to flange, the tie bolts and studs, flange bolts and nuts shall conform to ASTM A354 Grade BC or ASTM A193 Grade B7 115/125 KSI Min. Tensile Strength for 4" diameter and under. Lug and ring shall be ASTM A36 steel.

2.3.2 Stainless Steel Bolts and Nuts (Where Specified):

(a) Stainless steel flange bolts and nuts shall be in conformity with the current ASTM A193, Grade B8 (AISI 304) 75 KSI Min. Tensile Strength), Class 1 & ASTM A194, Grade 8 (AISI 304) or approved equal.

(b) Stainless steel bolts and nuts for harness flanges and connecting restrained harnesses to flange shall be in conformity with the current ASTM A193, Grade B8 (AISI 304) (Tensile Strength 100/125 KSI, Class 2 and ASTM A194, Grade 8 Strained Hardened (AISI 304) or approved equal.

2.3.3 Corrosion resistant steel (CRS) (For BURIED Piping Installations):

(a) CRS anchor bolts, flange bolts, studs and nuts shall be "Cor-Ten" type steel in conformity with the material characteristics listed in Sec.11-8 of AWWA C111 "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings", and also in conformity with the ASTM: A242 "High Strength Low-Alloy Structural Steel" Type 1, A588 "High Strength Low-Alloy Structural Steel With 50 KSI Minimum Yield Point" Grade A, or approved equal.

(b) At buried mechanical joints, bolts and nuts shall be in conformity with all of AWWA C111 dimensions and requirements.

(c) Above specified bolts and nuts shall be tension tested for a minimum ultimate tensile stress of 65 ksi using testing procedures corresponding to ASTM A307 requirements, and shall be proof load tested based on 45 ksi stress to AWWA C111 standards.

(d) Bolt heads shall be marked with manufacturer, ASTM material designation/grade, and country where manufactured. Markings shall be raised or depressed.

(e) At buried joint harnesses and restrained harnesses connected to flange, the tie bolts and studs, flange bolts and nuts shall be "Cor-Ten" type steel in conformity with the current ASTM: A325, "Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength", Type 3.

(f) Bolt strength shall be adequate to provide compression needed for water tightness of the gasket material used.

2.4 Concrete Anchors

2.4.1 Wedge Anchors:

(a) Manufacturers:

1) Power-Stud+ SD1, SD2, SD4 or SD6 by Dewalt.
2) Kwik Bolt 3 or Kwik Bolt TZ by Hilti Corp.
3) Or approved equal.

(b) Usage: In concrete:

1) 316 stainless steel.
2) Do not use when submerged or subjected to dynamic loads.

2.4.2 Expansion Anchors:

(a) Manufacturers:

1) Power-Bolt+ by Dewalt.
2) HSL-3 by Hilti Corp.
3) Or approved equal.

(b) Usage: In concrete:

1) 316 stainless steel.
2) Do not use when submerged, in overhead applications, or subjected to dynamic loads.

2.4.3 Sleeve Anchors:

(a) Manufacturers:

1) Lok-Bolt AS by Dewalt.

2) HLC by Hilti Corp.
3) Or approved equal.

(b) Usage: In masonry:

(1) 316 stainless steel.

2.4.4 Undercut Anchors:

(a) Manufacturers:

1) Atomic+ Undercut by Dewalt.
2) HDA by Hilti Corp.
3) Or approved equal.

(b) Usage: In concrete, overhead applications, and for dynamic loads:

1) 316 stainless steel.
2) Do not use when submerged.

2.4.5 Adhesive Anchors(Concrete):

(a) Manufacturers:

1) HIT RE 500-V3 or HIT-HY 200-R Adhesive Anchor by Hilti Corp.
2) Pure 110+, AC100+ Gold or PE 1000+ by Dewalt.
3) Or approved equal.

(b) Epoxy adhesive with 316 stainless steel stud assembly.
(c) Usage:

1) In concrete, submerged.
2) Do not use in overhead applications.

2.4.6 Adhesive Anchors(Masonry):

(a) Manufacturers:

1) HIT HY 70 Adhesive Anchor by Hilti Corp.
2) AC100+ Gold by Dewalt.
3) Or approved equal.

(b) Epoxy adhesive with 316 stainless steel stud assembly.
(c) Usage:

1) In masonry.
2) Grout masonry cores at anchor locations unless noted otherwise or approved by engineer.
3) Provide tube screen inserts for hollow masonry units or multi-wythe masonry.

4) Do not locate anchors in vertical mortar joints.

3. EXECUTION:

3.1 Inspection

3.1.1 Examine conditions under which bolts, anchors, or inserts are to be installed, and notify Engineer in writing of unsatisfactory conditions existing.

3.1.2 Do not proceed with the Work until unsatisfactory conditions or deficiencies have been corrected in a manner acceptable to Engineer.

3.2 Installation of Expansion Anchors and Undercut Anchors

3.2.1 Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer's instructions.

3.2.2 Torque anchor as specified by manufacturer recommendation. Do not cut reinforcing bars.

3.2.3 Provide embedded items for placement in concrete form work and assure that embedded items are protected from damage and are not filled in with concrete.

3.2.4 Expansion anchors may be used for hanging or supporting pipe 2 inches diameter and smaller.

3.2.5 Expansion anchors shall not be used for larger pipe or supporting vibrating equipment unless otherwise shown or approved by the Engineer.

3.2.6 Unless otherwise shown, anchor design shall be in accordance with ACI 349, Appendix B and approved by Engineer, and in no case shall be less than:

(a) Embedment depth in concrete	8 diameters
(b) Anchor spacing on centers	10 diameters
(c) Distance to edge of concrete	1.5 embedment
(d) Distance to edge of concrete where anchor is loaded in direction of edge	2.5 embedment

3.2.7 Undercut Anchors shall be installed in accordance with manufacturer's instructions.

3.3 Cleaning

3.3.1 After embedding concrete is placed, remove protection and clean bolts and inserts.

END OF THIS SECTION

DIVISION 6 - CARPENTRY

DIVISION 6 - CARPENTRY

SECTION 6A - ROUGH CARPENTRY

1. GENERAL:

1.1 Section Includes

1.1.1 Wood nailer at parapet.

1.1.2 Blocking at roof system.

1.1.3 Other miscellaneous wood blocking as required or as noted.

1.1.4 Shoring and temporary protection.

1.2 Related Sections

1.2.1 Section 7A - Elastomeric Membrane Roofing

1.3 References

1.3.1 ASTM A525 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-dip Process.

1.3.2 ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3.3 Federal Specifications (FS):

(a) FF-B-575C - Bolts, Hexagon and Square.
(b) FF-N-105B - Nails, Brads, Staples, and Spikes.
(c) FF-N-836D - Nut, Square, Hexagon, Cap, Slotted, Castle. Knurled, Welding, and Single Ball Seat.
(d) FF-S-111D - Screw, Wood.

1.4 Quality Assurance

1.4.1 Grading Rules:

(a) Lumber Grading Rules and wood species shall conform with Voluntary Product Standard PS20. Grading rules of the following associations shall also apply to materials produced under their supervision.

1. Northeastern Lumber Manufacturers Association, Inc. (NELMA).
2. Southern Pine Inspection Bureau (SPIB).
3. West Coast Lumber Inspection Bureau (WCLIB).
4. Western Wood Products Association (WWPA).
5. Redwood Inspection Service (RIS).

1.4.2 Grade Marks: Identify all lumber by official grade mark.

(a) Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable and condition of seasoning at time of manufacture.

1. S-Dry: Maximum 19 percent moisture content.
2. MC-5 or KD: Maximum 15 percent moisture content.
3. Dense.

1.5 Submittals

1.5.1 Submit under provisions of Division 1.

1.5.2 Rough Carpentry: Submit certification that lumber and connection material conforms to specified minimum grade.

1.6 Delivery, Storage, and Handling

1.6.1 Deliver, store, protect and handle products to site under provisions of Division 1 and in accordance with the manufacturer's instructions.

1.7 Basis of Payment

1.7.1 Payment for work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.7.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. MATERIALS:

2.1 Blocking, nailing, etc. shall be construction grade douglas fir, hem-fir, or No. 1 common southern pine.

2.2 Fasteners for wood nailers for roofing, shall be not less than 4.76 mm (3/16-inch) diameter stainless steel, zinc coated steel, or equivalent zinc-coated wire anchors, spaced 24 inches on center.

2.3 Pressure treatment of wood shall comply with applicable requirements of AWPA C1, C2, and C9. Preservative shall be CA-B (Copper Azole Type B) minimum retention of 0.25. After treatment, kiln-dry lumber to maximum moisture content of 19%.

2.4 Blocking, nailers and other items, whether or not covered by other materials, shall be pressure treated.

2.5 Wood members in connection with roofing and flashing shall be pressure treated.

2.6 Lumber for temporary protection shall be southern yellow pine and an exterior type, Grade C, plugged fir plywood.

2.7 Anchors, connectors, and fastenings, not indicated or specified otherwise, shall be of the type, size, and spacing necessary to suit the conditions encountered and as recommended

by the National Lumber Manufacturer's Association. Sizes, types, and spacing of nails, screws, or bolts for installation of manufactured building materials, shall be as recommended by the product manufacturer unless indicated or specified otherwise; bolts, nuts, washers, and all other rough hardware embedded in, or in contact with, exterior walls of masonry shall be zinc-coated, except as specified otherwise. Rough hardware shall be formed and punched before coating.

3. EXECUTION:

3.1 Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Provide blocking where indicated and as necessary to secure the work.

3.2 All field-cut edges and surfaces of treated lumber shall be liberally coated with a concentrated solution of preservative.

3.3 Delivery and Storage

3.3.1 Protect lumber against dampness before and after delivery. Store under cover in a well ventilated area and where not exposed to extreme changes in temperature or humidity until used.

END OF THIS SECTION

DIVISION 7 – THERMAL MOISTURE PROTECTION

DIVISION 7 - THERMAL MOISTURE PROTECTION

SECTION 7A - ELASTOMERIC MEMBRANE ROOFING

1. GENERAL:

1.1 Section Includes

1.1.1 Fully adhered elastomeric 60 mil sheet membrane roofing over insulation.

1.1.2 Roof insulation.

1.1.3 Flexible flashings and base flashings around all openings and roof edge terminations as required by all trades.

1.1.4 Membrane terminations.

1.1.5 Rubber roof walkway pads (1/2" thick) for roof traffic surfacing.

1.2 Related Sections

1.2.1 Section 3A - Cast-in-Place Concrete.

1.2.2 Section 6A - Rough Carpentry.

1.2.3 Section 7B - Sheet Metal Flashing and Trim.

1.2.4 Section 7C – Joint Sealers

1.2.5 Section 7D – Board Insulation

1.3 References

Insulation Board

1.3.1 ASTM C1289 – Faced Rigid Cellular Polyisocyanurate Insulating Board.

1.3.2 ASTM C1621 - Compressive Properties of Rigid Cellular Plastics.

1.3.3 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

Roofing Membrane and Roof Walkway Pad

1.3.4 ASTM D412 - Rubber Properties in Tension.

1.3.5 ASTM D746 - Brittleness Temperatures of plastics and Elastomers by Impact.

1.3.6 ASTM D624 - Rubber Property-Tear Resistance.

1.3.7 ASTM D822 - Practice for Operating Light-and-Water-Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products.

1.3.8 ASTM D1004 - Initial Tear Resistance of Plastic Film and Sheeting.

1.3.9 ASTM D2240 - Rubber Property - Durometer Hardness.

1.3.10 ASTM E96 - Water Vapor Transmission of Materials.

1.3.11 NRCA (National Roofing Contractors Association) - Roofing and Waterproofing Manual.

1.3.12 ULI - Fire Hazard Classifications.

1.4 System Description

1.4.1 Elastomeric sheet membrane roof assembly to conform to UL requirements for a Class A rated assembly, and I-90 requirements for wind uplift resistance.

1.5 Submittals

1.5.1 Submittals: Procedures for submittals as specified in Division 1.

1.5.2 Shop Drawings:

(a) Roof Plan (use 1/4" = 1'-0"): Submit general roof plan showing tapered insulation plan, which includes all valleys, ridges, slopes, saddles and crickets, roof walkway pads, and general drainage pattern based on tapered insulation.
(b) Detail Drawings (use 1-1/2" = 1'-0"): Submit shop drawings detailing base flashings, roof edge termination flashings, reglets, membrane terminations, roof drains, roof projection flashings, roof hatch flashings.

1.5.3 Samples: Submit samples for the following items:

EPDM Membrane: 8"x10", 3 pieces.
Termination bars: 2 pieces.
Rigid insulation board: 8"x10", 3 pieces.
Rubber roof walkway pads: 8"x10", 3 pieces

1.5.4 Product Data:

(a) Provide product data for sheet membrane, elastic flashing, joint cover sheet, and joint and crack sealants, with temperature range for application of membrane.
(b) Rigid insulation board(s).
(c) Rubber roof walkway pad

1.5.5 Manufacturer's Installation Instructions: Provide manufacturer's instructions for a fully adhered membrane roof system, and indicate special precautions required for

seaming the membrane; include installation instructions for roofing rigid insulation board.

1.5.6 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5.7 Manufacturer's Field Reports: Submit under provisions of Division 1.

1.5.8 Reports: Indicate procedures followed, ambient temperatures, and wind velocity during application.

1.6 Quality Assurance

1.6.1 Perform Work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

1.7 Qualifications

1.7.1 Manufacturer: Company specializing in manufacturing the products specified in this section with ten years documented experience.

1.7.2 Applicator: Company specializing in performing the work of this section with ten years documented experience and approved by system manufacturer.

1.8 Regulatory Requirements

1.8.1 Conform to applicable code for roof assembly fire hazard requirements.

1.8.2 ULI: Class A Fire Hazard Classification.

1.9 Delivery, Storage, and Handling

1.9.1 Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.

1.9.2 Store products in weather protected environment, clear of ground and moisture.

1.9.3 Stand roll materials on end.

1.10 Environmental Requirements

1.10.1 Do not apply roofing membrane during inclement weather or when air temperature is below 40 degrees F and in accordance with manufacturer's instructions.

1.10.2 Do not apply roofing membrane to damp or frozen deck surface.

1.10.3 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.11 Coordination

1.11.1 Coordinate the work with installing associated flashing as the work of this section proceeds.

1.12 Warranty

1.12.1 Provide 20 year warranty under provisions of Division 1.

1.12.2 Warranty: Cover damage to building resulting from failure to prevent penetration of water. Warranty shall commence from the Final Acceptance of the Pump Station.

1.13 Basis of Payment

1.13.1 Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.13.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Manufacturers - Membrane Brand - Membrane System (fully adhered type)

2.1.1 Carlisle SynTec Systems: - Sure-Seal.

2.1.2 Firestone Building Products Co.: - Rubbergard EPDM.

2.1.3 Substitutions: Under provisions of Division 1.

2.2 Membrane System

2.2.1 Fully adhered 0.060 inch (60 mil) thick EPDM system.

2.2.2 Roofing system total R value (average): as required to achieve an average R-value of 19.0.

2.3 Sheet Materials

2.3.1 Sheet: 60 mil thick EPDM membrane:

Properties	Test	Results
Tensile Test	ASTM D412	1300 psi
Elongation	ASTM D412	350%

Tear Strength	ASTM D624	175 psi
Water Absorption	ASTM D471	4%
Moisture Vapor-perms	ASTM E96	20
Low Temperature Brittleness	ASTM D746	-75 F
Resistance to Ozone	ASTM D1149	No cracks

2.3.2 Manufacturer's 5" wide (minimum), pressure sensitive, self-adhering EPDM seam cover and as recommended by Manufacturer.

2.3.3 Manufacturer shall guaranty membrane over insulation.

2.4 Base and Flexible Flashing

2.4.1 Sheet: 60 mil thick EPDM; perm rating of 0.5 maximum; tensile strength of 1200 psi elasticity of 50 percent with full recovery without set; black color; manufactured by membrane manufacturer.

2.5 Vapor Retarder Materials

2.5.1 Fire Retardant Sheet Vapor Retarder: UL requirements; plastic sheet; manufactured by membrane manufacturer, including compatible fire retardant adhesive.

2.6 Accessories

2.6.1 Sealants: As recommended by membrane manufacturer.

2.6.2 Reglet Strip Devices: 16 oz. Copper or as recommended by Manufacturer.
2.6.3 Roof Traffic Surfacing: Rubber roof walkway pads: 1/2" thick rubber pads:

(a) As recommended by roofing membrane manufacturer

2.7 Manufacturers - Roofing Insulation Materials

2.7.1 Firestone Building Products Co.

2.7.2 Atlas Roofing Corporation.

2.7.3 Substitutions: Under provisions of Division 1.

2.8 Insulation Materials

2.8.1 Polyisocyanurate rigid insulation and polyisocyanurate insulation board with cellulosic fiber insulation board overlay (sandwich/composite construction); Flat and tapered board insulation, 1/4-inch/ft. taper, with the following characteristics:

Polyisocyanurate board:

(a)	Board Density:	(2.0 lb/cu ft).
(b)	Thermal Resistance:	R-value of 6 per inch.
(c)	Compressive Strength:	20 psi minimum per ASTM D1621.
(d)	Water Absorption:	In accordance with ASTM C2842, less than 1.5 percent by volume maximum.
(e)	Board Edges:	Ship lapped.
(f)	Board Thickness:	As required to achieve an average R-value of 19.0.

Overlay boards(s):

(a)	2" high density fiberboard:	R-value of 1.39 per 2" per ASTM C208.
(b)	Gypsum decking overlay (if req'd):	R-value of 1.12 per 1" per ASTM C1177.

2.9.2 Protection Boards: All polyisocyanurate in contact with concrete roof deck and membrane roofing shall be overlaid (or composite sandwich construction) with 2" High Density fiberboard. Note: several manufacturers may require gypsum overlay when used with fully adhered.

2.10 Adhesive Materials

2.10.1 Adhesive: Type recommended by insulation manufacturer for application that provides a fully adhered system.

2.11 Components and Accessories

2.11.1 Crickets & Saddles: Slope 1/4"/ft.

2.11.2 Protective Boards: see item 2.9.2 above.

2.11.3 Underlayment: see item 2.9.2 & 2.10.1 above.

2.11.4 Wood Nailers: Coordinate and specify thickness of wood blocking to be equal to the thickness of all layers of insulation and protection board at all locations. Coordinate with Division 6A Rough Carpentry.

2.11.5 Termination Bar:

(a) 1/8" x 1 1/2" aluminum or stainless steel bar with 45 degree sealant pocket where space permits.

(b) 1/8" x 1" aluminum or stainless steel bar under counter flashing or other restricted areas.

2.11.6 Metal Flashings: Coordinate with Section 7B Sheet Metal Flashing and Trim.

2.11.7 Sealants: Coordinate with Section 7C Joint Sealers.

2.11.8 Top Surface Reflective Coating

(a) Coating: An acrylic based coating consisting of primer and finish coats as recommended by manufacturer for a reflective roof coating. Acrylic coating shall be in a white or light color as selected by Engineer from manufacturer's standard available colors.

3. EXECUTION:

3.1 Examination

3.1.1 Verify that surfaces and site conditions are ready to receive work.

3.1.2 Verify deck is supported and secured.

3.1.3 Verify deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains.

3.1.4 Verify deck surfaces are dry and free of snow or ice.

3.1.5 Beginning of installation means acceptance of the surface of the substrate.

3.1.6 Comply with manufacturer's climatic restrictions.

3.2 Preparation

3.2.1 Fill concrete surface honeycomb and variations with latex filler.

3.2.2 Verify that all work of other trades which penetrates and modifies the roof deck or requires workmen and equipment to traverse the roof deck has been completed.

3.3 Roof Insulation Installation

3.3.1 Lay underlayment and bottom layer of insulation in accordance with manufacturer's instructions.

3.3.2 Adhere insulation with a bonding mastic or adhesive between concrete roof surface and insulation system, and between successive insulation boards in accordance

with manufacturer's recommendations and instructions. Ensure compatibility of adhered insulation method(s) and bonding adhesive to the EPDM membrane system.

3.3.3 Lay insulation in parallel course with all joints staggered between courses and each course firmly adhered to deck.

3.3.4 Where more than one layer of insulation is required, stagger joints where possible in relation with the layer beneath and firmly adhere each layer to the previous layer.

3.3.5 Lay insulation boards to moderate contact without forcing joints. Cut insulation to fit neatly to perimeter blocking and protrusions through roof.

3.3.6 Miter cut all valleys.

3.3.7 Place fiberboard or other protective covering as the top surface that meets the EPDM membrane roofing system or as required by roofing manufacturer.

3.4 Membrane Application

3.4.1 Install membrane roofing in accordance with membrane manufacturer's instructions for a fully adhered membrane system using manufacturer's recommended bonding adhesive.

3.4.2 Overlap edges and ends minimum 4 inches and adhesive seal. Apply uniform bead sealant to joint edge.

3.4.3 Centered over all field seams, apply a minimum 5" wide strip of pressure sensitive, self adhering EPDM.

3.4.4 Shingle joints on sloped substrate in direction of drainage.

3.4.5 Minimize wrinkles and bubbles.

3.4.6 Seal adjoining surfaces.

3.4.7 Continue membrane up vertical surfaces minimum 8 inches unless otherwise noted.

3.4.8 Install membrane flashings. Seal watertight to membrane.

3.4.9 Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or moving.

3.4.10 Apply roof control and expansion joint materials to isolate roof into areas per manufacturer's recommendations. Seal roofing membrane sheet to joint flange; apply sealant to edge or seam.

3.4.11 Place traffic surfacing (roof walkway pads) at locations noted.

3.4.12 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

3.5 Flashing and Accessories

3.5.1 Apply membrane base flashing to seal membrane to vertical elements.

3.5.2 Coordinate installation of roof drains, roof hatches, roof handrailing, and related flashing.

3.5.3 Seal flashing and flanges of items penetrating membrane.

3.5.4 Protective - Reflective Coating.

1. Apply coating to exposed membrane surfaces and base flashing in accordance with manufacturer's instructions.

3.6 Field Quality Control

3.6.1 Field inspection will be performed under provisions of Division 1.

3.6.2 Correct identified defects or irregularities.

3.6.3 Request site attendance of roofing and insulation materials manufacturers during installation of the Work.

3.6.4 Inspection shall be performed by manufacturer of roofing system for compliance to the Work of this Section. The manufacturer shall certify the installation is complete and in accordance with the manufacturer's requirements for optimal roof life.

3.7 Cleaning

3.7.1 Remove and legally dispose of all debris from the job site.

3.7.2 In areas where finished surfaces are soiled by work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

3.7.3 Repair or replace defaced or disfigured finishes caused by work of this Section.

3.8 Protection

3.8.1 Protect building surfaces against damage from roofing work.

3.8.2 Where traffic must continue over finished roof membrane, protect surfaces.

END OF THIS SECTION

SECTION 7B - SHEET METAL FLASHING AND TRIM

1. GENERAL:

1.1 Section Includes

1.1.1 Coping, sill, lintel, base, through wall and cap flashings.

1.1.2 Counterflashing.

1.1.3 Fascias.

1.1.4 Scuppers, downspouts, and accessories.

1.2 Products Furnished but not Installed Under this Section

1.2.1 Section 3A - Cast-in-Place Concrete.

1.3 Related Sections

1.3.1 Section 3A - Cast-In-Place Concrete.

1.3.2 Section 4A – Unit Masonry

1.3.3 Section 5B - Metal Fabrications.

1.3.4 Section 6A – Rough Carpentry

1.3.5 Section 7A - Elastomeric Membrane Roofing.

1.3.6 Section 7C - Joint Sealers.

1.3.7 Section 15A - General Mechanical Provisions.

1.4 References

1.4.1 AISI (American Iron and Steel Institute) - Stainless Steel Uses in Architecture.

1.4.2 ASTM A167 - Stainless and Heat-Resisting Chromium- Nickel Steel Plate.

1.4.3 ASTM B32 - Solder Metal.

1.4.4 FS O-F-506 - Flux, Soldering, Paste and Liquid.

1.4.5 FS QQ-S-571 - Solder, Tin Alloy.

1.4.6 NAAMM - Metal Finishes Handbook.

1.4.7 NRCA (National Roofing Contractors Association) - Roofing Manual.

1.4.8 SMACNA - Architectural Sheet Metal Manual.

1.4.9 ASTM A240 - Heat-resisting, Chromium & Chromium-Nickel Stainless Steel Plate, Sheet, and Strip.

1.5 Submittals

1.5.1 Submit under provisions of Division 1.

1.5.2 Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashing, terminations, and installation details.

1.5.3 Samples: Submit two samples 300 mm (12") long of each type of metal coping, downspouts, flashing, and accessories illustrating typical material, and finish.

1.6 Qualifications

1.6.1 Fabricator and Installer: Company specializing in sheet metal flashing work with 5 years minimum experience.

1.7 Delivery, Storage and Handling

1.7.1 Deliver, store, protect, and handle products to site under provisions of Division 1.

1.7.2 Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

1.7.3 Prevent contact with materials during storage which may cause discoloration, staining, or damage.

1.8 Basis of Payment

1.8.1 Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.8.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Stainless Steel Flashing Trim and Coping: Through wall, base, lintel, sill, cap and coping; Brake formed to required profiles.

2.1.2 Scuppers and downspouts; Brake formed to required profiles.

2.1.3 Substitutions: Under provisions of Division 1.

2.2 Sheet Materials

2.2.1 Stainless Steel: ASTM A240, type 304, 20 gauge, architectural grade alloy, finish to be 2B.

2.3 Accessories and Components

2.3.1 Fastener: Same material and finish as flashing metal with soft neoprene washers at exposed fasteners.

2.3.2 Underlayment: 6 mil polyethylene.

2.3.3 Slip Sheet: Rosin sized building paper.

2.3.4 Sealant: Type specified in Section 7D.

2.3.5 Solder: ASTM B32; 50/50 type.

2.3.6 Flux: FS O-F-506.

2.3.7 Scupper: Same material and finish as flashing metal. Fabricate to dimensions as shown on drawings.

2.3.8 Downspout: Same material and finish as flashing metal. Fabricate to 3" x 4" rectangular profile.

2.3.9 Splash Pads: Precast concrete type: minimum 3000psi at 28 days, with minimum 5 percent air entrainment.

2.4 Fabrication

2.4.1 Form sections true to shape, accurate in size, square, and free from distortion or defects. Form scupper and downspout sections to sizes as shown on drawings. Downspout shall be rectangular 3"x4" profile.

2.4.2 Fabricate cleats, hold-down clips, and starter strips of same material as sheet, minimum 50 mm (2 inches) wide, interlockable with sheet.

2.4.3 Form pieces in longest practical lengths.

2.4.4 Hem exposed edges on underside 13 mm (1/2 inch); miter and seam corners.

2.4.5 Form material with flat lock seam.

2.4.6 Solder and seal metal joints. After soldering, remove flux. Wipe and wash solder joints clean.

2.4.7 Fabricate corners from one piece with minimum 406 mm (16 inch) long legs; solder for rigidity, seal with sealant.

2.4.8 Fabricate vertical faces with bottom edge formed outward 6.3 mm (1/4 inch) and hemmed 45° to form drip.

2.4.9 Fabricate flashing to allow toe to extend 50 mm (2 inches) over roofing. Return and brake edges.

3. EXECUTION:

3.1 Examination

3.1.1 Verify roof openings, pipes, or vents through roof are solidly set and nailing strips located.

3.1.2 Verify roofing termination and base flashing are in place, sealed, and secure.

3.2 Preparation

3.2.1 Install starter and edge strips, and cleats before starting installation.

3.2.2 Field measure site conditions prior to fabricating work.

3.3 Installation

3.3.1 Secure flashing in place using concealed fasteners. Use exposed fasteners only in locations approved by Engineer.

3.3.2 Lap, Cleat and seal all joints.

3.3.3 Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

3.3.4 Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

3.3.5 Seal metal joints watertight.

3.3.6 Secure scuppers and downspouts in place using concealed fasteners where applicable.

3.3.7 Set concrete splash pads under downspouts.

3.4 Field Quality Control

3.4.1 Field inspection will be performed under provisions of Division 1.

3.4.2 Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF THIS SECTION

SECTION 7C - JOINT SEALERS

1. GENERAL:

1.1 Section Includes

1.1.1 Preparing sealant substrate surfaces.

1.1.2 Sealant and backing.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.

1.2.2 Section 4A - Unit Masonry System.

1.2.3 Section 7A – Elastomeric Membrane Roofing

1.2.4 Section 7B - Sheet Metal Flashing and Trim: Sealants used in conjunction with metal flashings.

1.2.5 Section 8A – Stainless Steel Doors and Frames.

1.2.6 Section 8B – Door Hardware.

1.2.7 Divisions 5, 10 through 16

1.3 References

1.3.1 ASTM C804 – Use of Solvent-Release Type Sealants.

1.3.2 ASTM C920 - Elastomeric Joint Sealants.

1.3.3 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

1.3.4 ASTM D1751 – Preformed Expansion Joint Filler for Concrete Paving and Structural Construction.

1.3.5 FS HH-F-341 _ Fillers, Expansion Joint: Bituminous

1.3.6 FS TT-S-00227 - Sealing Compound: Elastomeric Type, Multi-Component.

1.3.7 FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.

1.3.8 SWRI (Sealing, Waterproofing, and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 Submittals

1.4.1 Submit under provisions of Division 1.

1.4.2 Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

1.4.3 Samples: Submit two samples 102 mm x 13 mm (4 x 1/2 inches) in size illustrating color for selection.

1.4.4 Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

1.4.5 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 Quality Assurance

1.5.1 Perform work in accordance with SWRI requirements for materials and installation.

1.6 Qualifications

1.6.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.

1.6.2 Applicator: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.7 Environmental Requirements

1.7.1 Do not install solvent curing sealants in enclosed building spaces without providing adequate ventilation.

1.7.2 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8 Coordination

1.8.1 Coordinate work under provisions of Division 1.

1.8.2 Coordinate the work with all sections referencing this section.

1.9 Basis of Payment

1.9.1 Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.9.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Sealants

2.1.1 Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G, A, O; single component, moisture curing, low modulus type; colors to be selected by Engineer from manufacturer's standard color selection (see schedule below);

Color Schedule:

(a) Exterior wall joints: match mortar joint color.
(b) Sheet metal coping: match sheet metal color
(c) Exterior doors: match door color.
(d) Exterior louvers, etc: match louver, equipment color(s)
(e) Interior doors: match door color
(f) Other surfaces: match substrate color as approved by Engineer

2.2 Accessories

2.2.1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.

2.2.2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

2.2.3 Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.

2.2.4 Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

2.2.5 Bituminous and Fiber Joint Filler: ASTM D1751 or FS HH-F-341.

3. EXECUTION:

3.1 Examination

3.1.1 Verify that substrate surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.

3.1.2 Verify that joint backing and release tapes are compatible with sealant.

3.2 Preparation

3.2.1 Remove loose materials and foreign matter which might impair adhesion of sealant.

3.2.2 Clean and prime joints in accordance with manufacturer's instructions.

3.2.3 Perform preparation in accordance with ASTM C804 for solvent release sealants.

3.2.4 Protect elements surrounding the work of this section from damage or disfiguration.

3.3 Installation

3.3.1 Install sealant in accordance with manufacturer's instructions.

3.3.2 Measure joint dimensions and size materials to achieve required width/depth ratios.

3.3.3 Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.

3.3.4 Install bond breaker where joint backing is not used.

3.3.5 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

3.3.6 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.3.7 Tool joints concave.

3.4 Cleaning and Repairing

3.4.1 Clean work under provisions of Division 1.

3.4.2 Clean adjacent soiled surfaces.

3.4.3 Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 Protection of Finished Work

3.5.1 Protect finished installation under provisions of Division 1.

3.5.2 Protect sealants until cured.

END OF THIS SECTION

SECTION 7D - BOARD INSULATION

1. GENERAL:

1.1 Section Includes

1.1.1 Cavity Wall: 2" thick board insulation for cavity wall.

1.1.2 Foundation Wall: 2" thick board insulation for foundation wall, 6" to 4'-6" below grade.

1.2 Related Section

1.2.1 Division 3 - Concrete.

1.2.2 Section 4A - Unit Masonry.

1.3 References

1.3.1 ASTM C272 - Water Absorption of Core Materials for Structural Sandwich Constructions.

1.3.2 ASTM C591 – UnFaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation Board.

1.3.3 ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

1.3.4 ASTM C1621 - Compressive Properties of Rigid Cellular Plastics.

1.3.5 ASTM D1622 - Apparent Density of Rigid Cellular Plastics.

1.3.6 ASTM D2126 - Response of Rigid Cellular Plastics to Thermal and Humid Aging.

1.3.7 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

1.3.8 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

1.3.9 ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

1.4 System Description

1.4.1 Materials of this Section shall provide a continuous thermal barrier at building enclosure elements.

1.5 Submittals

1.5.1 Submit under provisions of Division 1.

1.5.2 Product Data: Provide data on product characteristics, performance criteria, and limitations.

1.5.3 Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation and installation techniques.

1.5.4 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.6 Delivery, Storage, and Protection

1.6.1 Deliver, store, protect and handle products to site under provisions of Division 1 and in accordance with the manufacturer's instructions.

1.7 Environmental Requirements

1.7.1 Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.8 Basis of Payment

1.8.1 Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for PUMP STATION GENERAL WORK.

1.8.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Manufacturers - Insulation Materials

2.1.1 Dow.

2.1.2 Owens Corning.

2.1.3 Substitutions: Under provisions of Division 1.

2.2 Insulation Materials

2.2.1 Extruded Polystyrene Insulation: Rigid, closed cell, extruded, polystyrene insulation with integral high density skin, conforming to the following:

(a) Thermal Resistance: R-value of 5 per inch.

(b) Compressive Strength: 25 psi minimum.

(c) Water Absorption: In accordance with ASTM C272, less than 0.1 percent by volume maximum.

(d) Board Edges: Square

(e) Board Thickness: 2" min. thickness for walls and foundations. Foundation walls to 4'-6" below grade minimum for frost protection.

2.3 Adhesive Materials

2.3.1 Adhesive: Type recommended by insulation manufacturer for application.

2.4 Accessories

2.4.1 A ½" or 5/8" fiber board for protection of rigid insulation surfaces.

2.4.2 Nails or Staples: Steel wire; galvanized; type and size to suit application.

2.4.3 Insulation Fasteners: Impale clip type of galvanized steel; of type to be mechanically fastened to surface to receive rigid insulation; length to suit insulation thickness; capable of securely and rigidly fastening insulation in place.

3. EXECUTION:

3.1 Examination

3.1.1 Verify substrate and adjacent materials and insulation boards are dry and ready to receive insulation and adhesive.

3.1.2 Verify substrate surface is flat, free of honeycomb, fins, irregularities and materials that may impede adhesive bond.

3.1.3 Verify insulation boards are unbroken, free of damage.

3.2 Installation – Masonry Cavity walls and Foundation Walls

3.2.1 Secure fasteners to substrate at a frequency of 6 per insulation board.

3.2.2 Adhere a 6 inch wide strip of polyethylene sheet over control and expansion joint with double beads of adhesive each side of joints. Tape seal joints between sheets. Extend sheet full height of joint.

3.2.3 Apply adhesive in three continuous beads per board length to full bed 1/8 inch thick on substrate. Daub adhesive tight to protrusions to ensure continuity of vapor and air barrier.

3.2.4 Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent boards and no protrusions. Place impale fastener locking discs.

3.2.5 Cut and fit insulation tight to protrusions or interruptions to the insulation plane.

3.2.6 In masonry cavity walls, coordinate placement of rigid insulation boards with installation of masonry wire reinforcing, brick ties, flashing and other masonry and insulation accessories, and in accordance with manufacturer's instructions.

3.2.7 Cut and fit insulation tight to cavity wall protrusions and interruptions to the insulation plane.

3.3 Protection of Finished Work

3.3.1 Protect finished work under provisions of Division 1.

3.3.2 Do not permit work to be damaged prior to covering insulation.

END OF THIS SECTION

DIVISION 8 – DOORS AND WINDOWS

DIVISION 8 - DOORS AND WINDOWS

SECTION 8A - STAINLESS STEEL DOORS AND FRAMES

1. GENERAL:

1.1 Section Includes

1.1.1 Exterior stainless steel doors

1.1.2 Exterior stainless steel frames.

1.1.3 Exterior stainless steel insulated infill panels (to match style of door leaf) at transom area.

1.1.4 System Description (Design Requirements)

Design and fabricate exterior assemblies to comply with requirements for system performance characteristics listed below as demonstrated by testing manufacturer's corresponding stock systems according to test methods designated.

(a) Thermal Movement: Allow for expansion and contraction resulting from ambient temperature range of 120 deg. F.

(b) Wind Loading: Provide capacity to withstand loading indicated below, test in accordance with ASTM E330.
1) Uniform pressure of 20 psf inward and 20 psf outward.

(c) Transmission Characteristics of Assemblies: Provide exterior doors with jamb and head frames complying with requirements indicated below for transmission characteristics and test methods.
1) Air Leakage: Air infiltration/lin. Feet of perimeter crack not more than 0.50 cfm for single doors and 1.0 cfm for pairs of doors per ASTM E283 at pressure differential of 1.567 psf.
2) Condensation Resistance: Not less than 48 crf per AAMA 1503-09.
3) Thermal Transmittance: U-Value of not more than 0.93 Btu/(hr/sq ft/deg F) per AAMA 1503.1.

1.2 Related Section

1.2.1 Section 3A – Cast-In-Place Concrete.

1.2.2 Section 4A – Unit Masonry

1.2.3 Section 5A - Metal Fabrications.

1.2.4 Section 8B - Door Hardware.

1.2.5 Section 15A - General Mechanical Provisions: Louver and Damper coordination.

1.3 References

1.3.1 ANSI A250.6 – Hardware Reinforcing on Standard Steel Doors and Frames.

1.3.2 ANSI A250.8 – Recommended Specifications for Standard Steel Doors and Frames.

1.3.3 ANSI A250.10 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

1.3.4 ANSI/SDI A250.11 – Recommended Erectin Instructions for Steel Frames.

1.3.5 ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

1.3.6 ASTM A510– Standard Specification for General Requirements for Wire Rods and Course Round Wire, Carbon Steel.

1.3.7 ASTM A1008 – Standard Specification for Sheet, Sheet Steel, Cold Rolled, Carbon, Structural, High Strength low Alloy, High Strength Low Alloy with Improved Formability Solution Hardened, and Bake Hardened.

1.3.8 ANSI/ASTM A568 – Standard Specification for Sheet, Sheet Steel, Carbon, and High Strength low Alloy Hot rolled and Cold Rolled Sheet Steel.

1.3.9 ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanealed) by the Hot Dip Process.

1.3.10 DHI A115.1.G – Door Hardware Institute, Installation Guide for Doors and Hardware.

1.3.11 SDI 117 – Steel Door Institute, Manufacturing Tolerances for Steel Doors and Frames.

1.3.12 SDI 122 – Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

1.4 Submittals

1.4.1 Submit under provisions of Division 1.

1.4.2 Shop Drawings: In addition to requirements below, provide a schedule of doors and frames using same reference numbers for details and openings as those on Drawings:

(a) Elevations of each door design.
(b) Details of doors, including vertical and horizontal edge details.
(c) Frame details for each frame type, including dimensioned profiles.
(d) Details and locations of reinforcement and preparations for hardware.
(e) Details of each different wall opening condition.
(f) Details of anchorages, accessories, joints, and connections.
(g) Details of glazing frames and stops showing glazing, where applicable.

(h) Fire-resistance ratings.

1.4.3 Manufacturer's Installation Instructions: Indicate special installation instructions.

1.4.4 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 Qualifications

1.5.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.6 Quality Assurance

1.6.1 Steel Door and Frame Standard: Comply with ANSI A250.8 unless more stringent requirements are indicated.

1.7 Delivery, Storage and Protection

1.7.1 Deliver, store, protect and handle products to site under provisions of Division 1.

1.7.2 Deliver doors and frames cardboard wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory finished doors and frames.

1.7.3 Inspect doors and frames on delivery for damage and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Engineer. Remove and replace damaged items that cannot be repaired as directed.

1.7.4 Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum ¼ inch spaces between stacked doors to permit air circulation.

1.8 Basis of Payment

1.8.1 Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.8.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Ceco Door Products.

2.1.2 Steelcraft.

2.1.3 Curries Company

2.1.5 Substitutions: Under provisions of Division 1.

2.2 Materials

2.2.1 Stainless Steel: ASTM A240, Type 304.

2.2.2 Insulated Panel Core:

(a) Stiffened: Continuous Vertical formed stainless steel sections, 0.026 inch (0.6mm) minimum thickness, spaced with interior webs not more than 6 inches (152mm) apart, which upon assembly, span the full thickness of the interior of the door. Voids between stiffeners shall be filled with fiberglass or mineral rock-wool batt-type material.

2.2.3 Core: Polyurethane foam.

2.2.4 Insulated door insulation R-value of 11.0 minimum.

2.3 Doors and Frames

2.3.1 Doors: Level 2 Heavy Duty 1-3/4 inches thick, seamless construction (i.e.: Level II, Model 2).

2.3.2 Doors and Frames: Face sheet construction. (Level II, Model 2) Heavy Duty 0.053 inch minimum wall thickness for both door and frame construction.

2.3.3 Frames: shall be full profile weld type; provide minimum of three anchors per jamb suitable for adjoining wall construction. Provide anchors of not less than 0.042 inch in thickness or 0.167 inch diameter wire. Frames over 7'-6" shall be provided with an additional anchor per jamb.

2.3.4 Frames: Base anchors shall be provided with minimum thickness of 0.042 inches. For existing masonry wall conditions that do not allow for the use of a floor anchor, an additional jamb anchor shall be provided.

2.3.5 All frames shall be fully prepared for all mortise template hardware and reinforced only for surface mounted hardware. Drilling and /or tapping shall be completed by others.

2.3.6 Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8.

2.3.7 Thermal Break Construction: Fabricate stainless steel framing system with integrally concealed, low conductance, thermal barrier located between exterior materials and exposed interior members eliminating direct metal to metal contact.

2.4 Door Silencers

2.4.1 Fabricate stops to receive three silencers on strike jambs of single door frames and two silencers on heads of double door frames.

2.5 Accessories, Supports and Anchors

2.5.1 Fabricated from not less than 0.042 inch thick, stainless steel sheets.

2.5.2 Wall anchors in masonry construction: 0.177 inch diameter, steel wire complying with ASTM A510 may be used in place of steel sheet.

2.5.3 Inserts, Bolts and Fasteners: Manufacturer's standard units for stainless steel doors and frames.

2.5.4 Exterior Top Caps: Stainless steel flush channel.

2.5.5 Frame Thermal Breaks: Rigid polyvinylchloride extrusion.

2.5.6 Compression Weatherstripping: Manufacturer's standard replaceable stripping of either molded neoprene gaskets complying with ASTM D2000 or molded PVC gaskets complying with ASTM D2287.

2.6 Fabrication

2.6.1 Fabricate doors and frames to comply with ANSI/SDI 250.8 and to be rigid, neat in appearance, and free form defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project Site.

2.6.2 Stainless Steel Doors and Insulated Matching Panels: 1.6 mm (16 gauge) thick stainless steel sheet door and panel faces.

2.6.3 Flush Design: Non fire rated:

(a) Flush Design: Butt seam door construction, longitudinal edges fully welded with no visible edge seam.
(b) Top and Bottom Channels: Inverted, recessed, welded steel channels.
(c) Astragals: Stainless steel Z shaped astragals for double doors.
(d) Exterior Door: Flush stainless steel top caps.
(e) Fabricate with stainless steel hardware reinforced plates welded in place.
(f) Core: Stiffened

2.6.4 Clearances for Non Fire Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than ¼ inch between pairs of doors. Not more than ¾ inch at bottom.

2.6.5 Stainless Steel Frames:

(a) Stainless Steel Frames: 2.0 mm (14 gauge) thick stainless steel, welded type construction, mitred corners.

(b) Factory assemble and weld stainless steel frames.
(c) Stainless steel mullions for double doors: Removable type.
(d) Fabricate with stainless steel hardware reinforcement plates welded in place.
(e) Reinforce frames wider than 1200 mm (48 inches) with roll formed stainless steel channels fitted tightly into frame lead, flush with top.

2.6.6 Single-Acting, Door Edge Profile: Square Edge

2.6.7 Double-Acting, Door Edge Profile: Round vertical edges with 2-1/8 inch radius.

2.6.8 Tolerances: comply with SDI 117.

2.6.9 Fabricate concealed stiffeners, reinforcement, edge channels, louvers and moldings from stainless steel sheet.

2.6.10 Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

2.6.11 Hardware Preparation:

(a) Prepare doors and frames to receive mortised and concealed hardware according to door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.

2.6.12 Frame Construction:

(a) Fabricate frames, including transom, sidelight frame, etc. to shape or configuration shown.
(b) Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
(c) Provide temporary spreader bars.

2.6.13 Coordinate fabrication of doors and frames with louver and damper size and mounting requirements as specified in Division 15, and as indicated on drawings. Fabrication to include trim to hide exterior mounting fasteners for the louvers and dampers, as required.

2.6.14 Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied hardware may be done at project site.

2.6.15 Locate hardware as indicated on Shop Drawings, or, if not indicated, according to ANSI A250.8.

2.6.16 Glazing Stops: Manufacturer's standard, formed from 0.032 inch thick steel sheet.

2.6.17 Prepare frame for silencers. Provide three single rubber silencers for single doors and two single silencers on frame head at double doors.

2.6.18 Fabricate frames with 4 inch head member or as indicated.

2.7 Weatherstripping

2.7.1 Weatherstripping: Provide compression weatherstripping against fixed stops for exterior doors. At other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.

(a) Provide EPDM/vinyl blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.

2.8 Finish

2.8.1 Standard Stainless Steel Finish: #2B Mill Finish.

2.8.2 Apply one coat of bituminous paint to concealed steel surfaces in contact with cementitious or dissimilar materials.

3. EXECUTION:

3.1 Examination

3.1.1 Verify that opening dimensions and tolerances are acceptable.

3.2 Installation

3.2.1 General: Install doors, frames, glazing and hardware in accordance with Shop Drawings, manufacturer's instructions, and as specified.

3.2.2 Placing Frames:

(a) Comply with provisions in ANSI/SDI A250.1 unless otherwise indicated.
(b) Set frames accurately in position, plumbed, aligned and braced securely until permanent anchors are set.
(c) After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
(d) Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
(e) In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
(f) For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.

3.2.3 Coordinate installation of frames with louvers and dampers.

3.2.4 Door Installation:

(a) Comply with ANSI A250.8 unless otherwise indicated.
(b) Fit hollow metal doors accurately in frames within tolerances specified in

ANSI A250.8.

(c) Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G

3.2.5 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

3.2.6 Hardware: Install hardware using templates provided. Refer to Section 8B for hardware installation requirements.

3.3 Tolerances

3.3.1 Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4 Adjusting and Cleaning

3.4.1 Adjust work under provisions of Division 1.

3.4.2 Adjust door for smooth and balanced door movement.

3.4.3 Protection Removal: Immediately before final inspection, remove protective material or wrappings from doors and frames where applicable.

3.4.4 Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.5 Schedule

3.5.1 See Drawings and refer to Shop Drawings.

END OF THIS SECTION

SECTION 8B - DOOR HARDWARE

1. GENERAL:

1.1 Section Includes

1.1.1 Hardware for stainless steel doors.

1.1.2 Thresholds.

1.1.3 Weatherstripping.

1.2 Products Furnished but not Installed Under This Section

1.2.1 Section 8A – Stainless Steel Doors and Frames.

1.3 Related Sections

1.3.1 Section 4A - Unit Masonry.

1.3.2 Section 5A - Metal Fabrications.

1.3.3 Section 8A – Stainless Steel Doors and Frames.

1.4 References

1.4.1 ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

1.4.2 BHMA - Builders' Hardware Manufacturers Association.

1.4.3 DHI - Door and Hardware Institute.

1.4.4 NAAMM - National Association of Architectural Metal Manufacturers.

1.4.5 NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

1.4.6 UL 305 - Panic Hardware.

1.5 Submittals

1.5.1 Submit under provisions of Division 1.

1.5.2 Shop Drawings: Indicate locations and mounting heights of each type of hardware.

1.5.3 Submit manufacturer's parts lists, templates.

1.5.4 Product Data: Provide data on specified hardware.

1.5.5 Samples: Submit 1 sample of hinge, lockset, latchset, closers, thresholds, flushbolts, astragal, IDOT Deadbolt, and weatherstripping illustrating style, color, and finish.

1.5.6 Samples: May be incorporated into the work or returned to supplier.

1.5.7 Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.6 Project Record Documents

1.6.1 Submit under provisions of Division 1.

1.6.2 Record actual locations of installed cylinders and their master key code.

1.7 Operation and Maintenance Data

1.7.1 Submit under provisions of Division 1.

1.7.2 Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.8 Quality Assurance

1.8.1 Perform work in accordance with the following requirements:

(a) ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

1.9 Quality Assurance

1.9.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

1.9.2 Hardware Supplier: Company specializing in supplying commercial door hardware with 5 years documented experience.

1.9.3 Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC), as certified by the Door and Hardware Institute to assist in the work of this section.

1.10 Regulatory Requirements

1.10.1 Conform to applicable code for requirements applicable to fire rated doors and frames.

1.11 Delivery, Storage, and Handling

1.11.1 Deliver, store, protect, and handle products to site under provisions of Division 1.

1.11.2 Package hardware items individually; label and identify package with door

opening code to match hardware schedule.

1.11.3 Deliver keys to Engineer by security shipment direct from hardware supplier.

1.11.4 Protect hardware from theft by cataloging and storing in secure area.

1.12 Coordination

1.12.1 Coordinate work with other directly affected Sections involving manufacturer or fabrication of internal reinforcement for door hardware.

1.13 Warranty

1.13.1 Provide five year warranty under provisions of Division 1.

1.13.2 Warranty: Include coverage of door closures. Warranty shall commence from the Final Acceptance of the Pump Station.

1.14 Maintenance Materials

1.14.1 Provide maintenance materials under provisions of Division 1.

1.14.2 Provide special wrenches and tools applicable to each different or special hardware component.

1.14.3 Provide maintenance tools and accessories supplied by hardware component manufacturer.

1.15 Basis of Payment

1.15.1 Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

1.15.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Exit Devices (Rim Type): Corbin Russwin, Adams Rite.

2.1.2 Exit Devices (Vertical Rod Type): Corbin Russwin, Adams Rite.

2.1.3 Mortise Lockset: Corbin Russwin, Schlage, and Yale.

2.1.4 Dummy Trim: Corbin Russwin, Schlage and Yale.

2.1.5 Hinges: Hager, Stanley, and Lawrence.

2.1.6 Closers: Corbin Russwin, LCN, and Norton.

2.1.7 Flush Bolts: Hager, Rockwood, Baldwin, Ives.

2.1.8 Weatherstripping: National Guard Products, Hager, Penko, Reese Enterprises.

2.1.9 Thresholds: National Guard Products, Hager, Pemko, Reese Enterprises.

2.1.10 Astragals: National Guard Products, Reese Enterprises, Pemko.

2.1.11 Door Sweeps: National Guard Products, Pemko.

2.1.12 Kick plates: Hiawatha, Ives, Brookline, Rockwood.

2.1.13 Wall stops: Ives, Rockwood.

2.1.14 Substitutions: Under provisions of Division 1.

2.2 Keying

2.2.1 Supply 5 keys for each lock.

2.2.2 Keys shall match Department's keying system.

2.2.3 Serial numbers shall be stamped or engraved on all keys.

2.3 Finishes

2.3.1 Finishes: Identified in schedule at end of section.

3. EXECUTION:

3.1 Examination

3.1.1 Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

3.2 Installation

3.2.1 Install hardware in accordance with manufacturer's instructions and requirements of NAAMM.

3.2.2 Use templates provided by hardware item manufacturer.

3.2.3 Conform to ANSI A117.1 for positioning requirements for the handicapped.

3.3 Field Quality Control

3.3.1 Field inspection will be performed under provisions of Division 1.

3.3.2 Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's

instructions and as specified.

3.3.3 Provide two copies of certification to Engineer.

3.4 Protection of Finished Work

3.4.1 Protect finished work under provisions of Division 1.

3.4.2 Do not permit adjacent work to damage hardware or finish.

3.5 Schedule

General: Provide hardware to match door and frame as required to provide a fully operation door assembly. Refer to drawings for designated door.

3.5.1 Exit Devices: (Rim Type-Single Leaf Door) Heavy Duty, visible parts US 32D finish, non ferrous internal parts, surface mounted rim type with ¾" throw on latch bolt. Keyed access with trim lever handle mounted on exterior side of door leaf.

a. Corbin Russwin Model ED5200
b. Adams Rite Model 8300
c. Or approved equal.

3.5.2 Exit Devices: (Vertical Rod Type-Active Leaf Door of Double Doors) Heavy Duty, visible parts US 32D finish, non ferrous internal parts, surface mounted vertical rods with two point latching on active leaf. Keyed access with trim lever handle mounted on exterior side of active door leaf. Corbin Russwin ED 5400 Series.

a) Corbin Russwin Model No. ED5400
b) Adams Rite Model 8100
c) Or approved equal.

3.5.3 Mortise Lockset (Entrance Type): Wrought bronze, visible parts US32D finish, non-ferrous internal parts, with minimum 3/4" throw on latch bolt, 1" throw on deadbolt. Cylinder shall be as specified by Engineer. Latch bolt by grip either side. Dead bolt by key outside or by thumbturn lever inside, inside grip simultaneously retracts latchbolt and deadbolt

a. Corbin Russwin Model ML2048 x LSM
b. Schlage Model L9453x03
c. Yale Model 8847 CRE
d. Or approved equal.

3.5.4 Dummy Trim Lockset x Lever Action: (No lever on inside face) Heavy Duty, visible parts US 32D finish, non ferrous internal parts, surface mounted rim type with ¾" throw on latch bolt. Keyed access with trim lever handle mounted on exterior side of door leaf.

a. Corbin Russwin Model LSM

b. Schlage Model L9176x03
c. Yale Model CRE
d. Or approved equal.

3.5.5 IDOT standard outside deadbolt: Heavy duty, high security padlock locking bolt with a 3/4" throw adjustable from 3/4" to 2-3/8" shall be provided mounted on the exterior of doors. Doors shall be reinforced as necessary for installation of the outside deadbolt. Heavy duty padlock for the doors will be provided by IDOT.

3.5.6 Hinges: Stainless steel, heavy weight, five knuckle, four ball bearing with non-rising pin, button tip and ring, non-removable stainless steel pin on exterior doors, US32D finish.

(1) Door size to 8'-0" x 4'-0"
2 pr. 4.5" x 4.5"

(2) Door size over 8'-0" x 4'-0"
2-1/2 pr. 6" x 6", or as required by door manufacturer.

a. Hager Model BB1199.
b. Stanley Model FBB 191
c. Lawrence Model BB4101
d. Or approved equal.

3.5.7 Closers: Heavy duty parallel arms with adjustable closing speed, with hold-open for outswinging exterior doors. 626(satin chrome plated).

a. Corbin Russwin Model DC6000 Series (DC6210 A2 M72)
b. LCN Model 4010/4110 Smoothe Series
c. Norton Model 7500 Series
d. Or approved equal.

3.5.8 Flush Bolts: US32D(satin stainless steel finish), full mortised extension flush bolts with dust proof strike, located at inactive leaf of all pairs of doors. Corbin Russwin Model 2849 with No. 70-1/2M Strike.

a. Hager Model 282D x 26D
b. Rockwood Model 555 x 26D
c. Baldwin Model 0600 x 26D
d. Ives Model FB458 X 26D
e. Or approved equal.

3.5.9 Weatherstripping: Head and jamb gasket, aluminum with clear anodized aluminum finish and neoprene insert.

a. National Guard Products Model 110 NA
b. Hager Model 873SNMIL
c. Pemko Model 332 CR
d. Reese Enterprises Model DS 69C
e. Or approved equal.

3.5.10 Thresholds: Heavy Duty, clear anodized aluminum finish, with chemically treated stainless steel screws, set in full bed of sealant. 5" x 12". Thermally broken.

a. National Guard Products Model 8425 x AL
b. Hager Model 412S x AL
c. Pemko Model 252 x 3AFG x AL
d. Reese Enterprises Model S282A x AL
e. Or approved equal.

3.5.11 Astragals: Full height, clear anodized aluminum, surface mounted, meeting stile gasketing with silicone seal.

Doors with one active leaf:
a. National Guard Products Model 109NA
b. Reese Enterprises Model 93C
c. Pemko Model 375CR
d. Or approved equal.

3.5.12 Door Sweep: Nylon brush gasketing, clear aluminum finish.

a. National Guard Products Model 600A
b. Pemko Model 18137CNB
c. Or approved equal.

3.5.13 Kick Plate: 10 inch x 2 inch LDW x US 32D x 16GA.

a. Hiawatha
b. Ives
c. Brookline
d. Rockwood
e. Or approved equal.

3.6 Hardware Schedule per Door

Door		Hardware Req'd
D1	(exterior double door)	Exit Device (vertical rod type) on active leaf with keyed access and lever trim exterior side, dummy trim inactive leaf, hinges, weatherstripping, door sweep each door, two closers, threshold, flush bolts on inactive leaf, astragal on active leaf, IDOT Std. Deadbolt, kick plates on each door leaf.
D2	(exterior double door)	Exit Device (vertical rod type) on active leaf with keyed access and lever trim exterior side, dummy trim inactive leaf, hinges, weatherstripping, door sweep each door, two closers, threshold, flush bolts on inactive leaf, astragal on active leaf, IDOT Std. Deadbolt, kick plates on each door leaf.
D3	(exterior door)	Exit Device (rim type) with keyed access and lever

		trim exterior side, hinges, weatherstripping, door sweep, closer, IDOT Std. Deadbolt, threshold, kick plate.
D4	(exterior door)	Exit Device (rim type) with keyed access and lever trim exterior side, hinges, weatherstripping, door sweep, closer, IDOT Std. Deadbolt, threshold, kick plate.

END OF THIS SECTION

DIVISION 9 - PAINTING

DIVISION 9 - PAINTING

SECTION 9A - PAINTING

1. GENERAL:

1.1 Description

1.1.1 This item of work includes the furnishing, preparation and application of painting and related items to complete the work indicated on drawings and described in these specifications.

1.1.2 All work under this Section shall be subject to the applicable provisions of Section 100 of the Standard Specifications. Refer to Division 1 for additional requirements.

1.1.3 Terms used in this Section shall be as defined in ANSI/ASTM DIG.

1.2 Reference Standards

1.2.1 The work shall be in conformance with the applicable standards/regulations of:

(a) Society of Protective Coatings.

(b) National Fire Protection Association (NFPA).

(c) American National Standards Institute (ANSI).

(d) Occupational Safety and Health Act (OSHA)

(e) SSPC SP10 "Near White Metal Blast Cleaning", Society of Protective Coatings.

(f) Military Specification MIL-L-81352A.

(g) Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction.

1.2.2 The term "finishes" as used herein means all painting and coating systems materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.2.3 Consult the specifications for work and materials of other trades to determine the provisions regarding their finishing. Surfaces left unfinished by the requirements of other specifications shall be painted or finished as part of this work. Work requiring finish and not specified shall be finished same as specified for similar work. Finishing specified hereinafter shall be in addition to shop and prime coats specified in other sections.

1.2.4 The work under this section shall be done by a firm with not less than 5 years of experience in commercial painting and finishing. Documentation of this

experience shall be included together with the product data submitted for approval.

1.3 Quality Assurance

1.3.1 Painting shall conform to applicable Section 1008, PAINT MATERIALS and MIXED PAINTS, of the IDOT Standard Specifications.

1.3.2 The types of paint products to be used in the work shall be identified by the manufacturer's name and number.

1.3.3 The products of manufacturers other than those herein named, which are approved equal to the products specified, may be substituted, except that, all paints applied to a surface shall be products of one manufacturer. Data showing equivalent performance of each paint product to be submitted for review at least 30 calendar days before the painting is to begin, and no painting shall proceed until the substituted products have been accepted.

1.3.4 All paints and painting materials shall be delivered to the work in the original and unopened containers plainly marked with the name, brand, shelf life, and analysis of the product, and the name of the manufacturer.

1.4 Delivery and Storage of Materials

1.4.1 Deliver materials in original containers with seals unbroken and labels intact. Do not deliver or store on the site materials other than those approved for use. Empty containers shall have labels canceled.

1.4.2 Store materials outside the building. Keep storage place neat and clean and correct all damage thereto or to its surroundings.

1.4.3 Materials shall not be mixed or applied in any room having finished floor installed without providing adequate protection. Only materials used during the course of one day may be kept within the building. Remove oily rags and waste from building every night and take every precaution to avoid danger of fire.

1.5 Submittals

1.5.1 Submit product data under provisions of Section 1A.

1.6 Shop Drawings: Submit the following for approval:

1.6.1 Copies of manufacturer's technical information, including paint label analysis and application instructions, certification of coating, primer and finish coat for the material and service for each coating system proposed for use.

1.6.2 Copies of Contractor's proposed surface preparation and work area protection procedures in each area of the work.

1.6.3 List each material and cross-reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classification.

1.6.4 Copies of manufacturer's complete color charts for each coating system.

1.7 Basis of Payment

1.7.1 The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

1.7.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Tnemec Co., Inc.

2.1.2 Sherwin-Williams

2.1.3 Substitutions: Under provisions of Division 1.

2.2 Colors

2.2.1 Unless otherwise indicated, colors will be selected by the Engineer during the submitted review process.

2.2.2 Complete color charts shall be submitted of proposed paint manufacturers to the Engineer for final paint color selections.

2.2.3 Unless otherwise indicated, all surfaces without a final finish color shall be painted. In general, colors will be differentiated as follows:

(a) Ceiling.
(b) Grade floor.
(c) Lower level floors.
(d) Lower level concrete walls.
(e) Interior metal trim.
(f) Exterior metal trim (excluding louvers, s.s. coping, and aluminum framing).
(g) Exterior piping and appurtenances (such as sluicegate stands and operators).
(h) Natural or anodized aluminum surfaces shall not be painted. Surfaces and equipment which are provided with a factory final finish shall not be painted.
(i) Stainless steel exterior coping, and other stainless steel surfaces shall not be painted unless noted otherwise.
(j) Exterior concrete walls of building.
(k) Interior concrete walls of building (including masonry surfaces that are not glazed block surfaces).
(l) Safety items as necessary (bollards, hoist beams/trolley, etc.).

Notes:

1. Walls and floor at wet well level shall not be painted.

2. All piping shall be shop finish painted.

2.3 Color Coding

2.3.1 Piping and electrical conduit shall be color coded with colors as selected by the Engineer. Electrical conduits shall be painted the color of the wall/ceiling against which it is run. Conduits are not required to be painted if they are not running against a wall or ceiling.

2.4 Non-Slip Floor Coating

2.4.1 Concrete floors above the wet pit shall have an abrasive coating of Series 69 Hi-Build Epoxoline II as manufactured by Tnemec Co., Inc., Macropoxy 646 as manufactured by Sherwin-Williams, or equal. Bare concrete shall be primed at a dry film thickness of 2.0-3.0 mils. The first coat shall have a dry film thickness of 2.0-3.0 mils which includes silica sand to provide a non-skid surface. The second coat shall have a dry film thickness of 2.0-3.0 mils. The epoxy coating shall be applied in accordance with the manufacturer's recommendations.

3. EXECUTION:

3.1 Preparation

3.1.1 Inspect surfaces with regard to their suitability to receive a finish after preparatory work. The application of finish shall be an indication of the Contractor's acceptance of the surface.

3.1.2 Clean surfaces to be painted of loose dirt and dust before painting is started. Adjacent surfaces shall also be clean before starting painting. Do preparatory work necessary to produce a surface suitable to receive the specified finish.

3.1.3 Wash uncoated metal surfaces with mineral spirits to remove dirt and grease before applying paint materials. Blast profile shall not exceed 30% of total film thickness of coating. Preparation shall conform to primer manufacturer's requirements. Prime surfaces as soon as practical after preparation. Do not leave prepared, uncoated surfaces overnight. Touch up shop coats damaged by welding or abrasion.

3.1.4 Prior to painting, all surfaces shall be prepared and cleaned as specified and required. Surfaces shall be dry before any paint is applied. Special surface preparation work shall be as directed by the manufacturer of the paint specified to be applied to the surface. Paint shall not be applied before the prepared surfaces are approved.

3.1.5 Prior to painting steel, all welds, beads, blisters or protuberances, other than identification markings, shall be ground smooth. Pits and dents shall be filled, and other imperfections shall be removed. All rust, mill scale, oil, grease and dirt shall be removed by sandblasting in the shop in accordance with Societyof Protective Coatings Specification No. SP-10, Near White (SSPC-SP-10). Cleaned metal shall be primed the same day immediately after sandblasting to prevent rusting.

3.1.6 Prior to painting other metals, all welds, beads, blisters or protuberances, other than identification markings, shall be ground smooth and other imperfections shall be removed. All nonferrous metals, galvanized steel and stainless steel whether shop primed or field primed, shall be solvent-cleaned in accordance with SSPC-SP-1 prior to the application of the primer.

3.1.7 Pipe covering and duct covering shall have all adhering debris removed and indentations or unsightly spots smoothed out to an even surface and shall be brushed clean.

3.1.8 Concrete surfaces and concrete masonry shall be brushed and washed. All loose dirt, free lime, form oil, curing compounds and other foreign matter shall be removed by approved methods. Concrete surfaces requiring repair shall be patched and surfaces to receive paint shall be spackled and repaired. Concrete surfaces to be painted shall be acid-etched as recommended by the manufacturer of the coating to be applied to produce a slightly granular surface required for adherence of the paint to the concrete unless otherwise indicated. Concrete and concrete masonry shall be thoroughly dry prior to painting.

3.2 Protection of Non-Finish Items

3.2.1 Furnish and lay drop cloths or other means of protection for finished surfaces during the work.

3.2.2 Before painting, remove hardware, accessories, plates, lighting fixtures and similar items or provide ample protection of such items. Upon completion of work in each area, replace above items. Use only skilled mechanics for removing and replacing items.

3.2.3 If finished surfaces are damaged, entirely remove the stains or replace the damaged material, making good any damage to other work in connection therewith, without additional cost to the Department.

3.3 Application

3.3.1 The following items shall not be painted, unless otherwise specified: ducts, covering over ducts, registers, grilles, dampers and linkage, name and identification plates and tags, floor gratings, brass valves, stainless steel, wood, cast-iron piping installed underground.

(a) The following items shall be furnished with the manufacturer's standard prime and finish coats applied in the shop: pumps, motors, air compressors, wall fans, control and SCADA panels, panelboards, transformers, unit heaters, aluminum fascia, motor control centers, hoisting equipment.

(b) The following items shall be shop primed and field painted: structural steel and wrought metals, pipelines, hangers and supports, valves, valve operators and stands, guard housings, steel lintels, hollow metal doors and frames.

(c) All items not shop primed or shop finished shall be field primed and finished where exposed to view. The work shall generally include, but not be limited to, the following: interior concrete block, interior concrete walls, columns, beams and ceilings, covering over insulation on piping, electrical conduit, small piping and copper tubing, exterior PVC piping.

3.3.2 The work shall include all touch-up and remedial painting as required until the completion and acceptance of the final work.

3.3.3 Spray painting shall not be allowed.

3.4 Installation

3.4.1 Furnish equipment for the proper execution of the work. Erect and place same in such a way as not to interfere with work of other trades. Upon completion, dismantle and remove same from the job site.

3.4.2 Employ skilled mechanics to ensure good workmanship. Thoroughly mix materials immediately before application of paint. Surfaces shall be clean, dust free, dry and adequately illuminated. Each coat shall be thoroughly dry before applying succeeding coat.

3.4.3 Finished work shall be uniform and of approved color, smooth and free from runs, sags, and defective application. Edges of paint adjoining other materials or colors shall be sharp and clean, without overlapping. Before applying succeeding coats, primers and undercoats shall be completely integral and performing the function for which they are specified. Prepare and touch up scratches, abrasions, or other disfigurement and remove any foreign matter between successive coats.

3.4.4 Blast cleaned metal surfaces shall be coated immediately after cleaning, before any rusting or other deterioration or contamination of the surface occurs. Blast cleaned surfaces shall be coated not later than eight hours after cleaning under ideal conditions or sooner if conditions are not ideal.

3.4.5 Avoid degradation and contamination of blasted surfaces and avoid intercoat contamination. Clean contaminated surfaces before applying next coat. Ensure method of cleaning contaminated surface follows manufacturer's recommendations.

3.4.6 Primers and undercoats of paint and enamel shall be tinted or shaded different colors than the finish coats. Each coat of material shall be inspected and approved by the Engineer before application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the work in question shall be recoated. Inform the Engineer when each coat is ready for inspection and approval.

3.4.7 Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

3.4.8 Painting shall not be done when the temperature is below 10 degrees C (50 degrees F) and when satisfactory results cannot be obtained due to high humidity

or excessive temperatures. Paints or other finishes shall not be applied to wet or damp surfaces.

3.4.9 All painting shall be done in accordance with the paint manufacturer's recommendations.

3.4.10 All wall surfaces which will be concealed by equipment shall be painted before equipment installation.

3.5 Cleaning

3.5.1 Upon completion of painting work, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.5.2 Rubbish, debris, empty paint cans and discarded materials shall be placed in metal containers and removed from the site.

3.6 Schedule

3.6.1 Material Painting Schedule

Class of Work	Primer Shop Coat	Field or Shop Finish Coats 1st	2nd	3rd
Nonferrous Metal and Galvanized Steel:				
Interior		A	A	A
Exterior		A	A	C
Steel and Iron:				
Interior	B	B*	A	A
Exterior	B	B*	A	C
Submerged or Constantly Wetted	B	B*	D	D
Asphaltic Coated Steel		E*	A	A
Concealed in Masonry	B	B*		
Exposed to Potable Water	B	B*	B	F
Wrapped in Insulation	B	B*		
Exterior, Exposed to Process Wetting and Drying	B	B*	D	D
Concrete:				
Interior		A	A	A
Exterior		H	H	H

Pipe and Duct Insulation: Exposed	A	A
PVC	A	A

*Touch-up bare metal with primer.

3.6.2 Paint Schedule

(a) Alphabetical designations in the following list are given solely for the purpose of indicating the type and quality of materials desired. Equivalent material from other approved manufacturers may be substituted.

Symbol	Product Name and Number	Volume Solids %	Dry Film Thickness Micrometers	Mils Per Coat
A	Tnemec Series 66HS, Sherwin-Williams Macropoxy 646, or approved equal	69	51-76 um	(2.0-3.0 mils)
B	Tnemec Series 140-1225 Biege Pota-Pox Plus, Sherwin-Williams Macropoxy 5500, or approved equal	69	102-152	(4.0-6.0)
C	Tnemec Series 1074 Endura-Shield, Sherwin-Williams Hi-Solids polyurethane gloss, or approved equal	54	51-76	(2.0-3.0)
D	Tnemec Series 66HS, Sherwin-Williams Macropoxy 646, or approved equal	69	76-127	(3.0-5.0)
E	Tnemec Series 90-97 Tneme-Zinc, Sherwin-Williams Corothane I Mio-Zinc, or approved equal	63	64-89	(2.5-3.5)
F	Tnemec Series 140-WH02 (15BL) Pota-Pox Plus, Sherwin-Williams Macropoxy 5500, or approved equal	69	102-152	(4.0-6.0)

G	Tnemec Series 66HS, Sherwin-Williams Macropoxy 646, or approved equal	69	178-254	(7.0-10.0)
H	Tnemec Series 180 Acrylic Emulsion, Sherwin-Williams Loxon XP, or approved equal	44	102-152	(4.0-6.0)

3.6.3 Notes

(a) Where aluminum surfaces come in contact with incompatible metals, lime, mortar, concrete or other masonry materials, these areas shall be given one field coat of Tnemec Series 66HS, Sherwin-Williams Macropoxy 646, or approved equal.

(b) Stainless steel, where indicated shall be protected by two coats of clear acrylic lacquer conforming to the requirements of Military Specification MIL-L-81352A. Surface preparation shall consist of removing all oil and foreign matter by wiping clean with cloth and lacquer thinner.

(c) Applicable to insulated and uninsulated pipes: Steel pipe not available with a shop coat shall be prime coated in the field immediately after installation.

(d) Piping shall be painted up to and including the flanges attached to mechanical equipment. Electrical conduit shall be painted up to and including the flexible conduit connected to equipment.

(e) All steel pipes, ductile iron fitting and flanges located at the wet well, intermediate floor and discharge floor shall be shop finish painted before shipment. Provide field touch-up paint as required.

3.6.4 General Color Scheme

General color scheme shall be as follows:

(a) Exterior Concrete Walls - light.
(b) Interior Concrete Walls – beige.
(c) Interior Concrete Ceiling – white.
(d) Interior Grade Floor - gray.
(e) Interior Steel Frame and Metal Trim – light gray.
(f) Exterior Metal Trim (except aluminum and stainless steel) – light gray.
(g) Exterior piping and appurtenances – Turbine Blue.
(h) Interior piping – Turbine blue.
(i) Electrical Conduits – light gray.
(j) Fire protection equipment – standard red.
(k) Hoist Beams/Trolley – Safety yellow.

(l) Bollards (Guard Posts) – Safety yellow.

Note: Contractor to submit manufacturer's color chart for Engineer's selection.

END OF THIS SECTION

DIVISION 10 - SPECIALTIES

DIVISION 10 - SPECIALITIES

SECTION 10A - SPECIALTIES

1. GENERAL:

1.1 Description

1.1.1 This item of work includes the furnishing and installation of bulletin board, fire extinguishers, first aid kit, shop desk, nameplate, metal shelf, trash bins and related items to complete the work shown and specified.

1.1.2 Refer to Division 1 for additional requirements.

1.2 Related Sections

1.2.1 Section 5B - Bolts, Anchor Bolts, Expansion Anchors, and Concrete Inserts.

1.2.2 Section 9A – Painting.

1.3 Submittals

1.3.1 Submit shop drawings and product data under provisions of Section 1A.

1.4 Delivery, Storage and Handling

1.4.1 Delivery, storage and handling shall be in accordance with the provisions of Section 1A.

1.5 Warranty

1.5.1 Provide warranty under provisions of Section 1A.

1.6 Basis of Payment

1.6.1 Specialties shall be paid for as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for work described herein.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Bulletin Board

2.1.1 Furnish and install one (1) two panel bulletin board with glass doors as shown. Bulletin board panels shall be 1/4" cork mounted on hardboard. Doors shall have 1/4" glass and shall be continuously hinged with flat key tumbler locks. Overall dimensions shall be approximately 40" high, 60" long, 3" deep.

2.2 Station Identification Plate

2.2.1 Furnish and secure in position and location, one cast bronze tablet for each such required tablet. The tablet shall be made by a firm specializing in bronze tablet work and shall be of best grade of statuary bronze. Lettering shall be arranged as directed and of a style to be selected. All lettering and designs to be of embossed type, milled and polished. Background shall be pebble finish, left rough. A full-size rubbing shall be submitted for approval before casting.

2.2.2 Lettering shall read as shown on drawing.

2.3 Staff Gauges

2.3.1 Two staff gauges (one in the wet pit and one in the discharge chamber), calibrated in feet and tenths of a foot, shall be provided to show the depth of the water.

2.3.2 Each gauge shall be porcelain enameled iron rod. The rods shall be professional type, 2-1/2" wide minimum, with large bold markings of a height for the full height of the wet well.

2.3.3 Each staff gauge shall be attached and supported using corrosion resistant hardware at locations to avoid conflict with level controls, etc.

2.4 Shop Desk

2.4.1 A metal shop desk shall be provided. The desk shall have a 43 inch high work surface and shall be approximately 53 inches high by 34.5 inches wide by 30 inches deep. The unit shall have a rear top shelf riser, a 3.5 inch high drawer on nylon rollers and a large storage compartment with locking door and an adjustable shelf. The unit shall have 14 ga. corner posts and a minimum 20 ga. top and shall have a gray enamel painted finish.

2.5 First Aid Kit

2.5.1 Furnish and install a first aid kit with brackets for wall mounting as directed in the pump room and Electrical Control Room.

2.6 Fire Extinguishers

2.6.1 Furnish and install two fire extinguishers as directed. The extinguishers shall be multipurpose Dry Chemical Type with a U.L. rating of 20A: 120B: C, 20 pound capacity in enameled steel containers. The extinguishers shall be installed with wall brackets of size required for type and capacity of extinguisher indicated.

2.7 Clock

2.7.1 Clock shall be synchronous motor type, 12" face, 120 V. 60 Hz. Cord length shall be coordinated with electrical contractor to ensure it is adequate to reach nearest receptacle.

2.8 Metal Shelf

2.8.1 Metal shelf shall be approximately 53" long, 12.5" wide by 15" deep to be wall mounted avove the bulletin board.

2.9 Trash Can

2.9.1 Trash can shall be made of polyethylene and the capacity shall be approximately 40-50 gallon industrial type with wheels/casters.

3. EXECUTION:

3.1 Installation

3.1.1 Install the specified specialties in accordance with manufacturer's recommendations and instructions to permit intended performance.

3.1.2 The manufacturer or supplier of the specified specialties shall furnish a qualified field engineer for whatever period of time may be necessary to assist and direct the contractor in the proper installation of the equipment furnished, to observe and check initial performance, and whose duty shall include the instruction of the plant operating personnel in the proper operating and maintenance procedures.

3.2 Painting

3.2.1 The specified specialties shall be painted in accordance with applicable AWWA standard specified and with Section 9A of these specifications.

END OF THIS SECTION

SECTION 10B - FIBERGLASS REINFORCED PLASTIC PRODUCTS AND FABRICATIONS

1. GENERAL:

1.1 Related Documents

1.1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.2 Summary

1.2.1 This section includes the following FRP Products design, fabrications, and installation:

1. FRP Grating.
2. FRP Railing.
3. Grating Fasteners.
4. FRP Ladders.
5. FRP Structural Shapes.
6. FRP Stairs and Platforms.

1.3 Scope of Work

1.3.1 Furnish all labor, materials, equipment and incidentals necessary to install the fiberglass reinforced plastic (FRP) products as specified herein.

1.4 Quality Assurance

1.4.1 The material covered by these specifications shall be furnished by a reputable and qualified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.

1.4.2 Substitution of any component or modification of system shall be made only when approved by the Architect or Engineer.

1.4.3 Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

1.4.4 In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.5 Design Criteria

1.5.1 The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.

1.5.2 Design of FRP live loads on grating shall not be less than 100 pounds per sq. ft. Grating deflection at the center of a simple span not to exceed the lesser of 0.375 inch or clear span divided by 125.

1.5.3 Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members. Connections shall be designed to transfer the loads.

1.6 Submittals

1.6.1 Shop drawings of all FRP structural members, handrails, gratings, plate, ladders and appurtenances shall be submitted to the Engineer for review.

1.6.2 Manufacturer's catalog data showing:

1. Dimensions, spacings, and construction of grating.
2. Design tables showing limits for span length and deflection under various uniform and concentrated loads.
3. Materials of construction.
4. Chemical resistance table

1.6.3 Detail shop drawings showing:

1. Dimensions.
2. Sectional assembly.
3. Location and identification mark.
4. Size and type of supporting frames required.

1.6.4 All shop drawings shall be sealed by Structural Engineer registered in the State of Illinois.

1.7 Shipping and Storage Instructions

1.7.1 All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.

1.7.2 Items shall be covered and protected from exposure to sun or ultra violet light during storage.

1.7.3 All materials and equipment necessary for the fabrication and installation of the grating, plate, handrails, structural shapes and building panels shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.

1.7.4 Identify and match-mark all materials, items, and fabrications for installation and field assembly.

1.8 Basis of Payment

1.8.1 FRP products shall be paid for as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for work described herein.

1.8.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 General

2.1.1 Materials used in the manufacture of the FRP products shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

2.1.2 All materials shall be of the kind and quality specified, and where the quality is not specified, it shall be the best of the respective kinds and suitable for the purpose intended.

1. Resins shall be VINYL ESTER resin for ladders and cages and other members that may be submerged in the wet well or discharge chamber and in continuous contact with sewage.

2. Resins for members for exterior or dry service shall be either polyester or vinyl ester resin.

2.1.3 After fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating to prevent intrusion of moisture.

2.1.4 All exposed surfaces shall be smooth and true to form.

2.1.5 FRP Manufacturers:

1. Strongwell Corporation.
2. Fibergrate Composite Structures.
3. Bedford Reinforced Plastics.
4. Or approved equal.

2.1.6 Grating Fastener Manufacturers:

1. As recommended by grating manufacturer.

2.2 Gratings

2.2.1 General

1. Grating shall be shipped from the manufacturer, palletized and banded with exposed edges protected by cardboard to prevent damage in shipment.

2. Each piece shall be clearly marked showing manufacturer's applicable drawing number.

2.2.2 All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

2.2.3 Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.

2.2.4 Resin shall be Vinyl Ester, Isophthalic Polyester, Polyester *or* Modified Acrylic, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

2.2.5 All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

2.2.6 All grating products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test. Gratings shall also have tested burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per ASTM D635.

2.2.7 All mechanical grating clips shall be manufactured of Type 316SS (stainless steel).

2.2.8 Pultruded I-bar grating with bearing bars at 1 ½ in o.c. and cross bars at maximum 12 in o.c.

2.2.9 Measurements: Grating supplied shall meet the minimum dimensional requirements as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work.

2.2.10 Determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication. Provide additional support bars, hold-downs or framing as required for cutouts shown on plans.

2.2.11 Sealing: All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

2.3 Grating Fasteners

2.3.1 Grating fasteners shall be Type 316 stainless steel saddle clips or C-clips.

2.3.2 Fasteners shall allow grating panels to be secured to structural steel beam supports without field drilling, welding or otherwise damaging steel coating. Each outside panel edge and/or corner of gratings supported by structural steel I-beams or channel beams shall be secured to structural steel support with stainless steel G-clips specifically designed for securing grating shapes to steel members without drilling or damaging steel surface coating. Hold-down clips shall be provided and spaced at a maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

2.4 Structural Shapes and Plate

2.4.1 Structural shapes and plate shall be made from a premium grade polyester or vinyl ester resin.

2.4.2 Structural shapes and plates shall be manufactured by the pultrusion process.

2.4.3 Structural FRP members composition shall consist of a glass fiber reinforced polyester or vinyl ester resin matrix, approximately 50% resin to glass ratio. A synthetic surface veil shall be the outermost layer covering the exterior surfaces. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats shall be used internally for transverse strength.

2.4.4 Structural members shall be designed to support all applied loads. Deflections in any direction shall not be more than L/150 of span for structural members. Connections shall be designed to transfer the loads.

2.5 Fiberglass Ladders

2.5.1 Ladders shall be fiberglass reinforced plastic (FRP) constructed of siderails, rungs, and brackets.

2.5.2 Resins for ladders shall be vinyl ester resin.

2.5.3 All finished surfaces of FRP items and fabrication shall be smooth, resin-rich, free of voids, and without dry spots, due to wear or weathering. All pultruded structural shapes shall be further protected for ultraviolet (UV) light.

The side rails and rungs shall be fiberglass reinforced pultruded structural shapes pigmented throughout in OSHA safety yellow.

The side rail shall be 1-3/4" square tube or greater with a wall thickness of 1/4" or greater. The rungs shall be 1" diameter or greater pultruded structural shapes, continuously fluted or gritted to provide a non-slip surface.

Type 304 or 316 stainless steel bolts shall be used for connecting brackets and other components to ladder.

Ladders systems shall meet the load and design requirements set forth in OSHA 1910.27 (latest edition). The ladder shall also be capable of supporting a concentrated vertical load of 1,200 pounds applied at the mid-span of the rung.

2.5.4 Ladders shall be fully shop assembled. All rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both epoxy and rivets to provide both a chemical and mechanical lock, respectively.

3. EXECUTION:

3.1 Preparation

3.1.1 Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 Inspection and Testing

3.2.1 The Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.

3.2.2 All labor, power, materials, equipment and appurtenances required for testing shall be furnished by the Contractor at no cost to the Department.

3.2.3 Members and components shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits.

3.3 Installation, General

3.3.1 Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required.

3.3.2 Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

3.3.4 Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

3.3.5 At all unsupported cutouts, install hold downs at uncut bearing bars beyond cutout area and install support bars from hold down to hold down. Lock grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products.

3.3.6 Install items specified as indicated and in accordance with manufacturer's instructions.

END OF SECTION

DIVISION 14 – CONVEYING SYSTEMS

DIVISION 14 - CONVEYING SYSTEMS

SECTION 14A - HOIST EQUIPMENT

1. GENERAL:

1.1 Section Include

1.1.1 Hand-operated trolley hoists.

LOCATION	CAPACITY (TON)	OPERATING LIFT (FEET)
Pump Room	1	53

1.2 System Description

1.2.1 Design Requirements:

(a) Design and fabrication of hoist shall be in accordance with the applicable requirements of HMI-200.

(b) Operating chains of hoist shall loop not more than 4 ft above the finished operating floor.

1.3 References: Equipment shall meet the requirements of the following specifications unless more stringent requirements are otherwise specified:

1.3.1 ANSI B30.16 - Safety Standard for Overhead Hoists.

1.3.2 HMI 200 – Standard Specification for Hand-Operated Chain Hoist.

1.4 Submittals

1.4.1 Product Data:

(a) Details of trolley hoists

(b) Operation and Maintenance data.

1.4.2 Submit in accordance with Section 1A.

1.5 Quality Assurance

1.5.1 Proportion parts of mechanism for stresses that occur during continuous operation, during installation, and during fabrication.

1.6 Basis of Payment

1.6.1 Trolley hoists shall be paid for as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for work described herein.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 ACCO Material Handling Solutions.
2.1.2 Budgit Hoists.
2.1.3 Columbus McKinnon Corporation.
2.1.4 Substitutions: Under provisions of Section 1A.

2.2 Trolley hoists

2.2.1 Plain push type.
2.2.2 Compatible with monorail beam.
2.2.3 Operating chain and lift chain shall be zinc plated.
2.2.4 Trolley hoist shall have corrosion resistant.
2.3.5 Provide chain container for each hoist.
2.3.6 Hooks shall have spring latches and be supported on thrust bearing allowing 360 degree rotation under capacity load.

2.3 Marking

2.3.1 Permanently mark capacity of hoists and trolleys on each hoist and trolley.

3. EXECUTION:

3.1 Installation

3.1.1 Install hoist as shown on Drawings, in accordance with approved submittals and manufacturer's recommendations.

3.2 Field Quality Control

3.2.1 Field load test hoist in accordance with OSHA, ANSI, and local requirements.

END OF SECTION

DIVISION 15 - MECHANICAL

DIVISION 15 - MECHANICAL

SECTION 15A - GENERAL MECHANICAL PROVISIONS

1. GENERAL:

1.1 Section Includes

1.1.1 The scope of work under this Division shall be all mechanical work required for the project work as shown or specified.

1.1.2 The mechanical work shall include the furnishing and installing of various items of mechanical equipment and appurtenances. Unless otherwise specifically indicated, electrical work shown on the electrical drawings shall be provided under Division 16. Any additions or modifications to the work shown on the electrical drawings required for the proper installation or operation of work under this Division shall be provided under this Division, at no additional cost to the Department, in conformance with the requirements of Division 16. The Contractor shall be responsible for ascertaining the extent of electrical connections required for items furnished under this Division, for ascertaining the extent of electrical work shown on the electrical drawings and for coordinating the electrical work accordingly.

1.1.3 The specifications and drawings are intended to generally define the work required, but they do not include every equipment and installation detail. The work shall include all items and appurtenances required to fully complete the work and provide functional pump station conforming to the current operation philosophy, whether specifically identified or not, such that the electrical systems are complete and operational.

1.1.4 Furnishing and installing of work under this Division shall comply with Division 1 requirements relating to the furnishing and installing of work.

1.2 Code Compliance

1.2.1 Unless otherwise indicated, in the absence of more stringent requirements in the Specifications or on the Drawings, the work shall be in compliance with the requirements of applicable codes, as a minimum.

1.3 Standards

1.3.1 Wherever the following abbreviations are used in these Specifications, or on the Drawings, they are to be construed the same as the respective expressions represented:

MHSWPS	Manual for Highway Storm Water Pumping Station
AASHTO	American Association of State Highways and Transportation Officials
ANSI	American National Standards Institute

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWWA	American Water Works Association
IPCEA	Insulated Power Cable Engineers Association
IES	Illuminating Engineering Society of North America
	Illinois Plumbing Code
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
OSHA	Occupational Safety and Health Administration
UL	Underwriter's Laboratories
HIS	Hydraulic Institute Standard
FM	Factory Mutual
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association

1.3.2 Wherever a reference is made to a standard or standard specification, the reference shall be to the edition current at the time of bidding, including any revisions or amendments.

1.4 Verification of Contract Drawings

1.4.1 The Contractor shall familiarize himself with the details of the total construction insofar as they may affect the work under this Division, including floor elevations, physical dimensions of structures, materials of construction and the nature of work required under other Divisions. No additional compensation will be granted for failure to consider the total project work.

1.4.2 The contract drawings (Drawings) for electrical work are generally diagrammatic and do not necessarily depict all items to scale. The Drawings indicate the general locations of major elements of the work, however, field conditions or interferences, may require changes in the installation. The Contractor shall coordinate his work to avoid interferences and shall obtain approval prior to making any changes from the installation shown.

1.4.3 Prior to installation, the Engineer may make reasonable minor changes in the locations of the installation without additional cost to the State.

1.4.4 The electrical work shown on the electrical drawings (or on electrical portions of multi-trade drawings) shall be provided under Division 16. Any changes in the electrical installation required for the proper installation or operation of items provided under this Division shall be provided under this Division in full conformance with the requirements of Division 16. In other words, if a change to the electrical work is required to accommodate equipment provided under Division 15, that electrical change shall be the responsibility of Division 15 and it must be in full compliance with the requirements of Division 16.

1.5 Coordination

1.5.1 The Contractor shall coordinate the work under this Division with the work of other trades. This shall include an orderly exchange of information and shall be accomplished such that the total work is not delayed and that interferences are avoided.

1.6 Workmanship

1.6.1 The mechanical work shall be performed in a neat and workmanlike manner in accordance with the best practices of the trade.

1.6.2 Unless otherwise indicated, all materials and equipment shall be installed in accordance with the codes, contract requirements and manufacturer's recommendations.

1.7 Protection of Work

1.7.1 All mechanical work, including equipment and appurtenances, shall be protected from damage until final acceptance. Equipment shall be covered to protect against dirt, moisture, paint and the like. The work shall be protected from mechanical injury by appropriate covering or shielding.

1.7.2 Prior to final acceptance, protective measures shall be removed and equipment and items shall be cleaned as required to deliver the installation to the State in clean, undamaged condition.

1.8 Clean-up and Safety

1.8.1 The work site shall be maintained in a clean condition, free of hazards, all in conformance with the requirements of Article 104.06 of the Standard Specifications. Special care shall be taken to assure that systems are not left in a hazardous condition.

1.9 Materials and Equipment

1.9.1 Quality

(a) All materials, equipment and appurtenances shall be new, shall be suitable for the application and shall be the product of established, reputable manufacturers.

1.9.2 Standards

(a) The construction, sizes, ratings and capacities of items shall be in conformance with the requirements of the codes and with ASTM and ASME standards, as applicable.

1.9.3 UL and/or FM Label

(a) Unless otherwise indicated, materials and equipment shall bear the UL and/or FM label whenever such labeling is available for the type of material or equipment being furnished.

1.9.4 Other Requirements

(a) Refer to Division 1 for other requirements relating to materials and equipment.

1.10 Erecting and Jointing Interior Piping

1.10.1 Description

(a) This section includes furnishing of supports and hangers and installation of all interior piping and supports.

(b) Piping of the materials, coatings and linings shown or specified shall be installed and supported at the locations specified or where shown.

1.10.2 Delivery, Storage and Handling

(a) All products and materials shall be delivered, stored and handled as specified in Division 1.

(b) Extreme care shall be taken in loading and unloading the pipe and fittings. The work shall be done slowly using skids or suitable power equipment keeping the pipe under control at all times.

(c) Under no condition is the pipe to be dropped, bumped, dragged, pushed or moved in any way which will cause damage to the pipe, lining or coating.

(d) When handling the pipe with a crane, a suitable pipe hook or sling shall be used around the pipe. Under no condition is the sling to be allowed to pass through the pipe unless adequate measures are taken to prevent damage to the pipe ends, lining and coating.

(e) Any piping or fittings damaged in the process of delivery, storing, handling, or laying shall be replaced or repaired as approved.

1.10.3 The interior of pipelines shall be cleaned of all dirt and superfluous material of every description in an approved manner.

1.10.4 All bolts shall be primed by dipping with a bituminous coating, except the threads, which are coated immediately prior to installation of the nuts.

1.10.5 All threads shall be coated with a suitable pipe dope, Masters Metallic Compound, Loctite, or equal, before jointing.

1.10.6 Installed piping shall be free of sags or bends.

1.10.7 Piping shall be installed to allow for expansion and contraction without stressing pipe, joints or connected equipment.

1.10.8 The fire rated integrity shall be maintained where pipes pass through fire rated walls, partitions, ceilings, and floors.

1.10.9 Pipelines shall be fitted and installed in a neat and workmanlike manner in accordance with approved shop drawings.

1.10.10 Flanged joints shall be made with bolts or bolt studs with a nut on each end.

1.10.11 Welding of pipe joints shall conform with the requirements of ANSI B31.1 unless otherwise specified. All off site welding of steel pipe shall conform to the appropriate requirements.

(a) Pipe and fittings with wall thickness of 3/16-inch and larger shall have ends beveled for welding. Parts to be welded shall be securely held in place and in proper alignment during welding.

(b) The abutting pipe ends shall be separated before welding to permit complete fusion to the inside wall of the pipe without overlapping.

(c) Welding shall be continuous around the joint and completed without interruption.

(d) Welds shall be of the single vee butt type, of sound weld metal thoroughly fused into the ends of the pipe and into the bottom of the vee.

(e) Welds shall be free from cold shuts, pinholes, oxide inclusions or other defects.

1.10.12 Anchors and stands shall be furnished and installed when specified, shown, or required for holding the pipelines and equipment in position or alignment.

Where adjustable supporting devices are not required, pipelines 3 inches in diameter and smaller shall be supported on cast-iron, malleable iron, or steel hooks, hook plates, rings or ring plates.

1.10.13 Hangers and Supports

(a) Pipe hangers shall be provided at each change in pipe direction at minimum spacing recommended by manufacturer or reference standards, on both sides of pipe mounted valves and equipment and on both sides of pipe loops and expansion absorbing devices.

(b) Brackets shall be used for the support of piping from vertical surfaces.

(c) Anchors shall be furnished and installed when specified, shown, or required for holding the pipelines and equipment in position or alignment.

(d) Hangers and supports shall be installed to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

(e) Hangers shall be adjusted to distribute loads equally on the attachment and to achieve any indicated slope of the pipe.

(f) Supports shall be stainless steel in all areas except galvanized steel where specified in Section 15E.

1.10.14 For sleeve type couplings, equally tighten diametrically opposite bolts on the coupling to bring the gaskets up evenly all around the pipe. Final tightening shall be done with torque wrenches set for the torque recommended by the coupling manufacturer.

1.10.15 All piping shall be installed in accordance with the manufacturer's recommendations and approved Shop Drawings and as specified in Division 1.

1.10.16 After installation of the interior piping and supports, control equipment and all appurtenances, the units shall be subjected to a field running test, as specified in Division 1, under actual operating conditions. Where field welding of pipe joints shown, specified, permitted, or required meet the requirements of ASME/ANSI B31.1 -Power Piping, Chapter VI Section 137.4 Hydrostatic Testing. Testing of pipelines shall be in accordance with the requirements of Division 15A Section 12.

1.11 Leakage Tests

1.11.1 Leakage tests shall be performed for any signs of leakage in all pipelines and structures required to be watertight.

1.11.2 Leaks shall be repaired by replacing broken pipe or joint assemblies found to leak at no addition to the Contract Price.

1.12 Testing

1.12.1 All mechanical equipment and systems provided under this Division shall be adjusted and tested. The Contractor shall adjust, repair or replace faulty or improper Division 15 work or equipment discovered during testing.

1.12.2 Tests may be made progressively as portions of the work are complete.

1.12.3 Tests shall be made in the presence of the Engineer.

1.12.4 A written record of tests shall be maintained by the Contractor and, when complete, it shall be submitted for the record.

1.12.5 The Contractor shall perform all tests necessary to assure proper functioning of materials and equipment. Specific special required tests shall be as described in individual equipment specifications, however, the absence of a specific test requirement does not relieve the Contractor from responsibility to adequately test the equipment and systems for proper operation.

1.12.6 Except where otherwise specifically indicated, testing must be complete prior to final inspection. All instruments, tools, etc., required for the tests shall be provided by the Contractor. Additional testing may be requested by the Engineer during final inspection to spot-check test results or to demonstrate proper functioning of the systems. These tests shall be performed by the Contractor at no additional cost to the State.

1.13 O&M Manuals and Data to be Filed with the Engineer

1.13.1 Legible 11"x17" shop drawings and O&M manuals, as specified in Section 1A and herein, shall be furnished to the Engineer when installation is complete, before testing and final acceptance.

1.13.2 As a minimum, the O&M manuals shall include:

(a) A table of contents.

(b) Approved, final shop drawings and product data for all equipment and materials incorporated in the work under this Division.

(c) Tabulation of motor & equipment name plate data.

(d) Manufacturer's maintenance manuals for all equipment furnished under this Division for which maintenance is recommended by the manufacturer.

1.13.3 All data shall be neat and clearly legible. The table of contents and tabulations of set points and other recorded test data shall be typed. Sloppy, illegible, inaccurate, or incomplete data and title block without drawing numbers shall not be accepted.

1.13.4 See Division 1 for further requirements.

1.15 Record Drawings

1.15.1 Record drawings shall be prepared and submitted in accordance with Division 1.

1.15.2 Alterations and additions to the mechanical installation depicted on the contract drawings which are made during the execution of the work shall be neatly and plainly marked in red on a set of Record Drawings kept at the contractor's field office for the project. These drawings shall be updated as the work progresses and shall be available for inspection by the Engineer at all times during the course of the work.

1.16 Final Acceptance Inspection

1.16.1 When the work is complete, tested and fully operational, and only after the Record Drawings have been reviewed and accepted, the Contractor shall schedule a Final Acceptance Inspection with the Engineer.

1.16.2 The Final Acceptance Inspection shall be made for the complete work at the facility as a whole and shall be as further described in Section 105 of the Standard Specifications.

1.17 Guarantees

1.17.1 Guarantees shall be provided for equipment, materials and work provided under this Division as specified in Division 1.

1.18 Maintenance

1.18.1 During the course of the construction work and until final acceptance, the Contractor shall be responsible for maintenance and operational integrity of the facility as specified in Division 1.

1.19 Basis of Payment

1.19.1 Work required to comply with this Division shall be paid as specified under each individual Section, which shall be payment in full for the work described.

1.19.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

Not Used

3. EXECUTION:

Not Used

END OF THIS SECTION

SECTION 15B - BASIC MECHANICAL MATERIALS AND METHODS

1. GENERAL:

1.1 Description

1.1.1 Basic materials and methods specified herein shall be incorporated in the work wherever applicable unless specifically indicated otherwise.

1.1.2 The basic materials and methods specified herein are intended to define a minimum standard of quality and workmanship.

1.2 Concrete

1.2.1 Concrete for equipment bases and other work under this Section shall be provided under this Section in conformance with Division 3.

1.3 Cutting and Patching

1.3.1 All cutting and patching of building materials required for work under this Section shall be provided under this Section.

1.3.2 Cutting and patching shall be provided under this Section in conformance with Division 1.

1.4 Fasteners

1.4.1 Fasteners used to mount pipe supports and other items attached to the structure shall be suitable for the weight supported and shall be compatible with the structure material, i.e. wood screws shall be used for wood, toggle bolts shall be used for hollow masonry, expansion bolts or power-set studs shall be used for solid masonry or concrete and clamps shall be used for structural steel.

1.4.2 Installation shall conform to requirements of Division 5 - Metals.

1.5 Support and Anchors

1.5.1 This section includes requirements for designing and providing all hanging and supporting devices of construction shown, specified, or required for pipelines, apparatus, HVAC system, plumbing, miscellaneous system, and equipment other than electrical equipment. Installation shall conform to requirements of Division 5 - Metals.

1.5.2 Submittals

(a) All submittals, including the following, shall be provided as specified in Division 1.

(b) Shop drawings shall be submitted to show the quantity, type, design and location of all supports, hangers and anchors required.

1.5.3 Supporting devices adequate to maintain the pipelines, apparatus, and equipment in proper position and alignment under all operating and testing conditions with due allowance for expansion and contraction shall be provided. Installation shall conform to requirements of Division 5 - Metals.

1.5.4 Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Supporting devices shall accommodate loads imposed during leakage tests for the test pressures specified. The required strength of supporting devices shall be based on the combined weight of the piping and connected equipment, the weight of the denser of the fluids used in operations or testing and the weight of insulation where applicable. Supports shall be installed with a working safety factor of not less than 5. Installation shall conform to requirements of Division 5 - Metals.

1.5.5 Springs shall be provided where necessary. Hangers and supports shall be of standard design where possible and shall be best suited for the service required. Proper pipe protection saddles shall be included for hangers and supports on pipes which are covered with insulation. Where required, supports shall be screw adjustable after installation unless approved otherwise. Installation shall conform to requirements of Division 5 - Metals.

1.5.6 All supporting devices shall be designed to minimize interference with access and movement. Eliminate the potential for injuries due to protruding supporting devices. Installation shall conform to requirements of Division 5 - Metals.

1.5.7 All piping supports, hanger rod size, brackets and spacing shall meet the requirements of ANSI/ASME B31.1, MSS SP-58, SP-69, SP-89 and SP-90 except as modified herein. Installation shall conform to requirements of Division 5 - Metals.

1.5.8 All products and materials shall be delivered, stored and handled as specified in Division 1.

1.5.9 Structural and miscellaneous steel, metal castings, ductile iron pipe and fittings, steel pipe and fittings, and supports meeting the requirements of Division 5 - Metals shall be used.

1.5.10 Overhead hangers shall be supported using threaded rods properly fastened in place by suitable screws, clamps, inserts, or bolts, or by welding. Hangers shall be subjected to tensile loading only. Where lateral or axial movement may occur, suitable linkage shall be provided to permit sway. Installation shall conform to requirements of Division 5 - Metals.

1.5.11 Suspended piping shall be supported by adjustable ring or clevis hangers and threaded rods from heavy duty concrete inserts or other fastening devices, except as otherwise specified or noted. Installation shall conform to requirements of Division 5 - Metals.

1.5.12 Brackets shall be of welded steel and designed for the following load classifications:

Load Classification	Maximum Load per Bracket
Light	750 pounds
Medium	1,500 pounds
Heavy	3,000 pounds

When medium or heavy brackets are bolted to vertical surfaces, backplates of adequate size and thickness shall be furnished and installed to distribute the load against the vertical surfaces. When the use of backplates is not practicable, the brackets shall be fastened to the vertical surfaces in such a manner that the safe bearing strength of the vertical surfaces will not be exceeded.

1.5.13 Piping shall be connected, supported and guided to permit and control pipe expansion and contraction and to accommodate building expansion, contraction and settling without damage to the piping or support system.

(a) Anchors shall be furnished and installed when specified, shown, or required for holding the pipelines and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures, either directly or through brackets.

(b) Anchors shall be cast-iron chair type anchors for piping with steel straps, except where anchors form an integral part of pipe fittings or where an anchor of special design is required.

(c) Insert material shall be stainless steel. Inserts shall be designed to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically. Inserts shall be recessed near the upper flange to receive reinforcing rods. Inserts shall be designed so that they may be held in position during concrete placing operations. Inserts shall be designed to carry safely the maximum load that can be imposed by the rod which they engage.

1.5.14 Hanger and supports shall be installed in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1 and Section 15A.

1.5.15 Supports shall be stainless steel in all areas except galvanized steel where specified in Section 15E.

1.5.16 Hangers, supports, anchors, and similar devices shall be painted as specified in Division 9.

1.5.17 Field welds, bolted connections and abraded areas shall be cleaned and painted as specified in Division 9.

1.6 Basis of Payment

1.6.1 The work required to comply with this Division shall be paid as specified under each individual Section, which shall be payment in full for the work described.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

Not Used

3. EXECUTION:

Not Used

END OF THIS SECTION

SECTION 15C - PIPING AND APPURTENANCES

1. GENERAL:

1.1 Section Includes

1.1.1 The work specified herein includes furnishing and installing all piping, fittings, valves, and accessories, required for a complete and satisfactorily working installation as shown and specified.

1.2 Related Sections

1.2.1 Section 5C - Bolts, Anchor Bolts, Expansion Anchors, and Concrete Inserts.
1.2.2 Section 9A – Painting.
1.2.3 Section 15A - General Mechanical Provisions.
1.2.4 Section 15B - Basic Mechanical Materials and Methods.
1.2.5 Section 15D - Pumping Equipment.

1.3 Submittals

1.3.1 Submit shop drawings and product data under provisions of Sections 1A and 15A.

1.3.2 Submit detailed drawings and data on pipe fittings, valves, slide gate, actuators and appurtenances and as specified under individual subsection.

1.3.3 Pipe and equipment manufactures' submittals as specified under individual subsection.

1.3.4 A certification of the welder's qualification, in conformity with the requirement of the code, shall be submitted to the engineer.

1.4 Delivery, Storage and Handling

1.4.1 Delivery, storage and handling shall be as specified under Section 1A.

1.5 Warranty

1.5.1 Provide warranty under provisions of Section 1A.

1.6 Basis of Payment

1.6.1 The piping and appurtenances work shall be paid as part of the contract lump sum price for

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which shall be payment in full for the work described herein.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Water Piping

2.1.1 General

(a) All piping shall be generally arranged and aligned as shown and specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the ENGINEER.

(b) Piping shall be installed as directly as possible between connecting points insofar as the work of other trades permit. Where interference occurs with another trade whose work is more difficult to reroute, the Contractor shall revise the routing as required to avoid subject interferences. Piping shall be carefully installed to provide for proper alignment, slope and expansion.

(c) To allow for expansion and contraction, pipe shall be guided and supported in such manner that pipe lines shall not creep, sag or buckle. Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping. Pipe support shall not be limited to support indicated on the drawings.

(d) Small tubing to gauges, controls, or other equipment, installed on any apparatus shall not be coiled nor excessive in length but shall be installed neatly, carefully, bent at all changes in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

(e) Prior to the start of any piping installation work, the Contractor shall prepare and submit for approval detailed piping installation drawings. These shall be prepared on the basis of actual equipment being furnished and actual dimensions of walls, openings and other significant elements.

(f) Piping and appurtenances shall conform to applicable Section 1006, METALS, of the Standard Specifications.

2.1.2 Ductile Iron Pipe and Fittings

(a) Ductile iron pipe shall meet the requirements of AWWA C151, Class 53 for exposed interior piping and buried piping.

(b) Ductile iron fittings shall have flanged joints or mechanical joints as shown or specified.

(c) Fittings shall be provided as shown and specified and shall be ductile iron meeting the requirements of AWWA C110.

(d) Pipe shall be installed in maximum lengths of 10 feet.

(e) Buried piping shall have restrained mechanical joints. Anchor bolts and nuts shall be "Cor-Ten" type steel for buried pipe installation per Section 5E.

2.1.3 Flanged Connections

(a) Flanged connections shall be made as shown and specified. All flanges shall be drilled in conformance with the 125/150 ANSI Standard template.

(b) Class 150 pound steel flanges shall be smoothed finished (flat faced) for connection to dissimilar metals such as cast iron.

(c) Flanged joints shall be made with bolts or bolt studs with a nut on each end. Bolts, stud bolts, and nuts shall meet the requirements of ASTM A 307 Grade B and ASME B16.1 and Section 5E. Bolts shall have a 1/4-inch projection beyond the nut when joint with gasket is assembled.

(d) Rubber gaskets for flanged joints shall meet the requirements of AWWA C207 as modified and supplemented herein. Gaskets shall be 1/8-inch thick. Gaskets shall be full face.

2.1.4 Wall Pipe

(a) Wall pipe shall be furnished and installed for all storm water piping passing through walls, as shown. Wall pipe material, thickness and coatings shall be the same as the connected piping.

(b) Wall pipe shall meet the requirements of AWWA C110.

(c) Wall pipe shall have an integrally cast intermediate collar located at the center of the wall.

2.1.5 Temporary bulkheads shall be provided at the ends of pipeline sections where adjoining pipelines have not been completed and are not ready to connect. Temporary bulkheads shall be removed when they are no longer needed.

2.1.6 Polyvinyl Chloride (PVC) Pipe and Fittings

(a) PVC pipe and fittings shall be Schedule 80 meeting the requirements of ASTM D 1784 Class 12454-B and ASTM D 1785.

(b) Joints shall be ASTM D 2855 solvent welded joints utilizing ASTM D 2564 solvent cement.

2.1.7 Submittals

(a) All submittals, including the following, shall be provided as specified in Division 1 with the following stipulations.

(b) The following shop drawings shall be submitted.

1) Flanged, screwed, welding and mechanical coupling fittings and pipe, couplings, harnessing and special fittings. When special designs or fittings are required, the Work shall be shown in large detail and the special or fitting shall be completely described and dimensioned.

2) Fully Dimensioned layout of pipe, fittings, couplings, sleeves, expansion joints, supports, anchors, harnessing, valves and equipment. Pipe size, type and materials shall be labeled on drawing and a schedule shall be included.

3) Cross sections showing elevation of pipe, fittings, sleeves, couplings, supports, anchors, harnessing, valves and equipment.

4) Catalog data for pipe, couplings, harnessing and fittings.

(c) The following certifications shall be submitted:

1) Certificate of compliance for pipe, fittings, restrained flange adapter, gaskets, specials, and coatings in accordance with this Division.

2) A certification of the welder's qualifications.

2.1.8 Quality Assurance

(a) Certified welders, having current certifications conforming to the requirements of the ANSI code shall perform all welding on steel pipelines.

2.1.9 Painting and Coating

(a) All pipe and fittings shall be lined and coated in accordance with the piping schedule. All bolts, nuts, couplings and the like shall be coated after the joint has been made.

(b) Ductile-iron pipe and fittings shall be shop coated on the outside with one coat of liquid epoxy primer Symbol B as specified in Section 9A, 4.0 mils minimum dry thickness, for use in exposed locations, such as inside buildings, where finish painting or insulating is required.

(c) Pipe for use not exposed to view shall also be coated with liquid epoxy primer Symbol B as specified in Section 9A.

(d) Immediately after facing and drilling, the back of the flanges and bolt holes shall be coated with liquid epoxy primer coating meeting the requirements of AWWA C210.

(e) The weight and class designation shall be conspicuously painted in white on the outside of each pipe, fitting, and special casting after the shop coat has hardened.

(f) Painting shall be in accordance with Section 9A and meeting the requirements of AWWA C210.

(g) Galvanizing: Provide galvanizing in accordance with ASTM A 53 where shown or specified.

(h) PVC pipe and fittings shall not be painted or coated.

(i) Sleeve –type Couplings

1) Couplings shall be shop coated with liquid epoxy primer in accordance with Section 9A and meeting the requirements of AWWA C210.

2.2 Discharge or Recirculation Knife Gate Valve

2.2.1 Valve shall be of wafer face-to-face design with full diameter flanges having through pipe flange bolt holes to permit independent upstream or downstream pipe flange removal without affecting the shut-off or body shell pressure rating of the valve.

(a) Body shell pressure rating shall be minimum 50 psi.

(b) Shut-off pressure rating shall be minimum 50 psi.

2.2.2 The valve body shall be tested at 1.5 times the rated pressure and the valve gate at 1.1 the rated pressure while in the fully shut position with zero leakage permitted past the seat or to the exterior of the valve.

(a) Valve body material shall be cast 316 stainless steel.

(b) Gate shall be type 316 stainless steel.

2.2.3 Resilient seat ring material shall be type 316 stainless steel and seat material shall be natural or synthetic rubber material suitable for the application. The packing shall be a mixture of PTFE fibers and grease compounded to permit ease of handling but with sufficient fluidity to transmit equal sealing pressure across the full length of the packing chamber.

2.2.4 The actuator support structure of the valve shall be fabricated of carbon steel. If external support of the actuator is required to insure overall valve performance, the valve manufacturer shall include suitable located support brackets with instructions for proper support and alignment. The valve yoke shall be of sufficient strength to withstand five times the maximum operating torque and thrust.

(a) The drive stem shall be of chrome steel.

(b) The stem drive nut shall be of bronze.

(c) Yoke bearings shall be cast bronze.

(d) All mechanical fasteners shall be cadmium plated.

2.2.5 The valve shall be furnished with a resilient seat which seals around the edge, not the face, of the gate and shall be mechanically retained without the use of

adhesives. The seat design shall provide drip-tight shut-off at the fully rated pressure difference in either direction.

2.2.6 The packing shall be a square braided PTFE impregnated synthetic fiber material.

2.2.7 The valve shall have scraper blades on both sides of the gate to wipe the faces of the gate clean of any media prior to contact with the packing.

2.2.8 Both faces of gate shall have a surface finish of 16 microinch to insure ease of operation and seal performance.

2.2.9 The gate shall be guided for the full length of the stroke and supported to withstand full rated shut-off pressure in either direction for the full length of valve stroke. The interior of the valve port shall be contoured to insure self cleaning of the valve. The resilient seat in the bottom port area of the valve shall be flush with the port area and shall not form a cavity in which debris can collect.

2.2.10 Valve furnished electric motor actuator shall be of rising or non-rising stem design.

2.2.11 All non-stainless steel metal surfaces shall be painted with a zinc free primer.

2.2.12 Provide valve open and close mechanical status indication device for all knife gate valves.

2.2.13 Provide handwheel and direction of arrows indicating direction of opening and closing.

2.3 Motor Operated Actuator for Discharge or Recirculation Knife Gate

2.3.1 General: The electric valve actuator shall include a motor, operator unit gearing, limit switch gearing, limit switches, torque switches, stem nut, de-clutch lever, and auxiliary hand wheel, reversing motor starter and space heaters, as a self-contained unit. The actuator shall meet AWWA-C-540-93 specifications. A 3-pole, disconnect switch (NEMA 7 enclosure for hazardous locations and NEMA 4X stainless steel for non-hazardous locations) shall be built in the motor starter or furnished with the actuator for field mounting. Unless otherwise noted the actuator shall be designed to operate the valve at the rate of 12 inches per minute.

2.3.2 Enclosures: The valve actuator motor and electrical enclosures shall be non-explosion proof for the discharge knife gate valve and shall be NEMA 4X ; disconnects not integral to the actuator /motor starter shall be NEMA 4X stainless steel and NEMA 7 enclosure for the Rercirculation Knife Gate Valve.

2.3.3 Motor: The motor shall be 460 volts, 3 phase, 60 hertz specifically designed for gate valve actuator service and shall be of high starting torque, totally enclosed, non-ventilated construction (discharge gate actuator), Class 1 Division 2 explosion proof (recirculation gate valve actuator), Class F insulation, 85°C rise,

40°C ambient. Motor leads shall be brought into the control compartment or limit switch compartment for external connections.

The motor shall be of sufficient size to open or close the valve from any position and under any condition of operation the valve may be subjected to. The motor duty rating shall be sufficient for one complete cycle (open-close-open, or reverse) without exceeding its temperature rating and shall not be less than 30 minutes continuous. The motor shall be pre-lubricated and all bearings shall be of the anti-friction type. The motor speed shall not exceed 188.5 radian per second (1,800 rpm).

2.3.4 Electric Actuator Gearing: The actuator gearing shall be a double reduction unit with the capability of changing the output speed with a relatively fast, simple gear change. The power gearing shall consist of spur or helical gears and worm gearing. The spur or helical gearing and worm shall be of hardened alloy steel and the worm gear shall be alloy bronze. All gearing shall be accurately cut with hobbing machines. All power gearing shall be grease lubricated. Ball or roller bearings shall be used throughout. All other gears shall be made of bronze or steel.

2.3.5 Position Limit Switch: Position limit switches and associated gearing shall be an integral part of the valve actuator. Limit switch gearing shall be of the intermittent type, made of bronze or stainless steel, grease-lubricated, and enclosed in its own gear case to prevent dirt and foreign matter from entering the gear train. The limit switches shall be geared to the driving mechanism and in step at all times whether in motor or manual operation. The trip points of the switches shall be adjustable over the entire range of the valve travel. They shall not be subject to breakage or slippage due to over-travel. Limit switches shall be of the heavy duty, open contact type with a rotary wiping action.

2.3.6 Torque Switch: Each valve actuator shall be equipped with a double torque switch which is responsive to loads encountered in both the opening and closing direction. Each side of the switch shall have a graduated dial and shall be adjustable. The torque switch shall operate during the complete valve cycle without the use of auxiliary relays, linkages, latches, or other devices. The torque switch shall be designed to shut off the actuator motor in the event that abnormally high torque is realized in either direction of travel. The torque switch is utilized as a protective device in valve applications requiring position seating. For torque seated valves, such as wedge gate and glove valves, the closing torque switch shall shut off the actuator motor when a predetermined torque is reached, corresponding to the required seating torque of the valve.

2.3.7 Manual Operation: A handwheel shall be provided for manual operation with an arrow to indicate "open" rotation. The handwheel shall not rotate during motor operation. A fused motor shall not prevent manual operation. When in manual operating position, the unit will remain in this position until the motor is energized. The actuator will automatically return to electric operation when the motor is energized. The actuator will remain in motor position until handwheel operation is desired. Movement from motor operation to handwheel operation is accomplished by a positive de-clutching lever which disengages the motor and related gearing mechanically but not electrically with no damages to clutch a

gear mechanism. It shall not be possible for the unit to be simultaneously in manual and motor operation.

2.3.8 Provide stem protector for rising stem in suitable length and diameter per manufacturer's recommendation to allow for full extension of the stem. Stem protector shall couple to the top of the actuator by means of a national pipe thread (NPT) and shall be capped and vented.

2.3.9 Hammerblow Device: The valve control shall have a built-in lost motion device that travels sufficiently enough to allow the motor to reach full speed before imparting a hammerblow to start valve in motion in either the closing or opening direction. This lost motion device also must permit motor to attain full speed before load is encountered, and load should be shared equally by two lugs cast integrally on the drive sleeve. Lost motion device is not to be provided for those valves used in inching, throttling, regulating, or modulating service.

2.3.10 Motor Starter: The motor starter shall be 3 phase AC full voltage reversing, rated 600V AC operated at 480V, 60 Hz unless otherwise noted. The starter shall include two 3 pole contactors mechanically and electrically interlocked, fused control transformer with 120V secondary, 120V, 60 Hz coils, 3 phase thermal overload relay, and auxiliary contacts. Heavy duty industrial type control station rated 10 amperes at 480 VAC, with local-off-remote selector switch, open-close-stop pushbuttons and open-closed indicating lights shall be provided on the motor starter, except where the valve actuator is inaccessible from the operating floor the control station shall be remotely mounted from the actuator. Terminal blocks shall be provided for all external wiring connections. Each terminal shall be properly marked.

2.3.11 Space Heater: Space heaters shall be provided in the motor enclosure and starter or limit switch enclosure. The heaters shall be 120V, 60 Hz, with sufficient capacity to prevent condensation in the enclosures.

2.3.12 Power Input: The power input to the actuator shall be 480V, 3 phase, 60 Hertz.

2.3.13 The valves /motor/starter/disconnect switch shall be located such that it provides easy access and working space for maintenance.

2.4 Rubber Flapper Swing Check Valve

2.4.1 Rubber flapper swing check valve shall consist of the following components:

(a) Cast iron body.
(b) Cast iron body cover.
(c) Precision molded steel reinforced solid Buna-N flapper with O-ring design seating edge.
(d) Backflow device.

2.4.2 Flapper shall be captured between the body and the body cover in a manner to permit the flapper flex from closed to full open position during flow through the valve. Flapper shall be easily removed without need to remove valve from line. Check valve shall have full pipe size flow area. Seating surface shall be on a 45

degree angle requiring the flapper to travel only 45 degree from closed open position for minimum head loss.

2.4.3 Buna-N flapper shall have a spring molded internally to permit the flapper to close against a slight head and prevent slamming.

2.4.4 Provide backflow device for allowing reverse flow through the check valve.

2.4.5 Valve shall be designed with zero leakage.

2.4.6 Rubber flapper swing check valve shall be manufactured by Apco Valve & Primer Corporation or approved equal.

2.5 Air/Vacuum Valve

2.5.1 Air/vacuum valve shall be designed for sewage service to exhaust small quantity of air from the pump column during pumping operations and to allow small quantity of air to enter the pump column during pump shutdown to prevent vacuum from developing.

2.5.2 The valve shall be spherical float operated and shall close drop tight against a renewable rubber seat. All interial metal parts shall be made of stainless steel.

2.5.2 The body and cover shall be constructed of cast iron ASTM A 126. The float shall be constructed of stainless steel ASTM A 240. The valve seat shall be Buna-N rubber.

2.5.3 Inlet and outlet shall be standard pipe NPT thread. A mushroom cap shall be provided at the outlet.

2.5.4 The valve shall be manufactured by Apco Valve & Primer Corporation, GA Industries or approve equal.

2.6 Pipe Supports and Anchors

2.6.1 Pipe supports and anchors shall be furnished and installed as shown on the Drawings or as specified in Division 15B.

2.7 Restrained Flange Adapter

2.6.1 Flange adapter shall be made of ductile iron conforming to ASTM A536 and have flange boltcircles that are compatible with ANSI/AWWA C115/A21.15.

2.6.2 Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restrained capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.

2.6.3 The flange adapter shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

2.6.4 The flange adapter shall have a safety of factor of 2 for ductile iron pipe.

2.6.5 The flange adapter shall be the SERIES 2100 MEGAFLANGE adapter as produced by EBAA Iron, Inc. or approved equal.

2.7 PVC Ball Valve and Check Valve

2.7.1 PVC ball valve shall be trunnion ball design with Viton or EPDM O-rings. Ball valve shaft shall be reinforced with stainless steel rod.

2.7.2 PVC ball check valve shall be design with union connector with Viton and EPDM O-rings seals. Ball shall be supported by a system of guide ribs to give full flow with minimum turbulence and chatter.

2.8 Pressure Gauges

2.8.1 Provide ½ % accuracy pressure gauges with stainless steel movements with Bourdon tube and socket type as per manufacturer's recommendations for service and pressure. All gauges, unless otherwise specified, shall have dials not less than 41/2" in diameter, with white faces and black graduations.

2.8.2 Gauges shall be liquid filled (Glycerline or silicone), such as Ashcroft 1279. Discharge gauge shall be 0 to 75 ft.

3. EXECUTION:

3.1 Transportation and Delivery

3.1.1 Every precaution shall be taken to prevent damage to the pipe during transportation and delivery to the site. Extreme care shall be taken in loading and unloading the pipe and fittings. Such Work shall be done slowly with skids or suitable power equipment, and the pipe shall be under perfect control at all times. Under no condition shall the pipe be dropped, bumped, dragged, pushed, or moved in any way which will cause damage to the pipe or coating. When handling the pipe with a crane, a suitable pipe hook or sling around the pipe shall be used. Under no condition shall the sling be allowed to pass through the pipe unless adequate measures are taken to prevent damage to the pipe ends.

3.1.2 If any pipe or special is damaged in the process of transportation, handling or laying, such pipe or pipes shall be replaced or repaired by the Contractor at its own expense.

3.1.3 The Contractor shall furnish and install suitable blocking and stakes to prevent the pipe from rolling. The type of blocking and stakes, and the method of installation, shall be approved by the Engineer.

3.2 Piping Installation General

3.2.1 The dimensions shown on the Drawings for the location of pipelines have been established with the intent that there will be no interferences. The Contractor shall check all dimensions shown on the Contract Drawings prior to the installation of

Work and shall notify the Engineer promptly of any interferences or errors discovered. If interferences are found to exist prior to or during construction, changes in the location of pipelines to avoid such interferences shall be made at no extra cost to the Department and in a manner as reviewed by the Engineer.

3.2.2 Elevations and dimensions locating pipelines are shown on the Drawings to the centerlines of the pipe unless otherwise indicated.

3.2.3 Piping connections and dimensions to equipment are subject to changes as reviewed by the Engineer to suit the types of equipment furnished.

3.2.4 Piping suspended from ceilings shall be installed to provide maximum head room consistent with good installation.

3.2.5 The layout of the piping and fittings shall be carefully checked to determine that the related equipment can be properly assembled to produce a workable arrangement. Defective or improperly fabricated Work shall be rejected and replaced with Work which, when completely assembled, shall result in an arrangement which shall function as intended and as shown on the Drawings.

3.2.6 All pipelines shall be straight and true in alignment, grade and location indicated, designated or required, and all installation shall be made in a workmanlike manner to the satisfaction of the Engineer. The pipe and fittings shall be adequately braced and blocked or tied, hung or supported for satisfactory installation.

3.2.7 As soon as pipes are in place, all open ends shall be capped until permanent connections are made. All pipelines shall be securely supported when required either by hanging from beams with suitable pipe hangers or supported on walls by suitable wall brackets. Where it is necessary, install hangers or supports after concrete is poured or other masonry Work finished. Anchor bolts with expansion shields shall be used.

3.2.8 Where pipes pass through masonry walls, floors and partitions, the juncture shall be made as shown on Plans. Where no details are shown, the Contractor shall either rough in the piping before the concrete is poured or the masonry completed, or shall provide suitable plugs, sleeves or forms for piping. After the pipes have been installed, the openings shall be filled solid; suitable allowance being made, however, for the expansion and contraction of the piping. The cutting of concrete for pipe shall be avoided wherever possible, and in no case where such cutting is necessary shall reinforcing rods be cut or disturbed, and no such cutting shall be done without the permission of the Engineer. All openings made for pipe Work shall be neatly patched in a workmanlike manner.

3.2.9 Horizontal runs shall be given as steep a pitch with even grade toward the outlet as conditions will permit, and care shall be taken in laying out piping that there is no interference with the proper location of piping for other purposes or other equipment. No change shall be made in the general location shown for piping, or in the method of running and connecting same, except with the written approval of the Engineer. When any change is made, a record of the location of all pipes so changed shall be kept by the Contractor and a copy of such record shall be given to the Engineer showing the location of all piping.

3.3 Protection of Piping System

3.3.1 Install and maintain pipe and equipment which is clean and free from rust, dirt, scale, etc.

3.3.2 Install temporary airtight covers at all pipe and equipment openings. Special attention shall be given to vacuum and air piping and each pipe section shall be individually inspected prior to placing. No piping shall be placed when wet, nor shall any free moisture be present inside any air piping during installation.

3.4 Pipe Supports and Hangers

3.4.1 Pipe supports and hangers shall be in accordance with Section 15B.

3.5 Welding

3.5.1 All welding of piping and/or special fittings shall be done in conformity with the current ANSI B31.1, "Pressure Piping".

3.5.2 Tee connections in welded piping shall be made with a factory fabricated butt welding tee or with weld-o-let of butt, socket or threaded type. When weld-o-lets are used, the branch connection shall be one-half the diameter of the main or less. Scarf welding or direct butt welding of side connections shall not be permitted. Tees fabricated from pipe shall not be permitted.

3.5.3 Long radius welding elbows shall, whenever possible, be used for changing direction of welded pipelines. Mitered joints shall be subject to approval by the Engineer.

3.6 Flanged Joints

3.6.1 All flanged joints shall be made temporarily with gaskets in place using a minimum number of bolts to support the piping. Any misalignment of the assembled piping shall be adjusted or corrected in a manner approved by the Engineer.

3.6.2 Tightening of flange bolts to "pull up" misaligned flanges will not be permitted and shall not be done. The misaligned flanges shall be machined to fit, or approved spacer pieces and gaskets shall be installed if necessary and directed by the Engineer. The temporary assembly of the flanged piping shall demonstrate that there will be no undue stresses in the piping or at the connections to the equipment. The temporary assembly shall be approved by the Engineer before the joints are tightened. Flanged joints shall then be completed and made watertight and the tension in the flange bolts, when tightened, shall not exceed 15,000 psi at the minor diameter of the bolt threads.

3.7 Sleeve Type Couplings

3.7.1 For sleeve type couplings, diametrically opposite bolts shall be equally tightened on the connection so that the gaskets will be brought up evenly all around the pipe.

Final tightening shall be done with torque wrenches set for the torque recommended by the coupling manufacturer.

3.8 Testing

3.8.1 Pipes shall be flushed clean and tested and any leaks shall be made tight.

3.9 Painting

3.9.1 Piping, fittings and appurtenances shall be painted in accordance with Section 9A - Painting.

3.10 Supports for Present Piping

3.10.1 Wherever Contractor is required to expose, suspend or reroute present piping, supports for such piping shall be provided as is required for new piping in accordance with paragraph 3.4 Pipe Supports, this Section.

3.11 Wrecking and Repair

3.11.1 The Contractor shall do its own excavation for piping as required to complete the Work. If excavation is required below present concrete slabs, the backfill materials shall be sand flushed in place or class B concrete fill as required by the Engineer. The concrete used to repair the structure shall be Class A concrete. Where reinforcing is cut, dowels shall be used for laps. Junctures between the present portions of slabs remaining and new slabs shall be uniformly saw cut.

3.11.2 All such repair procedures shall be subject to review by the Engineer.

3.12 Installation of Pipe and Fittings

3.12.1 All pipe and fittings shall be installed in accordance with the specifications contained herein and in Division 15A and 15B and in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

3.15 Schedule

3.15.1 Valve Schedule

Service	Valve Type	Size Inches	Joint Type	Actuator Type	Remarks
Recirculation	Knife Gate	18	F	E	
Discharge	Knife Gate	16	F	E	
Discharge	Knife Gate	6 & 10	F	H	
Discharge	Flapper Check	6 &10	F		

Drain	Knife Gate	6	F	H
Discharge	Air/vacuum	2	T	

Note:

(1) Abbreviations used in the schedule are as follows:

Joints & Actuators

F Flanged
T Threaded
E Electric motor actuator (Non-modulating)
H Hand wheel manual operator

3.15.2 Inside Piping Schedule

Service	Size (Inches)	Pipe Material[1]	Protective Coatings[3] Int.	Ext.	Joints[2]	Test Pressure (psig)	Remarks
Pump Discharge	6, 10	DI	P Max Pump	P	F	NA	
Force Main in Discharge Chamber	16	DI	P	P	F	NA	
Recirculation	18	DI	P	P	F	NA	
Drain Pipe	6	DI	P	P	F	NA	

Notes:

(1) DI Ductile Iron

(2) F Flanged

(3) N No Finish
P Shop Finish Painted

4) NA = Not Applicable

END OF THIS SECTION

SECTION 15D - PUMPING EQUIPMENT

1. GENERAL:

1.1 Description

1.1.1 This section includes requirements for furnishing and installing submersible motor pumping units, together with base elbows, guide rail or cable system, chain and cable holders and all appurtenances necessary for a complete installation.

1.1.2 Pumping units include main pumps and low flow pump as shown on the Drawing and specified.

1.1.3 Pump shall be of the vertical, centrifugal, heavy duty, non-clog, close-coupled, submersible type, with bottom suction and side discharge, each driven by submersible electric motor mounted as an integral part of the pump. The pumping unit shall be designed to pump at the capacities specified. The pumping units shall be designed for continuous and intermittent duty.

1.1.4 All pumps of a specified type shall be identical, the product of the same manufacturer. Refer to Division 15A. All main and low flow pumps within the pump station shall be interchangeable at any location without requiring piping and flange modification, and all main and low flow pumps shall be identical with respect to its technical rating, dimensions and flange connections.

1.1.5 The pumps and associated facilities, including pump station wet well layout and configuration, supporting structures, electrical equipment and all other related items, have been designed based on a single pump manufacturer. If an alternate pump manufacturer is utilized, Contractor is responsible for all revisions and re-design required to accommodate the proposed pumps to provide a properly functioning pumping system.

1.1.6 Furnish one spare main pump with plug. The spare main pump assembly shall not be included in MAIN PUMPS unit price work and will be paid for at the contract lump sum work for COMPLETE SPARE MAIN PUMP ASSEMBLY which shall be payment in full for the work specified.

1.1.7 Furnish one spare low flow pump with plug. The spare low flow pump assembly shall not be included in LOW FLOW PUMP unit price work and will be paid for at the contract unit price each for COMPLETE SPARE LOW FLOW PUMP ASSEMBLY which shall be payment in full for the work specified.

1.1.8 Spare main pump and low flow pumps shall be subject to install field tests per 3.2.2 of this section.

1.1.9 Spare main pump and low flow pumps shall be stored at pump room floor at EL. 644.

1.2 Operating Conditions

1.2.1 The main pump shall be capable of a draw down to a low water level at El. 606.00 without cavitation occurring. Manufacturer's certification of the preceding shall be provided as part of the submittal data.

1.2.2 The new pumps including main pumps and low flow pumps shall operate at the capacities and heads and over the range of operating conditions specified without overloading, cavitation, and vibration. The pumps shall conform with the following requirements:

Items	Requirements	
	Main Pump	Low Flow Pump
	(MP1 thru MP3)	(LFP1)
Capacity at primary rating point	1,500 gpm	600 gpm (BEP)
Total head at primary rating point	48 ft	41 ft
Overall efficiency, wire to water, at rating point, minimum, percent	71	62
Shutoff head: Maximum	73 ft	70 ft.
Capacity at secondary rating point	1996 gpm (BEP)	577 gpm
Total head at secondary rating point	41 ft	42 ft
Overall efficiency, wire to water, at secondary head, minimum, percent	75	62
Capacity at tertiary rating point	2,314 gpm	558 gpm
Total head at tertiary rating point	36 ft	43 ft
Overall efficiency, wire to water, at tertiary rating point, min. percent	74	61
Diameter of sphere that will pass through pump, minimum	4-1/4 inch	3 inch
Pump suction diameter, minimum	10 inch	6 inch

Pump discharge diameter, minimum	8 inch	6 inch
Pump speed, maximum, rpm	1,180	1,720
Motor horsepower, maximum	44 hp	10 hp
Motor efficiency at full load, minimum, percent	94.4	82.1
Motor power factor at full load, minimum	0.82	0.85
Locked rotor kVa/hp, maximum, NEMA code letter	G	F
Maximum overall pump height including lifting eye	4'-1/2"	2'-2"
Minimum pump start per hour	10	10
Minimum Service Factor	1.15	1.15

1.2.3 Each pump shall have a continuously rising characteristic curve from the rating point to shutoff which passes through the rating point, and which meets or exceeds the specified heads and capacities, all within the Hydraulic Institute tolerances per Section 14.6.3.4 and Table 14.6.3.4.

1.2.4 Submersible units shall be capable of sustaining full reverse runaway speed without damage.

1.2.5 Motors shall be capable of operating pumps over entire range of pump curves operating conditions without overloading and without using the service factor.

1.2.6 The entire pumping equipment including power supply system shall meet the NEC requirement for Class 1, Div. 2, Group D hazardous locations.

1.3 Related Sections

1.3.1 Section 3A - Cast-In-Place Concrete
1.3.2 Section 3B - Grout
1.3.3 Section 5C - Bolts, Anchor Bolts, Expansion Anchors and Concrete Inserts
1.3.4 Section 9A - Painting
1.3.5 Section 15A - General Mechanical Provisions
1.3.6 Section 15B - Basic Mechanical Materials and Methods
1.3.7 Section 15C - Piping and Appurtenances
1.3.8 Section 16A - General Electrical Provisions
1.3.9 Section 16C – Basic Electrical Materials and Methods
1.3.10 Section 16D - Supervisory Control and Data Acquisition (SCADA) Equipment
1.3.11 Section 16F – Motor Control Center

1.3.12 Section 16H - Major Electrical Equipment

1.4 Submittals

1.4.1 All submittals, including the following, shall be provided as specified in Division 1.

1.4.2 Submit a list of not less than five (5) installations where pumping equipment of the type and approximate size specified herein have been in successful operation for at least five (5) years.

1.4.3 Submit location where pumps and motor are manufactured and the nearest permanent service headquarters of the pump and motor manufacturers.

1.4.4 Submittal data shall include:

(a) Complete manufacturer's specifications and descriptive bulletins highlighting applicable data for all equipment including size, capacity, description and make of pumps and motors. Detailed data sheets for pumps and motors, cable, temperature/moisture monitoring unit.

(b) Detailed control description, illustrations, wiring diagrams of manual-off-automatic controls and starting equipment.

(c) Complete motor and manufacturer supplied cables and cable support data.

(d) Pump performance curves for the specified conditions including head, input kilowatts, and overall efficiency, as a function of capacity from zero to maximum capacity.

(e) Drawings of the equipment, including arrangement and erection drawings of the equipment and equipment operating characteristics in such detail as to give all dimensions necessary to accurately locate through the floors and walls all openings for pipes, anchor bolts and fittings for motors, pumps, motor and pump control center openings, and conduit between the associated equipment. This includes drawings, indents, pockets, and clearances necessary in the floors and walls for proper installation of the equipment specified.

(f) General arrangement drawing of pumping unit, suction elbow and pump stand. Include equipment weight and anchor methods and materials.

(g) Cross section drawing of pumping unit.

(h) Factory and field testing procedures shall be submitted prior to factory testing.

(i) Parts list with materials of construction technical descriptions and complete model number and quantity

(g) Motor performance characteristics.

(k) Spare parts list with technical description, complete model number and quantity.

(l) Painting procedure, details of finish color and ANSI numbers.

(m) Six certified copies of the Shop Test results including analysis of test results and recommendations.

1.4.5 Submit copies of all manufacturers' guarantees and warranties obtained by the contractor to be transferred to the Department, at the time of final acceptance of this project by the Department.

1.4.6 Motor data shall include:

(a) Manufacturer
(b) Nameplate rated kilowatts (horsepower)
(c) Rated voltage
(d) Full load rpm
(e) Efficiency
(f) Full load current
(g) No load current
(h) Full load power factor
(i) NEMA design letter
(j) Locked rotor motor starting inrush current and NEC code letter
(k) Insulation class
(l) Service factor
(m) Recommended starting restrictions, including allowable starts per hour
(n) Recommended maximum KVAR rating of power factor correction capacitors.
(o) Class 1, Division 2, Group D rating showing UL or FM approval
(p) Weight of the pump/motor unit

1.4.7 Pump nameplate technical data

(a) Pump manufacturer name
(b) Pump model and serial number
(c) Nominal size
(d) Impeller code
(e) Impeller diameter
(f) Suction and discharge size
(g) Specific duty conditions
(h) Customer name
(i) Rated rpm and rated HP
(j) Max temperature rating
(k) Total weight of pump and motor assembly.

1.5 Quality Assurance

1.5.1 General

(a) Pumping equipment shall be produced by a manufacturer who regularly engages in the design, manufacture, assembly and production of submersible sewage pumping equipment of the size and type as specified for not less than five years.

(b) Motor wiring shall be rated for service in hazardous Class I, Division 2, Group D location.

(c) All materials used in the construction of the equipment herein specified shall be new and of the highest available grade and of properties best suited to the Work required.

(d) One manufacturer shall be responsible for providing pumping equipment, including pump motor and all accessories.

(e) Unless otherwise indicated, all pumps of a specified type under this Section shall be identical, the product of the same manufacturer.

(f) To ensure that all equipment is properly coordinated and will function in accordance with the intent of these Specifications, the Contractor shall obtain all the equipment specified herein from the pump manufacturer in whom shall be vested unit responsibility for the proper function of the complete system, including pumps, motors, electrical, control equipment and accessories as shown and specified. Contractor, however, shall retain overall responsibility for equipment coordination, installation, testing, commissioning and operation.

1.5.2 Contractor's Responsibility

(a) If the power demand of pumping units proposed to be provided for this Project exceeds the maximum horse power and/or full load amps as specified and as provided or shown in the Drawings, it is the Contractor's sole responsibility, without additional cost to the Department, to upgrade all affected electrical facilities such as, but not limited to, wiring, conduits, motor controls, switchgear, transformers and incoming facilities to be able to operate all the pumping units satisfactorily and to meet the Specifications.

1.5.3 Manufacturer's Certifications

(a) Submit manufacturer's certification that he has carefully examined all of the Contract Documents in detail, including the arrangement and conditions of proposed structures affecting the performance of the pumping equipment units, and the detailed requirements of manufacturing and subsequent installation of the pumping equipment units.

(b) Submit manufacturer's certification that there are no omissions, ambiguities or conflicts in the Contract Documents or in the pumping station piping layout that affect the pumping units, as shown on the Drawings which have not already been clarified in writing by the Engineer.

(c) Submit manufacturer's certification that they have reviewed the location and discharge piping design, the discharge valve locations and types, the loads imposed on the pumping units from the connections, the pumping unit locations such as the physical separation to each other and adjacent walls, the water to be pumped, and pumping station piping layout, as shown on the Drawings, and that any incidental modifications thereto will not affect the specified pumping unit performance and efficiency to be furnished under this Contract, and they will be solely responsible for furnishing and delivering pumping equipment that will perform and meet the requirements, as specified in the Contract Documents.

(d) Submit manufacturer's certification that they have inspected the storage of the pumping equipment and find no conditions that have adversely affected the equipment.

(e) Submit manufacturer's certification that they have supervised the installation of the pumping equipment and that the pumping equipment has been properly installed.

(f) Submit manufacturer's certification that they have inspected the pumping equipment after 1000 hours of operation and certify the pumping equipment is operating satisfactorily.

(g) Submit manufacturer's certification that the pumps were certified by UL and/or FM as listed in these specifications and meet the requirements of Class I Division 2.

1.5.4 Data to be filed with the Engineer

(a) Record Drawings: The Contractor shall keep one record copy of all Specifications, Plans, Addenda, Supplementary Drawings, Working Drawings, Change Orders and Clarifications at the site in good order. Specifications, Plans, Supplementary Drawings and Working Drawings shall be annotated to show all changes made during the construction process. These shall be available to the Engineer at all times and shall be delivered to the Engineer upon completion of the work.

(b) Four bound copies of operating and maintenance instructions, diagrams, parts, lists, requirements and other information pertinent to the operation of the various systems and equipment including bill of material with technical description, detailed technical data sheets, record shop drawings, catalog cuts highlighting applicable data shall be furnished to the Engineer. Refer to Division 1.

1.5.5 Source Quality Control

(a) Factory tests shall be performed on each pumping unit including spare pump in accordance with the test code of the current Hydraulic Institute, except as modified herein. The pumps shall be tested in the position that they will be installed. Pumps shall demonstrate compliance with Grade 1U from Hydraulic Institute Standard 14.6.

(b) Detailed factory test procedures shall be submitted prior to testing.

(c) Tests shall be conducted at rated speed to determine the curves of head, electric input kilowatts, and overall efficiency, wire to water, as a function of capacity. A minimum of six points shall be taken, including shutoff. One point shall be as near as possible to each specified condition of head and capacity and the remaining points at capacities necessary to provide a uniform distribution of data. Capacity shall be expressed in gallons per minute and head shall be expressed in feet. Raw test data, calculated results and sufficient information for computation and plotting of the curves shall be furnished with the certified shop test curves.

(d) Certified test curves shall be furnished for approval prior to shipment. All tests shall be witnessed by the manufacturer by a Registered Professional Engineer registered in the state in which the shop tests are performed. The witnessing Registered Professional Engineer shall sign and seal each copy of the curve and test data sheets. Six copies of the curves along with the certified drive unit test data, shall be furnished for approval. Shipment of the pumping units shall not be made until the test data and curves are approved.

(e) Curves shall be drawn to such scale that values can be read accurately within 1%. The efficiency curves submitted shall constitute a guarantee within 1% on the scale, for all deliveries between 3/4 rated capacity and 1-1/4 rated capacity.

(f) In addition to the hydraulic test, the pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

1) Impeller, motor rating and electrical connections shall first be checked for compliance with the Specifications.

2) Motor and power cable insulation shall be tested for moisture content or insulation defects with a megga-ohm meter.

3) Winding resistance factory test for pump motors.

4) Moisture and temperature detector factory tests and describe acceptance and rejection criteria.

5) Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

6) Describe tests acceptance and rejection criteria.

7) The pump shall be run for 30 minutes submerged, a minimum of 6 ft. under water.

8) After operational test and hydraulic test, the moisture and temperature detector tests as described in 1.5.5. c and the insulation test 1.5.5. f shall be performed again and readings shall be recorded. A written

report, stating the foregoing steps have been done, shall be submitted prior to shipment.

9) Each pump shall be subjected to a hydrostatic test and certification of the hydrostatic test shall be provided. The hydrostatic pressure shall, in any case, not be less than 200% the shut-off pressure of the pump as shown by the characteristic curve. The minimum test duration time shall be 10 minutes.

10) The certified test reports shall be submitted within two weeks from the completion of the tests. The results shall be certified that the equipment supplied meets the contract requirements.

(g) The Contractor shall provide transportation and reasonable expenses to and from all factory pump testing for two (2) representatives of the Department to witness such testing. The Department shall designate these individuals. The Contractor shall notify the Engineer of a scheduled test date two months prior to said date and shall arrange an exact suitable date not less than two weeks prior to the test.

1.6 Warranty

1.6.1 Refer to Division 1.

1.6.2 Provide 5 years non-prorated guarantee or warranty from the date of final acceptance of the Pump Station.

1.7 Delivery, Storage and Handling

1.7.1 Products and materials shall be delivered, stored and handled as specified in Division 1.

1.8 Spare Parts

1.8.1 The following spare parts shall be provided; two sets for the main pump and two sets for the low flow pump:

(a) Two sets of mechanical seals - upper and lower
(b) Two sets of cable entry grommets
(c) Two sets of Motor Bearings
(d) Two sets of Wear Rings

1.8.2 A complete set of special wrenches, spanners, eyebolts and other special tools shall be furnished sufficient to completely dismantle and reassemble each kind and size of pumping unit. Tools shall be forged steel, case hardened, full finished, and furnished with a metal tool case with a handle and provision for padlocking.

1.9 Basis of Payment

1.9.1 The pumping equipment shall be paid for per contract unit price each for

MAIN PUMPS
LOW FLOW PUMP

which shall be payment in full for the work described herein unless otherwise noted.

1.9.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Pump Specifics

2.1.1 Design

(a) Manufactured by Flygt, no substitutions allowed.

(b) The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars or cable system extending from the station floor to the discharge connection.

(c) Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.

(d) No portion of the pump/motor unit shall bear directly on the sump floor.

2.1.2 Cooling System

(a) Each pump/motor unit shall be cooled by a self supplying cooling system. A motor water jacket is required. The water jacket shall thus provide heat dissipation for the motor regardless of whether the motor is submerged in the pumped media or submerged by air.

2.1.3 Casing

(a) Pump casing shall be of the centerline discharge type.

(b) Pump casing shall be ASTM A48 Class 35B cast iron, with smooth surfaces devoid of blow holes or other casting irregularities.

2.1.4 Impellers

(a) The impeller shall be of Duplex Stainless Steel (ASTM CD-4MCuN), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-

cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be capable of handling solids, fibrous materials, sludge and other matter normally found in wastewater. The required impeller shall be factory trimmed to meet the specific pumping head and capacity ranges.

(b) The impeller shall be secured to the shaft with a stainless steel key and lock nut in such a way that it cannot unscrew or become loosened due to rotation in either direction.

(c) Each pump shall be equipped with a stainless steel renewable impeller wear ring.

(d) Low Flow Pump impeller shall be adaptive type.

2.1.5 Oil Chamber

(a) The pumps shall be equipped with an oil chamber to function as a buffer between the pumped liquid in the casing and the motor. The oil chamber shall be arranged to accommodate thermal expansion of the oil and furnished with an oil chamber drain plug that is accessible from outside the pump unit and permits changing oil without dismantling pump components. The oil chamber shall be ASTM A48 cast iron. The oil sample shall be taken from the oil chamber in place and without the need to pull the pump out of the wet well.

2.1.6 Mechanical Seal

(a) Pumps shall have a double or tandem mechanical seals. The upper seal unit, between the oil chamber and motor housing, shall have one stationary ceramic or tungstein-carbide ring and one positively driven rotating tungstein-carbide or carbide seal ring. The lower seal unit, between the pump casing and oil chamber, shall have one stationary ring and one positively driven rotating ring. The rings shall be tungstein-carbide or ceramic. Metal parts shall be stainless steel. The spring element of the lower seal shall be protected from solids contained in the pumped liquid. Do not rely upon the pumped liquid for lubrication.

(b) Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

2.1.7 Motor

(a) Submersible pump motors shall be of 460-volt, 3-phase, 60-hertz squirrel cage induction type conforming to the latest applicable requirements of NEMA and NEC standards and suitable for application in Class 1,

Division 2, Group D hazardous location. Motor shall be UL or FM approved.

(b) Motors shall have suitable output torque and speed characteristic to start and operate the pump over the range of specified conditions. Nameplate horsepower rating shall not be exceeded under maximum load conditions for constant speed pumping units. The motors shall be for continuous load operation and shall be capable of sustaining continuous on-off cycling of ten starts per hour minimum without exceeding the 80 degree C temperature rise.

(c) The stator windings and stator leads shall have a minimum of NEMA Class H (180 degrees C) moisture resistant insulation. The stator coils shall be dipped and baked in Class F varnish and shall be heat-shrink fitted into the stator housing. Impregnation resin shall be applied to stator assembly in three dip and bake steps.

(d) Motors shall have an ASTM A48 cast iron stator housing. For motors that employ cooling water jackets, the water jacket passages shall preclude clogging by solids contained in the pumped liquid.

(e) The motor cables shall be multi-conductor flexible cables designed specifically for use with submersible pumps and shall be of stranded, tinned copper conductors with 600V ethylene-propylene insulation, cabled with non-hygroscopic vulcanized rubber fillers and binder tape, covered with water & oil resistant chloroprene rubber jacket, rated 90° C in 40° C ambient. Separate cables shall be provided for power and control. The power and control cables shall have sufficient length to reach the termination boxes as shown on Plans without splices.

(f) Motor cable entries shall have a mechanical locking ring or compression type cord grip to protect the cable jacket from being pulled out of the motor. Do not use epoxy for this purpose. Cable entries shall have watertight seals. Cable entry leads shall be isolated from the internal motor leads to prevent entry of water into the motor chamber by leakage or wicking. One cable for power and one cable for controls shall be provided. Cables shall be suitable for submersible pump application and shall conform to NEC specifications for cable sizing. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter.

(g) The motor shall be designed for operating under completely submerged or unsubmerged conditions without damage while pumping under load.

(h) The combined service factor (combined effect of voltage, frequency and specific gravity) shall not be less than 1.15.

(i) The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

(j) The rated motor horsepower shall not be less than the brake horse power of the pump throughout the range of operating conditions specified.

(k) Provide motor in accordance with Section 16H-2.4.

(l) Motor nameplate shall be per NEMA standards and must show these specific items; Manufacturer's name; Model number; Series number; Rated volts and no load and full load amps; Rated frequency & number of phases; Rated full load speed; Rated temperature rise, the insulation system class; Time rating; Rated horsepower; Locked rotor indicating code letter; Service factor; Efficiency; Frame size, Design code and Class 1, Division 2 explosion proof rating; total weight of the pump unit.

2.1.8 Shaft

(a) Shafts shall be one piece, fully machined pump and motor shafts. Maximum shaft deflection under maximum pumping load to shall be 0.002 inches at the lower mechanical seal face.

(b) Shafts material shall be stainless steel ASTM A 276 Type 410 and adequately designed to meet the maximum torque required at any start-up condition or operating point in the system. Carbon steel shafts shall be protected from exposure to the pumped liquid by a stainless steel sleeve, carbon steel sleeve or chrome plating.

2.1.9 Bearings

(a) The pump shaft shall rotate on permanently lubricated bearings. One assembly shall carry only radial loads and be free to float axially within the frame. The other assembly shall carry both radial and axial loads and be restrained from axial movement.

(b) Bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize deflection

(c) Bearings shall conform with ANSI B3.15 and B3.16, Load Ratings and Fatigue Life for Ball and Roller Bearings, and have 20,000 hour minimum L_{10} bearing life at the maximum pumping load that occurs under the specified operating conditions.

2.1.10 Protection Monitoring System

(a) Each pumping unit shall be supplied with a monitoring system to protect critical machine functions during operation.

(b) Three thermoswitches, one per phase, shall be provided in the motor windings to protect against overheating by initiating an alarm on high temperature.

(c) A moisture sensor shall be provided to protect against damage from water contamination. The sensor shall be arranged to initiate the alarm upon sensing moisture in the oil chamber or prior to water reaching the motor windings.

(d) A monitoring device or devices designed to be compatible with the sensors and motor controls shall be provided for each pump. The monitoring system shall be intrinsically safe, intrinsically safe barriers shall be provided where required. The protective monitoring unit shall be installed on MCC bucket door for each pump configured with ability to automatically reset.

(e) Interface and coordination between pump and MCC manufacturers shall be required prior to shipment.

2.1.11 Guide Rail and Base Elbow

(a) Each pump shall have a base elbow and guide rail or cable system to permit installation and removal of the pump from its base elbow discharge connection without requiring personnel to enter the wet well.

(b) The guide rail or cable system shall include a stainless steel non-sparking guide bracket which is an integral part of the pump casing and permits sliding the pumping unit along two unthreaded stainless steel guide rails or cable. Guide system shall be Schedule 40 stainless steel pipe or cable connected to the base elbow at the bottom. Guide rails shall be supported at intermediate locations and at the top with stainless steel brackets bolted to the wall of the wet well or concrete slab. Each pump lifting eye shall be suitable for electric hoist hook.

(c) Each pump shall have a cast iron base elbow arranged for automatic pump connection. The pump casing shall have a machined discharge flange with a stainless steel non-sparking liner arranged to be non-sparking which, when the pump is lowered into the pumping position, will automatically align and mate with the plain-end of the base elbow. The discharge connection shall require no motion other than vertical to seat the mating flange of the casing to the base elbow. Sealing of the pump connection shall be accomplished by metal to metal watertight contact. The base elbow shall support the weight of the pumping unit and prevent it from bearing directly on the wet well floor.

(d) Anchor bolts, nuts, washers, and accessories and other adapter equipment necessary for mounting the pumping equipment and appurtenances shall be provided. Anchor bolts, nuts, washers, accessories and adaptor equipment shall be ANSI TYPE Series 304 stainless steel.

2.1.12 Power Cable Holder

(a) Contractor shall coordinate the installation of the cable holder with the aluminum hatch cover supplier.

(b) Provide all stainless steel cable support grip, cable pull line, snap hook and anchor as required or as shown on the drawing.

2.2 Operation and Control

2.2.1 Pump controls shall be provided in accordance with Division 16.

2.2.2 Pumps shall function in rising water and in falling water as shown on the drawings.

2.2.3 Float Level Detectors

(a) The float level detecting devices shall be located in the wet well as shown and as specified in Section 16D. One float shall be supplied for each control level.

2.3 Bolts, Studs and Nuts

2.3.1 All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, "Screw Threads", Coarse Thread Series, class 2 Fit, unless otherwise specified.

2.3.2 Bolts heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, "Wrench-Head Bolts and Nuts and Wrench Openings", Heavy Series, unless otherwise specified. All nuts shall be hexagonal in shape.

2.3.3 Stainless steel anchor bolts, flange bolts, studs and nuts shall be in conformity with the current ASTM Designation: A193, Grade B8 (AISI 304), Class 1 and ASTM A194, Grade 8 (AISI 304), AISI 316 or approved equal.

3. EXECUTION:

3.1 General

3.1.1 All equipment shall be installed in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Divisions 1 and 15A. The manufacturer shall inspect the pump installation and shall certify that the pumps have been installed properly. Information submitted for approval shall include a letter of intent to provide this certification. All wiring and piping shall be completed and all necessary adjustments to equipment shall be made to provide a complete operational pumping system.

3.1.2 The manufacturer shall have joint responsibility with the Contractor for the proper installation and operation of the equipment, and jointly with the Contractor shall furnish a written statement to the Engineer certifying that the equipment as installed complies with the Plans and Specifications, will perform as specified, and is properly installed.

3.2 Field Quality Control

3.2.1 Representative of the Manufacturer

(a) The services of a qualified representative of the manufacturer shall be provided to instruct on proper installation of the equipment, inspect the completed installation, make any necessary adjustments, participate in the startup of the equipment, participate in the field testing of the equipment, place the equipment in trouble-free operation, and instruct operating personnel in its operation and maintenance.

3.2.2 Field Testing

(a) Written test procedures shall be submitted two weeks prior to field testing. The pumps shall be tested in accordance with the manufacturer's instructions and Hydraulic Institute Standards.

(b) After installation of the pumping units, control equipment and all appurtenances, each unit shall be subjected to a field running test under actual operating conditions. Water for these tests shall be the responsibility of the Contractor and adequate water supply shall be available for testing of two pumps concurrently. Field tests shall be performed in the presence of Engineer and IDOT and as directed by the Engineer. Tests shall demonstrate that under all conditions of operation each unit:

1) Has not been damaged during transportation or installation.

2) Has been properly installed.

3) Has no physical or mechanical defects.

4) Has been properly connected.

5) Is free of overheating of any parts.

6) Is free of overloading of any parts.

7) Verification of pump shaft rotation in proper direction.

8) The pump shall be free of any vibration and cavitation.

9) Each pump shall be run momentarily against a closed discharge valve with the discharge pressure being monitored, to confirm that the Design Shut-off Head (and proper impeller size) have been furnished.

(c) Hand, off, auto, lead/lag, bump mode of each pump shall be tested from local control station, SCADA panel, and MCC to demonstrate that the pumps and control system operate as specified. Any defects in the equipment or failure to meet the requirements of the Specifications shall be promptly corrected.

1) Each Pump operates as expected at specified levels for on/off operation based on SCADA entered level variable data.

2) Each Pump operates as expected at specified levels for on/off operation based on ball float level switches.

3) Each pump shall be tested to verify rated flow.

4) Verify that each Pump does not operate from local control station and or from MCC when hand-off-auto switch is in off position.

5) Each Pump start and stop operates as expected manually from MCC and from local control station located at the discharge floor elevation 631 ft.

6) Each Pump is sequenced as expected for rising and falling water levels in the wet well (this shall be a real water test, and Pump operation may be simulated by not allowing pump to actually run in order to accomplish testing).

7) Every possible pump auto sequence of each pump shall be tested for lead/lag/standby for rising and falling water levels based on SCADA controls.

8) Every possible pump auto sequence of each pump shall be tested for lead/lag/standby for rising and falling water levels based on hard wire float mode control through float switches.

(d) The following shall be checked on start-up:

1) Current draw and voltage on all legs of each pump shall be observed and recorded to see if there is any imbalance.

2) Megga-ohm meter testing shall be performed and record reading on each pumps.

3) Winding resistance test for each phase shall be performed and recorded for each pump.

4) Pump controls and terminations shall be checked.

5) At a minimum, each pump including all spare pumps, shall be run in recirculation a minimum of 30 minutes.

6) Moisture and temperature detector tests and record results on each pump.

7) Each PLC I/O point shall be verified for proper operation. Analog signals shall be simulated with multimeter at 0,4,8,12,16, and 20 mA levels. Results of I/O checkout shall be witnessed by Engineer. A sign-off sheet shall be generated for each I/O point.

8) Additional tested as described in Section 16D.

3.3 Painting

3.4.1 All pumping equipment shall be painted as specified in Division 9.

3.4 Equipment Schedule and Pumping Operating Elevations

3.5.1 Refer to Drawing M9.

3.6 Start-up

3.6.1 The start-up services for the following equipment shall be coordinated with IDOT and IDOT shall be notified at least two weeks in advance:

Pumping Equipment

END OF THIS SECTION

DIVISION 15E - VENTILATION

1. GENERAL:

1.1 Section Includes

The work specified herein includes furnishing and installing the ventilating system including fans, louvers, dampers, air inlets and outlets and all associated appurtenances and work as indicated and as specified herein.

1.2 Related Sections

1.2.1 Section 4A - Unit Masonry.
1.2.2 Section 5B - Bolts, Anchor Bolts, Expansion Anchors, and Concrete Inserts.
1.2.3 Section 15A - General Mechanical Provisions.
1.2.4 Section 15B - Basic Mechanical Materials and Methods.
1.2.5 Section 16A - General Electrical Provisions.
1.2.6 Section 16B - Basic Electrical Materials and Methods.

1.3 References

All reference standards shall be from the latest edition.

1.3.1 AMCA 99 Standards Handbook.

1.3.2 AMCA 210 Laboratory Methods for Testing Fans for Rating Purposes.

1.3.3 AMCA 300 Test Code for Sound Rating Moving Air Devices.

1.3.4 AMCA 301 Method of Publishing Sound Ratings for Air Moving Devices.

1.3.5 ASHRAE Standards American Society of Heating, Refrigerating and Air Conditioning Engineers.

1.3.6 NFPA 90A Installation of Air Conditioning and Ventilating Systems.

1.3.7 OSHA Occupational Safety and Health Administration

1.3.8 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1.3.9 UL 181 Underwriters Laboratories- Factory-Made Air Ducts and Connectors.

1.4 System Description

1.4.1 Ventilation system consisting of dampers, louvers exhaust and supply fans for the Electrical Control Room, Pump Room, Discharge Floor, Intermediate Floor and Wet Well areas. The Electrical Control Room ventilation system will

operate when temperature rises above setpoint 85° F (adjustable), while the Pump Room and Pump Levels ventilation systems will operate whenever the building is occupied or combustion gas level rises above setting point or temperature rises in the space above setpoint 85°F (adjustable).

1.4.2 All fan and damper motors associated with the Electrical Control Room shall be corrosion resistant equipment. All fans and damper motors associated with the Pump Room, Discharge Floor, Intermediate Floor and Wet Well shall be rated for use in Class I, Division 2 areas.

1.5 Submittals

1.5.1 Submit Product Data in sufficient detail to confirm compliance with requirements of this section.

1.5.2 Submit shop drawings and product data in accordance with sections 1A and 15A.

1.6 Warranty

1.6.1 Provide warranty under provisions of Section 1A.

1.7 Delivery, Storage and Handling

1.7.1 Delivery, storage and handling shall be as specified under Section 1A.

1.8 Definitions

1.8.1 Low Pressure (Three pressure classifications):

(a) 1/2 inch WG positive or negative static pressure and velocities less than 1,500 fpm.

(b) 1 inch WG positive or negative static pressure and velocities less than 2,000 fpm.

(c) 2 inch WG positive or negative static pressure and less than 2,500 fpm.

1.9 Basis of Payment

1.9.1 The pump station ventilation work shall be paid at the Contract lump sum price for
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which shall be payment in full for the work described herein.

1.9.2 Refer to 1.22 of Section 1A for Method of Measurement.

2.0 PRODUCTS:

2.1 Ductwork and Ductwork Accessories:

2.1.1 Ductwork Materials:

(a) General: All ductwork shall be constructed of non-combustible or conforming to requirements for Class 0 or 1 air duct materials, or UL 181.

(b) Exposed Ductwork Materials - Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.

(c) Sheet Metal:

1) Aluminum Sheet - ANSI/ASTM B209 aluminum sheet, alloy 3003H-14.
2) Stainless Steel Sheet - ASTM A480, 304 stainless steel sheet No. 1 finish for concealed work and No. 4 finish for exposed work.

(d) Ductwork Material Selection

1) All ductwork installed within an electrical control room shall be constructed of aluminum ductwork.
2) All ductwork other then within an electrical control room, shall be constructed of stainless steel.

2.1.2 Miscellaneous Ductwork Materials

(a) Duct Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

(b) Ductwork Support Materials and Fasteners: 304 stainless steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

2.1.3 Fabrication - General

(a) Fabricate ductwork of gauges and reinforcement complying with SMACNA Duct Construction Standards and ASHRAE handbooks for 2-In. W.C. Pressure Class.

(b) Ductwork shall be constructed to provide the minimum clear inside dimensions indicated on the Drawings.

(c) Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with centerline radius 1.5 times the associated duct width; and fabricate to include airfoil turning vanes in elbows where shorter radius is necessary.

(d) Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse

joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.

(e) Limit angular tapers to 30°(for contracting tapers and expanding tapers).

(f) Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.

(g) Button punch snaplock construction will not be accepted on aluminum ductwork.

(h) When approved by the Engineer, size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

(i) Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

(j) Use double nuts and lock washers on threaded rod supports.

(k) Fabricate ductwork with accessories installed during fabrication to the greatest extent possible

2.1.4 Duct Sealants:

(a) Manufacturers:

1) 3M 800.
2) H.B. Fuller/Foster.
3) Or equal.

(b) Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations.

(c) Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

2.1.5 Gaskets:

(a) For 2-IN. Pressure Class and lower, provide soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

2.1.6 Turning Vanes:

(a) Provide turning vanes constructed of curved blades supported with bars perpendicular to blades and set into side strips suitable for mounting in ductwork.

(b) Turning vanes installed in aluminum ductwork shall be of aluminum construction.

(c) Manufacturer - Subject to compliance with requirements, provide turning vanes of one of the following:

1) Cain Mfg Co.
2) Tuttle & Bailey.
3) Or equal.

2.1.7 Duct Hardware:

(a) Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
(b) Manufacturers - Subject to compliance with requirements provide duct hardware of one of the following:

1) Ventfabrics, Inc.
2) Young Regulator Co.
3) Or equal.

2.1.8 Duct Access Doors:

(a) Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Access doors shall be constructed of same material as the duct system served.
(b) Provide flush frames for uninsulated ductwork, extended frame for externally insulated duct.
(c) Provide one side hinged, other side with 1 handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.
(d) Provide access doors on exhaust systems upstream of all elbows with turning vanes and upstream of electric heating coils.
(e) Manufacturers - Subject to compliance with requirements provide duct access doors of one of the following:

1) Ruskin Mfg. Co.
2) Ventfabrics, Inc.
3) Or equal.

2.1.9 Flexible Connections:

(a) Provide flexible duct connections wherever ductwork connects to vibration isolated equipment.
(b) Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make air tight joint.
(c) Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.
(d) Manufacturers - Subject to compliance with requirements provide flexible connections of one of the following:

1) Ventfabrics.
2) Hypalon.
3) Or equal.

2.2 Dampers:

2.2.1 Rectangular Manual Balancing Dampers (MVD):

(a) Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA Standards. Dampers greater than 10-in height shall be multiblade type.
(b) 16-gage galvanized steel frame and damper blade with 20-gage blade stop. Dampers installed in aluminum or stainless steel duct systems shall be constructed of 304 stainless steel.
(c) ½-in hex axle with molded synthetic bearings.
(d) All dampers shall be furnished with locking hand quadrant. Dampers installed on insulated duct systems shall be furnished with extended quadrant.
(e) Manufacturer - Subject to compliance with requirements, provide dampers of one of the following:

1) Ruskin model MD35.
2) Greenheck.
3) Or equal.

2.2.2 Gravity Backdraft Dampers (BDD):

(a) Parallel blade, counterbalanced, adjustable backdraft damper.
(b) Provide in vertical or horizontal configuration as required by installation location.
(c) Aluminum frame and blade construction with vinyl blade seals.
(d) Units installed in Electrical Control Rooms shall be set for 0.05 beginning pressure relief.
(e) Manufacturer – Subject to compliance with requirements, provide dampers of one of the following:

1) Greenheck model BR.
2) Dayton.
3) Or equal.

2.2.3 Fire Dampers (FD):

(a) Manufacturers:

1) Greenheck.
2) Louvers and Dampers, Inc.
3) Ruskin.
4) Or equal.

(b) Provide curtain type fire dampers of sizes as shown on Drawings.
(c) All fire dampers shall have a 1-1/2-hr fire rating as indicated on Plans.
(d) Dynamic type damper, rated for 4-inches of water column pressure and 2,500-fpm velocity.
(e) 304 stainless steel casing.
(f) Provide with fusible link rated at 160°F to 165°F.
(g) Provide damper with positive lock in closed position.

2.2.4 Insulated Blade Control Dampers:

(a) Manufacturer:

1) Greenheck model ICD-45.
2) Ruskin.
3) Or equal.

(b) General:

1) No single damper shall be larger in size than 48-in in either dimension. Where a larger damper is required, multiple damper assemblies shall be provided.
2) Where multiple damper assemblies are provided, a common actuator may be used to drive a maximum of four dampers. Provide stainless steel connecting linkage as required. Where an assembly is constructed of more than four dampers, multiple actuators shall be provided.

(c) 0.125-in aluminum channel frame insulated with polystyrene on four sides and thermally broken with dual polyurethane resin gaps.
(d) Aluminum airfoil blades internally insulated with polyurethane foam and thermally broken.
(e) Plated steel axle with dual bearings. Bearings shall have acetal inner sleeve and flanged outer bearing with no metal-to-metal or metal-to-plastic contact.
(f) External (out of the airstream) blade to blade linkage.
(g) Suitable for pressures to 8-in. w.c. and velocities to 4,000-fpm with maximum AMCA leakage rate of 8 cfm/sq. ft at 4-in w.c.

2.2.5 Damper Actuators:

(a) Actuators shall be adequately sized for the damper size and air pressures anticipated in the system with a safety factor of two.
(b) Actuators shall have ISO9001 quality certification and be UL listed under standard 60730-1 or UL listed under standard 873.
(c) Actuators used on dampers shall be designed to directly couple and mount to a stem, shaft or ISO style-mounting pad. Actuator mounting clamps shall be a V-bolt with a toothed V-clamp creating a cold weld, positive grip effect. Single point, bolt, or single screw actuator type fastening techniques or direct-coupled actuators requiring field assembly of the universal clamp is not acceptable.
(d) Actuators shall two position (Open-Close). Actuators shall have visual position indicators and shall operate in sequence with other devices if required.
(e) Provide all actuators with proof of full open limit switch.
(f) Actuators shall have an operating range of –22° to 122°F.
(g) Actuators shall be capable of operating on 120 VAC power supply. Power consumption shall not exceed 10 VA.
(h) Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire

rotation.

(i) For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Spring return actuators shall be capable of CW or CCW mounting orientation. Spring return models > 60 in-lbs. and non-spring return models > 90 in-lbs. shall be capable of mounting on shafts up to 1.05-in diameter. Spring return actuators with more than 60 in-lb. of torque shall have a metal, manual override crank. Actuators using "on-board" chemical storage systems, capacitors, or other "on-board" non-mechanical forms of fail-safe operation are unacceptable. Upon loss of control signal, a proportional actuator shall fail open or closed as described below. Upon loss of power, a nonspring return actuator shall maintain the last position.

(j) Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required. Dampers requiring greater torque or higher close off may be assembled with multiple low torque actuators. Dual mounted actuators using additional anti-rotation strap mechanical linkages, or special factory wiring to function are not acceptable. Actuators in a tandem pair must be "off the shelf," standard actuators ready for field wiring.

(k) Damper actuators shall not produce more than 62 dB (A) when furnished with a mechanical fail-safe spring. Non-spring return actuators shall conform to a maximum noise rating of 45 dB(A) with power on or in the running or driving mode.

(l) All damper operators shall be oil submerged, geartrain type, inherently positive positioning.

(m) The actuators shall be mounted externally of ducts or air handling equipment wherever possible for ease of service and isolated from internal temperatures.

(n) Actuator enclosure:

1) Unless otherwise indicated, NEMA 2.
2) In areas designated as Class 1, Division 2 hazardous environments, provide explosion proof (NEMA 7) enclosure.

(o) Fail Position: (Loss of Power)

1) Outside Air Louvers/Intakes: Closed.
2) Exhaust Air Louvers/Hoods: Closed.

2.3 Fans:

2.3.1 Centrifugal Wall Ventilators:

(a) Applicable Units:

1) EF-PR.

(b) Manufacturers:

1) Greenheck.
2) Carnes Company.

3) Cook Company.
4) Or equal.

(c) Type: Provide centrifugal wall ventilators of types, sizes, direct or belt-driven and capacities as shown on drawings or schedules.

(d) Construction: Fan and motor housing shall be constructed of aluminum, fan hood shall be beaded or internally supported for rigidity. Fans shall be provided with pre-punched square mounting plate for mounting to wall. Up-blast type fans shall be provided with drain for the wind band. Drive assembly shall be isolated from fan plate to reduce vibration and noise transmission.

(e) Wheel, Shaft and Drive: Fan wheel shall be backward inclined non-overloading or forward curved as noted above. Bearings shall be heavy-duty pillow block bearings selected for minimum life of 100,000 hours at maximum rated speed of the fan. Drives shall be sized for a minimum of 150% of installed motor horsepower. Sheaves shall be of cast iron construction. Motor sheaves shall be adjustable for system balancing. Fans shall be dynamically and statically balanced and tested before shipment. Fans scheduled to be of spark resistant construction shall be constructed of non-ferrous materials in accordance with AMCA Type B Spark Resistant Construction.

(f) Motors: Provide TEFC motors for all belt drive fans unless scheduled to be explosion proof, ODP for direct drive fans. Fans scheduled to be explosion proof shall be furnished with motor suitable for a Class 1, Division 2, Group D hazardous environment.

(g) Accessories: Provide fans with the following accessories and as scheduled:

1) Dampers: Provide motor operated or gravity actuated dampers as scheduled. Dampers supplied shall meet the applicable requirements of this Section.
2) Birdscreen: Provide manufacturer's standard aluminum birdscreen.
3) Wall Grille: Provide manufacturer's standard wall grille as scheduled.

2.3.2 Centrifugal Inline Fans:

(a) Applicable Units:

1) SF-1
2) EF-1

(b) Manufacturers:

1) Greenheck.
2) Carnes Company.
3) Cook Company.
4) Or equal.

(c) Type: Inline centrifugal exhaust ventilator.

(d) Construction: Fan housing shall be constructed of aluminum. Fan wheel shall be backward inclined, non-overloading of aluminum construction. Drives shall be sized for a minimum of 150% of driven horsepower.
(e) Motors: Provide TEFC motors for all belt drive fans unless scheduled to be explosion proof, ODP for direct drive fans. Fans scheduled to be explosion proof shall be furnished with motor suitable for a Class 1, Division 2, Group D hazardous environment.
(f) Accessories: Provide fans with the following accessories:

1) Inlet and discharge collars.
2) Vibration isolation kit for horizontal hanging installation.
3) Aluminum belt and motor cover.

2.3.3 Axial Wall Fans:

(a) Applicable Units:

1) SF-ECR

(b) Manufacturers:

1) Greenheck.
2) Carnes Company.
3) Cook Company.
4) Or equal.

(c) Type: Axial flow, direct or belt driven propeller fan as scheduled.
(d) Construction: Fan panel shall be single piece construction of galvanized or painted steel with deep formed inlet venturi and pre-punched mounting holes. Drive support frame shall be of heavy gauge steel construction.
(e) Wheel, Shaft and Drive: Propeller shall be constructed of cast aluminum blades securely fastened to cast hub. Hub shall be keyed to ground and polished shaft. Bearings shall be heavy-duty pillow block bearings selected for minimum life of 100,000 hours at maximum rated speed of the fan. Drives shall be sized for a minimum of 150% of installed motor horsepower. Sheaves shall be of cast iron construction, motor sheaves shall be adjustable for system balancing. Fans shall be dynamically and statically balanced and tested before shipment.
(f) Motors: Provide TEFC motors.
(g) Finish: Factory applied prime and finish coatings in manufacturer's standard corrosion resistant paint.
(h) Accessories: Provide fans with the following accessories as scheduled:

1) Dampers: Provide motor operated or gravity actuated dampers as scheduled. Dampers provided shall be the applicable requirements of this Section.
2) Filtered Wall Housing: Provide manufacturer's standard filtered wall housing for scheduled fan size. Housing shall be constructed of steel with pre-punched mounting holes and finished with corrosion resistant coating. Provide with 2-in

washable filter elements. Provide housing with motor side guard of welded steel wire construction.

3) Provide special coatings as scheduled.

2.4 Gravity Roof Ventilators:

2.4.1 Applicable Units:

(a) RH-ECR

2.4.2 Manufacturers:

(a) Greenheck.
(b) Carnes Company.
(c) Cook Company.
(d) Or equal.

2.4.3 General: Provide gravity roof ventilators of types, sizes, and capacities as shown on drawings or schedules.

2.4.4 Type:

(a) Hooded Low Silhouette: Aluminum hood with easily removable cover to allow access to damper assembly.

2.4.5 Construction: Ventilators shall be provided with pre-punched square curb cap for mounting to roof curb.

2.4.6 Accessories: Provide gravity ventilators with the following accessories as scheduled:

(a) Dampers: Provide motor operated or gravity actuated dampers as scheduled. Dampers shall meet the applicable requirements of this Section.
(b) Birdscreen: Provide manufacturer's standard aluminum birdscreen.
(c) Insect screen: Provide manufacturer's standard stainless steel insect screen as scheduled.
(d) Roof Curb: Provide roof curb as scheduled.

1) Provide manufacturer's standard shop-fabricated units, modified if necessary to comply with requirements. Provide curbs of heights and constructed of metal gauges as shown on drawings, where not noted, provide curbs of height required, constructed of 14 gauge metal.
2) Fabricate units from aluminum.
3) Provide treated wood nailer, not less than 1-5/8" thick and of width of support wall assembly. Anchor nailer securely to top of metal frame unit.
4) Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3-lb. density and 1-1/2" minimum thickness, except as otherwise indicated and cover insulation with aluminum liner.

2.5 Electric Heaters:

2.5.1 Explosion-Proof Electric Unit Heaters:

(a) Applicable Units:

1) EUH-PR-1, EUH-PR-2, EUH-PR-3

(b) Manufacturers:

1) Ruffneck Heaters
2) Berko.
3) Qmark.

(c) Type: Propeller type, spark resistant, explosion-proof electric unit heater, suitable for a Class 1, Division 2, Group D hazardous environment.

(d) Construction: Unit casing shall be constructed epoxy coated heavy gauge steel with 14-ga. heavy duty steel frame.

(e) Heating Element:

1) Provide units of voltages and capacities as scheduled.
2) Heat exchanger shall have heavy duty immersion heating elements enclosed in a heat transfer fluid.
3) Heating element shall be designed to ensure surface temperature does not exceed 320°F.

(f) Fans: Fan shall have permanently lubricated explosion-proof motor with built-in overloads.

(g) Controls: Provide the following control devices prewired to unit.

1) Magnetic contactor.
2) Automatic overtemperature cutout.
3) Transformer for 24-volt control circuit.
4) Wall mounted explosion-proof thermostat meeting applicable requirements of this Section.

2.5.2 Propeller Electric Unit Heaters:

(a) Applicable Units:

1) EUH-ECR

(b) Manufacturers:

1) Berko.
2) Qmark.
3) Or equal.

(c) Type: Propeller type electric unit heater.

(d) Construction: Unit casing shall be constructed heavy gauge steel.

Provide with louvered air outlet and inlet grille to act as fan guard.

(e) Heating Element: Element shall aluminum-finned, copper clad steel sheath construction. Provide units of voltages and capacities as scheduled.

(f) Fans: Fan shall be of aluminum construction and dynamically balanced.

(g) Controls: Provide the following control devices prewired to unit.

1) Power contactor.
2) Fan Delay Relay: Provide fan delay relay to keep unit fan running until all heat is dissipated from the heating elements.
3) Automatic overtemperature cutout.
4) Transformer for 24-volt control circuit.
5) Wall mounted thermostat meeting applicable requirements of this Section.

2.6 Air Grilles:

2.6.1 Manufacturers:

(a) A-J Manufacturing Company.
(b) Carnes.
(c) Titus.
(d) Or equal.

2.6.2 Construction: Provide grilles constructed of aluminum or stainless steel as scheduled.

2.6.3 Performance: Provide grilles that do not exceed scheduled maximum pressure drop and noise criteria ratings at scheduled airflow rate or airflow rate as shown on drawings.

2.6.4 Substrate Compatibility: Provide grilles with border styles that are compatible with adjacent substrate and specifically manufactured to fit into construction openings with accurate fit and adequate support. Refer to Drawings and Specifications for types of substrate which will contain each type of grille.

2.6.5 Grille Face / Pattern: Provide grilles of the following face / pattern type as scheduled. Blade width and spacing shall be dictated by the model number shown in the schedules.

(a) Single Deflection: Provide grilles with ¾-inch horizontal or vertical set of blades. Refer to schedules for position of each set of blades.
(b) Double Deflection: Provide grilles with ¾-inch horizontal and vertical sets of blades. Refer to schedules for position of each set of blades.

2.6.6 Finish: Provide grilles with anodized, matte or white baked enamel finish as scheduled.

2.7 Louvers:

2.7.1 Manufacturers:

(a) Greenheck.
(b) Carnes.

(c) Ruskin.
(d) Or equal.

2.7.2 Construction: Provide louvers constructed of aluminum extrusions, Alloy 6063-T5. Weld units or use stainless steel fasteners.

2.7.3 Performance: Provide weatherproof louvers of sizes as shown in schedules or on drawings. Louvers shall not exceed scheduled maximum values for free area face velocity and pressure drop at schedules airflow rates. Intake air louvers shall not have rated minimum water entrainment velocity lower than scheduled maximum free area velocity.

2.7.4 Substrate Compatibility: Provide louvers with frame and sill styles compatible with adjacent substrate and specifically manufactured to fit into construction openings with accurate fit and adequate support for weatherproof installation. Refer to Drawings and Specifications for types of substrate which will contain each type of louver.

2.7.5 Finish: Provide louvers with 70% Kynar finish. Finish color to be Anodized Aluminum.

2.7.6 Accessories: Provide louvers with the following accessories as scheduled:

(a) Bird Screen: Provide manufacturer's standard aluminum bird screen mounted on inside face of louver.
(b) Provide motor operated or gravity backdraft dampers as scheduled. Dampers shall meet applicable requirements of this Section.
(c) Extended sill.

2.8 Thermostats:

2.8.1 Explosion Proof Thermostats:

(a) Manufacturer:

1) Johnson Controls A19AUC
2) Honeywell.
3) Or equal.

(b) Suitable for use in Class 1, Division 2 Group D hazardous environment.
(c) Liquid filled, coiled bulb type element.
(d) SPDT, cooling or heating as required by application.
(e) Suitable for pilot duty (24 to 600 VAC) or line voltage duty up to 16-FLA at 120V.
(f) 20°-80°F temperature adjustment range with front of device dial.
(g) Coordinate requirements with equipment served.

2.8.2 Space Thermostats:

(a) Manufacturer:

1) Johnson Controls A19PRC
2) Honeywell.
3) Or equal

(b) NEMA 4X corrosion resistant enclosure.
(c) Coiled bulb type element.
(d) SPDT, cooling or heating as required by application.
(e) Suitable for pilot duty (24 to 600 VAC) or line voltage duty up to 16-FLA at 120V.
(f) 30°-100°F temperature adjustment range with front of device dial.
(g) Coordinate requirements with equipment served.

3.0 EXECUTION:

3.1 Ductwork

3.1.1 Low pressure duct work shall be fabricated and supported in accordance with SMACNA Duct Construction Standards - Metal and Flexible and ASHRAE handbooks. The duct gages, reinforcing and sealing shall be suitable for the operating pressures of the system.

3.1.2 Double nuts and lock washers shall be used on threaded rod supports. Hanger rods shall be galvanized steel, threaded at both ends or continuously threaded.

3.1.3 During construction, temporary closures of metal or taped polyethylene shall be provided on open duct work to prevent the entry of construction dust. For a facility in continuous operation, the closures may only be required during dust-generating construction operations, as directed by the Engineer.

3.1.4 Increase duct sizes gradually, not exceeding 15 degrees divergence whenever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

3.1.5 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular duct elbows are used, provide turning vanes.

3.1.6 The installation shall conform to the requirements of NFPA 90A and 90B, as applicable.

3.1.7 Provide ductwork with inside dimensions equal to sizes indicated on Drawings.

3.1.8 Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with ties, braces, hangers and anchors of type holding ducts true-to-shape and preventing buckling.

3.1.9 After installation, seal ductwork to seal class recommended and method prescribed in SMACNA - HVAC Duct Construction Standards.

3.1.10 Complete fabrication at Project necessary to match shop-fabricated Work and accommodate installation requirements.

3.1.11 Locate ductwork runs, except as otherwise indicated, vertically and horizontally, avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route not obstructing usable space or block access for servicing building or its equipment. Hold ducts close to walls, overhead construction, columns and other structural and permanent enclosure elements of building.

3.1.12 Coordinate duct installations with installation of accessories, dampers, equipment, controls, and other associated Work of ductwork system.

3.1.13 Support ductwork to comply with SMACNA - HVAC Duct Construction Standards, hangers and support section.

3.1.14 Where dissimilar metal ducts meet, provide positive electrical isolation using insulating materials, sealants and fasteners.

3.1.15 Clean ductwork internally of dust and debris as it is installed. Clean external surfaces of foreign substances causing corrosive deterioration of metal.

3.1.16 Strip protective paper from stainless ductwork surfaces, and repair finish wherever damaged.

3.1.17 Unless otherwise indicated, ducts shall be attached using rivets, bolts or sheet metal screws compatible with the duct material, i.e. aluminum screws for aluminum duct.

3.1.18 Sealant shall be non-hardening, water resistant, fire resistive and compatible with the mating materials. The sealant shall be applied as recommended by the manufacturer, either used alone or with tape or heavy mastic.

3.1.19 Contractor shall verify the location of all duct runs and wall, floor and ceiling penetrations.

3.1.20 Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter. Install access doors where indicated and at each control damper.

3.2 Fans

3.2.1 Do not operate fans for any purpose until ductwork is clean, bearings lubricated, and fan has been test run under observation.

3.2.2 Install fans as indicated, with resilient mountings and flexible electrical leads.

3.2.3 Install flexible connections between fan inlet and discharge ductwork. Ensure metal bands of connections are parallel with minimum 1" flex between ductwork and fan while running.

3.2.4 Each fan shall be provided with the controls as indicated on the electrical drawings. Refer to Division 16.

3.2.5 Support fans in accordance with manufacturer's instructions. As part of submittals, include drawings showing fan support design and construction materials.

3.4 Field Quality Control

3.4.1 Upon completion of installation, start-up and test each electric unit heater, power and gravity ventilator to demonstrate capabilities and compliance with requirements.

3.4.2 Where possible, field correct malfunctioning units then retest to demonstrate compliance.

3.4.3 Replace units which cannot be satisfactorily corrected.

3.4.4 Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards.

3.4.5 Prepare report of test results, including instrumentation calibration reports, in format recommended by applicable standards.

3.5 Air Balancing

3.5.1 Quality Assurance:

(a) A firm certified by National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) in those testing and balancing disciplines similar to those required for this project.

(b) Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated and NEBB "Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems".

3.5.2 Air side system balancing shall include but not be limited to the following procedures:

(a) Test and adjust fan RPM to design requirements. For fans operating with pressure controlled VFDs, fan speed shall first be set to lowest output that allows design flow to most remote terminal served. Measured minimum required supply air pressure shall be identified to the Temperature Controls Contractor for establishing setpoint.
(b) Test and record motor full load amperage.
(c) Check all fans for correct rotation.
(d) Test and record system static pressures, suction, discharge and external at all air handling equipment.
(e) Test and adjust system for design outside air and re-circulated air quantities.
(f) Adjust and record all main supply and return air ducts and zones to proper design CFM.

(g) Test and adjust each diffuser, grille and register to within 5% of design requirements. Record data and location. Use manufacturer's rating and calculations.
(h) Adjust all grilles to minimize drafts in all areas.
(i) Test and record all air temperatures - supply, return, mixed, and outside air

3.5.3 The contractor shall include the cost of new sheaves and belts if it becomes necessary to change the drives during balancing of system.

3.5.4 Patch holes in ductwork and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer.

3.5.5 Mark equipment settings, including damper control positions, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

3.5.6 Balancing contractor shall coordinate damper position settings with temperature control contractor to verify airflows and positions. Include time for this verification. See HVAC controls specification for time included by temperature controls contractor to work with balancing contractor.

3.5.7 Balancing contractor to work with temperature control contractor and HVAC contractor to verify correct operation of entire HVAC system, before submitting report.

3.6 Start-Up

3.6.1 Manufacturers or authorized Manufacturer's representative to provide start-up services for fans and unit heaters.

3.7 Spare Parts

3.7.2 General- Furnish to Engineer, with receipt, the following spare parts for each fan

(a) One (1) set of matched fan belts for each belt-driven fan
(b) Two (2) sets filters for each unit requiring filters.

3.8 Training/Start-Up Services

3.7.1 Provide one half day training session for Department's personnel. Training schedule shall be approved by Engineer.
3.7.2 Provide one half day start-up/installation inspection services.

3.9 Cleaning

3.9.1 Clean factory-finished surfaces. Repair marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 15F - MISCELLANEOUS MECHANICAL ITEMS

1. GENERAL:

1.1 Section Description

1.1.1 This Section shall include all work required for the satisfactory operation of pump station, furnishing and installing complete, the Items indicated on the Drawings, as specified herein and not limited to the items listed below:

(a) Cable Support system for power and control cables supplied by the pump manufacturer.
(b) Stilling Wells for floats.
(c) Pavement Flood Float Alarm Box
(e) Pump Dolly
(f) Refer to Division 1 for additional requirements.

1.2 Related Sections

1.2.1 Section 15A - General Mechanical Provisions.
1.2.2 Section 15B - Basic Mechanical Materials and Methods.
1.2.3 Section 15C - Piping and Appurtenances.
1.2.4 Section 15D - Pumping Equipment.
1.2.5 Section 16D - Supervisory Control and Data Acquisition (SCADA) Equipment.

1.3 Submittals

1.3.1 Submit shop drawings and product data under provisions of Sections 1A and 15A.

1.4 Delivery, Storage and Handling

1.4.1 Delivery, storage and handling shall be in accordance with the provisions under Section 1A.

1.5 Warranty

1.5.1 Provide warranty under provisions of Section 1A.

1.6 Basis of Payment

1.6.1 Payment: The work specified under this Section and as required shall be included for payment in the Contract lump sum price for the item, PUMP STATION MECHANICAL WORK.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Cable Supports

2.1.1 The cable supports shall be constructed as indicated on the Drawings. The cable support shall be complete and shall support all cables required for the main pumps and low flow pumps whether or not shown on the Drawings. Mesh cable supports and grips shall be of stainless steel.

2.2 Stilling Well

2.2.1 Stilling well shall be provided as indicated on the Drawings and as specified herein. Stilling well shall be provided for the Float Control Systems specified under Division 16.

2.2.2 Stilling wells for back-up float systems shall be constructed of 3/8" fiberglass consisting of 60% polyester resin and 40% glass material with stainless steel barrel slide bolt latch and stainless steel door hinges. Barrel shall stay firmly in place until the handle is lifted from the groove.

2.2.3 All hardware and metal parts shall be all stainless steel.

2.3 Pavement Flood Float Alarm Box

2.3.1 Pavement flood float alarm box shall be provided as indicated on the Drawings and as specified herein. Pavement flood float alarm box shall be provided for the Float Control System specified under Division 16.

2.3.2 Pavement flood float alarm box shall be constructed of 3/8" fiberglass consisting of 60% polyster and 40% glass material with stainless steel hasps with padlocks.

2.3.3 All hardware and metal parts shall be all stainless steel.

2.3.4 Fasteners shall be concealed or type that cannot be readily be removed when the door is locked.

2.3.5 Pavement flood float alarm box shall be located at the railroad bridge underpass support pier on the East bound US 14 approximately 12" above the grade.

2.4 Pump Dolly

2.4.1 Furnish two (2) pump dollies for moving pumps at floor El. 644.0 for the low flow pump and main pump.

2.4.2 Dolly shall be shop wagon Stock No. 7045902 manufactured by Little Giant and distributed by C&H Distributors, LLC with the following design:

(a) Dolly shall be 48"x30" with 18" deck height and 3,000 lbs capacity, 12 gauge steel deck, flush edges, double grip T-bar handle, 1" axle and roller bearing wheels.

(b) Dolly shall easily be mobile while carrying heavy loads.

3. EXECUTION:

3.1 Installation

3.1.1 Install the specified specialties in accordance with manufacturer's recommendations and instructions to permit intended performance.

END OF THIS SECTION

DIVISION 16 - ELECTRICAL

DIVISION 16 - ELECTRICAL

SECTION 16A - GENERAL ELECTRICAL PROVISIONS

1. GENERAL:

1.1 Description

1.1.1 The scope of work under this Section shall generally be all electrical work required for the project work as specified or as indicated on the drawings.

1.1.2 The electrical work shall include the furnishing and installing of various items of electrical equipment and, unless otherwise indicated, shall also include the electrical connection of various items such as electric pump motors, fan motors and similar items furnished under other Sections. The Contractor shall be responsible for ascertaining the extent of electrical connections required for items furnished under other Sections and for coordination the electrical work accordingly.

1.1.3 The specifications and drawings are intended to generally define the work required, but they do not include every equipment and installation detail. The work shall include all items and appurtenances required to fully complete the work, whether specifically identified or not, such that the electrical systems are complete and operational.

1.1.4 Refer to Division 1 for other requirements relating to the furnishing and installing of work which shall apply to the work under this Division.

1.2 Code Compliance

Unless otherwise indicated, in the absence of more stringent requirements in the Specifications or on the Drawings, the work shall be in compliance with the requirements of the National Electrical Code.

1.3 Standards

1.3.1 Wherever the following abbreviations are used in these Specifications or on the Drawings, they are to be construed the same as the respective expressions represented:

AASHTO	American Association of State Highways and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
FM	Factory Mutual
ICEA	Insulated Power Cable Engineers Association

IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society of North America
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Assoc.
NESC	National Electrical Safety Code
NETA ATS	InterNational Electrical Testing Agency, Acceptance Testing Specifications
NFPA	National Fire Protection Agency
OSHA	Occupational Safety and Health Administration
UL	Underwriter's Laboratories

1.3.2 Wherever a reference is made to a standard or standard specification, the reference shall be to the edition current at the time of bidding, including any revisions or amendments.

1.4 Verification of Contract Drawings

1.4.1 The Contractor shall familiarize himself with the details of the total construction insofar as they may affect the work under this Division, including floor elevations, physical dimensions of structures, materials of construction and the nature of work required under other Divisions. No additional compensation will be granted for failure to consider the total project work.

1.4.2 The contract drawings (Drawings) for electrical work are generally diagrammatic and do not necessarily depict all items to scale. The Drawings indicate the general locations of major elements of the electrical system, outlets, fixtures, pull boxes and the like, however, field conditions or interferences, may require changes in the installation. The Contractor shall coordinate his work to avoid interferences and shall obtain the approval of the Engineer prior to making any changes from the installation shown.

1.4.3 Prior to installation, the Engineer may make reasonable minor changes in the locations of the installation without additional cost to the State.

1.5 Coordination

1.5.1 The Contractor shall coordinate the work under this Division with the work of other trades. This shall include an orderly exchange of information and shall be accomplished such that the total work is not delayed and that interferences are avoided. The Contractor shall coordinate all electrical systems into a complete operational package. The Contractor shall assign one contact person for all such coordination work, has an understanding and working knowledge of the electrical

control systems on this project. This person shall oversee and assume proper operation of the complete electrical control system including all testing and calibration as outlined herein. The Contractor shall provide the name and phone numbers of this individual at the preconstruction inspection.

1.6 Workmanship

1.6.1 The electrical work shall be performed in a neat and workmanlike manner in accordance with the best practices of the trade.

1.6.2 Unless otherwise indicated, all materials and equipment shall be installed in accordance with the applicable codes, contract requirements and manufacturer's recommendations.

1.7 Testing

1.7.1 All electrical equipment and systems provided under this Division shall be adjusted and tested. The Contractor shall adjust, repair or replace faulty or improper Division 16 work or equipment discovered during testing.

1.7.2 In addition, all electrical items provided under other Divisions and connected and/or adjusted under this Division shall be tested and if a failure occurs due to the connecting or adjusting methods used, the failure shall be remedied under this Division by repair, replacement, or change, as determined by the Engineer, at no additional cost to the Department.

1.7.3 Tests may be made progressively as portions of the work are complete; all systems will require demonstration to the Engineer to demonstrate that they are functional and comply with the Contract Documents.

1.7.4 Tests shall be made in the presence of the Engineer; Engineer shall be notified a minimum of 14 days prior to testing.

1.7.5 A written record of tests shall be maintained by the Contractor and, when complete, it shall be submitted to the Engineer for the record.

1.7.6 Independent Contractor shall perform all tests necessary to assure proper functioning of materials and equipment. As a minimum, the tests shall include the following:

(a) Before making final connections check the insulation resistance of all cables of 3-phase circuits that operate above 150 volts.

(b) Check wiring for proper phase sequencing including buses, feeder cables and transformers and assure proper connection at motors for proper rotation.

(c) Measure and record the line-to-line and line-to-neutral voltages at the line side of the service entrance, all panel buses or main terminals and at the primary and secondary terminals of all transformers furnished under this Division except for control transformers which are integral to motor starter units. Set the taps on transformers as required or as directed by the Engineer.

(d) Check and record the motor nameplate data for each motor. Check the ratings of motor circuit protective devices and assure compatibility of the devices for the connected motors. In particular, assure that the motor starter overload elements are proper for the motor nameplate full load amperes.

(e) Set control relays, protective relays and instruments in accordance with manufacturer's recommendations. Record the set points.

(f) Check all control circuits for proper functioning of all devices and check all switches, contactors, pushbuttons, limit switches, thermostats, circuit breakers and the like for proper operation.

(g) Check all alarm circuits for proper operation and proper set points, as applicable. Record any appropriate set points.

(h) Measure and record the line currents of each phase of each 3-phase motor and 3-phase transformer under load.

(i) Align and adjust lighting fixtures and assure proper operation of all controls, ballasts and lamps.

(j) All equipment must be properly calibrated for proper operation of the system.

(k) All equipment devices shall be tested for proper operation, including but not limited to, selector switches, pushbuttons, indicating lights, timers, lock-out relay, and counters.

(l) See Testing Electrical Systems under paragraph 3.8 of this Section for further testing requirements.

1.7.7 Testing must be complete prior to final inspection. All instruments, tools, etc., required for the tests shall be provided by the Contractor. All equipment shall be properly calibrated for proper operation of the complete system. Additional testing may be requested by the Engineer during final inspection to spot-check test results or to demonstrate proper functioning of the systems. These tests shall be performed by the Contractor at no additional cost to the State.

1.7.8 The Contractor shall simulate the automatic operation of the complete pump station to assure proper operation. After assurance of proper operation, the Contractor shall demonstrate automatic operation including simulation to the Engineer's satisfaction.

1.7.9 Note that failure to test the equipment completely is not an allowance for an extension.

1.8 O&M Manuals and Data to be filed with the Engineer

1.8.1 Submit legible 11" x 17" shop drawings and product data and O&M manuals under provisions of Section 1A and data, as specified herein, shall be furnished to the Engineer when installation and testing are complete, before final acceptance.

1.8.2 As a minimum, the data files shall include requirements of Section 1A plus the following:

(a) A tabulation of cable insulation / megger tests. Tabulations shall include acceptable insulation resistance test values.

(b) A tabulation of motor nameplate data.

(c) A tabulation of voltage tests.

(d) A tabulation of motor current tests.

(e) A tabulation of relay and control device set points.

(f) A tabulation of alarm set points.

(g) A tabulation of breaker settings, timer set points, and protection relay setpoints. Tabulation shall include complete model or catalog number of each breaker, protection relay and fuse.

(h) A tabulation of motor winding resistance tests for pump motors.

(i) A Study Report providing summary of results of power systems study under Section 16B including:

1. Description, purpose, basis, and scope of study and legible single line diagram of power system.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short circuit duties and commentary regarding same.
3. Protective device time versus current color coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Fault current calculations including definition of terms and guide for interpretation of computer printout.
5. Tabulation of appropriate tap settings for relay units.
6. Arc flash calculations and tabulation of incident energy level (calories/cm^2) for each equipment location and recommended personal protective equipment (PPE).

(j) Complete testing report for the testing of electrical systems under paragraph 3.8 of this Section utilizing NETA printed forms. Submit report no later than 30 days after testing is complete. Submit proof of testing agency qualification.

1.9 Record Drawings

1.9.1 Record Drawings shall be prepared and submitted in accordance with Division 1. Note that equipment wiring diagrams shall be project specific and cross reference terminal and wiring numbers to other equipment. Showing generic terminations and wiring numbers is not acceptable.

1.10 Guarantees

Guarantees shall be provided for equipment, materials and work provided under this Division as specified in Division 1.

1.11 Basis of Payment

1.11.1 The work shall be paid for at the Contract lump sum price for PUMP STATION ELECTRICAL WORK, which shall be payment in full for the work described herein unless otherwise noted.

1.11.2 The work for Electric Service specified under Subsection 3.4 shall be paid under the pay items: ELECTRIC SERVICE INSTALLATION; AND ELECTRIC SERVICE CONNECTION.

1.11.3 The work for Telephone specified under Subsection 3.5 shall be paid under the pay item TELEPHONE SERVICE INSTALLATION AND CONNECTION.

1.11.4 Refer to 1.22 of Section 1A for Method of Measurement.

1.12 Classification of Electrical Enclosures and Installations in Project Locations

Unless otherwise specified in the individual Specification Section or shown on Plans, type of electrical enclosures and installations shall be in accordance with the following:

NEMA 7(CLASS I, Division 2, GROUP D): All spaces in the pump station including Wet Well, Intermediate Level, Discharge Level, and Discharge Chamber, except otherwise indicated.

NEMA 1: Electrical Control Room.

NEMA 4X Stainless Steel: Outdoor area and other wet or damp area.

1.13 Final Acceptance Inspection

1.13.1 When the work is complete, tested and fully operational, and only after the O&M Manuals and Record Drawings have been reviewed and accepted, the Contractor shall schedule a Final Acceptance Inspection with the Engineer.

1.13.2 The Final Acceptance Inspection shall be made for the complete work at the facility as a whole and shall be as further described in Section 105 of the Standard Specifications.

2. PRODUCTS:

2.1 Materials and Equipment

2.1.1 Quality

All materials, equipment and appurtenances shall be new, shall be suitable for the application and shall be the product of established, reputable manufacturers.

2.1.2 Standards

The construction, sizes, ratings and capacities of items shall be in conformance with the requirements under paragraph 1.3.1 of this Section, as applicable.

2.1.3 UL Label

Unless otherwise indicated, materials and equipment shall bear the UL label whenever such labeling is available for the type of material or equipment being furnished.

2.1.4 Service Equipment

Equipment which is used as electric service equipment shall bear a UL listing: "SUITABLE FOR USE AS SERVICE EQUIPMENT".

2.1.5 Other Requirements

Refer to Division 1 for other requirements relating to materials and equipment.

3. EXECUTION:

3.1 General

3.1.1 Provide other trades with advance information on locations and sizes of concrete pads, frames, boxes, sleeves and openings needed for the Work. Also provide information and shop drawings necessary to permit trades affected to install their Work properly and without delay.

3.1.2 Prior to submittal of shop drawings coordinate electrical equipment, particularly motor control equipment and control panels, with all applicable equipment and systems furnished under other Divisions of the Specifications. Acknowledge in submittal drawings any designated instrument tag numbers when tag numbers are assigned in drawings or specifications. Acknowledge that coordination of all applicable equipment has been performed.

3.1.3 The electrical system design, including, but not limited to, the type, size and quantity of equipment and components, layout, installation and connections as shown on Plans and/or as indicated in the Specifications, is based on electrical, electro-mechanical and/or electronic equipment supplied by selected manufacturers. If equipment furnished by the Contractor requires a different electrical system than that specified hereinafter or shown on Plans, the Contractor shall make all necessary modifications to the electrical system design, subject to

the Engineer's approval, to provide a complete electrical system ready for successful operation. The costs of making the modifications to the electrical system shall be entirely borne by the Contractor without extra cost to the Department. If equipment furnished by the Contractor necessitates changes to electric, gas and/or telephone utilities' service equipment, or to the Work specified under other Sections of the Specifications, then the cost for making the changes shall also be entirely borne by the Contractor without extra cost to the Department.

3.1.4 Locate all equipment such that they are readily accessible for operation, maintenance, repair and replacement. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place. In general, such equipment is not to be blocked or concealed except where specifically permitted. Do not route conduits across or through access or maintenance space of other equipment. Where equipment is permitted to be concealed, provide approved access door. Where equipment is concealed in fire-resistance rated walls or partitions, provide access doors having same fire-resistance rating as well as partitions in which door is placed.

3.1.5 Where electrical equipment is to be installed in limited space, provide additional drawings (scale - minimum 1/4 in. = 1 ft.) as necessary to show physical and dimensional relationship between electrical equipment and adjacent equipment furnished under other Divisions of the Specifications. Acknowledge locations of adjacent structural or mechanical systems, including ductwork, piping, or equipment accesses. Acknowledge clearances established by all codes and regulations are met or exceeded.

3.1.6 The installation shall be such that its components will function together as workable systems. It shall be complete, with all accessories necessary for its operation, and shall be left with all equipment properly adjusted and in working order. The Work shall be executed in conformity with the best practices and so as to contribute to efficiency of operation, minimum maintenance, accessibility and appearance.

3.1.7 Location of electrical equipment shown on Plans are approximate and are subject to minor changes as directed by and at no extra cost to the Department.

3.1.8 Perform equipment tests as per manufacturer's instructions except where otherwise specified.

3.2 Protection of Work

3.2.1 All electrical work, including equipment, fixtures and appurtenances shall be protected from damage until final acceptance. Fixtures and equipment shall be covered to protect against dirt, moisture, paint and the like. The work shall be protected from mechanical injury by appropriate covering or shielding.

3.2.2 Prior to final acceptance, protective measures shall be removed and equipment and items shall be cleaned as required to deliver the installation to the State in clean, undamaged condition.

3.3 Clean-Up and Safety

3.3.1 The work site shall be maintained in a clean condition, free of hazards, all in conformance with the requirements of Article 107 of the Standard Specifications. Special care shall be taken to assure that electrical systems are not left in an exposed or otherwise hazardous condition. All electrical boxes, cabinets, pole handholes, etc., which contain wiring, either energized or non-energized, shall be closed or shall have their covers in place and shall be locked when possible, during off-work hours.

3.4 Electric Service

3.4.1 Work under this Section shall include all equipment, wiring and appurtenances required for both the complete, operational temporary and permanent electric service. IDOT and CMS shall be notified a minimum of eight (8) weeks prior to the Contractor requiring electric service arrange for the new service and account.

3.4.2 All electric utility's charges for disconnecting the existing electric service and providing new service to the pump station shall be paid to the utility by the Contractor. All costs shall be covered under pay item, ELECTRIC SERVICE INSTALLATION; AND ELECTRIC SERVICE CONNECTION.

3.4.3 The Drawings and Specifications indicate the general nature of work required for electric service. The Contractor shall verify the service requirements, shall ascertain the installation requirements and the items of equipment, wiring, appurtenances being furnished by the utility and shall provide all other material and work required for a complete installation.

3.4.4 Power metering cabinets shall consist of transformers, and meter socket in a NEMA 3R enclosure. Coordinate the transformer rating with the electric utility.

3.4.5 All electric service work must conform to the requirements of the electric utility and NEC.

3.4.6 The Contractor shall obtain approval of the electric utility for the electric service and metering prior to installation. Copies of approved documents and drawings shall be submitted to the Engineer for the record prior to installation.

3.4.7 Existing Pump Station shall remain operational until new Pump Station is operational. Contractor is responsible for coordinating with Com Ed for service disruptions such that the reliable power is available for continuous operation of the pump station.

3.5 Telephone Service

3.5.1 Work under this Section shall include all equipment, wiring and appurtenances required for complete, operational telephone service and a telephone connection for the SCADA system and AEGIS system. Two separate lines shall be installed; the second line shall be shared between the AEGIS system and station phone.

3.5.2 Charges by the telephone utility shall be paid to the utility by the Contractor under the pay item, PUMP STATION TELEPHONE SERVICE INSTALLATION AND CONNECTION. The installation of the telephone service and lines shall be coordinated with to Raymond Eaves or Kevin Schlenger of IDOT Business Services, telephone number (847) 705-4011.

3.5.3 The Drawings and Specifications indicate the general nature of the work required for telephone service. The Contractor shall verify the service requirements, shall ascertain the installation requirements and the items of equipment, wiring and appurtenances being furnished by the utility and shall provide all other material and work required for a complete installation.

3.5.4 All telephone service work must conform to the requirements of the telephone utility.

3.5.5 The Contractor shall obtain approval of the telephone utility for the modification of the telephone wiring. Copies of approved documents and drawings shall be submitted to the Engineer for the record prior to installation.

3.6 Final Acceptance Inspection

3.6.1 When the work is complete, tested and fully operational, and only after the O&M Manuals and Record Drawings have been reviewed and accepted by the Engineer, the Contractor shall schedule a Final Acceptance Inspection with the Engineer. The Contractor shall test for the proper operation of all equipment prior to the final acceptance inspection and to make any corrections necessary to establish proper operation. THE FINAL ACCEPTANCE INSPECTION SHALL NOT BE HELD WHILE FINAL CONNECTIONS AND CHECKS ARE BEING MADE.

3.6.2 The Final Acceptance Inspection shall be made for the complete work at the facility as a whole and shall be as further described in Division 1.

3.7 Maintenance

3.7.1 During the course of the construction work and until final acceptance, the Contractor shall be responsible for maintenance and operational integrity of the facility as specified in Division 1.

3.8 Testing Electrical Systems

3.8.1 Summary

(a) Prior to energizing equipment, retain services of recognized independent testing agency for purpose of performing inspections and tests as herein specified. Independent testing agency shall provide four copies of test procedures prior to commencement of testing with applicable NETA ATS tables and the latest version of NETA ATS a minimum of 30 days prior to field testing.
(b) Ensure electrical equipment supplied by Contractor is operational within industry and manufacturer's tolerances and installed in accordance with Specifications.

(c) Device Ratings and Settings: Verify ratings and settings of overload relays, timers, motor circuit protectors, and overcurrent protection devices. Make final adjustments of devices in accordance with Section 16B.

3.8.2 General

(a) Testing agency shall meet federal, state, and local safety requirements for accreditation of testing laboratories, CFR Title 29, part 1907, "Accreditation of Testing Laboratories." and have membership in InterNational Electrical Testing Agency (NETA).

(b) Contractor's Responsibilities:

1. Supply source of test power to test install equipment at each equipment location.
2. Notify testing agency when equipment becomes available for tests.
3. Coordinate work to minimize Project delay.
4. Supply complete set of approved and updated record electrical drawings, specifications, and pertinent change orders to testing laboratory prior to commencement of testing.

(c) Testing Agency Responsibilities:

1. Notify Engineer and IDOT a minimum of 15 days prior to commencement of testing.
2. Provide material, test procedures, applicable tables of NETA to verify acceptance of test results, equipment, labor, and technical supervision to perform such tests and inspections.
3. Test labeling: On satisfactory completion of tests for each piece of equipment, attach dated and signed "Satisfactory Test" label to tested component.
4. Test forms submitted for Engineer review shall include the range of accepted values in the test forms for insulation resistance tests.

(d) Test Work and equipment installed to ensure proper and safe operation in accordance with intent of Drawings and Specifications.

1. Check interlocking and automatic control sequences and test operation of safety and protective devices.
2. Identify and list deficiencies and correct defects found by Work of this paragraph (3.8 Testing Electrical Systems).
3. Where test results are not within manufacturer's published data or NETA ATS, investigate and correct problem identified then retest. Repeat until problem is corrected. Contractor is responsible for all costs associated with retesting and corrective actions.
4. Cooperate with Power Company, supplier, contractor and manufacturer representatives in order to achieve proper intended operation of equipment.

(e) Test, adjust, and record operating voltages at each system level before energizing branch circuits.

1. Transformer taps shall be adjusted to obtain as near as possible nominal system voltage.
2. Where transformer is under utility jurisdiction, obtain services of utility to correct voltage.
3. Replace devices and equipment damaged due to failure to comply with this requirement.

(f) Balance load among feeder conductors at each panelboard, switchboard or substation and reconnect loads as necessary to obtain reasonable load balance on each phase. Electrical unbalance shall not exceed 10%.

3.8.3 Motor Control Center and Panelboard Assemblies

(a) Refer to paragraph 3.8.4 for appropriate inspections and tests of the motor control center and panelboard bus.
(b) Refer to paragraph 3.8.5 for appropriate inspections and tests of the motor control center and panelboard circuit breakers.
(c) Refer to paragraph 3.8.6 for appropriate inspections and tests of the motor control center motor starters.
(d) Refer to paragraph 3.8.11 for appropriate inspections and tests of the motor control center automatic transfer switches.
(e) Verification and marking of phase sequence rotation shall be performed.

3.8.4 Motor Control Centers and Panelboard Bussing

(a) Visual and Mechanical Inspections:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect for physical and mechanical damage.
3. Verify equipment supplied and connected in accordance with Specifications.
4. Inspect for proper alignment, anchorage, grounding and required clearance areas.
5. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles/sections have been removed.
6. Verify that fuse and circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker's address for microprocessor-communication packages.
7. Verify that current and voltage transformer ratios correspond to approved shop drawings.
8. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.
9. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper ft-lb levels or NETA ATS Table 100.12.
10. Key interlock system shall be physically tested to ensure proper function.
11. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
12. Inspect insulators for evidence of physical damage or contaminated surfaces.
13. Verify correct barrier and shutter installation and operation.

14. Exercise all active components.
15. Doors, panels, and sections shall be inspected for paint, scratches, and fit.
16. Inspect mechanical indicating devices for correct operation.
17. Verify that filters are in place and vents are clear.
18. Perform visual and mechanical inspection of instrument transformers in accordance with paragraph 3.8.7.
19. Mechanical operation of relays, switches, and other devices.
20. Inspect control power transformers.

    i. Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
    ii. Verify that primary and secondary fuse or circuit breaker ratings match approved shop drawings.
    iii. Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

(b) Electrical Tests:

1. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute in accordance with NETA ATS Table 100.1.
2. Perform a dielectric withstand voltage test on each bus, each phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with NETA ATS Table 100.2 The test voltage shall be applied for one minute.
3. Perform electrical tests on instrument transformers in accordance with paragraph 3.8.7.
4. Perform ground-resistance tests in accordance with Section 3.8.9.
5. Determine accuracy of all meters and calibrate watthour meters in accordance with paragraph 3.8.8.
6. Control Power Transformers.

    i. Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with NETA ATS Table 100.1 unless otherwise specified by the manufacturer.
    ii. Perform a turns-ratio test on all tap positions.
    iii. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source. Verify correct potential at all devices.
    iv. Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
    v. Verify correct function of control transfer relays located in the switchgear with multiple control power sources.

7. Voltage Transformers.

i. Perform secondary wiring integrity test. Verify correct potential at all devices.
ii. Verify secondary voltages by energizing the primary winding with system voltage.

8. Perform current-injection tests on entire current circuit in each section of switchgear.

iv. Perform current tests by secondary injection with magnitudes such that a minimum of 1.0 ampere flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.

9. Verify operation of cubicle switchgear/switchboard space heaters.
10. Perform system function tests to verify the correct operation of all sensing devices, alarms, and indicating devices and the correct operation of all interlock safety devices for fail-safe functions in addition to the design function.
11. Perform phasing checks on double-ended or dual-source switchgear to insure correct bus phasing from each source.

(c) Test Values:

1. Bolt torque levels shall be in accordance with manufacturer's instructions. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
2. Insulation-resistance values of bus insulation shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1 Values of insulation-resistance less than this table or manufacturer's recommendations should be investigated. Dielectric withstand voltage tests shall not proceed until insulation-resistance levels are raised above minimum values.
3. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
4. Results of electrical tests on instrument transformers shall be in accordance with paragraph 3.8.7.
5. Results of ground-resistance tests shall be in accordance with paragraph 3.8.9.
6. Accuracy of meters shall be in accordance with paragraph 3.8.8.
7. Control Power Transformers.
8. Voltage Transformers.
9. Current-injection tests shall prove current wiring is in accordance with design specifications.
10. Heaters shall be operational.
11. Results of system function tests shall be in accordance with NETA ATS Section 8.
12. Phasing check shall prove the motor control center phasing is correct and in accordance with the system design. Phase sequence shall be identified in the incoming sections of the MCC and labeled.

3.8.5 Circuit Breakers (600 V) – Insulated-Case/Molded-Case

(a) Visual and Mechanical Inspections:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect for physical and mechanical damage.
3. Inspect for proper alignment and anchorage.
4. Verify the unit is clean.
5. Operate the circuit breaker to insure smooth operation.
6. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper ft-lb levels or NETA ATS Table 100.12.
7. Inspect operating mechanism, contacts, and arc shuts in unsealed units.
8. Perform adjustments for final protective device settings in accordance with coordination study.

(b) Electrical Tests:

1. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1.
2. Perform a contact/pole-resistance test.
3. Determine long-time pickup and delay by primary current injection.
4. Determine short-time pickup and delay by primary current injection.
5. Determine ground-fault pickup and time delay by primary current injection.
6. Determine instantaneous pickup by primary current injection.
7. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.
8. Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset all trip logs and indicators.
9. Verify operation of charging mechanism.

(c) Test Values:

1. Bolt torque levels shall be in accordance with manufacturer's instructions. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
2. Settings shall comply with coordination study recommendations.
3. Insulation-resistance values of bus insulation shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1 Values of insulation-resistance less than this table or manufacturer's recommendations should be investigated.
4. Long-time pickup values shall be as shown in coordination study, and the trip characteristic shall not exceed manufacturer's published time-current

characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS Table 100.7.

5. Short-time pickup values shall be as shown in coordination study, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band.
6. Ground fault pickup values shall be as shown in coordination study, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band.
7. Instantaneous pickup voltage shall be as shown in coordination study, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band.
8. Pickup values and trip characteristics shall be within manufacturer's published tolerances.
9. Minimum pickup voltage of the shunt trip and close coils shall conform manufacturer's published data. In the absence of the manufacturer's published data, refer to NETA ATS Table 100.20.
10. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.
11. The charging mechanism shall operate in accordance with manufacturer's published data.

3.8.6 Motor Controllers

(a) Refer to paragraph 3.8.5 for appropriate inspections and tests for motor circuit protectors.

(b) Visual and Mechanical Inspections: Include following inspections and related work:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect for physical and mechanical damage.
3. Inspect for proper alignment, anchorage, and grounding.
4. Verify the unit is clean.
5. Check tightness of accessible bolted electrical connections by calibrated torque wrench method. Refer to manufacturer's instructions for proper ft-lb levels or NETA ATS Table 100.12.
6. Test all electrical and mechanical interlocking systems for correct operation and sequencing.
7. Verify correct barrier and shutter installation and operation.
8. Exercise all active components and confirm correct operation of all indicating devices.
9. Inspect contactors.

   a. Verify mechanical operation.
   b. Verify contact gap, wipe, alignment, and pressure in accordance with manufacturer's published data.

10. Verify overload protection rating is correct for its application. Set adjustable or programmable devices according to protective device coordination study.
11. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

(c) Electrical Tests:

1. Perform insulation-resistance tests for one minute on contactor(s), phase-to-phase and phase-to-ground and across the open contacts in accordance with NETA ATS Table 100.1.
2. Perform a contact resistance test.
3. Measure blowout coil circuit resistance.
4. Measure resistance of power fuses.
5. Energize contactor using an auxiliary source. Adjust armature to minimize operating vibration where applicable.
6. Test control power transformer in accordance with paragraph 3.8.7.
7. Test motor protection devices in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Section 7.9.
8. Verify operation of cubicle space heater.

(d) Test Values:

1. Bolt torque levels shall be in accordance with manufacturer's instructions. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
2. Mechanical and electrical interlocks shall operate in accordance with system design.
3. Barrier and shutter installation and operation shall be in accordance with manufacturer's design.
4. Indicating devices shall operate in accordance with system design.
5. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1 Values of insulation-resistance less than this table or manufacturer's recommendations should be investigated.
6. Resistance of blowout coils shall be in accordance with manufacturer's published data.
7. Resistance values shall not deviate by more than 15 percent between identical fuses.
8. Contractor coil shall operate within minimal vibration and noise.
9. Control power transformer test results shall be in accordance with paragraph 3.8.7.
10. Motor protection parameters shall be in accordance with manufacturer's published data.
11. System function test results shall be in accordance with manufacturer's published data and system design.
12. Heaters shall be operational.

3.8.7 Instrument Transformers

(a) Visual and Mechanical Inspection:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect for physical and mechanical damage.
3. Verify correct connection of transformers with system requirements.
4. Verify that adequate clearances exist between primary and secondary circuit wiring.
5. Verify the unit is clean.
6. Check tightness of accessible bolted electrical connections by calibrated torque wrench method. Refer to manufacturer's instructions for proper ft-lb levels or NETA ATS Table 100.12.
7. Verify that all required grounding and shorting connections provide contact.
8. Verify correct primary and secondary fuse sizes for voltage transformers.
9. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

(b) Electrical tests:

1. Confirm transformer polarity electrically.
2. Verify connection at secondary CT leads by driving low current through leads and checking for this current at applicable devices.
3. Confirm transformer ratio.
4. Measure insulation resistance of transformer secondary and leads with 500 v megohm meter.
5. Measure transformer primary insulation with applicable overpotential tests.
6. Verify connection of secondary PT leads by applying low voltage to leads and checking for this voltage at applicable devices.

3.8.8 Metering and Instrumentation

(a) Visual and Mechanical Inspection:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect meters and cases for physical.
3. Clean front panel and remove shipping restraint material.
4. Verify tightness of electrical connections.
5. Record model number, serial number, firmware revision, software revision, and rated control voltage.
6. Verify operation of display and indicating devices.
7. Record passwords.
8. Verify unit is grounded in accordance with manufacturer's instructions.
9. Verify unit is connected in accordance with manufacturer's instructions and approved shop drawings.
10. Set all required parameters including instrument transformer ratios, system type, frequency, power demand methods/intervals, and communications requirements.

(b) Electrical Tests:

1. Apply voltage or current as appropriate to each analog input and verify correct measurement and indication.
2. Confirm correct operation and setting of each auxiliary input/output feature including mechanical relay, digital, and analog.
3. After initial system energization, confirm measurements and indications are consistent with loads present.

(c) Test Values:

1. Tightness of electrical connections shall assure a low resistance.
2. Display and indicating devices shall operate per manufacturer's published data.
3. Measurement and indication of applied values of voltage and current shall be within manufacturer's published tolerances for accuracy.

3.8.9 Grounding System

(a) Visual and Mechanical Inspection:

1. Verify grounding system is in compliance with drawings, specifications, and NFPA 70 National Electrical Code Article 250.
2. Inspect physical and mechanical condition of ground system.
3. Inspect tightness of accessible bolted electrical connections by calibrated torque wrench method. Refer to manufacturer's instructions for proper ft-lb levels or NETA ATS Table 100.12.

(b) Electrical Tests:

1. Subject completed grounding system to megger test at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
2. Measure ground resistance not less than 2 full days after last trace of precipitation, and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
3. Perform tests by 2 point method according to Section 9.03 of IEEE 81.

(c) Maximum grounding resistance values are as follows:

1. Equipment Rated 500 kVA and Less: 10 ohms.
2. Equipment Rated 500 to 1000 kVA: 5 ohms.
3. Equipment Rated More than 1000 kVA: 3 ohms.
4. Unfenced Substations and Pad-Mounted Equipment: 5 ohms.
5. Manhole Grounds: 10 ohms.

(d) Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify ENGINEER promptly and include recommendations to reduce ground resistance and to accomplish recommended work.

(e) Report: Prepare certified test reports, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.8.10 Ground Fault Systems

(a) Visual and Mechanical Inspections:

1. Inspect for physical damage and compliance with Drawings and Specifications.
2. Inspect neutral main bonding connection to ensure following.

   i. Zero sequence system grounded upstream of sensor.
   ii. Ground strap systems grounded through sensing device.
   iii. Ground connection made ahead of neutral disconnect link.

3. Inspect control power transformer to ensure adequate capacity for ground fault system.
4. Manual operate monitor panels (if present) for following:

   i. Trip test.
   ii. No trip test.
   iii. Non-automatic reset.

5. Record proper operation and test sequence.
6. Inspect zero sequence systems for symmetrical alignment of core balance transformers about current carrying conductors.
7. Verify ground fault device circuit nameplate identification by actuation observation.
8. Pickup and time delay settings shall be set in accordance with settings developed through coordination study and as approved by ENGINEER.

(b) Electrical Tests:

1. Test in accordance with manufacturer's instructions.
2. Measure system neutral insulation resistance to ensure no shunt ground paths exist, neutral-ground disconnect link removed, neutral insulation resistance measured, and link replaced.
3. Relay pickup current shall be determined by primary injection at sensor and circuit interrupting device operated.
4. Relay timing shall be tested by injecting 150% and 300% of pickup current into sensor. Total trip time shall be electrically monitored.
5. System operation shall be tested at 55% rated voltage.
6. Zone interlock system shall be tested by simultaneous sensor current injective and monitoring blocking function.

(c) Test Parameters:

1. System neutral insulation shall be minimum of 100 ohms, preferably 1 megohm or larger.

2. Relay pickup current shall be within 10% of device dial or fixed setting, and in no case greater than 1,200 amp.
3. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves, but in no case longer than 1 sec.

3.8.11 Transfer Switches

(a) Visual and Mechanical Inspections:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, grounding, and required clearances.
4. Verify the unit is clean.
5. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
6. Verify that manual transfer switch warnings are attached and visible.
7. Verify tightness of all control connections.
8. Inspect bolted electrical connections for high resistance using one or more of the following methods:

    a. Use of low-resistance ohmmeter in accordance with NETA ATS 7.5.1.2.2.
    b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    c. Perform thermographic survey in accordance with NETA ATS Section 9. Coordinate timing of survey with Contractor so that switch is loaded and pumps are operational.

9. Perform manual transfer operation.
10. Verify positive mechanical interlocking between normal and alternate sources.

(b) Electrical Tests:

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with NETA ATS Section 7.22.3.1.
2. Perform a contact/pole-resistance test.
3. Verify settings and operation of control devices.
4. Calibrate and set all relays in accordance with NETA ATS Section 7.9.
5. Verify phase rotation, phasing, and synchronized operation as required by application.
6. Perform automatic transfer tests at the same time that the generator is tested:

    a. Simulate loss of normal power.
    b. Return to normal power.
    c. Simulate loss of emergency power.

d. Simulate all forms of single-phase conditions.

7. Verify correct operation and timing of the following functions:

a. Normal source voltage-sensing and frequency-sensing relays.
b. Engine state sequence.
c. Time delay upon transfer.
d. Alternate source voltage-sensing and frequency-sensing relays.
e. Automatic transfer operation.
f. Interlocks and limit switch function.
g. Time delay and retransfer upon normal power restoration.
h. Engine cool down and shutdown feature.

(c) Test Values:

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar connections by more than 50 percent of the lowest value.
2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
3. Results of the thermographic survey shall be in accordance with NETA ATS Section 9.
4. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
5. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. In the absence of manufacturer's published data, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
6. Control devices shall operate in accordance with manufacturer's published data.
7. Relay test results shall be in accordance with NETA ATS Section 7.9.
8. Phase rotation, phasing, and synchronization shall be in accordance with system design specifications.
9. Automatic transfer shall operate in accordance with manufacturer's design.
10. Operation and timing shall be in accordance with manufacturer's and system design requirements.

3.8.12 Dry Type Transformers

(a) Tests: Include following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping

bracing has been removed. Include internal inspection through access panels and covers.

2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A.
3. Conduct ratio and polarity tests.
4. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.

   Minimum test voltage: 1000 volts, direct current.
   Minimum insulation resistance: 500 megohms.
   Duration of each test: 10 minutes.
   Temperature correction: correct results for test temperature deviation from 20 degrees Celsius standard.

(b) Test failures: compare test results with specified performance or manufacturer's published data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

END OF THIS SECTION

SECTION 16B - ELECTRICAL POWER SYSTEM STUDIES

1. GENERAL:

1.1 Section Includes:

1.1.1 Short circuit study, protective device evaluation study, protective device coordination study, and arc flash study on entire electrical power distribution system. Two iterations shall be modeled: current conditions and future conditions.

1.1.2 Portions of electrical distribution system from normal and alternate sources of power throughout distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions and maximum incident energy shall be covered in studies.

1.1.3 Model shall be included which includes future equipment. For the purposes of the model, five – 100 HP, one – 50 HP submersible pump, conductors between utility transformer and motor control center shall be doubled (i.e. from 2 sets to 4 sets), utility transformer size in KVA shall be doubled with impedance remaining the same, and main breaker in motor control center trip shall be increased to 800 amps shall be included. Arc flash labels shall reflect current conditions.

1.2 Contractor shall engage services of independent engineering firm (cannot be same manufacturer of equipment supplied on project) for purpose of performing power system studies as specified. Independent engineering firm shall have a minimum of 10 years experience in Power System Studies.

1.3 The Electrical Power System Studies shall be performed and the shop drawing shall be submitted and approved prior to submitting the shop drawing for the electrical equipment.

1.4 A Study Report providing summary of results of power systems study. Include:

1.4.1 Description, purpose, basis, and scope of study and single line diagram of power system.

1.4.2 Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short circuit duties and commentary regarding same.

1.4.3 Protective device time versus current color coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

1.4.4 Fault current calculations including definition of terms and guide for interpretation of computer printout.

1.4.5 Tabulation of appropriate tap settings for relay units.

1.4.6 Arc flash calculations and tabulation of incident energy level (calories/cm^2) for each equipment location and recommended personal protective equipment (PPE).

1.5 Regulatory Requirements:

1.5.1 Conform to those listed in Section 16A.

1.6 Qualifications of engineering firm:

1.6.1 Corporately and financially independent engineering organization which can function as unbiased engineering authority, professionally independent of manufacturers, suppliers and installers of equipment or system studies as specified.

1.6.2 Study report shall be signed and sealed by Professional Engineer registered in same State as project location.

1.6.3 Engineering organization may be testing organization.

1.7 Basis of Payment

1.7.1 The work shall be paid at the contract lump sum price for

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which shall be payment in full for the work described herein.

1.7.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

(Not Used)

3. EXECUTION:

3.1 Studies to include the following for two models (one for pump station under construction and a second for future pump station as described above):

3.1.1 Utility Company incoming service lines.
3.1.2 Main switching station.
3.1.3 Power transformers.
3.1.4 Generator System.
3.1.5 Low voltage switchgear.
3.1.6 Motor control centers.
3.1.7 Power and lighting distribution panels.
3.1.8 Cable, wire, and conduit systems.
3.1.9 Contractor and company performing the power system studies are responsible for gathering information on the equipment and conductors required to perform the power system studies.

3.2 Short Circuit Study

3.2.1 Provide complete report with printout data sheets using digital computer type programs as part of study.

3.2.2 Include utilities' short circuit contribution, resistance and reactance components of branch impedances, X/R ratios, base quantities selected, and other source impedances.

3.2.3 Calculate short circuit momentary duty values and interrupting duty values based on assumed 3-ph bolted short circuit at switch gear base medium voltage

controller, switchboard, low voltage MCC, distribution panelboard, pertinent branch circuit panel, and other significant locations through system. Include short circuit tabulation of symmetrical fault currents and X/R ratios. List with respective X/R ratio each fault location, total duty on bus, and individual contribution from each connected branch.

3.3 Equipment Device Evaluation Study

3.3.3 Provide protective device evaluation study to determine adequacy of circuit breakers, molded case switches, automatic transfer switches, knife switches, controllers, surge arresters, busways, and fuses by tabulating and comparing short circuit ratings of these devices with calculated fault currents. Apply appropriate multiplying factors based on system X/R ratios and protective device rating standards. Notify ENGINEER of problem areas or inadequacies in equipment due to short circuit currents and provide suggested alternate equipment.

3.4 Equipment Device Coordination Study

3.4.1 Provide protective device coordination study with necessary calculations and logic decisions required to select or check selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. Objective of study to obtain optimum protective and coordination performance from these devices.

3.4.2 Include as part of coordination study, medium and low voltage classes of equipment from utility's incoming line protective device down to and including largest rated device in 480 v MCCs and panelboards. Include phase and ground overcurrent protection as well as settings of other adjustable protective devices.

3.4.3 Draw time-current characteristics of specified protective devices in color on log-log paper or computer printout. Include with plots complete titles, representative one-line diagram and legends, associated Power Company's relays or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. Indicate types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing in-rush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits, and significant symmetrical and asymmetrical fault currents. Provide coordination plots for phase and ground protective devices on system basis. Provide sufficient number of separate curves to indicate coordination achieved.

3.4.4 Provide separate selection and settings of protective devices in tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment, and recommended settings. Tabulate recommended power fuse selection for medium voltage fuses where applied in system. Notify ENGINEER of discrepancies, problem areas or inadequacies and provide suggested alternate equipment ratings and/or settings.

3.5 Arc Flash Study

3.5.1 Provide Incident Energy Study – An incident energy study shall be done in accordance with the IEEE 1584, "IEEE Guide for Performing Arc Flash Hazard Calculations" as referenced in NFPA 70E, "Standard for Electrical Safety in the Workplace", in order to quantify the hazard for selection of personal protective equipment (PPE).

3.5.2 Adjust system design to optimize the results of the study as it relates to safety and reliable electrical system operation (e.g. overcurrent device settings, current limiting devices). This includes mitigation, where possible, of incident energy levels that exceed 40 calories/cm^2. Provide suggested alternate equipment and settings to minimize incident energy levels.

3.5.3 Provide incident energy level (calories/cm^2) for each equipment location and recommended PPE.

3.5.4 Based on the results of the incident energy study provide and install a warning label (orange <40 cal/cm^2) or danger label (red > 40 cal/cm^2) for each piece of equipment. The label must be readable in both indoor and outdoor environments and contain the following information:

(a) Arc hazard boundary (feet and inches).
(b) Working distance (feet and inches).
(c) Arc flash incident energy at the working distance (calories/cm2).
(d) PPE category and description including the glove rating.
(e) Voltage rating of the equipment.
(f) Limited approach distance (feet and inches).
(g) Restricted approach distance (feet and inches).
(h) Prohibited approach distance (feet and inches).
(i) Equipment/bus name.
(j) Date prepared.

3.5.5 Provide one day of arc flash safety training, travel time excluded and at jobsite or classroom designated by the Department for up to five participants, that contains the requirements referenced in OSHA 1910.269, OSHA 1910 Subpart S and NFPA 70E. Training shall include but not be limited to the following:

(a) Proper use of the system analysis data.
(b) Interpretation of hazard labels.
(b) Selection and utilization of personal protective equipment.
(c) Safe work practices and procedures.

3.6 Protective Device Testing, Calibration, and Adjustment

3.6.1 Comply with Section 16A, see Testing Electrical Systems under paragraph 3.8.

END OF THIS SECTION

SECTION 16C - BASIC ELECTRICAL MATERIALS AND METHODS

1. GENERAL:

1.1 Description

1.1.1 Basic materials and methods specified herein shall be incorporated in the work wherever applicable unless specifically indicated otherwise.

1.1.2 The basic materials and methods specified herein are intended to define a minimum standard of quality and workmanship.

1.1.3 Refer to Division 1 for additional requirements.

1.2 Related Sections

1.2.1 Section 16A – General Electric Provisions.
1.2.2 Section 16C – Basic Electrical Equipment Materials and Methods.
1.2.3 Section 16D – Supervisory Control and Data Acquisition (SCADA) Equipment.

1.3 References

Codes and Standards referred to in this Section are:

Fed. Spec.

W-F-408	-	Fittings for conduit, metal (rigid thick wall and thin wall).
ASTM B-3	-	Specification for soft annealed copper wire.
ASTM B-8	-	Specification for concentric lay stranded copper conductors, hard medium, hard or soft.
ASTM B-33	-	Specification for tinned or soft or annealed copper wire for electrical purposes.
ASTM D 635	-	Test method for rate of burning and/or extent and time of burning of self-supporting plastics in a horizontal position.
HH-I-595	-	Insulation tape, electrical, pressure sensitive adhesive, plastic.

Fed. Spec.

WC-596	-	Electrical power connectors.
NEC	-	National Electrical Code
NEMA WD-1	-	General requirements for ac switches.

UL 50 - Cabinets and boxes.

UL 96A - Installation Requirements for Lightning Protection Systems.

ANSI/NFPA 780- Standard for the Installation of Lightning Protection Systems.

1.4 Submittals

1.4.1 Provide shop drawings and product data under provisions of Section 1A for the following items: Raceways, Cabinets and Enclosures with NEMA classification higher than NEMA 1, and conductor and cables.

1.4.2 All iron and steel products, which are to be incorporated into the raceway work, including conduit and all conduit fittings, shall be domestically manufactured or produced and fabricated as specified in Article 106.

1.4.3 Electrical Identification, Grounding, Wiring Devices, Supporting Devices, and Cabinets and Enclosures with NEMA 1 classification submittals are not required if CONTRACTOR supplies material or equipment as specified. If CONTRACTOR proposes substitutes to material or equipment submittals identified below are required.

(a) Product data.
(b) Submit in accordance with Section 1A.

1.5 Warranty

1.5.1 Provide warranty under provisions of Section 1A.

1.6 Lightning Protection Manufacturer Requirements

1.6.1 Contractor shall retain services of installing manufacturer who is recognized and is UL listed for lighting protection systems and subscribes to the UL Follow-Up Service as herein specified. Installer shall provide four copies of recent project qualifications and project specific floor plan layout and detail submittals.

1.7 Basis of Payment

1.7.1 The work shall be paid at the contract lump sum price for

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which shall be payment in full for the work described herein.

1.7.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Raceways

2.1.1 METAL CONDUIT AND TUBING

(a) Galvanized Rigid Steel Conduit: ANSI C80.1.

(b) Flexible Metal Conduit: Zinc-coated steel.

(c) Liquidtight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.

(d) Plastic- Coated Steel Conduit and Fittings: UL Listed (UL 6); rigid steel conduit system as specified with coated interior walls and external PVC coating, 40 mil (.1 mm) thick. The PVC coating must have been investigated by UL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations shall be UL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating shall be UL listed.

1) The PVC coating shall have the following characteristics:

Hardness:	85+ Shore A Durometer
Dielectric Strength:	400V/mil @ 60 Hz
Aging:	1,000 Hours Atlas Weatherometer
Temperature	The PVC compound shall conform at 0° F. to Federal Specifications PL-406b, Method 2051, Amendment 1 of 25 September 1952 (ASTM D 746)
Elongation:	200%

2) The exterior and interior galvanized conduit surface shall be chemically treated to enhance PVC coating adhesion and shall also be coated with a primer before the PVC coating to ensure a bond between the zinc substrate and the PVC coating. The bond strength created shall be greater than the tensile strength of the plastic coating.

3) The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above -1°C (30°F).

4) An interior urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. The interior coating shall be applied in a manner so there are no runs, drips, or pinholes at any point. The coating shall not peel, flake, or chip off after a cut is made in the conduit or a scratch is made in the coating.

5) Conduit bodies shall have a tongue-in-groove gasket for maximum sealing capability. The design shall incorporate a positive placement feature to assure proper installation. Certified test results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours shall be submitted for review when requested by the Engineer.

6) The PVC conduit shall pass the following tests:

Exterior PVC Bond test RN1:

Two parallel cuts 13 mm (1/2 inch) apart and 40 mm (1 1/2 inches) in length shall be made with a sharp knife along the longitudinal axis. A third cut shall be made perpendicular to and crossing the longitudinal cuts at one end. The knife shall then be worked under the PVC coating for 13 mm (1/2 inch) to free the coating from the metal.

Using pliers, the freed PVC tab shall be pulled with a force applied vertically and away from the conduit. The PVC tab shall tear rather than cause any additional PVC coating to separate from the substrate.

Boil Test:

Acceptable conduit coating bonds (exterior and interior) shall be confirmed if there is no disbondment after a minimum average of 200 hours in boiling water or exposure to steam vapor at one atmosphere. Certified test results from a national recognized independent testing laboratory shall be submitted for review and approval. The RN1 Bond Test and the Standard Method for Measuring Adhesion by Tape Test shall be utilized.

Exterior Adhesion. In accordance with ASTM D870, a 6" length of conduit test specimen shall be placed in boiling water. The specimen shall be periodically removed, cooled to ambient temperature and immediately tested according to the bond test (RN1). When the PVC coating separates from the substrate, the boil time to failure in hours shall be recorded.

Interior Adhesion. In accordance with ASTM D3359, a 6" conduit test specimen shall be cut in half longitudinally and placed in boiling water or directly above boiling water with the urethane surface facing down. The specimen shall be periodically removed, cooled to ambient temperature and tested in accordance with the Standard Method of Adhesion by Tape Test (ASTM D3359). When the coating disbonds, the time to failure in hours shall be recorded.

Heat/Humidity Test:

Acceptable conduit coating bonds shall be confirmed by a minimum average of 30 days in the Heat and Humidity Test. The RN1 Bond Test and the Standard Method for Measuring Adhesion by Tape Test shall be utilized.

Exterior Adhesion. In accordance with ASTM D1151, D1735, D2247 and D4585, conduit specimens shall be placed in a heat and humidity environment where the temperature is maintained at 150°F (66°C) and 95% relative humidity. The specimens shall be periodically removed and a bond test (RN1) performed. When the PVC coating separates from the substrate, the exposure time to failure in days shall be recorded.

Interior Adhesion. In accordance with ASTM D3359, conduit specimens shall be placed in a heat and humidity environment where the temperature is maintained at 150°F (66°C) and 95% relative humidity. When the coating disbonds, the time to failure in hours shall be recorded.

2.1.2 Nonmetallic Conduit

(a) Rigid Nonmetallic Polyvinyl Chloride (PVC) Conduit: NEMA TC 2, Schedule 40 or 80 PVC.

(b) PVC Conduit Fittings: NEMA TC 3; match to conduit type and material.

2.1.3 Fittings

(a) Fittings for steel conduit:

1) Steel or malleable iron, zinc galvanized or cadmium plated.
2) Do not use set screw or indentor type fittings.
3) Do not use aluminum or die cast fittings.
4) GRS Connectors and Couplings:

i. Threaded.
ii. Insulated throat.
iii. Gland compression type.
iv. Rain and concrete type.

5) Comply with ANSI C80.4.
6) Comply with NEMA FB 1, compatible with conduit materials.

(b) Fittings for PVC Coated galvanized rigid steel conduits:

1) Use only fittings approved for use with that material. Patch nicks and scrapes with PVC coating after installing conduit.

(c) Conduit bodies:

2) Malleable iron with galvanized finish.

(d) Fittings for flexible metal conduit:

1) Insulated throat type.
2) Threaded.
3) Grounding type.
4) Liquidtight: 1 piece sealing "O" rings with connectors when entering boxes or enclosures. All liquid tight flexible metal conduit fittings shall have an insulated throat to prevent abrasion of the conductors and shall have a captive sealing O-ring gasket. The fittings shall be Listed under UL 514B. The insulated throat shall be rated up to 105° C.

(e) PVC Conduit Fittings:

1) NEMA TC 3; match to conduit type and material.

(f) Expansion Joints:

1) Conduit expansion fittings complete with copper bonding jumper, Crouse-Hinds Type XJ.
2) Conduit expansion/deflection fittings with copper bonding jumper, Crouse-Hinds Type XD.

(g) Seals:

1) Wall entrance, OZ/Gedney Type FSK or FSC.

(h) Drain Fittings:

1) Automatic Drain Breather:

i. Explosionproof - Safe for Class 1, Group C and D.
ii. Capable of passing minimum 25 cc water/min and minimum 0.05 cu ft air/min at atmospheric pressure.

2) Condensate Drain:

i. Conduit outlet body, Type T.
ii. Threaded, galvanized plug with 3/16 in. drilled holed through plug.

(i) Hazardous Areas:

1) Explosionproof.
2) Horizontal seal fittings, Crouse-Hinds Type EYS.
3) Vertical seal fittings, Crouse-Hinds Type EYD.
4) Vertical seal fittings shall have drain type plug.

2.1.4 Raceway/Duct Sealing Compound

(a) Nonhardening, putty-like consistency workable at temperatures as low as 35°F.

(b) Compound shall not slump at temperature of 300°F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

2.2 Conductors and Cables

2.2.1 Building Wire and Cables

(a) UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as required to meet application and NEC requirements.

(b) Wire and cable for 600 volts and below: Soft drawn, copper wire with 600 volt insulation.

1) Conductors:

i. Annealed, copper in accordance with ASTM B33.
ii. Stranding: Class B in accordance with ASTM B8.

2) Insulations and Coverings:

i. Rubber: Conform to NEMA WC 3.
ii. Thermoplastic: Conform to NEMA WC 5.
iii. Cross-Linked Polyethylene: Conform to NEMA WC 7.
iv. Ethylene Propylene Rubber: Conform to NEMA WC 8.

(c) Feeders and service conductors: Single conductor Type XHHW-2.

(d) Branch Circuits:

1) Single Conductor Type THHN/THWN (90° C): Above ground and underfloor conduits.
2) Single Conductor Type XHHW-2: Duct bank conduit.
3) No. 12 AWG minimum size (unless otherwise noted) for branch circuit wiring, including motor circuits.
4) Size 120 v branch circuits for length of run on following basis.

i. Wiring sized for 3% maximum voltage drop.

5) For other branch circuits, voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of the NEC 215.

(e) Control Circuits:

1) Single conductor Type THHN/THWN (90° C): Above ground and underfloor conduits.
2) No. 14 AWG minimum size (unless otherwise noted).
3) Multi-wire cable assembly: Duct bank conduits.

(f) Non-shielded Instrumentation, Graphic Indication, and Other Control Wiring Operating at Less Than 120 v: No. 14 AWG except as otherwise indicated with same insulation as control circuits.

1) Single conductor Type THHW/THWN (90° C), above ground and underfloor conduits.
2) Multi-wire cable assembly: Duct bank conduits.

(g) Shielded instrumentation wiring, above ground and underfloor conduits:

1) PVC insulation, tinned copper (19 by 27) stranded, No. 16 AWG, twisted pair or triplet cabled with aluminum mylar shielding, stranded, tinned, No. 18 AWG copper drain wire, and overall black FR-PVC, 90°C, 600 volt jacket.
2) Multi-wire cable assembly: Duct bank conduits.

(i) Telephone wire, above ground conduits:

1) Vinyl insulation, tinned copper, solid twisted pair, cabled conductors, and silver gray vinyl jacket.

i. Up to 4 conductors per cable: 22 AWG solid wire.
ii. Over 4 conductors per cable: 24 AWG solid wire.
iii. Duct Bank: High density polyethylene jacketed multi-wire cable assemblies.

(k) Fire Alarm Circuits: Type THHN/THWN, copper conductor, in raceway.

(l) Multi-Wire Control and Instrumentation Cable Assemblies:

1) Multi-conductor, color-coded cable with number and size of conductors indicated.
2) Where spare conductors are not indicated provide 10% spare conductors. One pair minimum.
3) Control and non-shielded instrumentation.

i. Bare soft stranded No. 14 or 12 AWG copper in accordance with ASTM B3.
ii. Class B stranded in accordance with ASTM B8.
iii. Type THWN insulation also meeting requirements of NEMA WC-5 with armor-nylon in accordance with UL 83-THHN/THWN.
iv. Color coded in accordance with NEMA WC-5 Method I Table K-2.
v. Cabled with suitable fillers.
vi. Overall black FR-PVC, 90°C, 600 volt sunlight resistant jacket.

4) Shielded Instrumentation:

i. Bare soft stranded No. 16 AWG copper in accordance with ASTM B3.
ii. Class B stranded tinned copper in accordance with ASTM B8.
iii. PVC with nylon armor insulation.
iv. Twisted pairs color coded in accordance with NEMA WC-5 Method I Table K-2, and numbered.
v. Individual and overall aluminum mylar shields and seven strand tinned copper drain wires.
vi. Overall black FR-PVC 90°C 600 volt sunlight resistant jacket.

2.2.2 Connectors and Splices

(a) Underwriters Laboratories (UL) -listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated.

(b) Select to comply with Project's installation requirements and as required to meet application.

(c) Conductors No. 10 AWG and Smaller: 3M Electric Products, Skotchlok, or equal pre insulated spring connector. Comply with manufacturer's

packaging requirements for number, size, and combination of conductors.

(d) Conductors No. 8 AWG and Larger: Bronze 2-bolt type connectors with spacer.

2.2.3 Terminations

(a) Power Conductors: Compression crimp type lugs.

(b) Control and Instrumentation Conductors: Compression crimp type fork tongue, insulated support type lugs on terminal strips. Do not splice.

2.3 Electrical Identification

2.3.1 Raceway and Conductor Labels

(a) Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide a single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

(b) Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1) Color: Black legend on orange field.
2) Legend: Indicates voltage.

(c) Adhesive Labels: Preprinted, flexible, self adhesive vinyl. Legend is over-laminated with clear, wear and chemical resistant coating.

(d) Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

(e) Colored Adhesive Tape: Self adhesive vinyl tape not less than 3 mils thick by 1 to 2 in. wide (0.08 mm thick by 25 to 51 mm wide).

(f) Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:

1) Size: Not less than 6 in. wide by 4 mils thick (152 mm wide by 0.102 mm thick).
2) Compounded for permanent direct burial service.
3) Embedded continuous metallic strip or core.
4) Printed Legend: Indicates type of underground line.

(g) Aluminum, Wraparound Marker Bands: Bands cut from 0.014 in. (0.4 mm) thick aluminum sheet, with stamped or embossed legend, and

fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

(h) Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

(i) Aluminum Faced Card Stock Tags: Wear resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 in. (0.05 mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

(j) Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 in. (51 by 51 mm) by 0.05 in. (1.3 mm).

2.3.2 Engraved Nameplates and Signs

(a) Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

(b) Engraved stock, melamine plastic laminate, 1/16 in. (1.6 mm) minimum thick for signs up to 20 sq in. (129 sq cm), 1/8 in. (3.2 mm) thick for larger sizes.

1) Engraved Legend: Black letters on white face.
2) Punched for mechanical fasteners.

(c) Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 in. (6.4 mm) grommets in corners for mounting.

(d) Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396 in. (1 mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4 in. (6.4 mm) grommets in corners for mounting.

(e) Fasteners for Plastic Laminated and Metal Signs: Self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers.

2.3.3 Miscellaneous Identification Products

(a) Cable Ties: Fungus-inert, self extinguishing, 1 piece, self locking, Type 6/6 nylon cable ties with following features:

1) Minimum Width: 3/16 in. (5 mm).
2) Tensile Strength: 50 lb (22.3 kg) minimum.

3) Temperature Range: Minus 40 to 185°F (Minus 4 to 85°C).
4) Color: As indicated where used for color coding.

(b) Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

2.4 Grounding

2.4.1 Grounding and Bonding Products

(a) Governing Requirements: Where types, sizes, ratings, and quantities are in excess of NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern.

2.4.2 Wire and Cable Grounding Connectors

(a) Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

1) Material: Copper.

(b) Equipment Grounding Conductors: Insulated with green color insulation.

(c) Grounding-Electrode Conductors: Stranded cable.

(d) Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.

(e) Bare Copper Conductors:

1) Solid Conductors: ASTM B3.
2) Assembly of Stranded Conductors: ASTM B8.
3) Tinned Conductors: ASTM B33.

2.4.3 Miscellaneous Conductors

(a) Grounding Bus: Bare, annealed-copper bars of rectangular cross section.

(b) Braided Bonding Jumpers: Copper tape, braided No. 3/0 AWG bare copper wire, terminated with copper ferrules.

(c) Bonding Straps: Soft copper, 0.05 in. (1 mm) thick and 2 in. (50 mm) wide, except as indicated.

2.4.4 Connector Products

(a) Pressure Connectors: High-conductivity-plated units.

(b) Bolted Clamps: Heavy-duty type.

(c) Exothermic-Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

2.4.5 Grounding Electrodes and Test Wells

(a) Grounding Rods: Copper-clad steel.

1) Size: 3/4 in. by 120 in. (19 by 3000 mm).

(b) Plate Electrodes: Copper, square or rectangular shape. Minimum 0.10 in (3 mm) thick, size as indicated.

(c) Test Wells: Fabricate from 15 in. (400 mm) long, square-cut sections of 8 in. (200 mm) diameter, Schedule 80, PVC pipe or as detailed on Drawings.

2.5 Wiring Devices

2.5.1 Manufacturers

(a) Wiring Devices:

1) Bryant Electric, Inc.
2) GE Company; GE Wiring Devices.
3) Hubbell, Inc.; Wiring Devices Div.
4) Killark Electric Manufacturing Co.
5) Pass & Seymour/Legrand; Wiring Devices Div.
6) Pyle-National, Inc.; an Amphenol Co.

(b) Wiring Devices for Hazardous (Classified) Locations:

1) Crouse-Hinds Electrical Co.; Distribution Equipment Div.
2) Killark Electric Manufacturing Co.
3) Pyle-National, Inc.; an Amphenol Co.

(c) Poke through, Floor Service Outlets and Telephone/Power Poles:

1) Hubbell, Inc.; Wiring Devices Div.
2) Pass & Seymour/Legrand; Wiring Devices Div.
3) Square D Co.
4) Wiremold.

2.5.2 Receptacles

(a) Straight Blade and Locking Receptacles: Heavy Duty specification grade.

(b) GFCI Receptacles: Termination type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle. Design units for installation in 2-3/4 in. (70 mm) deep outlet box without an adapter.

(c) Isolated Ground Receptacles: Equipment grounding contacts connected only to green grounding screw terminal of device with inherent electrical isolation from mounting strap.

1) Devices: Listed and labeled as isolated ground receptacles.
2) Isolation Method: Integral to receptacle construction and not dependent on removable parts.

(d) Industrial Heavy Duty Receptacles: Comply with IEC 309-1.

(e) Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.

1) Appleton or Crouse-Hinds with NEMA 5-20R.
2) Plugs: Match receptacles. Furnish 1 plug for each receptacle installed.

(f) Color: White unless otherwise indicated or required by Code.

2.5.3 Pendant Cord/Connector Devices

(a) Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy Duty grade.

1) Body: Nylon with screw open cable gripping jaws and provision for attaching external cable grip.
2) External Cable Grip: Woven wire mesh type made of high strength galvanized steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.5.4 Cord and Plug Sets

(a) Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1) Cord: Rubber insulated, stranded copper conductors, with type SOW-A jacket. Green insulated grounding conductor, and equipment rating ampacity plus minimum of 30%.
2) Plug: Nylon body and integral cable clamping jaws. Match cord and receptacle type for connection.

2.5.5 Switches

(a) Snap Switches: Heavy duty: quiet type.

(b) Snap Switches in Hazardous (Classified) Locations:

1) Appleton EFS series, Crouse-Hinds EDS series.
2) Comply with UL Standard 894.

(c) Color: White unless otherwise indicated or required by Code.

2.5.6 Wall Plates

(a) Single and combination types match corresponding wiring devices.

1) Plate Securing Screws: Metal with head color to match plate finish.
2) Finished Spaces: 0.04 in. (1 mm) thick, Type 302, satin finished stainless steel.
3) Unfinished Spaces: Galvanized steel.
4) Exterior and wet locations: Weatherproof plates and covers.

2.5.7 Poke Through Assemblies

(a) Factory fabricated and wired assembly of below floor junction box unit with multichanneled, through floor raceway/firestop unit and detachable matching floor service outlet assembly.

1) Size: Selected to fit nominal 3 in. 75 mm) cored holes in floor and matched to floor thickness.
2) Fire Rating: Unit is listed and labeled for fire rating of floor ceiling assembly.
3) Closure Plug: Arranged to close unused 3 in. (75 mm) cored openings and reestablish fire rating of floor.
4) Wiring: Three No. 12 AWG power and ground conductors, one 75 ohm coaxial telephone/data cable, and one four-pair, telephone/data cable.

2.6 Supporting Devices

2.6.1 Materials

(a) Stainless Steel.

2.6.2 Manufactured Supporting Devices

(a) Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

(b) Fasteners: Types, materials, and construction to match support materials listed above.

(c) Modular Mechanical Conduit Seals: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

(d) Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers.

(e) U-Channel Systems: Channels, with 9/16-in. dia holes, at minimum of 8 in. on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

2.6.3 Fabricated Supporting Devices

(a) Shop- or field-fabricate supports or manufacture supports assembled from U-channel components.

(b) Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

(c) Pipe Sleeves: Provide pipe sleeves of one of following:

1) Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from following gage metal for sleeve diameter noted:

i. 3 in. and smaller: 20 ga.
ii. 4 in. to 6 in.: 16 ga.
iii. Over 6 in.: 14 ga.

2) Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
3) Plastic Pipe: Fabricate from Schedule 40 galvanized steel pipe.

2.6.4 Fire Resistant Joint Sealers

(a) Manufacturers:

1) "Dow Corning Fire Stop Foam," Dow Corning Corp.
2) "Pensil 851," General Electric Co.
3) Or Equal.

(b) Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.

(c) Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.7 Cabinets, Boxes, and Fittings

2.7.1 General

(a) Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for use and location. Provide items complete with covers and accessories required for intended use. Provide gaskets for units in damp or wet locations.

2.7.2 Miscellaneous Materials and Finishes

(a) Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

(b) Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

(c) Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

(d) Finishes:

1) Exterior Finish: Galvanized or Gray baked enamel for items exposed in finished locations except as otherwise indicated.
2) Interior Finish: Where indicated, white baked enamel.

(e) Fastener Style:

1) Stainless steel door clamp assembly (Hoffman SS6LP series, Weigmann SSN4 series of equal) for stainless steel boxes. Screw-down clamps are not acceptable.
2) Snap-hinge covers or quarter turn semi-flush oil tight latch for non-metallic boxes.
3) External quick-release or quarter turn semi-flush oil tight latches for galvanized boxes.
4) Spring loaded, triple-thread, captive hex-head bolts for cast metal boxes.

2.7.3 Metal Outlet, Device, and Small Wiring Box

(a) General:

1) Conform to UL 514A and UL 514B.
2) Boxes shall be of type, shape, size, and depth to suit each location and application.

(b) Steel Boxes: Conform to NEMA OS 1. Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

(c) Galvanized Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.7.4 Pull and Junction Boxes

(a) General: Comply with UL 50 for boxes over 100 cu in. volume. Unless otherwise noted, boxes shall have continuous hinge on one side with fastening mechanism on the opposite side. Cover and fasteners shall be of material same as box and shall be of size and shape to suit application.

(b) Galvanized Steel Boxes: Flat rolled, code gauge, sheet steel with welded seams. Where necessary to provide rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

(c) Stainless-Steel Boxes: Fabricate of stainless steel conforming to Type 316 of ASTM A167. Where necessary to provide rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

(d) Galvanized Cast-Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.

(e) Boxes Approved for Classified Locations: Cast metal boxes conforming to UL 886 listed and labeled for use in specific location classification, and with specific hazardous material encountered. Conduit entrances shall be integral threaded type. Provide flat cover with multiple hinges and stainless steel, spring loaded, triple-thread, captive hex-head bolts.

2.7.5 Terminal Strips for Junction Boxes

(a) Manufacturers:

1) Square D Co.
2) Buchanan.
3) Or Equal.

(b) Channel mount snap-on type.

(c) Individual gangable with nylon bases.

(d) Solderless box lug type rated at 600 v to accommodate No. 22 to 8 AWG wire or as otherwise indicated.

(e) Provide 50% spare terminals.

2.8 Lightning Protection

2.8.1 Acceptable Manufacturers

(a) The system components shall be manufactured by a company that has been specializing in the design and manufacture of UL listed lightning protection equipment for at least 5 years.

2.8.2 Materials

(a) All manufactured and fabricated components shall conform to NFPA 780 Class I or Class II as needed for the structures on which they will be installed. The system components shall be fabricated from the following metals:

1) Conductors – Copper.
2) Air Terminals – Copper.

(b) All materials furnished for the lightning protection system shall bear the inspection label of UL.

(c) Class I materials shall be used on structures that do not exceed 75 feet in height and Class II materials shall be used on structures that are 75 feet or higher above average grade.

(d) Copper materials shall not be mounted on aluminum surfaces including Galvalume, galvanized steel and zinc; this includes these materials that have been painted.

(e) Aluminum materials shall not come into contact with earth or where rapid deterioration is possible. Aluminum materials shall not come into contact with copper surfaces.

2.8.3 Air Terminals

(a) Air terminals shall project a minimum of ten inches above the object or area it is to protect and shall be located at intervals not exceeding 20'-0" along ridges and along the perimeter of flat or gently sloping roofs (flat or gently sloping roofs include roofs that have a pitch less than 3:12). Flat or gently sloping roofs exceeding 50'-0" in width shall be protected with additional air terminals located at intervals not exceeding 50'-0". Air terminals shall be located within two feet of roof edges and outside corners of protected areas.

(b) Air terminals shall be installed on stacks, flues, mechanical units and other metallic objects not located within a zone of protection and which have an exposed metal thickness less than 3/16 of an inch. Objects having an exposed metal thickness 3/16 of an inch or greater shall be connected to the lightning protection system as required by the specific standards using main size conductor and bonding plates having a minimum of three square inches of surface contact area.

(c) Air terminal bases shall be securely fastened to the structure in accordance with the specified standards including the use of adhesive that is compatible with the surface it is to be used on or stainless steel fasteners.

(d) Main conductors shall be sized in accordance with the specified standards for Class I or Class II structures and shall provide a two way horizontal or downward path from each air terminal to connection with the ground system. Conductors shall be free of excessive splices and no bend of a conductor shall form a final included angle of less than neither 90 degrees nor have a radius of bend less than eight inches.

(e) Down conductors shall be sized in accordance with specified standards and in no case shall be smaller than the main roof conductor. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure. In no case shall a structure have fewer than two down conductors. Where down conductors are installed exposed on the exterior of a structure and are subject to physical damage or displacement, guards shall be used to protect the conductor a minimum of six feet above grade. Metallic guards shall be bonded at each end.

2.8.4 Roof Penetrations

(a) Roof penetrations required for down conductors shall be made using thru-roof assemblies with solid riser bars and appropriate roof flashing. Conductors shall not pass directly through roof.

2.8.5 Ground Terminations

(a) The down conductor shall be connected to the ground electrode using an exothermically welded connection.

3. EXECUTION:

3.1 Raceways

3.1.1 Examination

(a) Examine surfaces to receive raceways, wireways, and fittings for compliance with installation tolerances and other conditions affecting performance of raceway system.

(b) Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

(c) Install conduit identification tags as shown on Drawings.

3.1.2 Wiring Methods

(a) Outdoors, Damp or Wet Locations: Use following wiring methods unless otherwise noted on Drawings:

1) Outdoor Exposed: PVC-Coated galvanized rigid steel.
2) Concealed: Galvanized rigid steel.
3) Underground Power and Control, Single Run: Rigid nonmetallic (PVC) conduit.

   i. Concrete encased except for area lighting branch circuits or as otherwise noted on Drawings.

4) Underground Power and Control, Grouped: Rigid nonmetallic (PVC) conduit.

   i. Concrete encased except for area lighting branch circuits or as otherwise noted on Drawings.

5) Underground Shielded Instrumentation Cables and Shielded Instrumentation Cables run in concrete slabs, Single Run or Grouped: Galvanized rigid steel.
6) Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.

(b) Indoor Non-Hazardous Dry Locations: Use following wiring methods unless otherwise noted.

1) Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible metal conduit.
2) Exposed: Galvanized rigid steel conduit.

(c) Hazardous classified locations: Use the following wiring methods unless otherwise noted on drawings.

1) Exposed and concealed: PVC-Coated Galvanized rigid steel conduit.
2) Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Stainless steel explosion proof flexible conduit.

(d) Use 3/4 in. minimum size unless otherwise noted except conduit runs to room light switches may be 1/2 in.

(e) Unless specifically indicated otherwise on Drawings or in Specifications, use galvanized rigid steel conduit for general wiring.

(f) Encase galvanized rigid steel conduits installed underground or underfloor in at least 3 in. of concrete. PVC conduit may be used without encasing in concrete for underfloor conduit or where specifically indicated on Drawings.

1) Underground conduit shall be minimum of 1 in., buried at depth of not less than 24 in. below grade.
2) Provide conduits or ducts terminating below grade with means to prevent entry of dirt and moisture.
3) When using concrete encased PVC conduit provide PVC coated galvanized rigid steel elbows.

(g) Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1 in. (25 mm) concrete cover.

1) Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2) Space raceways laterally to prevent voids in concrete.
3) Run conduit larger than 1 in. trade size parallel to or at right angles to main reinforcement and spaced on center of at least 3 times conduit trade dia. with minimum 2 in. concrete covering. Conduits over 1 in. may not be installed in slab without approval of ENGINEER.
4) When at right angles to reinforcement, place conduit close to slab support.
5) Conduits embedded in concrete frame shall comply with applicable provisions of ACI 318.

3.1.3 Installation

(a) Conceal raceways by enclosing within finished walls, ceilings, and floors, unless otherwise indicated.

(b) Provide watertight conduit system where installed in wet places, underground or where buried in masonry or concrete.

1) Use threaded hubs when entering top of enclosures.
2) Use sealing type locknuts when entering sides or bottom of enclosures.

(c) Install two spare 1 in. conduits from top of each flush mounted panelboard to area above ceiling for future use. On flush mounted panelboards located on first and higher level floors, provide two spare 1 in. conduits from bottom of panelboard to ceiling area of floor below for future use.

(d) Keep raceways at least 6 in. (150 mm) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

(e) Install raceways level and square and at proper elevations. Provide adequate headroom.

(f) Complete raceway installation before starting conductor installation.

(g) Support raceway as specified in Section 16C-2.06.

(h) Use temporary closures to prevent foreign matter from entering raceway.

(i) Run concealed raceways with minimum of bends in shortest practical distance considering type of building construction and obstructions, except as otherwise indicated.

(j) Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow surface contours as much as practical.

1) Mount exposed horizontal runs as high above floor as possible, and in no case lower than 7 ft above floors, walkways, or platforms in passage areas.
2) Run parallel or banked raceways together, on common supports where practical.
3) Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

(k) Join raceways with fittings designed and approved for purpose and make joints tight.

1) Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
2) Use insulating bushings to protect conductors.

(l) Terminations: Where raceways are terminated with locknuts and bushings, align raceway to enter squarely, and install the locknuts with dished part against the box. Use two locknuts, one inside and one outside the box. Use insulating bushings. Provide insulated grounding bushings to terminate ground wire.

(m) Where terminations in threaded hubs, screw raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to box, and tighten chase nipple so no threads are exposed. Conduits terminating in junction and pull boxes shall be terminated with insulated and gasketed watertight threaded NEMA 4X conduit hubs. The hubs shall be Listed under UL 514B. The insulated throat shall be rated up to 105° C. When PVC coated conduit is utilized, the aforementioned hubs shall also be PVC coated.

(n) Install pull wires in empty raceways. Use monofilament plastic line having not less than 200 lb (90 kg) tensile strength. Leave not less than 12 in. (300 mm) of slack at each end of pull wire.

(o) Telephone and Signal System Raceways 2 in. Trade Size and Smaller: In addition to above requirements, install in maximum lengths of 150 ft

(45 m) and with maximum of two 90° bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.

(p) PVC Externally Coated Galvanized Rigid Steel Conduit: Use only fittings approved for use with that material. Patch nicks and scrapes in PVC coating after installing conduit.

(q) Where PVC coated conduit is utilized, all conduit fittings, couplings and clamps shall be PVC coated. All other mounting hardware and appurtenances shall be stainless steel.

The personnel installing the PVC coated conduit must be trained and certified by the PVC coated conduit Manufacturer or Manufacturer's representative to install PVC coated conduit. Documentation demonstrating this requirement must be submitted for review and approval.

3.1.4 Conduit Stub-Ups

(a) Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above finished slab.

(b) Transition under floor conduit to PVC coated galvanized rigid steel conduit before rising above floor. Under floor conduit elbows shall be PVC coated galvanized rigid steel conduit. Extend the PVC coated galvanized rigid steel conduit portion of the stub-up minimum 12 inch above floor or slab.

3.1.5 Conduit Bends

(a) Make bends and offsets so inside diameter is not reduced. Unless otherwise indicated, keep legs of bend in same plane and straight legs of offsets parallel.

(b) Provide NEMA standard conduit bends, except for conduits containing medium voltage cable, fiber optic cable, or conductors requiring large radius bends.

3.1.6 Flexible Connections

(a) Use maximum of 6 ft (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures.

(b) Terminate conduits at motor terminal boxes, motor operated valve stations or pipe-mounted instruments and other equipment subject to vibration with maximum of 3 ft (915 mm) liquidtight flexible metal conduit unless otherwise indicated.

(c) Use liquidtight flexible conduit in wet or damp locations.

(c) Use approved flexible connections in hazardous locations.

(d) Install separate ground conductor inside flexible conduit connections.

3.1.7 Fittings

(a) Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. Install raceway sealing fittings at following points and elsewhere as indicated:

1) Where conduits enter or leave hazardous locations.
2) Where conduits pass from warm locations to cold locations, such as boundaries of refrigerated spaces and air-conditioned spaces.
3) Where otherwise required by NEC.

(b) Use raceway fittings compatible with raceway and suitable for use and location. For GRS, use threaded galvanized rigid steel conduit fittings, except as otherwise indicated.

(c) Install automatic breather drain fittings according to manufacturers written instructions. Locate fittings to drain conduit system and prevent condensate from entering device enclosures. Install automatic breather drain fittings at following points and elsewhere as indicated.

1) Where vertical seals are installed.
2) Low points in conduit system.
3) Below filed instrumentation at junction boxes of flexible and rigid conduit.
4) Where otherwise required by NEC.

(d) Install wall entrance seal as dictated by application where conduits pass through foundation walls below grade.

(e) Install conduit expansion fittings complete with bonding jumper in following locations.

1) Conduit runs crossing structural expansion joints.
2) Conduit runs attached to 2 separate structures.
3) Conduit runs where movement perpendicular to axis of conduit may be encountered.

(f) Where conduit passes from inside of building to outdoors, it shall be firmly packed at fitting nearest wall line with Johns-Manville Duxseal to depth of at least 1 in. after wires and cables are pulled in; or, if conduit enters directly into equipment, it shall be fitted with seal and drain fitting to prevent water entering equipment.

3.1.8 Grounding

(a) Ground in accordance with Section 16C-2.4.

(b) Provide grounding connectors for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

3.1.9 Protection

(a) Provide final protection and maintain conditions, in manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1) Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2) Repair damage to PVC or paint finishes with matching touch-up coating recommended by manufacturer.

3.1.10 Cleaning

(a) Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.2 Electrical Identification

3.2.1 Installation

(a) Install as indicated where used for color coding.

(b) Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

(c) Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.

(d) Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

(e) Self Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

(f) Install painted identification as follows:

1) Clean surfaces of dust, loose material, and oily films before painting.
2) Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.
3) Apply one intermediate and one finish coat of silicone alkyd enamel.
4) Apply primer and finish materials according to manufacturer's instructions.

(g) Identify Raceway Systems containing power, control and instrumentation conductors with adhesive labels. Locate labels at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.5 m) in congested areas. Labels shall be color coded and identify the contents (i.e. orange label with black print reading 480V FEEDER – ID #P001)

(h) Indentify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of systems listed below for identification.

1) Fire Alarm Systems: Red.
2) Combined Fire Alarm and Security System: Red and blue.
3) Security System: Blue and yellow.
4) Telecommunications System: Green and yellow.

(i) Install Circuit Identification Labels on Boxes: Label externally as follows:

1) Exposed Boxes: Pressure sensitive, self adhesive plastic label on cover.
2) Concealed Boxes: Plasticized card stock tags.
3) Labeling Legend: Permanent, water proof listing of panel and circuit number or equivalent.

(j) Indentify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 in. (150 to 200 mm) below finished grade. Where multiple lines installed in common trench or concrete envelope provide multiple underground line warning tapes, one for each 16 inches of width of lines. If lines do not exceed an overall width of 16 in. (400 mm), use single line marker.

1) Install line marker for underground wiring, both direct buried and in raceway.

(k) Color Code Conductors: Secondary service, feeder, and branch circuit conductors throughout secondary electrical system.

1) Field applied, color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG.

i. Colored, pressure sensitive plastic tape in half lapped turns for distance of 6 in. (150 mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1 in. (25 mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.

ii. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3 in. (76 mm) from terminal and spaced 3 in. (76 mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

2) 208/120-V Systems: As follows:

i. Phase A: Black.
ii. Phase B: Red.
iii. Phase C: Blue.
iv. Neutral: White.
v. Ground: Green.

3) 480/277-V Systems: As follows:

i. Phase A: Brown.
ii. Phase B: Orange.
iii. Phase C: Yellow.
iv. Neutral: Grey
v. Ground: Green.

(l) Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, and switchboard rooms.

1) Legend: 1/4 in. (6.4 mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2) Fasten tags with nylon cable ties; fasten bands using integral ears.

(m) Apply identification to conductors as follows:

1) Conductors to Be Extended in Future: Indicate source and circuit numbers.
2) Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase.

Use color coding for voltage and phase indication of secondary circuit.

3) Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape.

(n) Apply warning, caution, and instruction signs and stencils as follows:

1) Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2) Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8 in. (9 mm) high lettering for emergency instructions on power transfer, load shedding, and or emergency operations.

(o) Install identification as follows:

1) Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of text with 1/2 in. (13 mm) high lettering on 1-1/2 in. (38 mm) high label; where 2 lines of text are required, use lettering 2 in. (51 mm) high. Use black lettering on white field. Apply labels for each unit of following categories of equipment.

i. Panelboards, electrical cabinets, and enclosures.
ii. Access doors and panels for concealed electrical items.
iii. Electrical switchgear.
iv. Motor control centers.
v. Push button stations.
vi. Power transfer equipment.
vii. Transformers.
viii. Power generating units.
ix. Telephone switching equipment.
x. Fire alarm master station or control panel.
xi. Security monitoring or control panel.

2) Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For

panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3.3 Conductors and Cables

3.3.1 Installation

(a) Install wires and cables as indicated, in accordance with NEC, according to manufacturer's written instructions and NECA "Standard of Installation".

(b) Run wire and cable in conduit unless otherwise indicated on Drawings. Pull conductors into raceway simultaneously where more than 1 is being installed in same raceway.

1) Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
2) Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
3) Do not draw conductor into conduits until building is enclosed, watertight, and work causing cable damage has been completed.

(c) Install cable supports for vertical feeders in accordance with NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

(d) For panelboards, cabinets, switches, and equipment assemblies, neatly form, train, and tie cables in individual circuits.

(e) Seal cable and wire entering building from underground between wire and conduit, where cable exits conduit, with non-hardening approved compound.

(f) Install wire and cables in separate raceway systems as follows:

1) Exit lights.
2) Shielded Instrumentation
3) Telephone cables.
4) Fire Alarm System.
5) As required by NEC.

(g) Where control or instrumentation cables are run in underground conduit and ducts provide multi-wire cable assemblies.

(h) Where power cables and instrument/signal cables enter and pass through same or distribution box, steel barrier or separate raceways shall continue through box to avoid magnetic interaction between power cables and instrumentation conductors.

(i) Do not run instrumentation cables into control cabinets or MCC unless cables are terminated in cabinet or MCC.

(j) Wiring at Outlets: Install with at least 12 in. (300 mm) of slack conductor at each outlet.

(k) Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

(l) Drawings do designate number of conductors in conduit. CONTRACTOR is responsible for verifying number of conductors in conduit prior to installation. Location of branch circuits and switch legs indicated on Drawings may be routed differently as dictated by construction and these Specifications.

3.3.2 Terminations and Splices

(a) Terminate control, instrumentation, and communication cables on terminal strips in separate terminal cabinets located near conduit entrances of buildings or as shown on Drawings.

(b) Power Cable Splices (no splices in cables unless approved by Engineer):

1) Provide continuous lengths of cable without splices in motor circuits and feeders unless otherwise noted. Splices may be installed in motor circuits and feeders with prior approval by ENGINEER.
2) Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
3) Use splice and tap connectors that are compatible with conductor material.
4) Where pre-insulated spring connectors are used for equipment connections, tape connector to wire to prevent loosening under vibration.
5) Each tap, joint or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and finish wrap of color coding tape where required by code.
6) Cable splices shall be made only in distribution boxes and junction boxes.

(c) Power Cable Terminations:

1) Termination of wires with full compression type lugs installed with appropriate hand or hydraulic tool. Use proper dies to achieve the desired compression.

2) For screw type terminal blocks, terminations for stranded conductors shall be made with T & B lock-on fork connector with insulated sleeves.
3) Motor lead conductor terminations shall be made with a T & B or approved equal, full compression lug, full ring type, bolted, and taped as required. For connecting motor lead to service wiring fasten full ring lugs together with cadmium plated steel cap screws, and cover with a minimum of 2 layers 1/2 lap, 3M Scotch No. 33 tape; option: T & B "Motor Stub Splice Insulator".

3.3.3 Control Circuits

(a) Control circuit wiring from same area for the same system returning to same panel, (e.g., LCP, DPC, etc.,) may be combined provided signal and voltage types are not mixed.

(b) Following types of wiring shall not be combined with other types:

1) 4-20 ma dc analog; shielded cable.
2) 24 vdc discrete (e.g., field or panel powered dry contacts).

3.3.4 Branch Circuits

(a) Motor branch circuits and branch circuits for 3 phase circuits shall not be combined.

(b) Branch circuits for single phase equipment devices from same lighting panel or power panel may be combined provided that such combining does not result in having to derate ampacity of conductors.

3.3.5 Feeders

(a) Extend feeders at full capacity from origin to termination.

(b) Each conduit raceway shall contain only those conductors constituting single feeder circuit.

(c) Where multiple raceways are used for single feeder, each raceway shall contain conductor of each phase and neutral if used.

(d) Where feeder conductors run in parallel, conductors shall be of same length, material, circular-mil area, insulation type, and terminated in same manner.

(e) Where parallel feeder conductors run in separate raceways, raceways shall have same physical characteristics.

(f) Confine feeders to insulated portions of building unless otherwise shown.

(g) On network systems, neutral shall be run with phase wires. Unbalanced neutral current shall not exceed normal or derated conductor capacity.

3.3.6 Motor and Equipment Wiring

(a) Provide motor circuits in accordance with diagrams and schedules on Drawings and code requirements, from source of supply to associated motor starter and starter to motor terminal box, including necessary and required intermediate connections.

(b) Do not include associated control conductors in same conduit with power conductors.

(c) Provide branch circuits to conform with NEC requirements and nameplate ratings. CONTRACTOR responsible for verification of ratings of motors and installing proper branch circuits.

3.3.7 Color Coding

(a) Conductors for Lighting and Power wiring:

Phase	208/120 v	480/277 v
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Travelers	Pink	Purple
Neutral	White	Grey
Ground	Green	Green

(b) Colored pressure-sensitive plastic tape.

1) Apply in half overlapping turns for minimum of three inches at terminal points, and in junction boxes, pull boxes, and troughs.
2) 3/4 in. wide with colors as specified.
3) Apply last two laps of tape with no tension to prevent possible unwinding.
4) Where cabling markings are covered by tape, apply tags to cable starting size and insulation type.

(c) Color code for insulated power system wiring shall be in accordance with NEC.

(d) Color code for intrinsically safe systems shall be light blue.

3.3.8 Control, Communication and Signal System Identification

(a) Install permanent wire marker at termination.

(b) Identifying numbers and letters on wire markers shall correspond to those on terminal blocks or wiring diagrams used for installing systems.

(c) Plastic sleeve or self adhesive vinyl cloth.

3.3.9 Feeder Identification

(a) Pullboxes and junction boxes, install metal tags on circuit cables and wires to clearly designate circuit identification and voltage.

(b) Comply with Section 16B-2.3.

3.3.10 Field Quality Control

(a) Visual and Mechanical Inspection:

1) Inspect cables for physical damage, proper connection and tagging in accordance with single-line diagram and schematics.
2) Test cable mechanical connections to manufacturer's recommended values using calibrated torque wrench.
3) Check cable color coding with specifications and NEC standards.

(b) Electrical Tests:

1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 min.
2) Perform continuity test to insure proper cable connection.

(c) Test Values:

1) Evaluation results by comparison with cables of same length and type. Investigate any value less than 50 megohms.

3.4 Grounding

3.4.1 Application

(a) Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.

1) Install equipment grounding conductor with circuit conductors for items below in addition to those required by Code:

i. Feeders and branch circuits.
ii. Lighting circuits.
iii. Receptacle circuits.
iv. Singe-phase motor or appliance branch circuits.

v. Three-phase motor or appliance branch circuits.

2) Isolated Grounding-Receptacle Circuits: Install separate insulated equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding-conductor terminal of applicable derived system or service, except as otherwise indicated.

3) Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply raceway with nonmetallic raceway fitting listed for purpose. Install fitting where raceway enters enclosure, and install separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding-conductor terminal of applicable derived system or service, except as otherwise indicated.

(b) Signal and Communications Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding-electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1) Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on 1/4 by 2 by 12 in. (6 by 50 by 300 mm) grounding bus.

2) Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

(c) Separately Derived Systems: Where NEC requires grounding, ground according to NEC Paragraph 250-30.

(d) Common Ground Bonding with Lightning Protection System: Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system grounding conductor and install in conduit.

(e) Piping Systems and Other Equipment: Comply with NEC Article 250 for bonding requirements.

3.4.2 Installation

(a) Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

(b) Grounding Rods: Locate minimum of 1 rod length from each other and at least same distance from any other grounding electrode.

1) Drive until tops are 2 in. (50 mm) below finished floor or final grade, except as otherwise indicated.

2) Interconnect with grounding-electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make these connections without damaging copper coating or exposing steel.

(c) Grounding Conductors: Route along shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

(d) Underground Grounding Conductors: Use bare tinned copper wire. Bury at least 24 in. (600 mm) below grade.

(e) Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding-clamp connectors. Where dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install grounding jumper across dielectric fittings. Bond grounding-conductor conduit to conductor at each end.

(f) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.

(g) Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

(h) Test Wells: One for each driven grounding electrode system, except as otherwise indicated. Set top of well flush with finished grade or floor. Fill with 1 in. 25 mm) maximum-size crushed stone or gravel.

3.4.3 Connections

(a) Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1) Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
2) Make connections with clean, bare metal at points of contact.
3) Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4) Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5) Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

(b) Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

(c) Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

(d) Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

(e) Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and grounding rods.

(f) Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

(g) Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on grounding conductor.

(h) Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.4.4 Underground Distribution System Grounding

(a) Ground pad-mounted equipment and noncurrent-carrying metal items associated with substation by connecting them to underground cable and grounding electrodes.

3.4.5 Field Quality Control

(a) Test in accordance with 16A-3.8.

(b) Testing Agency: Provide services of qualified independent testing agency to perform specified acceptance testing.

(c) Testing: Upon completion of installation of ground-fault protection system and after electrical circuits have been energized, demonstrate capability and compliance with requirements.

1) Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.

(d) Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.4.6 Restoration

(a) Restore surface features, including vegetation, at areas disturbed by work of this Section.

1) Re-establish original grades, except as otherwise indicated.
2) Where sod has been removed, replace it as soon as possible after backfilling is completed.
3) Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition.
4) Include topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
5) Maintain restored surfaces.
6) Restore disturbed paving.

3.5 Wiring Devices

3.5.1 Installation

(a) Mounting height as follows unless otherwise shown on Drawings:

1) Switches: 48 in. above floor.
2) AC Receptacles and Telephone Outlets: 15 in. above floor or 48 in. above floor in unfinished areas.

(b) Install devices and assemblies plumb and secure.

(c) Install wall plates when painting is complete.

(d) Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

(e) Protect devices and assemblies during painting.

3.5.2 Identification

(a) Comply with Section 16C-2.3.

1) Switches: Identify each switch with approved legend engraved on wall plate and identify panel board circuit number that it controls/is powered from.
2) Receptacles: Identify panelboard and circuit number from which served. Use machine printed, pressure sensitive, abrasion resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.5.3 Connections

(a) Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

(b) Isolated Ground Receptacles: Connect to isolated ground conductor routed to designated isolated equipment ground terminal of electrical system.

(c) Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A.

3.5.4 Field Quality Control

(a) Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

(b) Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

(c) Replace damaged or defective components.

3.5.5 Cleaning

(a) Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

3.6 Supporting Devices

3.6.1 Installation

(a) Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

(b) Coordinate with structural system and with other electrical installation.

(c) Raceway Supports: Comply with NEC and following requirements:

1) Conform to manufacturer's recommendations for selection and installation of supports.
2) Strength of each support shall be adequate to carry present and future load multiplied by safety factor of at least four. Where this determination results in safety allowance of less than 200 lbs,

provide additional strength until there is minimum of 200 lbs safety allowance in strength of each support.

3) Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4) Support parallel runs of horizontal raceways together on trapeze-type hangers.
5) Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 in. and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 in. dia or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
6) In vertical runs, arrange support so load produced by weight of raceway and enclosed conductors is carried entirely by conduit supports with no weight load on raceway terminals.

(d) Vertical Conductor Supports: Install simultaneously with installation of conductors.

(e) Miscellaneous Supports: Support miscellaneous electrical components as required to produce same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

(f) Sleeves: Install in concrete slabs and walls and other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

(g) Conduit Seals: Install seals for conduit penetrations of slabs below grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

(h) Conduit extending through roof shall pass through ceiling box at roof line.

1) Provide 14 ga minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit.
2) Install conduit and pitch pocket in advance of roofing work.

(i) Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with following:

1) Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or

expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2) Holes cut in concrete shall not cut main reinforcing bars. Fill holes that are not used.
3) Load applied to any fastener shall not exceed 25% of proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.

3.7 Cabinets, Boxes and Fittings

3.7.1 Installation, General

(a) Locations: Install items where indicated and where required to suit code requirements and installation conditions.

(b) Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

(c) Support and fasten items in accordance with Section 16C-2.11.

(d) Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated

(e) Remove sharp edges where they may come in contact with wiring or personnel.

3.7.2 Applications

(a) Hinged Door Enclosures: Sheet steel, baked enamel finish, NEMA type 12 enclosure except as indicated.

(b) Hinged Door Enclosures in Corrosive Locations: NEMA type 4X stainless steel metal enclosure, or as indicated on Drawings.

(c) Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types for each location in conformance with following requirements unless otherwise noted:

1) Interior Dry Locations: Install outlet and device boxes and associated covers and fittings of materials and NEMA types for each location in conformance with following requirements unless otherwise noted:
2) Locations Exposed to Weather or Dampness: Galvanized, cast metal, NEMA Type 3R.
3) Wet Locations: Stainless Steel, NEMA type 4X enclosures.
4) Corrosive Locations: Stainless Steel, NEMA type 4X enclosures.

5) Hazardous (Classified) Locations: NEMA type listed and labeled for location and class of hazard indicated.

(d) Pull and Junction Boxes:

1) Interior Dry Locations: Sheet steel, NEMA type 1 for flush mounting and feraloy Type FS or FD cast boxes with threaded conduit hubs for surface mounting.
2) Locations Exposed to Weather or Dampness: Stainless Steel, NEMA type 4X enclosures.
3) Wet Locations: Stainless Steel, NEMA type 4X enclosures.
4) Corrosive Locations: Stainless Steel, NEMA type 4X enclosures.
5) Hazardous (Classified) Locations: NEMA type listed and labeled for location and class of hazard indicated.

3.7.3 Installation of Outlet Boxes

(a) Outlets at Windows and Doors: Locate close to window or door trim.

(b) Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so centers of columns are clear for future installation of partitions.

(c) Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install boxes without plaster rings. Saw cut recesses for outlet boxes in exposed masonry walls.

(d) Gasketed Boxes: At following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:

1) Exterior Locations.
2) Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
3) Where exposed to moisture laden atmosphere.
4) Where indicated.

(e) Mounting: Mount outlet boxes for switches with long axis vertical or as indicated. Mount boxes for receptacles vertically. Gang boxes shall be mounted with long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on side opposite hinges and close to door trim, even though electrical floor plans may show them on hinge side.

(f) Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 in. sq by 1-1/2 in. deep, minimum with raised plaster or tile cover. Provide 3/8 in. fixture stud.

(g) Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

(h) Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

(i) Concrete Boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6 in. depth.

(j) Secure boxes rigidly to substrate upon which being mounted or solidly embed boxes in concrete or masonry. Do not support from conduit, mechanical ductwork or piping.

(k) Set boxes in concealed conduit runs, flush with wall surfaces, with or without covers as required.

(l) Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall minimum 12 in.

(m) Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with finished surface.

(n) Do not burn holes, use knockout punches or saw.

(o) Provide outlet box divider barriers between 277/480 v and 120/240 v devices as required and per NEC.

(p) Where emergency switches occur adjacent to normal light switches, install in separate boxes in accordance with NEC and device plate color coding separation.

3.7.4 Outlet Box Locations

(a) Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to minimum.

(b) Location of outlets and equipment as shown on Drawings is approximate and exact location to be verified and shall be determined by:

1) Construction or code requirement.
2) Conflict with equipment or other trades.
3) Equipment manufacturer's drawings.

(c) Minor modification in location of outlets and equipment shall not be considered as incidental up to distance of 10 ft with no additional compensation.

(d) Mounting heights for devices and equipment to be measured from finished floor to centerline of device and unless otherwise noted on Drawings as follows.

1) Switches: 48 in. above floor.

2) Ac Receptacles and Telephone Outlets: 15 in. above floor or 6 in. above counters, counter backsplashes, and baseboard radiators in finished areas; 48 in. above floor in unfinished areas.
3) Wall Bracket Lighting Fixtures: 7'-6" above floor.
4) Pushbuttons: 48 in. above floor.
5) Disconnect Switches: 60 in. above floor

3.7.5 Installation of Junction Boxes

(a) Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 in. sq by 4 in. deep. Do not exceed 6 entering and 6 leaving raceways in single box.

1) Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 in. inside boxes.
2) Mount pull boxes in inaccessible ceilings with covers flush with finished ceiling.
3) Size: Provide pull and junction boxes for telephone, signal, instrumentation, control, and other systems at least 50% larger than would be required by the NEC for boxes smaller than 24 in. by 24 in., or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.7.6 Grounding

(a) Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes grounding conductor, provide grounding terminal in interior of cabinet, box or enclosure.

3.7.7 Cleaning and Finish Repair

(a) Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

(b) Galvanized Finish: Repair damage using zinc-rich paint recommended by manufacturer.

(c) Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

(d) PVC Coated conduit shall be repaired as specified in conduit section.

3.8 Excavation and Backfill

3.8.1 Excavation and backfill for work under this Division shall be provided under this Division in conformance with Division 2.

3.9 Concrete

3.9.1 Concrete for equipment pads, conduit encasement, handholes, manholes and other work under this Division shall be provided under this Division in conformance with Division 3.

3.10 Cutting and Patching

3.10.1 All cutting and patching of building materials required for work under this Division shall be provided under this Division.

3.10.2 No structural members shall be removed, cut or otherwise modified without approval of the Engineer and any such work shall be done in a manner as directed by the Engineer.

3.10.3 Cutting and patching shall be performed in a neat and workmanlike manner, consistent with the best practices of the appropriate trade. All patching shall be done in a manner consistent with the building material being patched.

3.10.4 Holes made in concrete shall be made using a suitable core drill. The use of a star drill or air hammer will not be permitted.

3.10.5 In new construction, sleeves, chases, inserts and the like required for work under this Division shall be provided under this Division and the furnishing and placement of these items shall be fully coordinated with the other trades involved so as not to delay the construction.

3.11 Lightning Protection

3.11.1 The lightning protection system shall be installed in a neat and inconspicuous manner so all components will blend in with the appearance of the building. All conductors shall be concealed or semi-concealed during construction using methods recommended in NFPA 780 and UL 96A.

3.11.2 Air terminals shall have base supports designed for the surface on which they are used and shall be securely anchored. All exposed metal eave troughs, roof vents, guy wires, antennas, and air handling equipment shall be bonded to the lightning protection system in such a way that two paths to ground are provided.

3.11.3 The lightning protection system shall be bonded to structure/building electrical ground rings wherever they are available.

3.11.4 Copper lightning protection system components shall not be mounted to aluminum surfaces. Aluminum components shall be used to avoid electrolytic corrosion.

3.11.5 Grounded metal bodies within the bonding distance determined by NFPA 780 shall be bonded to the system in accordance with those requirements.

3.11.6 Underground metallic piping entering the building shall be bonded to the nearest down conductor or ground electrode.

3.11.7 Adhesive used with adhesive air terminal bases and conductor fasteners shall be compatible with roofing membrane. Verify with roofing contractor.

3.11.8 Terminals and cables attached to skylights and ventilation equipment must be attached so the panels are not compromised in any way. Fasteners used can only attach through the aluminum.

3.11.9 All roof and parapet penetrations must be sealed to insure no leaking.

END OF THIS SECTION

SECTION 16D - SUPERVISORY, CONTROL AND DATA ACQUISITION (SCADA) EQUIPMENT

1. GENERAL:

1.1. Descriptions and Responsibilities

1.1.1 Process Control System (PCS): a complete, integrated system of PLC's, HMI's, Windows-based computers, instruments, devices, wireless and wired process control networks, software, Application Engineering, and ancillary equipment for monitoring and control of stormwater/wastewater collection and treatment facilities.

1.1.2 System Integrator: Organization, whose principle function is design, program, configure, manufacture, provide and install and service of PCS. An organization, under the direction of the Contractor, who shall assume complete responsibility for: detail design, manufacture, installation, configuration, technically advising on and certifying correctness of installation, testing and adjusting, documenting and starting-up, and training of the complete PCS.

1.1.3 SCADA (Supervisory Control and Data Acquisition) system shall be provided to function as the "Master Control" for the Pump Station facility. The SCADA system shall consist of, but not be limited to; programmable controllers, computer, HMI's, software, network and communications equipment, process instrumentation and control devices, uninterruptible power supply (UPS), and other devices as required and/or as indicated on Drawings and Plans.

1.1.4 System Integrator shall inspect Equipment provided under this Section prior to shipment to Project site.

1.1.5 System Integrator shall coordinate work with Contactor to insure that:

1.1.5.1 All components provided under this Section are properly installed.

1.1.5.2 All components provided under this Section are properly configured.

1.1.5.3 The proper type, size, and number of control wires within conduits are provided.

1.1.5.4 Proper electric power circuits are provided for all components and systems.

1.1.6 System Integrator shall be responsible for the operational testing of the HMI, and PLC software programs.

1.1.7 Systems Integrator shall be responsible for the configuration and setup of the Power Monitoring Devices provided as part of the process control system. The setup shall include data access via the Process Control Network.

1.1.8 System Integrator shall be responsible for all Application Engineering. The System Integrator shall provide all programming and configuration of equipment and software including development of graphic displays and reports. Displays and

report development shall be coordinated with existing Department standards. A PDF sample program will be provided to the successful bidder.

1.1.9 System Integrator shall be responsible for coordination of voltage levels and signal types for signals connected to Process Control System. Provide relays, signal isolators, termination or pull-up resistors, signal conditioners or other devices only as required for proper interfacing and operation of non-compatible devices. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, isolation barriers, or relays to interface with equipment provided under this Contract shall be included whether shown on the Drawings or not.

1.1.10 All materials, equipment, labor, installation, configuration, software, programming, and incidentals required to achieve a fully integrated and operational system shall be furnished and installed complete by a qualified System Integrator with a minimum of 10-years experience with comparable size projects. The system integrator shall design and coordinate the instrumentation and control system for proper operation with related equipment and materials.

1.1.11 The System Integrator shall provide a detailed descriptive narrative of the Pump Station control system strategy describing auto/manual pump controls locally, at MCC, and at SCADA panel. The control system narrative shall include analog level control, float backup, monitoring and security systems, communications architecture and scheme for monitoring at District 1, IDOT TSC, and EMC Contractor's facility. The control system narrative shall include all system components shown on E Drawings within contract documents. HMI screens shall accompany the control system narrative along with any photographs, cut sheets, or other materials that aid in the understanding of Pump Station controls. Pump Station control system strategy shall use Contract documents as a basis for a more detailed narrative and expand in greater detail for each piece of equipment.

1.1.12 The System Integrator shall install the control system and shall perform all on-site testing, calibration, start-up, troubleshooting, and training of IDOT staff.

1.1.13 All necessary coordination required for interfacing the proposed Pump Station facility with the proposed SCADA system shall be provided by the System Integrator.

1.1.14 The Pump Station SCADA system shall be remotely monitored at District 1 Headquarters, IDOT TSC, and the Electrical Maintenance Facility via redundant 4G radio equipment and technology. The AEGIS system communicates via phone line. Each remote monitoring site monitors the respective Pump Station, as well as other IDOT Pump Station facilities. Currently, Allen Bradley RSView is the Human Machine Interface (HMI) software that is installed at the workstations at these locations and is the means in which the operators monitor the Pump Stations.

1.1.14.1 Contractor is responsible for coordination with the System Integrator and Electrical Maintenance Contractor required for ensuring the proper functioning of the remote monitoring systems.

1.1.14.2 All inputs at the remote monitoring locations shall be checked via each means of communications. Field test results of all I/O points verifying functionality for remote monitoring shall be submitted to Engineer and IDOT for review. Contractor to provide PLC I/O addresses for network monitoring from remote locations.

1.1.14.3 Payment for the work specified under this paragraph shall be paid for under Article 109.04 of IDOT's Standard Specifications for Road and Bridge Construction.

1.2. System Integrator

1.2.1 Meade Electric.

1.2.2 Wunderlich-Malec.

1.2.3 Complete Integration & Services.

1.2.4 ICS Healy-Ruff.

1.2.5 Or Approved Equal.

1.3. System Integrator Experience Requirement

1.5.1 The Contractor shall utilize a System Integrator having the experience and knowledge, as defined herein, to undertake the work specified in this Section. The System Integrator shall be an organization having the following organizational and individual experience, knowledge, and capabilities:

1.3.1.1 System Integrator shall be regularly engaged in the design, installation, and servicing of wastewater and storm-water collection and treatment PCS.

1.3.1.2 System Integrator shall demonstrate the ability to produce electrical and control logic diagrams in the level of detail required by this specification.

1.3.1.3 System Integrator shall have previously executed a minimum of five (5) wastewater collection treatment PCS projects of similar size and complexity to this Project incorporating PLC's and HMI platforms included in this Project.

1.3.1.4 Systems Integrator shall have previously successfully executed Ethernet wired networked projects of comparable size and complexity to this Project.

1.3.1.5 The person(s) performing the field Instrumentation and Controls work, as required by the Contract Documents, shall have a minimum of five (5) years experience on PLC-based systems.

1.3.1.6 System Integrator shall provide, on-site, a Control Systems Engineer to commission the functional testing, start-up and training as required by the Contract Documents. The individual shall have authored and

commissioned control logic for no fewer than three (3) projects of similar or greater complexity, and shall have a demonstrated proficiency in authoring logic in PLC ladder logic.

1.3.1.7 Upon request of Engineer and in addition to other specified requirements, Contractor shall provide a minimum of five (5) System Integrator references to confirm compliance with these requirements.

1.3.1.8 Upon written approval of Engineer, additional System Integrator's that meet all requirements may be considered by the Contractor.

1.4. Submittals

1.4.1 Submit project specific product data, shop drawings, project documentation, O&M data and record documents in accordance with the provisions of Section 1A. and the following:

1.4.2 Product Data

1.4.2.1 Bill of Material: List all the materials and equipment to be furnished. Tag number, manufacturer's complete catalog number, technical descriptions, service, location, and cross-reference numbers of instruction sheet, specification data sheet and wiring diagram shall be included under each item.

1.4.2.2 Specification Data and Drawings: Furnish instrument specification data sheet as per ISA standard instrument specification form, if applicable, wiring and/or connection diagram, outline dimensions, installation diagram and manufacturer's project specific catalog number for each instrument. A common set of drawings with setting and/or scale individually listed may be furnished for instruments with identical specification except setting and/or scale.

1.4.2.3 All Drawings shall be generated in CAD software. There shall not be handwritten additions/changes/updates. Photocopy or other electronic duplication and submission of Contract Documents is not acceptable and will be rejected.

1.4.3 System Diagrams

1.4.3.1 Panel Layout Drawings: Furnish panel drawings for each instrument/control panel/control station. Drawings shall show all panel mounted devices to scale, dimensioned and shall include legend. List bill of materials including manufacturer's part numbers, show panel or cabinet structure, outline dimension, internal and external device/equipment arrangements, devices, cutouts and mounting details of instruments, protection and control devices, terminal blocks, wire ways and piping. Prepare in general accordance with NFPA 79, Annex D. A detailed terminal block blowup section shall also be included showing terminal block number for each block (terminal schedule).

1.4.3.2 Elementary Schematic Diagrams: Furnish ladder type circuit diagrams prepared to facilitate the understanding of the system functionality, maintenance and fault detection.

a. Control devices shall be shown between vertical lines that represent control power wiring, with the left line representing control circuits common and right representing operating coils common except where permitted by Clause 9 of NFPA 79.
b. Control devices shall be shown on numbered horizontal lines (rungs) between the vertical lines.
c. Drawings shall include a cross referencing scheme used in conjunction with each relay, output device, limit switch, and other devices so that any contact related to a device can be readily located on the drawings.
d. Component designations shall be included for all devices, with the same designations used on Panel Layout Drawings.
e. All depictions of devices shall be specific for selected manufacturer included with submittal, and shall include detailed terminal numbering scheme as specified by manufacturer of said device.
f. Each panel terminal within a terminal strip shall be numbered. When multiple terminal strips exist, each shall be given a unique identification. Terminal strip identification shall be included on Panel Layout Drawings.
g. All wires shall be numbered; wire numbers shall be applied to labels in accordance with Section 16C. Wiring and devices external to panel shall be clearly identified.
h. Control devices shall utilize the symbology depicted in NFPA 79 and IEEE315.
i. Switch symbols shall be shown with utilities turned off and devices in their normal starting condition. Include control settings on the diagrams when available (timer settings, trip current, etc.).
j. Drawings shall indicate source of control circuit power (lighting panel circuit number, etc.).
k. Drawings shall be prepared on a per-panel basis.

1.4.3.3 Instrument Loop Diagram: Furnish all analog and digital loops for all instrument sensors, secondary instruments, I/O functions, alarms, control and displays using ISA standard symbols per ISA Standard S5.4.

1.4.3.4 SCADA System Block Diagram: Furnish system hardware configuration and identify model numbers of each system component.

1.4.3.5 PLC Equipment Layout Drawing: Furnish system hardware layout for each individual component (module, rack, power supply, etc.), and their relative location to one another. This shall be a scaled drawing whereby each component manufacturers number is easily readable.

1.4.3.6 Interconnecting Wiring and/or Piping Diagrams (to/from): Show schematically the wiring and conduit runs for each instrumentation and control system. The diagram shall show and identify, with location noted, all instruments, piping and appurtenances furnished under this Section and

related electrical equipment furnished under other Sections. All terminal blocks and pipe taps shall be identified.

1.4.3.7 SCADA System Block Diagram: Furnish system hardware configuration and identify model numbers of each system component.

1.4.3.8 I/O List segregated by PLC module and module type. Include detailed description of each I/O point with respect to function (i.e.: Pump 1 Running, etc.).

1.4.3.9 Process Control Network Drawings: Furnish Drawings showing connections between Process Control System devices including computers, HMI's, PLC's, radios, power monitors, network devices. Drawings shall indicate network domain and device IP addresses, subnet masks, gateways, and other pertinent network address information.

1.4.3.10 Detailed Pump Control system descriptions (floats and SCADA control) and associated communications with remote facilities.

1.4.3.11 SCADA screen shots.

1.4.4 Test Procedures

1.4.4.1 Detailed field test procedure for SCADA Panel.

1.4.4.2 Detailed field test procedure for Combustible Gas Monitor and associated alarms and circuits.

1.4.4.3 Detailed field test procedure for Fire Alarm Panel and associated sensors, alarms and circuits.

1.4.5 Software Documentation

1.4.5.1 Submit system software, application software, I/O point data base listing, programming ladder diagrams, graphic pages and report forms in prints. Software, application programs, ladder diagrams and control logic shall be submitted in CD format.

1.4.6 O&M and Instruction Manuals

1.4.6.1 Submit project specific instruction manuals covering installation, operation, calibration, maintenance, diagnostic and repair for all hardware and software. Refer to Section 1A for additional requirements.

1.4.7 Record Documents

1.4.7.1 Accurately record actual calibration setting and scales of instruments.

1.4.7.2 Approved Shop Drawings.

1.4.7.3 Record Contract Drawings.

1.4.7.4 Refer to Section 1A for additional requirements.

1.5. Work for Hire

1.5.1 Any and all configuration, programming, setup or other software functions (SOFTWARE) performed on all intelligent devices provided as part of this Project is considered "Work for Hire" under the 1976 Copyright Act as amended (title 17 of the United States Code). The SOFTWARE shall be owned by IDOT and shall be turned over to IDOT fully documented (with accompanying commentary) as the work is completed.

1.5.2 IDOT intends only to obtain the SOFTWARE for its own use.

1.5.3 IDOT will not prevent the SOFTWARE supplier from reuse of the SOFTWARE concepts and ideas for other projects. Any reuse of the SOFTWARE concepts and ideas generated under this Project is solely the responsibility of the SOFTWARE supplier. The SOFTWARE supplier shall defend, indemnify and hold harmless IDOT from all claims, damages and expenses (including reasonable litigation costs), arising out of any use, misuse or misapplication of SOFTWARE concepts and ideas.

1.6. Operational and Performance Requirements

1.6.1 The SCADA system includes a rack-mount computer system as the HMI screen server, redundant PLC processors for Pump Station system control, redundant analog wet-well level sensing system, and multi-float/relay level monitoring system as the tertiary pump control system. Communications with remote monitoring sites is also included.

1.6.2 The redundant PLC's utilize the analog level signals measured with the primary and secondary level sensors for Pump control, while the float mode utilizes the digital ball float signals for tertiary Pump control.

1.6.3 The redundant PLC's operate in parallel with the "primary" processor controlling the Pumps based on water level in the wet-well. The "secondary" processor monitors the health of the "primary" processor and, upon failure, immediately assumes control of the Pumps in a bump-less transfer over a fiber optic link between the "primary" and "secondary" processors. When a PLC processor fails it shall generate an alarm. Water elevations for SCADA Pump control is shown on Drawings.

1.6.4 The PLC shall check the validity of the primary level signal (LE/LIT-0111), and the secondary level signal (LT-0112) using float level signals as broad reference, and select a valid signal for pump control (LE/LIT-0111 as primary, LT-0112 as secondary). If the primary and secondary level signals differ (by an adjustable set value), it shall generate an alarm. The wet-well Inlet Chamber analog level signal (LE/LIT-0122) shall be used as another reference for determining signal validity. If the PLC deem both the primary and secondary level signals invalid (or out of range, broken wire, etc.), then the point level inputs signals from the multi-float system shall be used for pump control. If the primary PLC fails, and the secondary PLC

fails, then the point level inputs signals from the multi-float system shall be used for pump control.

1.6.5 The SCADA system shall be designed for full automatic PLC control of the Pump Station, and shall also be designed to allow manual operation. Pumping operation of the facility shall respond to water levels sensed in accordance with the pumping operation tables shown on the Drawings. The PLC's and associated personal computer with SCADA software herein specified shall be capable of automatically controlling pumping operations and storing and retrieval of all digital and analog points/trends for a period of 1 year.

1.6.6 The PLC logic shall operate the Pump Station as a 3-pump sequencer (with capability for 5-pumps in the future) for the Main Pumps and shall operate the singular Low Flow Pump when called. The Main Pump Lead/Lag/Standby sequencer at the HMI shall be Operator-selectable, and shall sequence based on: runtime hours, number of starts, or number of on/off cycles. The Operator may also choose to override the pump sequencer and opt for manual selection of pump sequence. These options and modifications shall be located at the HMI and shall be password protected.

1.6.7 The SCADA panel shall have a 3-position selector switch "Control Mode", "Floats/Reset/Auto" whereby in "Auto" mode:

1.6.7.1 The PLC will automatically sequence the Pumps in a Lead/Lag/Standby configuration (as described above).

1.6.7.2 Shall a pump fail (fail to start, overload, over-temp, seal fail, MCC breaker off, or H-O-A switch set to anything other than "AUTO"), then the failed Pump is automatically removed from the pump sequencer, and the Standby Pump takes the failed pump position in the pump sequencer. The failed pump then becomes the Standby Pump until the original fail condition is corrected.

1.6.7.3 Shall a Main Pump fail due to over-temp and/or seal fail (as detected by respective motor protection relay), then any succeeding pumps that fail due to the same condition (motor protection relay) shall remain in the pump sequencer and shall be called to run over-riding the condition.

1.6.7.4 If the primary and secondary analog level elements fail (as determined internal to the PLC, and/or both the redundant PLC's fail, and/or the high float switch is activated, and/or the low level switch is activated), then float mode control is automatically enabled (and alarmed) – and remains enabled until manually reset by an Operator at the Pump Station once the fail condition is corrected (this is accomplished by switching the 3-position selector switch to "reset" position, and then back to "Auto" position.

1.6.7.5 All pumps shall be inhibited from running if Discharge and Recirculation gates are confirmed closed.

1.6.8 The SCADA panel shall have a 3-position selector switch "Control Mode", "Floats/Reset/Auto" whereby in "Floats" mode:

1.6.8.1 The redundant PLC's are inhibited in this mode, and the Pump Station will operate exclusively on the tertiary backup float mode control.

1.6.8.2 The Float Mode backup system shall be hardwired such that Lead Pump is Main Pump 1, Lag Pump is Main Pump 2, and Standby Pump is Main Pump 3. Future pumps (not part of this contract) will be hardwired as Lag 2, and Lag 3. If a Pump fails (fail to start, overload, over-temp, seal fail, MCC breaker off, or H-O-A switch set to "off"), the Standby Pump does not start until called to run at Standby Pump Float level activation.

1.6.9 Initially, two of the three Main Pumps are allowed to run at any one time under PLC automatic control, or float mode control. Under future expansion, four of the five Main Pumps will be allowed to run at any one time.

1.6.10 The Lead Pump is defined as the first pump called to run on rising water level. The Lag Pump is defined as the second pump called to run on rising water level. If either of these two pumps fail to operate, the Standby Pump shall be called to run in its stead (in float mode control, the Standby Pump shall be called to run at elevation of Standby Pump float). The Main Pumps are preceded by the Low Flow Pump operating at the levels indicated on the Drawings.

1.6.11 Pumps, when called to run (in all modes of operation), shall be delayed by a time delay relay (located in the respective pump MCC bucket). Time delay relays shall be set such that only one Pump can be started at a time. Time delay setting for each pump shall be included in shop drawing phase and included in wiring schematics for the Pump Station.

1.6.12 Control of the Pumps shall be as shown in Figure 1.6.12 below:

FIGURE 1.6.12

PLC Control			**Float Mode Control**		
Elev.	Rising Level Action	Falling Level Action	Rising Level Action	Falling Level Action	Elev.
612.00	High Level Alarm		High Level Alarm		612.00
611.00			*Start Main Pump 3		611.00
608.00	Start Lag Main Pump		Start Main Pump 2		608.00
607.00	Start Lead Main Pump		Start Main Pump 1		607.00
	Stop Low Flow Pump		Stop Low Flow Pump		
606.00		Stop Main Pumps		Stop Main Pumps	606.00
		Start Low Flow Pump		Start Low Flow Pump	
605.00	Start Low Flow Pump		Start Low Flow Pump		605.00
604.50		Stop Low Flow Pump		Stop Low Flow Pump	604.50

603.50		Low Level Alarm		Low Level Alarm	603.50
			* Main Pump 3 shall only start if Main Pump 1 or 2 has failed.		

1.7. Related Sections

1.7.1 Section 16A – General Electrical Provisions.
1.7.2 Section 16C – Basic Electrical Materials and Methods.
1.7.3 Section 16E – Packaged Engine Generator Systems.
1.7.4 Section 16F – Motor Control Center.
1.7.5 Section 16H – Major Electrical Equipment.

1.8. Reference

1.8.1 ISA Standards and Recommended Practices for Instrumentation and Control.

1.9. Warranty

1.9.1 Provide warranty from all defects of material and workmanship for 1 year from the date final acceptance of Pump Station, whichever is longer.

1.10. Deliver, Storage and Handling

1.10.1 Delivery, storage and handling shall be in accordance with the provisions of Section 1A.

1.11. Basis of Payment

1.11.1 Supervisory, Control and Data Acquisition (SCADA) equipment will be paid for under the contract lump sum price for PUMP STATION SCADA EQUIPMENT (AND PROGRAMMING).

1.11.2 Combustible gas equipment shall be paid for under the contract lump sum price for GAS DETECTION PANEL.

1.11.3 Refer to 1.22 of Section 1A for Method of Measurement.

1.12. SCADA System I/O List

1.12.1 PLC (ControlLogix platform) Hardwired I/O Points:

CLX3.1 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:1/0	MAIN PUMP 1 CIRCUIT BREAKER OPEN
I:1/1	MAIN PUMP 1 HOA IN AUTO
I:1/2	MAIN PUMP 1 RUNNING
I:1/3	MAIN PUMP 1 OVERLOAD
I:1/4	MAIN PUMP 1 MOTOR HI TEMP
I:1/5	MAIN PUMP 1 MOTOR MOISTURE
I:1/6	MAIN PUMP 1 FLOAT CALL TO RUN

CLX3.2 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:2/0	MAIN PUMP 2 CIRCUIT BREAKER OPEN
I:2/1	MAIN PUMP 2 HOA IN AUTO
I:2/2	MAIN PUMP 2 RUNNING
I:2/3	MAIN PUMP 2 OVERLOAD
I:2/4	MAIN PUMP 2 MOTOR HI TEMP
I:2/5	MAIN PUMP 2 MOTOR MOISTURE
I:2/6	MAIN PUMP 2 FLOAT CALL TO RUN

I:1/7	MAIN PUMP 1 FAIL TO START
I:1/8	FLOAT SWITCH 5
I:1/9	SCREEN CHAMBER LVL FAIL-SAFE FAULT
I:1/10	SCREEN CHAMBER LVL OUT-OF-BOUNDS
I:1/11	DISCHARGE GATE CONFIRMED OPEN
I:1/12	DISCHARGE GATE CONFIRMED CLOSED
I:1/13	DISCHARGE GATE IN TRANSITION
I:1/14	DISCHARGE GATE IN REMOTE
I:1/15	

I:2/7	MAIN PUMP 2 FAIL TO START
I:2/8	FLOAT SWITCH 6
I:2/9	INLET CHAMBER LVL FAIL-SAFE FAULT
I:2/10	INLET CHAMBER LVL OUT-OF-BOUNDS
I:2/11	RECIRCULATION GATE CONF. OPEN
I:2/12	RECIRCULATION GATE CONF. CLOSED
I:2/13	RECIRCULATION GATE IN TRANSITION
I:2/14	RECIRCULATION GATE IN REMOTE
I:2/15	

CLX3.3 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:3/0	MAIN PUMP 3 CIRCUIT BREAKER OPEN
I:3/1	MAIN PUMP 3 HOA IN AUTO
I:3/2	MAIN PUMP 3 RUNNING
I:3/3	MAIN PUMP 3 OVERLOAD
I:3/4	MAIN PUMP 3 MOTOR HI TEMP
I:3/5	MAIN PUMP 3 MOTOR MOISTURE
I:3/6	MAIN PUMP 3 FLOAT CALL TO RUN
I:3/7	MAIN PUMP 3 FAIL TO START
I:3/8	FLOAT SWITCH 7
I:3/9	PRIMARY LEVEL FAIL-SAFE FAULT
I:3/10	PRIMARY LEVEL OUT-OF-BOUNDS
I:3/11	COMBUSTIBLE GAS MONITOR WARNING
I:3/12	COMBUSTIBLE GAS MONITOR ALARM
I:3/13	COMBUSTIBLE GAS MONITOR FAILURE
I:3/14	
I:3/15	

CLX3.4 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:4/0	(FUTURE) PUMP 4 CIRCUIT BRKR OPEN
I:4/1	(FUTURE) PUMP 4 HOA IN AUTO
I:4/2	(FUTURE) PUMP 4 RUNNING
I:4/3	(FUTURE) PUMP 4 OVERLOAD
I:4/4	(FUTURE) PUMP 4 MOTOR HI TEMP
I:4/5	(FUTURE) PUMP 4 MOTOR MOISTURE
I:4/6	(FUTURE) PUMP 4 FLOAT CALL TO RUN
I:4/7	(FUTURE) PUMP 4 FAIL TO START
I:4/8	(FUTURE) FLOAT SWITCH 9
I:4/9	FLOAT SWITCH 8
I:4/10	FLOAT SWITCH 1
I:4/11	FLOAT SWITCH DC
I:4/12	FLOAT SWITCH PF
I:4/13	PUMP STATION OCCUPIED
I:4/14	PUMP STATION INTRUSION
I:4/15	

CLX3.5 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:5/0	(FUTURE) PUMP 5 CIRCUIT BRKR OPEN
I:5/1	(FUTURE) PUMP 5 HOA IN AUTO
I:5/2	(FUTURE) PUMP 5 RUNNING
I:5/3	(FUTURE) PUMP 5 OVERLOAD
I:5/4	(FUTURE) PUMP 5 MOTOR HI TEMP
I:5/5	(FUTURE) PUMP 5 MOTOR MOISTURE
I:5/6	(FUTURE) PUMP 5 FLOAT CALL TO RUN
I:5/7	(FUTURE) PUMP 5 FAIL TO START
I:5/8	(FUTURE) FLOAT SWITCH 10
I:5/9	PUMP STATION SF-ECR RUNNING
I:5/10	PUMP STATION SF-ECR OVERLOAD
I:5/11	PUMP STATION SF1 RUNNING
I:5/12	PUMP STATION SF1 OVERLOAD
I:5/13	PUMP ROOM LIGHTS ON
I:5/14	STAIRWELL LIGHTS ON
I:5/15	

CLX3.6 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:6/0	LOW FLOW PUMP CIRCUIT BRKR OPEN
I:6/1	LOW FLOW PUMP HOA IN AUTO
I:6/2	LOW FLOW PUMP RUNNING
I:6/3	LOW FLOW PUMP OVERLOAD
I:6/4	LOW FLOW PUMP MOTOR HI TEMP
I:6/5	LOW FLOW PUMP MOTOR MOISTURE
I:6/6	LOW FLOW PUMP FLOAT CALL TO RUN
I:6/7	LOW FLOW PUMP FAIL TO START
I:6/8	FLOAT SWITCH 3
I:6/9	FLOAT SWITCH 2
I:6/10	ATS IN NORMAL POSITION VERIFIED
I:6/11	ATS IN EMERG GEN POSITION VERIFIED
I:6/12	ATS IN TEST MODE
I:6/13	ATS READY TO LOAD
I:6/14	
I:6/15	

CLX3.7 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:7/0	CIRCUIT 1 POWER
I:7/1	CIRCUIT 18 POWER
I:7/2	LINE FILTER 1 FAILURE
I:7/3	LINE FILTER 2 FAILURE

CLX3.8 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:8/0	GENERATOR FUEL TANK LOW ALARM
I:8/1	GENERATOR FUEL TANK LEAK ALARM
I:8/2	GENERATOR NOT IN AUTO
I:8/3	GENERATOR COMMON ALARM

I:7/4	24VDC POWER SUPPLY 1 ALARM
I:7/5	24VDC POWER SUPPLY 2 ALARM
I:7/6	UPS FAIL (COMMON TO BOTH UPS)
I:7/7	UPS BATT LOW (COMMON TO BOTH UPS)
I:7/8	FIRE ALARM
I:7/9	FIRE ALARM TROUBLE
I:7/10	PUMP STATION EF1 RUNNING
I:7/11	PUMP STATION EF1 OVERLOAD
I:7/12	PUMP STATION EF-PR RUNNING
I:7/13	PUMP STATION EF-PR OVERLOAD
I:7/14	PUMP STATION CONTROL IN AUTO
I:7/15	PUMP STATION IN FLOAT MODE

I:8/4	GENERATOR EMERGENCY STOP
I:8/5	GENERATOR RUNNING
I:8/6	GENERATOR SPD FAILURE
I:8/7	
I:8/8	
I:8/9	
I:8/10	
I:8/11	
I:8/12	
I:8/13	
I:8/14	
I:8/15	

CLX3.9 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:9/0	UTILITY POWER AVAILABLE
I:9/1	NORMAL ELECT SERV MAIN BKR CLOSED
I:9/2	NORMAL ELECT SERV MAIN BKR TRIPPED
I:9/3	NORMAL ELECT SERV FAILURE
I:9/4	NORMAL ELECT SERV GROUND FAULT
I:9/5	UTILITY SPD FAILURE
I:9/6	
I:9/7	
I:9/8	
I:9/9	
I:9/10	
I:9/11	
I:9/12	
I:9/13	
I:9/14	
I:9/15	

CLX3.10 - DIGITAL INPUT	
ADDR	DESCRIPTION
I:10/0	EMERG ELECT SERV MAIN BKR CLOSED
I:10/1	EMERG ELECT SERV MAIN BKR TRIPPED
I:10/2	EMERG ELECT SERV FAILURE
I:10/3	EMERG ELECT SERV GROUND FAULT
I:10/4	
I:10/5	
I:10/6	
I:10/7	
I:10/8	
I:10/9	
I:10/10	
I:10/11	
I:10/12	
I:10/13	
I:10/14	
I:10/15	

CLX3.11 - RELAY OUTPUT	
ADDR	DESCRIPTION
I:11/0	MAIN PUMP 1 SCADA CALL TO RUN
I:11/1	MAIN PUMP 1 SCADA MPR OVERRIDE
I:11/2	FUTURE PUMP 4 SCADA CALL TO RUN
I:11/3	FUTURE PUMP 4 SCADA MPR OVERRIDE
I:11/4	NORMAL POWER SERVICE FAILURE
I:11/5	SCADA FIRE ALARM RELAY TO FANS
I:11/6	PUMP RM EX. FAN PM-EF CALL TO RUN
I:11/7	PUMP RM SUP FAN PM-SF CALL TO RUN
I:11/8	
I:11/9	
I:11/10	
I:11/11	
I:11/12	
I:11/13	
I:11/14	
I:11/15	

CLX3.12 - RELAY OUTPUT	
ADDR	DESCRIPTION
I:12/0	MAIN PUMP 2 SCADA CALL TO RUN
I:12/1	MAIN PUMP 2 SCADA MPR OVERRIDE
I:12/2	FUTURE PUMP 5 SCADA CALL TO RUN
I:12/3	FUTURE PUMP 5 SCADA MPR OVERRIDE
I:12/4	LEAD PUMP SCADA CALL TO RUN LIGHT
I:12/5	LAG1 PUMP SCADA CALL TO RUN LIGHT
I:12/6	STANDBY PUMP SCADA CALL LIGHT
I:12/7	(FUTURE PUMP) SCADA CALL LIGHT
I:12/8	(FUTURE PUMP) SCADA CALL LIGHT
I:12/9	SCADA COMMON ALARM LIGHT
I:12/10	
I:12/11	
I:12/12	
I:12/13	
I:12/14	
I:12/15	

CLX3.13 - RELAY OUTPUT	
ADDR	DESCRIPTION

CLX3.14 - ANALOG INPUT	
ADDR	DESCRIPTION

I:13/0	MAIN PUMP 3 SCADA CALL TO RUN
I:13/1	MAIN PUMP 3 SCADA MPR OVERRIDE
I:13/2	LOW FLOW PUMP SCADA CALL TO RUN
I:13/3	PLC FAIL (N.C.)
I:13/4	SCADA COMMON ALARM
I:13/5	ANY PUMP MPR ALARM
I:13/6	EMERG POWER SERVICE FAILURE
I:13/7	
I:13/8	
I:13/9	
I:13/10	
I:13/11	
I:13/12	
I:13/13	
I:13/14	
I:13/15	

I:14/0	MAIN PUMP 1 MOTOR CURRENT
I:14/1	FUTURE MAIN PUMP 4 MOTOR CURRENT
I:14/2	PRIMARY WET PIT LEVEL (LE/LIT-0111)
I:14/3	GENERATOR FUEL TANK LEVEL
I:14/4	
I:14/5	
I:14/6	
I:14/7	

CLX3.15 - ANALOG INPUT	
ADDR	DESCRIPTION
I:15/0	MAIN PUMP 2 MOTOR CURRENT
I:15/1	FUTURE MAIN PUMP 5 MOTOR CURRENT
I:15/2	SECONDARY WET PIT LEVEL (LT-0112)
I:15/3	SCREEN CHAMBER LEVEL (LE/LIT-0121)
I:15/4	
I:15/5	
I:15/6	
I:15/7	

CLX3.16 - ANALOG INPUT	
ADDR	DESCRIPTION
I:16/0	MAIN PUMP 3 MOTOR CURRENT
I:16/1	LOW FLOW PUMP MOTOR CURRENT
I:16/2	INLET CHAMBER LEVEL (LE/LIT-0122)
I:16/3	RECIRCULATION FLOW (FE/FIT-0102)
I:16/4	
I:16/5	
I:16/6	
I:16/7	

1.12.2 PLC (MicroLogix platform) Hardwired I/O Points:

MLX 4.1 MICROLOGIX	
ADDR	DESCRIPTION
I:0/0	
I:0/1	
I:0/2	
I:0/3	
I:0/4	
I:0/5	
I:0/6	
I:0/7	
I:0/8	
I:0/9	
I:0/10	
I:0/11	
I:0/12	
I:0/13	
I:0/14	
I:0/15	
I:0/17	
I:0/18	
I:0/19	
O:0/0	
O:0/1	

O:0/2	
O:0/3	
O:0/4	
O:0/5	
O:0/6	
O:0/7	
O:0/8	
O:0/9	
O:0/10	
O:0/11	

1.12.3 SCADA data via Modbus TCP:

1.12.3.1 From MCC Power Monitors:

1) Normal Line-Line Voltage.
2) Emergency Line-Line Voltage.
3) Normal Line Current.
4) Emergency Line Current.
5) Normal Line Power (kW).
6) Emergency Line Power (kW).
7) Normal Line Power Factor.

1.12.3.2 From Surge Protective Device (SPD):

1) Battery Life (%).
2) Protection Available (%).
3) Sags.
4) Surges.
5) Swells.
6) Dropouts.
7) Outages.
8) Volts per Phase.
9) Frequency.

1.13. System Description

1.13.1 The following narrative points are not intended to be a comprehensive list of the system's features, only summarize the major functions of the system. The SCADA system specified herein shall perform the following generalized functions:

a) Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.

b) Collect and store accurate, reliable operating information for present and future uses.

c) Assist plant operating personnel by noting and communicating off-normal operating conditions and equipment failures.

d) Accumulate and store equipment running times for use in preventative maintenance.

e) Provide color graphic displays and summary reports for use by the plant operating and supervisory personnel.

f) Provide trending for all analog values.

g) Provide control system monitoring and diagnostics.

1.13.2 The system is based on the SCADA system architecture diagram shown on Drawings. The system shall include:

a) Redundant programmable logic controllers (PLC's) with local input/output (I/O), network communications and other capabilities as specified herein and shown on the SCADA system architecture diagram.

b) SCADA computer with redundant Human Machine Interface (HMI) with control/graphic software.

c) HMI's shall be linked to the PLC's over an Ethernet/IP based local area network (LAN) via managed Ethernet Switches.

d) Communications with Power Monitors.

e) Communications with outside entities (District 1, IDOT TSC, and Maintenance Contractor).

1.13.3 All process control functions including PID, calculations, sequencing, set-points, timing, etc., shall be done in the PLC. The real-time database, report generation, graphic screens, program development, set-point modification, data archiving, etc., shall be done by the HMI computer.

1.13.4 HMI computer shall be loaded with FactoryTalk View SE Client, and FactoryTalk Historian SE (250 tags).

2. PRODUCTS:

2.1 Field Devices:

2.1.1 Equipment listed in the table below shall conform to the instrumentation standards described in the paragraphs following the table:

a) Control Stations (Type A).
b) Control Stations (Type B).
c) Control Stations (Type C).
d) Analysis Instrumentation (A Series).
e) Flow Instrumentation (F Series).
f) Level Instrumentation (L Series).
g) Miscellaneous Instrumentation (M Series).
h) Pressure Instrumentation (P Series).

i) Temperature Instrumentation (T Series).

Tag	Device Type	Location/Description	Additional Information
CS-MP1	Type A	Main Pump No.1 Control Station	NEMA 7
CS-MP2	Type A	Main Pump No.2 Control Station	NEMA 7
CS-MP3	Type A	Main Pump No.3 Control Station	NEMA 7
CS-LFP	Type A	Low Flow Pump Control Station	NEMA 7
CS-EF-PR	Type B	Control Station – Exhaust Fan – Pump Room	NEMA 7
CS-SF1	Type B	Control Station – Supply Fan 1	NEMA 7
CS-SF-ECR	Type B	Ctrl. Sta. – Supply Fan – Elect. Control Room	NEMA 12
IS-EF-PR	Type C	Indicator Station – Exhaust Fan – Pump Rm.	NEMA 7
IS-SF1	Type C	Indicator Station – Supply Fan 1	NEMA 7
CGM	A25	Combustible Gas Monitor	
GS-1	A25	Combustible Gas Sensor, Intermediate Level	NEMA 7
GS-2	A25	Combustible Gas Sensor, Discharge Floor	NEMA 7
GS-3	A25	Combustible Gas Sensor, Pump Room	NEMA 7
FE/FIT-0102	F25	Recirculation Flow	
FS8	L8	High Level Alarm Float	See Figure 1.6.12 for float elevations.
FS7	L8	Ball Float for Pump Control	
FS6	L8	Ball Float for Pump Control	
FS6	L8	Ball Float for Pump Control	
FS5	L8	Ball Float for Pump Control	
FS4	L8	Ball Float for Pump Control	
FS3	L8	Ball Float for Pump Control	
FS2	L8	Ball Float for Pump Control	
FS1	L8	Low Level Alarm Float	
FSDC	L8	Discharge Chamber Flood Float (↑)	El. 635.50
FSPF	L8	Pavement Flood Float (↑)	El: 627.3
LE/LIT-0121	L10	Screen Chamber Level	Ultrasonic
LE/LIT-0122	L10	Inlet Chamber Level	Ultrasonic
LE/LIT-0111	L10	Primary Wet Well Level	Ultrasonic
LT-0112	L11	Secondary Wet Well Level	Hydrostatic
FAHS-1	N/A	Fire/Gas Horn and Strobe, Intermediate Floor	Provided by Fire Alarm Panel manufacturer. See Section 16H.
FAHS-2	N/A	Fire/Gas Horn and Strobe, Discharge Level	
FAHS-3	N/A	Fire/Gas Horn and Strobe, Pump Room	
FAHS-4	N/A	Fire/Gas Horn and Strobe, Electrical Control Room	
DS1	N/A	Door Switch, Pump Room West 1	Provided by AEGIS manufacturer. See Section 16H.
DS2	N/A	Door Switch, Pump Room West 2	
DS3	N/A	Door Switch, Electrical Control Room West 1	
DS4	N/A	Door Switch, Electrical Control Room West 2	
DS5	N/A	Door Switch, Electrical Control Room South	
DS6	N/A	Door Switch, Stairwell Entrance	
ISH-LP1-4	M34	Torodial Current Sensing Switch	Lights
ISH-LP1-25	M34	Torodial Current Sensing Switch	Lights
SD1	N/A	Electrical Control Room Smoke Detector 1	Provided by Fire

SD2	N/A	Electrical Control Room Smoke Detector 2	Alarm Panel manufacturer. See Section 16H.
HD6	N/A	Pump Room Heat/Smoke Detector 2	
HD5	N/A	Pump Room Heat/Smoke Detector 1	
HD4	N/A	Discharge Floor Heat/Smoke Detector 2	
HD3	N/A	Discharge Floor Heat/Smoke Detector 1	
HD2	N/A	Intermediate Level Heat/Smoke Detector 2	
HD1	N/A	Intermediate Level Heat/Smoke Detector 1	
LI-0111	M37	Process Indicator, Wet Well Level	Primary
LI-0112	M37	Process Indicator, Wet Well Level	Secondary
ISB8	M60	High Level Alarm IS Barrier	
ISB 7	M60	Future Pump Float IS Barrier	
ISB 6	M60	Start Lag Pump IS Barrier	
ISB 5	M60	Start Lead/Stop Low Flow Pump IS Barrier	
ISB 4	M60	Start Low Flow Pump IS Barrier	
ISB 3	M60	Stop Lead-Lag-Standby/Start Low Flow Pump IS Barrier	
ISB 2	M60	Stop Low Flow Pump IS Barrier	
ISB 1	M60	Low Level Alarm IS Barrier	
ISB DC	M60	Discharge Chamber Flood IS Barrier	
ISB PF	M60	Pavement Flood IS Barrier	
ISBSP1-5	M60	(5) Spare IS Barriers	
LF1	M62	Line Filter with Transient Protection 1	
LF2	M62	Line Filter with Transient Protection 2	
TS1	M64	SCADA Enclosure Thermostat	
FAN1	M66	SCADA Enclosure Fan	
UPS-1	M68	Uninterruptible Power Supply 1	
UPS-2	M68	Uninterruptible Power Supply 2	
PS1	M70	Power Supply 1, 24Vdc	
PS2	M70	Power Supply 2, 24Vdc	
PLC	M75	PLC Hardware	
SW-1	M80	Ethernet Switch	
SC-1	-	SCADA Computer	
NET-1	-	Network Rack, 19" Wall-mount, 19U	
PI-LFP1	P4	Low Flow Pump1 Discharge Pressure (ftH2O)	Local Indication
PI-MP1	P4	Main Pump 1 Discharge Pressure (ftH2O)	Local Indication
PI-MP2	P4	Main Pump 2 Discharge Pressure (ftH2O)	Local Indication
PI-MP3	P4	Main Pump 3 Discharge Pressure (ftH2O)	Local Indication

2.2 Control Stations – Definitions:

2.2.1 Type A.

a) One amber pilot light for PUMP CALL, One red pilot light for HOA SWITCH IN OFF POSITION, One green pilot light for PUMP RUN, One momentary contact black pushbutton (2NO) for MOTOR BUMP, One momentary contact green pushbutton (2NO) for START, One momentary contact extended head red pushbutton (2NC) for STOP.
b) Include nameplate from nameplate schedule described on Drawings.
c) Include legend plates engraved as shown on Drawings.

2.2.2 Type B.

a) One 3-position selector switch for HAND-OFF-AUTO, One red pilot light for HOA SWITCH IN OFF POSITION, One green pilot light for FAN ON.
b) Include nameplate from nameplate schedule described on Drawings.
c) Include legend plates engraved as shown on Drawings.

2.2.3 Type C.

a) One red pilot light for HOA SWITCH IN OFF POSITION, One green pilot light for FAN ON.
b) Include nameplate from nameplate schedule described on Drawings.
c) Include legend plates engraved as shown on Drawings.

2.3 Operator Devices and Control Station Components:

2.3.1 Manufacturer:

a) Allen Bradley 800T/800H.
b) Square D Class 9001, Type K.

2.3.2 Construction:

a) Heavy duty.
b) Watertight.
c) Oil-tight.
d) Flush panel mounting.
e) 30.5mm.
f) Match NEMA rating of device with the installed location environmental classification.

2.3.3 Pushbuttons:

a) Flush head unless specified elsewhere.
b) Contact Blocks:

1) Double break silver contacts.
2) Ac Ratings: 7,200 va make, 720 va break.
3) Single pole, double throw or double pole, single throw.
4) Up to six tandem blocks.

c) Momentary contact unless specified elsewhere.
d) Non-illuminated.
e) Legend plates, as required, for type of operation or as specified elsewhere.

2.3.4 Selector Switches:

a) Maintained position unless specified elsewhere.
b) Contact Blocks:

1) Double break silver contacts.
2) Ac Ratings: 7,200 va make, 720 va break.
3) Contact configuration as specified.
4) Up to six tandem blocks.

c) Number of positions as specified elsewhere.
d) Knob Lever Style unless specified elsewhere.
e) Legend plates as required for type of operation or specified elsewhere.

2.3.5 Pilot Lights:

a) LED Type.
b) Transformer type.
c) Colored lens as specified elsewhere.
d) Interchangeable lenses.
e) Transformer rated for 120Vac
f) Push to test.
g) Legend plates as specified elsewhere.

2.3.6 Control Stations:

a) NEMA ratings:

1) NEMA 7 in Class 1, Division 1 or 2 Hazardous (Classified) Locations.
2) NEMA 4X 316 stainless steel in indoor wet/corrosive locations or outdoors.
3) NEMA 12 in other areas.

2.3.7 Legend Plates:

a) Engraved metal.
b) 2-1/4" square minimum.
c) Silver background, black letters.

2.3.8 Nameplates:

a) Engraved laminated plastic.
b) Letters 3/16 in. high.
c) Black letters on white background.
d) Identify per equipment controlled, using names found on Drawings.

2.4 (A25) Combustible Gas Detector:

2.4.1 Manufacturer:

a) MSA.
b) General Monitors "Smart Sensor" Series.
c) Honeywell
d) The manufacturer must be capable of supplying all equipment used to check or calibrate the sensor / transmitter units.

e) The manufacturer must be capable of providing on-site service with factory trained personnel.
f) The manufacturer must be capable of providing on-site training for the Department.

2.4.2 Master Gas Controller:

a) Enclosure Type - NEMA 4X Metal Enclosure with Glass window for read-out viewing.
b) 6 input analog sensor channels minimum.
c) Operating Temperature range: -10° to +40°C (14° to 104°F).
d) Operating Humidity range 0-90% RH, non-condensing.
e) 115 / 230 VAC ± 15% 50/60 Hz.
f) The system shall have the ability to operate with 1 or 2 channel controller boards.
g) Each module shall have two (SPDT) relays with change-over contacts for verification of Warning and Alarm conditions.
h) Shall be a large 4-digit 7-segment back lit Liquid Crystal Display and bright LED's to provide ease of reading and alarm notification.
i) The Display provides information on the gas concentration, alarm status, measurement units, flags indicating status and settings such as calibration interval, time-out function, alarm ON delay and alarm inhibit.
j) Ability to choose from LEL, LELm, PPM, % Vol, g/m3 or blank.
k) Controller shall have user defined access codes to prevent accidental or undesired tampering.
l) Audible Alarm push-button reset switch shall silence the Audible Alarm when alarm points are exceeded. The LED visual alarms will remain on as long as alarm levels are exceeded. This push-button will reset latched alarms if normal gas conditions exist.
m) Warning and Alarm Relay Set Points shall be customer selectable between 1-100% of the measuring range.
n) Failure mode shall utilize two SPST relays in series and shall be normally energized. 5A / 24VDC and 250VAC - resistive load.
o) Shall be high brightness LED's to provide ease of reading and alarm / failure notification.
p) Each unit shall have two, SPDT relays.
q) Complies with UL / CSA 61010-1 per MET.
r) Instrument shall have one year parts and labor standard warranty with extended warranty available. Warranty shall commence from the Final Acceptance of the Pump Station.
s) The Controller shall not require periodic maintenance other than verifying the Sensor Transmitter inputs are responding to the target gases.
t) Provide relay contacts for remote monitoring alarming as shown on Drawings.
u) Provide reset pushbutton integral to front of Master Gas Controller.

2.4.3 Sensor Requirements:

a) Infrared (IR) Combustible Sensor shall detect 0-100% LEL of combustible gas.
b) Sensor module shall store all calibration data so that module may be calibrated off-site and field-installed without necessity of recalibration.
c) Heated optics prevent condensation buildup.

d) 4–20 mA analog output.
e) Complete product shall have minimum useful life of three (3) years.
f) IR source within infrared sensor will have minimum useful life of ten (10) years.
g) Sensor/transmitter will be contained within a 316 stainless steel enclosure suitable for location in Class I, Division 1 & 2, Groups A, B, C & D, Class II, Division 1, Groups E & F, Class III classified areas.
h) Optional junction box enclosure shall have minimum of three entries, allowing for mounting options for sensor, power and signal, and should be constructed with 316 stainless steel.

2.4.4 Hydrocarbon combustible gasses to be detected include:

a) Octane
b) Ethane
c) Ethanol
d) Propane
e) Butane

2.4.5 Provide permanently installed remote test gas applicator and tubing for all combustible gas detectors that are not easily accessed without the use of tools, ladders, or other means.

2.4.6 The gas detection system shall measure and display gas concentration. The system shall alarm when preset limits are exceeded. Relays and timers for different alarm set-point levels shall be provided as additional contacts for alarms and ventilation controls. Relays shall be located in SCADA Panel.

2.4.7 The system shall consist of two (2) dual-channel monitor/readout units, one (1) relay programmer module, one (1) power supply unit, four (4) alarm relays, a horn relay, a buzzer and four (4) remotely mounted gas sensor/transmitter units. An independent monitoring channel shall be provided with each sensor/transmitter having a full scale range as specified. The sensor units shall be capable of being located remote from the monitor/readout unit by up to 5000 feet. Sensor unit shall receive power from and send signals corresponding to gas values to the monitor/readout unit. Each sensor unit shall be mounted in an enclosure suitable for NEC Class I, Division 1, Group C & D hazardous locations. The sensor units shall have provisions for mounting to a wall or similar structure.

2.4.8 The combustible gas monitor/readout unit shall be of the wall-mount type suitable for mounting at location in Electrical Control Room. All wiring connections shall be marked with functional designations such that connections can be made without the use of diagrams or tables. All connections must be easily accessible from the front. An external sealed switch shall be provided to allow for alarm reset and audible alarm silencing without opening the enclosure. All unused channel spaces shall be neatly blanked off.

2.4.9 Alarms and relays at the monitoring/readout unit shall be set for the following levels of gas concentration:

a) "WARNING" 5% LEL

b) "ALARM" 10% LEL
c) "TROUBLE" Failure of sensor or master controller.

2.4.10 The combustible gas sensor/transmitter shall be of the infrared type sensing element with 3-wire loop detector lead-in (LDL) signal transmitting electronic circuit designed to monitor the presence of petroleum (complex hydrocarbon) vapor in the ambient air. The transmitter circuit shall produce a 4 -20 mA output signal proportional to 0 to 100% LDL and shall be mounted in an explosion proof enclosure with a 3-1/2 digit LCD display. The transmitter circuit shall have real time clock and internal memory for day stamping and logging minimum and maximum gas concentrations.

2.4.11 In response to a WARNING or ALARM signal from the gas detection system, due to a high concentration of explosive vapor in the monitored space, an explosion-proof horn and alarm strobe beacon shall be energized at all levels of the Pump Station. The ventilation system for the monitored space shall be activated.

2.4.12 A calibration test kit for field checking the calibration of the gas detection system shall be furnished. The kit shall be complete, including a light weight carrying case, dispensing valve, regulator assembly and hose, test coils and necessary cylinder for type of calibrating gas. The test kit shall be stored in an approved cabinet adjacent to and match the air monitor panel. Test kit shall include detailed instructions on carrying out calibration including programmed offsets for included test gas.

2.4.13 Spare parts shall be provided for the air monitoring equipment as follows:

a) One set of fuses, one sensor head assembly and one sensor.

2.4.14 The services of a qualified representative of the manufacturer shall be provided to inspect the installation, make any adjustments, test the equipment, field calibrate the air monitoring equipment upon completion of the installation; after 24 hours of operation and again after one week; and instruct the operating personnel in the operation, calibration and maintenance of the equipment.

2.4.15 The Combustible Gas Detection System and Fire Alarm System share common strobes and horn annunciators. Reset of system is accomplished at respective system responsible for alarming.

2.5 (F25) Transit-Time Ultrasonic Flowmeter:

2.5.1 Manufacturer:

a) GE
b) Siemens
c) Krohne
d) Or Equal.

2.5.2 Clamp-on Transducers.

2.5.3 Accuracy: +/-2% of reading.

2.5.4 Range: 1 ft/s minimum.

2.5.5 Repeatability: 0.3%

2.5.6 Remote Transmitter Power: 120Vac (20 Watts).

2.5.7 Single channel Transmitter.

2.5.8 NEMA 4X transmitter enclosure.

2.5.9 Output 4-20mAdc.

2.5.10 Externally mounted (clamp-on) sensors.

2.5.11 Sensors shall be FM approved for Class I, Div. 2 Group D locations.

2.5.12 Pipe diameter as shown on Drawings.

2.6 (L8) Direct Acting Float Switches

2.6.1 Manufacturer:

a) Contegra FS 90.
b) Siemens 9G-EF.
c) Anchor Scientific.
d) Or Equal.

2.6.2 Float: 316 Stainless steel ball with Teflon or Laminex coating.

2.6.3 Provide sufficient length of oil resistant jacketed cable for direct connection to junction box without splice.

2.6.4 For Class 1, Divisions 1 or 2 hazardous (classified) locations, provide intrinsically safe relays in corresponding control panel.

2.6.5 The float switches shall be mounted to a 1" pipe utilizing all 316 stainless steel float switch mounting hardware and secured in place by 316 stainless steel mounting clamps. See Drawings for mounting details.

2.6.6 Switch: non-mercury SPDT reed type 1A@150Vac/Vdc non-inductive.

2.6.7 Float shall have a 3-year factory warranty minimum. Warranty shall commence from the Final Acceptance of the Pump Station.

2.7 (L10) Ultrasonic Level Element and Transmitter

2.7.1 Manufacturer:

a) Siemens Sitrans LUT 420
b) Endress Hauser Prosonics FMU90
c) Or Equal.

2.7.2 Transducer:

a) Transducer shall emit ultrasonic signal with time lapse between transmitted and received signal converted into usable voltage capable of driving totalizer, sample rate counter, and liquid level indicator. DC voltage produced shall be proportional to distance from detector to material being measured.
b) Ambient temperatures: -40°F to +176°F.
c) Process temperatures: -40°F to +185°F.
d) Integral temperature sensor for compensation.
e) Beam angle shall not exceed 6°.
f) Mounting shall be as shown on detail Drawings.
g) Non-contact design detector with no moving parts or mechanical linkages.
h) Include submergence shield.
i) Explosion-proof element certified by Factory Mutual Research for Class I, Division I, Groups C and D when sensor is located in hazardous area.

2.7.3 Transmitter:

a) 120Vac Power Supply.
b) Ambient temperatures: -4°F to +122°F.
c) Shall have local LCD with bar graph indication.
d) One isolated 4-20 mAdc, output.
e) One form C and two form A output contacts.
f) Hand-held programmer.
g) Nema type 4X/IP65 enclosure
h) </= 3mm resolution
i) Accuracy: +/- 1mm plus 0.17% distance.
j) 10" blanking distance maximum.

2.7.4 Cable:

a) Provide sufficient standard length of manufacturer's signal cable connecting transducer and transmitter or junction box without splice.

2.7.5 Measurement Requirements:

a) Range of measurement is 0-15ft.

2.8 (L11) Submersible Level Element and Transmitter

2.8.1 Manufacturer:

a) Siemens A1000i.
b) KPSI
c) PMC Engineering
d) WIKA Instrument, LP
e) Or Equal.

2.8.2 Transducer: Level transmitter consisting of variable capacitance, hydrostatic head-pressure sensing assembly enclosed in submersible Type 316 stainless steel housing

with Teflon pressure sensing diaphragm, special cable containing 1/8 in. breather tube and signal wiring, and sealed breather bag and transmitter assembly.

2.8.3 Provide intrinsically safe barriers when used in hazardous areas.

2.8.4 Transducer:

a) Designed for continuous submergence.
b) Low movement Teflon-faced diaphragm.
c) Protective, weighted, plate kit for diaphragm.
d) Oil-filled.
e) Barometrically compensated
f) Temperature compensated.
g) Variable capacitance type internal sensing element.

2.8.5 Cable Assembly:

a) 1/2 in. outside dia.
b) Positive seal where entering transducer housing.
c) Contains 1/8 in. breather tube.
d) Provide sufficient length to accommodate installation.

2.8.6 Junction Box and Breather Assembly:

a) Desiccant systems not allowed.
b) 2-wire, 4-20 mAdc.
c) Fused.
d) Output loop resistance 0-750 ohms.
e) Span and off-set adjustable.
f) Active transient protection.
g) Repeatability: ± 0.25%.
h) Accuracy: ± 0.25% of full scale.
i) Loop powered.

2.8.7 Measurement Requirements:

a) Range of measurement is 0-34ft. (15psi)

2.9 (M34) Current Sensing Switch

2.9.1 Manufacturer:

a) AcuAMP ACS200
b) Eaton
c) Veris Industries
d) Or Equal

2.9.2 Input Range: 0-6, 6-40, 40-175 Amp (Jumper selectable).

2.9.3 Output: Normally open relay (1A @ 240Vac).

2.9.4 UL Listed.

2.9.5 Panel Mount.

2.10 (M37) Electronic Process Indicator:

2.10.1 Manufacturer:

a) Precision Digital.
b) Red Lion, IMP.
c) Moore Industries.

2.10.2 4-20mAdc Input.

2.10.3 4 ½ digit LED indicator.

2.10.4 Loop powered.

2.10.5 Enclosure shall reflect same NEMA rating as panel it is located in.

2.11 (M60) Intrinsically Safe Relay:

2.11.1. Manufacturer:

a) P.R. Electronics.

2.11.2. NAMUR or mechanical contacts.

2.11.3. Universal power supply: 21.6-253Vac / 19.2-300Vdc.

2.11.4. Output: SPDT, 250Vac, 1 amp.

2.11.5. Protection: IP20.

2.11.6. Mounting: DIN rail.

2.11.7. Operating temperature: -20°C to 60°C.

2.11.8. Operating humidity: <95% non-condensing.

2.11.9. Non-zener diode operation.

2.11.10.UL-913, UL-508 Listed.

2.12 (M62) Line Filter:

2.12.1 Manufacturer:

a) Emerson Islatrol IE Series.

2.12.2 UL 1449 Surge Voltage Rating:

a) 120V Normal Mode: 330 Volts.
b) 120V Common Mode: 400 Volts.

2.12.3 Peak Surge Current Capability (8 x 20 µs)

a) 120V Line to Neutral: 15,000 Amps.
b) Line to Ground: 15,000 Amps.
c) Neutral to Ground: 15,000 Amps.
d) Total: 45,000 Amps.

2.12.4 Frequency Response (Forward-Reverse)

a) Normal Mode: 100 kHz to 50MHz - 90 dBMin.
b) Common Mode: 5MHz to 50MHz - 60 dBMin.

2.12.5 Typical Category A Ringwave (6kV, 200A, 100kHz) Normal Mode/Common Mode

a) 3 Amp: 1 V/300 V
b) 5 Amp: 0.7 V/292 V
c) 10 Amp: 0.7 V/300 V
d) 20 Amp: 0.7 V/300 V

2.12.6 Typical Category B Ringwave (6kV, 500A, 100kHz) Normal Mode/Common Mode

a) 3 Amp: 178 V/300 V
b) 5 Amp: 162 V/291 V
c) 10 Amp: 153 V/300 V
d) 20 Amp: 200 V/300 V

2.12.7 MCOV

a) 120 Volt: 150 VRMS
b) 240 Volt: 275 VRMS
c) Line Frequency: 47 - 63 Hz
d) Connection: Terminal
e) Mounting Type: DIN/Flange
f) Weight: < 3 lbs

2.12.8 Response Time

a) Normal Mode: < 0.5 ns
b) Common Mode: < 5 ns
c) Operating Temperature: -40°C to +45°C
Derate Linearl to 60% at +70°C
d) Operating Humidity: 0% to 95%

2.12.9 Other Features:

a) LED status indication and form C contact for remote indication.
b) DIN mountable enclosure.

c) UL 1449, 1283, CUL recognized, CE.
d) Active tracking filtration.
e) 10 year warranty. Warranty shall commence from the Final Acceptance of the Pump Station.

2.13 (M64) Enclosure Thermostat:

2.13.1 Manufacturer:

a) Hoffman.
b) Honeywell.
c) Or Equal.

2.13.2 Features:

a) One normally open and one normally closed contact.
b) 32°F to 142°F adjustability.
c) Bimetallic sensor element.
d) DIN mountable.

2.14 (M66) Enclosure Fan:

2.14.1 Manufacturer:

a) Hoffman.
b) Dayton.
c) Or Equal.

2.14.2 Features:
a) Size for enclosure heat dissipation requirements.
b) Includes filters and grille.
c) Include one additional filter .
d) Include exhaust grille.

2.15 (M68) Uninterruptible Power Supply (UPS):

2.15.1 Manufacturer:

a) APC
b) Emerson
c) Alpha
d) Liebert
e) Eaton

2.15.2 Uninterruptible Power Supply (UPS) System shall be provided for the SCADA and instrumentation systems as shown on the Drawings and specified herein. The UPS shall sustain operation during short-term power failures, and shall provide power for an orderly shutdown to prevent the loss of data during power failure and shall provide full isolation between the control system and the plant power system.

2.15.3 Provide true on-line non switching uninterruptible power supply (UPS). Double power conversion on-line operation including rectifier and inverter, constantly conditioned AC output.

2.15.4 Provide make-before-break automatically operated bypass contactor to bypass UPS to allow operation of system controls in event of UPS failure.

2.15.5 Each system shall consist of a static dc to ac sine wave inverter, a battery charger, sealed batteries, a monitor and transfer switch, and accessories as listed below.

2.15.6 Each system shall operate on a 120-volt, 60-Hz ac branch circuit. The input ac circuit shall supply energy to the battery charger which shall supply energy to the inverter as well as to the battery to maintain its charge. The output of the inverter shall supply energy to the load. If the input ac circuit is interrupted, the inverter shall continue to supply energy to the load without interruption, drawing power from the battery. If the input ac circuit is restored prior to discharge of the battery, the charger shall resume the supply of energy to the inverter and shall restore the battery to full charge. In the event of malfunction of the battery charger, battery or inverter that results in interruption of the output from the inverter, the monitor shall detect this condition and shall automatically transfer the load to the system's ac input circuit within 25 milliseconds. After the malfunction is corrected, the load shall be retransferred to the inverter manually.

2.15.7 System output voltage shall be regulated within plus or minus 5 percent of 120 volts and frequency stability shall be plus or minus 1/2 percent of 60-Hz. The output characteristic shall be sinusoidal with not more than 5 percent total harmonic distortion at full load with input ac circuit at 120 volts. For a 20 percent instantaneous load change, voltage overshoot or undershoot shall be not more than plus or minus 10 percent. For a 10 to 90 percent load change, recovery time shall be not longer than 100 milliseconds.

2.15.8 The UPS system shall have an efficiency of at least 90% when operated from AC line.

2.15.9 UPS shall supply power to PLC's, HMI's, Ethernet Switch, DC power supplies, field instruments, and other low voltage control devices as specified and as shown on Drawings and Plans.

2.15.10 UPS shall have enough capacity to power these devices for a period of 30 minutes after the utility power has failed. Provide with extended battery module(s) to meet this requirement.

2.15.11 Size UPS for 125% of connected electrical load with 1500VA as a minimum UPS size.

a) The System Integrator shall provide sizing data on the UPS listing all loads and calculations required for sizing the UPS system, and include with submittal.

2.15.12 19" Rack Mount Form Factor shall be used unless stated otherwise on Drawings or Specifications.

2.15.13 UPS shall be located in network wall-mount Rack (NET-1). Additional batteries, if required, shall be mounted internal to the wall-mount rack.

2.16 (M70) DC Power Supplies:

2.16.1 Manufacturer:

a) Phoenix Contact Quint-PS
b) ABB
c) Sola/Hevi-Duty

2.16.2 General

a) Power supply shall be fully enclosed, and provide screw terminations. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529. Housing shall be at least IP20.
b) Power Supplies shall have an efficiency of at least 80%.
c) The power shall have an MTBF (Mean Time Between Failures) greater than 500,000 hours according to IEC 1709.
d) The power supply shall be able to withstand shock of 30G in all space directions according to IEC 68-2-27 and vibration up to 2.3G 90 min. (<15hz, amplitude = +/-2.5mm/15-150hz) according to IEC 68-2-6.
e) Power supplies shall be UL-508A listed to allow the use of the power supply at full rated output amperage with no "de-rating".

2.16.3 Mounting

a) All power supplies shall have integral metal mounting foot to attach to 35mm DIN-rail conforming to DIN EN50022.

2.16.4 Wire Connections

a) Attach wires to the power supplies by means of a cable-clamping terminal block activated by a screw. Connections shall be gas-tight, and the terminal block shall be fabricated with non-ferrous, non-corrosive materials.
b) Wire connection for currents less than 20A shall use pluggable terminals on both input and output ends.
c) Pluggable terminals shall accept wire sizes 24 through 14 AWG.

2.16.5 Equipment

a) Nominal current rating to be based on an operating temperature of 60°C or higher.
b) Power supplies shall have a visible "DC Power OK" indicator. This indicator will flash when the output drops below 10% of the adjusted output voltage.
c) Ambient temperature range for operation shall be at least -25°C to +70°C
d) Residual ripple shall not exceed 100 mV peak to peak at nominal current values.
e) Integral surge suppression shall be incorporated into the power supply.
f) Power supplies shall conform to CE electromagnetic compatibility as described in EN61000-6-2 and EN 50081-2.

g) Power supplies shall have means of limiting DC current in case of short circuit or an overload and shall automatically reset themselves when the fault is corrected.
h) Power supplies when wired in parallel will not require external circuitry.
i) Power supplies shall have a voltage monitoring relay contact and signaling output.
j) Input must auto-range between 85 to 264VAC and 90 to 350VDC for 1 phase power supplies with no manual intervention.
k) Power supplies shall have a power factor of at least 0.6.

2.17 (M75)Programmable Logic Controller Hardware:

2.17.1 Manufacturer:

a) Rockwell Automation.
b) No Substitutes.

2.17.2 A Programmable Logic Controller (PLC) system shall be furnished and shall be programmed to operate all functions specified herein. All analog and discrete inputs and outputs shall be provided as necessary. The logic program shall be of universal type architecture and shall not be of a proprietary language. In addition, the programmable controller shall be capable of being interrogated from the District 1 Dispatcher's Alarm Panel, as well as Maintenance Contractor via cellular modem. The programmable controller equipment supplier shall be responsible for coordinating and providing a complete and properly functioning software package for the control and operation of the equipment as specified herein.

2.17.3 The PLC shall be equipped with sufficient memory and I/O capacity to handle control functions of present system plus 20% spare memory and 10% spare I/O minimum.

2.17.4 The System Integrator shall furnish the Pump Station operational program. A CD ROM copy and printout of the PLC control program shall be furnished to DEPARTMENT at the time of start-up. Disk and printed copy of the operating program shall be maintained on the file with the System Integrator.

a) PLC shall be programmed using Studio 5000 (latest edition).
b) Program shall be fully commented including each page and each rung with detailed description of the logic performed.

2.17.5 Additional Materials:

a) Provide one shelf spare for each I/O module type used on project.
b) Provide one shelf spare for each power supply used on project.
c) Provide one shelf spare for each communications module used on project.

2.17.6 Chassis:

a) 1756-A4 for primary and secondary processor racks.
b) 1756-A17 for I/O racks.

2.17.7 Power Supply:

a) 1756-PA75 for primary and secondary processor racks.
b) 1756-PA75R for I/O racks.

2.17.8 Processor:

a) 1756-L72.
b) 4MB user Memory.
c) USB port.
d) Provide redundant processors.
e) Provide orderly shutdown on power failure, saving register contents with automatic restart on power restoration.

2.17.9 Communication Modules:

a) Ethernet communications with network switch: 1756-EN2T.
b) Ethernet ring topology for communications with remote I/O Rack: 1756-EN2TR.
c) Processor redundancy: 1756-RM.

2.17.10 Input/Output Modules:

a) Digital Input: 1756-IA16I.
b) Relay Output: 1756-OW16I.
c) Analog Input: 1756-IF8I.
d) Not Used.

2.17.11 Each relay output shall be individually protected with properly sized MOV, and interposing relay.

2.17.12 Wiring and Termination System:

a) Wiring of PLC I/O modules shall be through cable assemblies to individual terminal blocks.
b) Cable assemblies shall be pre-wired and shall have PLC I/O module-specific wiring arms on one end and flying leads on the other.
c) Provide sufficient terminations to accommodate active I/O points, spares, and future expansion.

2.17.13 Manufacturer part numbers listed above reflect information known at time of design and shall be independently researched and verified for availability with latest version available prior to submittal.

2.18 (M80) Managed Data Switch:

2.18.1 Manufacturer:

a) N-Tron 7026TX Series.
b) Sixnet.
c) Or Equal.

2.18.2 Features:

a) Twenty-Four (24) RJ-45 10/100BaseTX Ports.
b) ESD and Surge Protection Diodes on all Ports.
c) Auto Sensing 10/100 BaseTX, Duplex, and MDIX
d) Advanced management features including: VLAN, IGMP Snooping, Port Trunking, QoS, and Mirroring, Local Port IP addressing, EtherNet/IP CIP Messaging, Port Security – MAC Address Based.
e) Rack Mounting.
f) Redundant Power Inputs 18-49Vdc.
g) Fault Relay Support
h) -40°C to 80°C Operating Temperature.
i) UL Listed.

2.19 (P4) Pressure Gauge with Indicator:

2.19.1 Manufacturer:

a) Ashcroft.
b) US Gauge, a Division of Ametek, Inc.
c) Or Equal.

2.19.2 Housing Material: 316 Stainless Steel

2.19.3 Mounting: Stem

2.19.4 Dial Size: 4-1/2 inch

2.19.5 Accuracy shall be ±1% of span.

2.19.6 Scale shall read in feet of water column.

2.19.7 Units shall be bellows or Bourdon tube actuated pressure gauges. Gauges shall be stem mounting with 4-1/2-inch dial size, unless otherwise noted. Scale range shall be as noted and accuracy shall be plus or minus 1/2 percent of span.

2.19.8 The sensing element material shall be phosphor-bronze.

2.19.9 Element shall be suitable for temperatures of media monitored, and filled for alleviation of vibration.

2.19.10 Provide with two ½" full port stainless steel ball valves as shown on detail Drawings.

2.19.11 Provide with diaphragm seal as follows:

a) Lower Housing Material: Unless otherwise noted, type 316 Stainless Steel with flushing connections.
b) Diaphragm Material: Unless otherwise noted, type 316 Stainless Steel.
c) Upper Housing Material: Steel with bleed screw
d) Connections: Threaded Female NPT
e) Filling Fluid: Silicone

f) Unit shall be pressure-sensing suitable for measuring dirty or corrosive fluids.
g) Unit shall be arranged and designed to directly transmit the process pressure by means of the fluid through an opening in the lower housing to a pressure-sensing device attached and sealed to the upper housing by a drilled and threaded boss.
h) Seal shall be suitable for fluid pressures to 500 psig.
i) Unit shall have fill connections and other features required permitting refill of the seal volume and calibration of unit in the field.
j) Unit shall be suitable of for temperature of media monitored.
k) Ametek, Mansfield and Green Division, Type SG or Ashcroft Type 101.

2.20 Control Relays:

2.20.1 Manufacturer:

a) Allen Bradley.
b) Potter and Brumfield.

2.20.2 Operating Data:

a) Pickup Time: 13 ms maximum.
b) Dropout Time: 10 ms maximum.
c) Operating Temperature: -45°F to 150°F.

2.20.3 ac Coil:

a) 120Vac.
b) Continuous rated.
c) 3.5va inrush maximum.
d) 1.2va sealed, maximum.
e) 50-60 Hz.
f) Light to indicate energization.
g) Minimum Dropout Voltage: 10% of coil rated voltage.

2.20.4 dc Coil:

a) 24Vdc.
b) Continuous rated.
c) Light to indicate energization.
d) Minimum Coil Resistance: 24Vdc: 450 Ω.

2.20.5 Contacts:

a) Gold flashed fine silver, gold diffused for 1 amp or less resistive load.
b) Silver cadmium oxide.
c) 3 form C.
d) 300 vac.
e) 10 amp (B300) make, 1.5 amp break, (inductive).

2.20.6 Rated at 10 million operations.

2.20.7 11 pin, square socket (shall be same manufacturer as relay).

2.20.8 DIN rail mountable.

2.20.9 Enclosed and protected by polycarbonate cover.

2.20.10 Provide relay-retaining clips.

2.21 Interval/Duration Timer (Rear of Panel):

2.21.1 Manufacturer:

a) Idec
b) Potter and Brumfield, CN series.
c) Eagle Signal DM 100 series.

2.21.2 Mounting: Plug-in with dust tight cover.

2.21.3 Type: Integrated circuit.

2.21.4 Range: 0.5 sec to 99 min. Field selectable.

2.21.5 Contacts: 2 DPDT contacts rated 10 amp, 120 vac.

2.21.6 Power: 120Vac, 60 Hz.

2.22 Paragraph placeholder.

2.23 Terminal Blocks:

2.23.1 Manufacturer:

a) Allen Bradley.
b) Phoenix Contact.
c) Weidmuller.
d) Or equal.

2.23.2 300 v rating for 120 v circuits and below, 600 v rating for 480 v circuits.

2.23.3 Clamping screw type.

2.23.4 Isolating end caps for each terminal.

2.23.5 Identification on both terminals.

2.23.6 Clip-mounted on DIN rail.

2.23.7 Accept AWG 12 to 22.

2.23.8 Feed-Through Terminals:

a) 20 Amp rating

2.23.9 Switched Terminals:

a) Knife disconnect with test sockets.
b) 10 Amp rating.

2.23.10 Fused Terminals:

a) Hinged fuse removal/disconnect.
b) 10 Amp rating.
c) Include blown fuse indication.

2.24 Power and Data Port:

2.24.1 Manufacturer:

a) Hubbell PR4X205E
b) GracePort
c) Automation Direct ZP-PGA-32-201

2.24.2 General

a) One Ethernet port.
b) 120Vac GFCI Receptacle.
c) Bulkhead style.
d) Nema 4X.
e) Mounted on PLC Panel.
f) Wired to Ethernet switch.

2.25 Electronic Current Isolator:

2.25.1 Manufacturer:

a) Phoenix Contact Model MCR Series.
b) PR Electronics.
c) Entrelec.

2.25.2 Solid state instrument to electrically isolate one instrument loop from another instrument loop. Converter to accept 4-20 mAdc input signal and provide equal but isolated and power-boosted output.

2.25.3 Mounting: DIN Rail.

2.25.4 Temperature compensated, calibration-free.

2.25.5 Signals: Input: 4-20 mAdc into 50 ohms. Output: 4-20 mAdc into output load up to 500 ohms.

2.25.6 Isolation: Common mode up to 700Vac between input and output.

2.25.7 Accuracy: 0.5% of span.

2.25.8 Provide power supply specific to isolator.

2.26 SCADA Panel (PLC-1) located in Electrical Control Room:

2.26.1 A SCADA panel shall house redundant programmable logic controllers (PLC's) which shall be programmed for automatic control and monitoring of the operations of all control and monitoring functions at the Pump Station. The PLC's shall control the starting and stopping of one Low Flow Pump and three (future five) Main Pumps to prevent roadway flooding. The PLC's shall be configured with redundant processors communicating over fiber optic cable with individual power supplies for each processor and redundant power supplies for each I/O rack. I/O communication shall be over Ethernet with ring topology.

2.26.2 The SCADA panel shall be NEMA 12, 10 gauge steel, floor mounted, front accessible only, metal enclosed type, arranged for cable and/or conduit entry from the top as required. Panel design shall allow easy access to all internal wiring and appurtenances. Fluorescent lighting kit activated by door switches shall be provided. Thermostatically controlled ventilation fan, air filters, thermostatically controlled space heater, light kit and 120V receptacle shall be provided. Redundant front of panel HMI's shall also be included whose software application is located on a computer in the Network Rack Enclosure. The panel shall have a full piano hinge door(s) and a 3-point latch with a locking handle. The handle shall have a cylinder type lock keyed to match IDOT's system. Additional devices as shown on Drawings.

2.26.3 The SCADA panel shall be finished inside and out. Exterior color shall be ANSI 61 and shall match that for the motor control center, and the interior color shall be white or as otherwise approved by the Engineer.

2.26.4 Nameplates shall be as specified in Section 16C. All devices located on front door and inside the panel shall be identified with functional nameplates that match device ID's on Drawings.

2.26.5 The SCADA panel shall house relays, timers and intrinsically safe relays which shall be wired for backup automatic control and monitoring of the operations of critical functions at the Pump Station. Space shall be allocated for 25% spares for future equipment/devices to accommodate 2 additional Main Pumps. The logic shall control the starting and stopping of one Low Flow Pump and three Main Pumps to prevent highway flooding. The SCADA panel shall be configured with hardwired logic and shall serve as a simultaneous backup system to the primary and secondary PLC's in the same Panel. The panels shall conform to all applicable standards of NEMA and ANSI and shall be complete with float type water level control systems integrated as indicated on the Drawings and as specified.

2.26.6 Unless otherwise indicated, pushbuttons, selector switches, indicating lights, relays, and other devices shall be provided as part of the SCADA Panel and shall be as similar to those in the MCC and shall be of the same manufacturer and style.

2.26.7 Wiring shall be brought to terminal strips within the enclosure and 25 percent spare terminals shall be provided. The identification of terminals shall conform to the schematic diagrams and shall consist of slip-on heat shrink labels as manufactured by Brady, Thomas and Betts, or equal. Terminals and devices that are provided for intrinsically safe circuits shall be segregated from all other circuits/devices as described elsewhere.

2.26.8 The float control system circuit shall be as specified under "Float Control System". The float relays shall be intrinsically safe.

2.26.9 Intrinsically Safe circuits, wiring, mounting and installation shall be in accordance with NEC Article 504 (latest edition).

2.27 Float Control System:

2.27.1. The float system shall function as described on Drawings and as described under paragraph 1.6.

2.27.2. The float control system shall include floats, interconnecting integral cable of length required, and controls for the functions indicated.

2.27.3. The system shall be intrinsically safe for installation in the wet well, discharge chamber, and pavement installations.

2.27.4. The system shall be complete with control logic to provide the contacts for control and alarm functions indicated. Intrinsically safe relays and associated wiring shall be located in SCADA Panel.

2.27.5. The system shall be complete with all required mounting hardware and accessories.

2.27.6. The float system shall be complete with mounting arrangement with a stilling well of adequate size, as shown in Drawing details to minimize collection of debris and calm liquid disturbances. The mounting arrangement shall permit easy removal of the floats and easy realignment when replaced.

2.27.7. When float arrangement is such that there is a possibility of float switch entanglement with an adjacent float switch, then two float trees with stilling well assemblies shall be provided - staggering the switches as required to alleviate float switch entanglement.

2.28 Network Rack (NET-1) located in Electrical Control Room:

2.28.1. Manufacturer:

a) APC.
b) TrippLite.
c) Hoffman.
d) Or Equal.

2.28.2. 19" EIA Compliant Device Mounting.

2.28.3. 19U Wall-Mount Rack, ventilated, Lockable front glass door.

2.28.4. Nominal Dimensions (WxDxH): 24"x25"x36"

2.29 SCADA Panel HMI Computer:

2.29.1. Provide one fully configured computer system including hardware, peripherals, operating software, application software, and configuration as specified herein for running application, data logging, and trending animation.

2.29.2. Manufacturer:

a) Dell
b) HP
c) Or Equal.

2.29.3. The computer shall be a Intel processor based PC in a rack-mount configuration with the following features as minimum system requirements:

a) Rack-mount 4U configuration.
b) Intel Xeon Processor (6C, 15M, 3.6 GHz, 85W)
c) Memory: 16GB 2400MHz DDR4 Memory.
d) Internal Hard Drive: 1TB 2.5inch SATA (7.200 RPM)
e) Removable Media Options: 16x DVD ROM SATA
f) Recovery DVD.
g) 10/100/1000 Ethernet port, 1 VGA port
h) Graphics Card shall be dual-port, and capable of running multiple monitors simultaneously.
i) Operating System: Windows 7 (x64) Professional
j) Dual, hot-plug, redundant power supply, 1,100W
k) USB Quiet Keyboard
l) USB – Optical Mouse
m) Input Voltage: 90…264V ac, autoranging
n) Line Frequency: 47…63 Hz
o) Operating Temperature: 0…50 °C (32…122 °F)
p) Operating Humidity: 10…90% without condensation
q) Operating Vibration: 1 g peak, 10…500 Hz
r) Operating Shock: 15 g (1/2 sine, 11 ms)
s) Rating: NEMA Type 1, 12, 4, IP66
t) Certifications: UL 60950 recognized component, c-UL 950 recognized component, or UL/c-UL listed when marked; CE marked, C-Tick

2.29.4. Warranty: 3 years parts, 3 years labor, 3 years onsite services (3/3/3). Warranty shall commence from the Final Acceptance of the Pump Station.

2.29.5. Provide Microsoft Office Professional software installed.

2.29.6. Provide Adobe Acrobat reader software installed.

2.29.7. Provide virus scan software installed, with automatic updates turned off.

2.29.8. System requirements listed above reflect information known at time of design and shall be independently researched, verified, and updated based on availability, and compatibility prior to submittal. Submitted system shall be based on mid range level of performance. Operating system and software shall be most current version that is fully compatible with all software installed on the machine for the project.

2.29.9. Provide all software on original diskettes, software publisher licenses, and manuals.

2.29.10. The computer shall be capable of off line usage for purposes other than system logging and trending without loss of statistical data.

2.29.11. The computer shall be programmed for auto-startup and login after loss of power.

2.29.12. The computer shall be arranged for system monitoring and management. The primary function of the computer shall be to provide monitoring, trend analysis and, operational records for the pump station facility.

2.30 System Software

2.30.1. General Requirements

a) The System Integrator shall furnish and install all software and programming necessary to provide a fully debugged and operating system based on the system descriptions. The software required shall consist of those programs necessary for the System to perform the functions specified herein, plus enable convenient and efficient preparation of new programs. The System Integrator shall assume complete responsibility for the successful operation of all software and application programs provided as part of the System. All programs shall be completely debugged and operable prior to delivery of the System. IDOT shall not be required to expend any programming effort in order to achieve a fully operational system.

b) The System Integrator is responsible for computer hardware and software compatibility.

c) Software shall be modular, comprised of an integrated group of proven, standard software modules.

d) All of the programs are to be generalized in nature such that DEPARTMENT may later add new functions. Integration of future application programs and the servicing of their input and output requirements, including construction of new printing formats and other system interfaces, shall be accomplished without recompiling of application software.

e) Changes in process parameters, addition and deletion of process schemes or equipment, and addition or modification of graphic displays and printed report formats shall be via the use of process operator and control engineer oriented icons, graphics, and menus organized in a hierarchical fashion.

f) System parameters such as: date, time, set points, alarm limits, PID tuning constants, etc., shall be entered or modified via the LCD/keyboard. Any input

which modifies the system shall be logged and a historical disk file with date, new value, and previous value.

g) The System Integrator shall develop and implement all specified screens, logs, reports, etc. IDOT shall provide input to the System Integrator in the areas of presentation format, included information and other general operator interface considerations.

h) Provide Rockwell FactoryTalk View SE Station, FactoryTalk Historian SE (250 tags) and other software as required for a complete an operable system.

2.31 HMI Monitor:

2.31.1. Manufacturer:

a) Hope Industrial Systems Inc.

2.31.2. Two required. Both HMI's located at SCADA Panel.

2.31.3. Industrial monitor and touch screen, 22" panel mount active matrix LCD, NEMA 4X, stainless steel faceplate, 5-wire resistive analog touch-screen, mouse emulation, USB interface to computer.

2.31.4. 1680x1050 resolution, 16:10 widescreen aspect ratio, 16.7 million colors.

2.31.5. UL-508A listed.

2.31.6. Include vendor cables of sufficient length to connect to computer.

2.31.7. 3-year factory warranty. Warranty shall commence from the Final Acceptance of the Pump Station.

2.31.8. Include hinged screen protector.

2.32 Graphics and HMI Configuration:

2.32.1. HMI-1 shall be configured to display various graphics screens as the Operator selects for monitoring and control of the Pump Station. HMI-2 shall be configured to display an alarm annunciator-style graphics screen as default with the ability of each HMI to interpose functionality between the two with one click of mouse or active touch space on-screen. Each HMI shall have access to all graphics screens. The HMI's shall operate as redundant equipment.

2.32.2. All color displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers as shown on the Drawings. The following basic types of LCD displays are required:

a) Index displays
b) Graphic displays

c) Trend displays
d) Alarm summary displays
e) System status displays
f) Single point configuration/status displays
g) Pop-up displays
h) Help displays
i) Set-point displays

2.32.3. The LCD displays shall make maximum use of the colors available. Colors for status such as open/close, start/stop shall be the same as the indicators on the local control panels and motor control center. The use of color for status shall be unique and consistent for all graphic screens.

2.32.4. The LCD displays shall be interlinked for easy and direct access. Navigation shall be accomplished by mouse selection from Windows like pulldown menus or via hot links on displays. Display hot links shall allow navigation from the general to the specific and include a "PREVIOUS" select point for reversing the previous 10 navigation steps.

2.32.5. The system shall allow the operator to manually interrogate the status of pumps, valves, etc., via either keyboard entry on the currently displayed graphic screen.

2.32.6. Index displays: Display shall be provided as a guide to the available display options. The index displays shall be a complete and logical listing of the names and number of all screens. Provide hot links on the index displays to allow immediate access to any screen listed.

2.32.7. Graphic displays: The display shall depict basic process schematic diagrams with representative symbols for pumps, generator, etc., combined with real time process variables or conditions. The equipment represented on the display shall be suitably titled for identity. The displays shall be dynamic (i.e., symbols for a pump shall change color indicating run or stop or alarm, the volume of tanks shall be indicated by varying the height of the interior color of the tank symbol, etc.) The data shall be identified on the display by its name and tag number. All of the current data in the database shall be available for graphic displays. It shall be possible to easily modify an existing display or generate a new display. The graphic displays shall consist of a single master plant flow schematic and multiple subscreens detailing specific plant systems or elements. The process graphic displays shall be comprised of master, area and system displays. The master and area displays shall show general graphic representations of the facility covered with general equipment, alarm, analytical summaries and control capabilities. The system display shall detail all relevant aspects of the individual equipment or system (i.e., an individual pump). The intent is to provide the Operator with an overview (Master) with the capability to "zoom in" on a process (Area) or a piece of equipment (System) as necessary. The System Integrator shall use the Process, Mechanical, and Instrumentation Drawings included as part of this Contract to generate the graphic displays.

a) Trend display: The trend display shall display the value of a process variable versus time. The intent of the display is to resemble the type of plot produced on an analog recorder, only displayed on the LCD. Each of the assigned points will have its point identification number, point name, current value, and

instrument range displayed in the color used for its trend. Each point will be trended in a different color. The time period shall be selected and time and date of start, shall be displayed. The values displayed on an historical trend shall consist of the stored values for each variable trended. Provide both historical and real-time trending capability. Real-time trends shall be updated at the scan frequency of the variable. Provide historical and real-time trending for all analog inputs shown on the P&ID. Points shall be logically grouped on a trend screen as directed by IDOT or Engineer.

b) Alarm summary display: The display shall consist of all equipment current in alarm, and shall include the tag number, description, time of occurrence, present status (high, low, normal, etc.). The alarm summary shall identify alarm points by severity by utilizing distinct colors for each severity category. The severity classification shall be a configuration option.

c) System status displays: The displays shall summarize all error status of all devices in the system capable of reporting errors to the CPU (e.g., printers, communication devices, communication lines, remote PLCs, etc.). The display shall indicate if an error is detected or a failure occurs. These displays shall be used primarily for maintenance purposes.

d) Single Point Configuration/Status displays: The configuration/status displays shall be of the software vendors standard format.

e) Pop-up displays: Provide pop-up style displays for operator notification, help screens, or ancillary display functions. Pop-up display shall conform to Microsoft Windows look and feel including pop-up termination or action pushbuttons.

f) Help displays: Provide process help displays for all graphic screens developed for this project. Help displays shall be pop-up type and provide operator information about the process graphic currently displayed.

g) Set-point displays: Provide standard display for all PID loops presenting all analog process variables, associated PID set-points and loop tuning parameters stored in the PLC. Provide additional level of password protection prior to allowing any changes to loop tuning parameters.

h) Provide button link graphic icons that allow operator action by selection of the button with the mouse and mouse key. Button link shall be a standard graphic item and be modifiable for any process action or graphic call.

2.32.8. Alarm/Equipment Status Reporting:

a) The alarm log shall store all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it's a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be printed. All reports shall include the plant equipment number of the associated device.

b) Equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The status monitoring shall be capable of being disabled and/or suppressed from the operator's console. The equipment status log shall include the time, the equipment name, tag number, and the particular change in status.

2.32.9. Prior to final completion of construction project, the System Integrator shall turn over two CD's with all HMI and Historian programs fully documented and labeled: "Pump Station 8 HMI" with System Integrator full contact information. Two hardcopies of the HMI and Historian programs shall accompany the CD.

2.33 PLC Program Development and Software:

2.33.1. The System Integrator shall provide all PLC programming and configuration required to implement the control strategies specified in this Section and shown on Drawings for a complete and fully operational Pump Station.

2.33.2. ControlLogix PLC's shall be programmed using Allen-Bradley RSLogix 5000 (latest version compatible with all software and hardware), and be fully commented.

2.33.3. Provide PLC program fully documented with individual rung and page commentary describing the action and interaction of rung with other control ladder logic. A PDF of sample program will be provided to the successful bidder.

2.33.4. Prior to final completion of construction project, the System Integrator shall turn over two CD's with all PLC programs fully documented and labeled: "Pump Station 8 PLC Programs" with System Integrator full contact information. Two hardcopy of the PLC program shall accompany the CD.

2.34 PLC Program Development Guidelines:

2.34.1. Set-points, alarm values, timer values, control loop tuning parameters, and other numeric values used within PLC and HMI programs shall be part of continuous common data table within program. Parameter changes shall not require modification to instructions within program. Parameter changes shall be adjustable by changing data table through operator input via HMI.

2.34.2. Unless specified otherwise, procedure for control power fail restart for equipment shall be as follows:

a) Equipment shall shut down on loss of control power (if UPS has been exhausted).
b) Upon restoration of power, previously running equipment shall be restarted using same sequence of startup used for "Auto" control.
c) Prior to Restart, Auxiliary equipment shall be placed in "Off" position.
d) Equipment Restart shall be sequenced through use of timer functions to prevent simultaneous restart.

2.34.3. PLC shall not be enabled to control equipment unless respective field or MCC Hand/Off/Auto, Local/Remote, On/Off/Remote or Open/Close/Remote selector switch is in "Remote" or "Auto" position. Equipment status monitoring/displaying and process parameter logging/trending shall continue in all modes of control.

2.34.4. Determination of high (low) Off-Normal conditions shall be by comparing an analog input value to Operator entered set-point values. Off-Normal status bit shall be set when rising (falling) input value is equal or greater (less) than entered set-point value. Off-Normal status bit shall be reset when falling (rising) input value is equal or less (greater) than entered set-point value minus (plus) entered deadband value. Operator entered high (low) set-point values are absolute values and deadband values are relative values. All values are entered through HMI.

2.34.5. Setting of Off-Normal status bits shall cause status conditions to be displayed and/or alarmed at HMI.

2.34.6. Resetting Off-Normal status bits shall cause status conditions displayed and/or alarmed at HMI to be cleared.

2.34.7. Adjustable delay timers on alarm points shall prevent nuisance alarming or nuisance clearing of alarms. Timer values shall be ranged 0-30 seconds. Initial setting, unless otherwise specified shall be 5 seconds.

2.34.8. All status conditions at HMI shall also be logged to data table and event log.

2.34.9. Motor Running status shall be monitored and displayed at HMI continuously.

2.34.10. Setting of Motor Failed status bits:

a) If motor is required to run via PLC control (MCC Hand/Off/Auto selector switch in "Auto"),
b) And if absence of Motor Running status causes Motor Fail watchdog timer to time out,
c) Then Motor Failed status bit shall be set.

2.34.11. Setting a Motor Failed status bit shall cause motor command output to be inhibited and shall cause Motor Failed status to be displayed and alarmed at HMI.

2.34.12. Resetting of Motor Failed status bits:

a) If MCC Hand/Off/Auto selector switch is in "Auto" position,
b) And if failure condition is abated,
c) Then Motor Failed status bit shall be reset.

2.34.13. Resetting a Motor Failed status bit shall cause motor command output to be re-enabled and shall cause Motor Failed status displayed and alarmed at HMI to be cleared.

2.34.14. Adjustable filtering of analog inputs shall eliminate process upsets due to noise. Filtering shall be by running-average method.

2.34.15. Integration algorithm shall be included for "Totalizing" analog flow signals.

2.34.16. Integration algorithm shall be included for "Totalizing" Equipment Run times (Elapsed Time Meter). Pump ETM and Pump number of starts shall be password protected and require Supervisor level verification to reset.

2.34.17. PLC input coils shall be configured as non-latched unless specified otherwise.

2.34.18. PLC output contacts shall be configured as maintained unless specified otherwise.

2.34.19. The following are PLC generated alarms or conditions (specific to Pump Station 8) that are extrapolated based on field I/O conditions:

a) If LE/LIT-0122 (located in the Inlet Chamber) exceeds 608.00 elevation, then the PLC shall evaluate level differential between LE/LIT-0121 (located in the Screen Chamber) and LE/LIT-0122 (located in the Inlet Chamber). If level differential exceeds an Operator adjustable set-point (initially set at 18") an alarm shall be generated. Level differential calculation shall only be made when LE/LIT-0122 exceeds 608.00 elevation.

b) "SCADA MPR Override" output shall be generated if more than one Main Pump exhibits a High Temp or Seal Fail as detected by the Motor Protection Relay (MPR). Effectively, this allows the Lag Pump and the Standby Pump to operate with the MPR in alarm.

c) "Pump Off" is defined as the MCC Hand/Off/Auto switch in the "off" position, while "Pump Not Running" is defined as the inverse of pump running.

d) "Pump Fail to Stop" status alarm shall be generated if a Pump is running and Low Water Level float is activated.

e) "Pump Alarm" status transmitted to AEGIS shall be determined as any pump in overload, over-temp, seal-fail, or fail-to-start condition.

f) "Not in Auto" is defined as the inverse of any PLC input "In Auto".

g) "Equipment Out Of Service" status shall be determined by main breaker in the off position, and the Hand-Off-Auto selector switch in the off position. Pumps shall be removed from PLC automatic sequencer when not in service.

h) "Gates in Non-Discharge Mode" status is set when the Recirculation Gate (RG) is not closed, and/or the Discharge Gate (DG) is not open.

i) "SCADA Call" output to supply fans and exhaust fans is generated whenever lights are on in the Pump Station in a respective area as the fans.

j) "FLOAT FAIL" alarm shall be generated when a float fails to activate when water level (as measured by analog level elements) exceeds the floats expected activation level by more than 12". Additionally, if a float remains active when water level drops below the floats deactivation level by more than 12".

k) "PLC Fail" output that is de-energized when primary and secondary level elements are out of range, and/or both PLC processors fail.

l) An alarm shall be generated if the lights and or the fans in the Pump Station are continuously on for more than (an Operator adjustable) 4 hours.

m) An alarm shall be generated if Control Mode Selector Switch is left in "Reset" position for 30 seconds or greater. "Reset" position is determined as not in auto and the station not in float mode (as determined by Float Mode Relay active).

n) An alarm shall be generated if the primary or secondary analog level signals are outside the two float elevations (above and below) for a period of 30 minutes.

2.35 HMI Program Development Guideline:

2.35.1. Graphical Screens:

a) Overview screens and reports shall be first screens configured. Coordinate layout and information requirements with Engineer and IDOT prior to development of screens – see EXECUTION Section below for details and requirements.
b) HMI screens shall be developed for the complete operation of the Pump Station as allowed by design and PLC involvement in the processes.
c) Screen development is understood to be partially an art form in conveying the data in graphical manner that is best understood. Screen development shall be a coordinated effort with IDOT with input from being incorporated while staying within the scope of the project. Changes in color, texture, font, area of screen an item is located, and other artistic changes shall be incorporated without additional costs to IDOT.
d) Graphic screens for HMI shall be formatted to resemble P&ID's, one-line diagrams, and physical layout of the Pump Station. As a minimum, one graphic display per process loop shall be provided.
e) Screens shall be simplified representation of process flow stream and associated equipment as shown on Drawings. Only major devices shall be shown. Non-reporting equipment (isolation valves, check valves, indicators) need not be shown.
f) Each screen shall include a legend of shapes and colors that depict status of equipment.
g) The following shall be provided as minimum:

1) Main Menu Screen: Icon selection of all graphics screens available for selection.
2) Alarm Annunciator-style Screen: The display shall be designed to have the look of an annunciator panel whereby critical Pump Station equipment is listed in individual squares that change color depending upon status of the equipment. If the equipment is operating normal with no alarms, then the square is gray in color. If the equipment is under an alarm condition, the respective square shall turn red and flash. The following equipment (or condition) shall be individually segregated with an alarm square:

a. Low Flow Pump Fail to Start
b. Low Flow Pump Overtemp/moisture
c. Low Flow Pump Overload

d. Main Pump 1 Fail to Start
e. Main Pump 1 Overtemp/moisture
f. Main Pump 1 Overload
g. Main Pump 2 Fail to Start
h. Main Pump 2 Overtemp/moisture
i. Main Pump 2 Overload
j. Main Pump 3 Fail to Start
k. Main Pump 3 Overtemp/moisture
l. Main Pump 3 Overload
m. Low Water Level
n. High Water Level
o. Pavement Flooded
p. Discharge Chamber Flooded
q. Float Failure
r. Intrusion Alarm
s. Fire Alarm
t. Fire Panel Trouble
u. Normal Electrical service Failure
v. Emergency Electrical Service Failure
w. SCADA Power Failure
x. SCADA Panel Common Alarm
y. Gates in non-discharge Mode
z. Combustible Gas Alarm
aa. Combustible Gas Warning
bb. Combustible Gas Panel Trouble
cc. UPS Low Battery
dd. UPS Failure
ee. PLC Failure
ff. Station in Float Mode
gg. Pump Not in Auto
hh. Pump "Under Maintenance"
ii. Bar Screen Clogged
jj. Control Mode Switch in Reset Position
kk. Up to (10) additional as defined by Engineer.

3) System Overview: Depiction of wetwell (including wetwell level) and pumps, status of pumps (running/off/under maintenance), status of gates/valves Open/Closed/Transitioning), and Lead/Lag/Standby position of each pump in the pump sequencer. Icon of all other Screens shall be provided for jump to that specific screen.
4) Float Status Screen: Shows wetwell level and status of each float switch with legend for status. This screen may be combined with System Overview Screen if all equipment depictions are clear, concise, and unambiguous to the Operator. Icon of all other Screens shall be provided for jump to that specific screen.
5) Individual Pump Screens: Containing graphical information about each Pump. See Drawings for specific requirements (total runtime hours, total number of starts, running/off/under maintenance status, amps, breaker position, overload, overtemp, seal fail status, not in auto, etc.). Icon of all other Screens shall be provided for jump to that specific screen.

6) Motor Current Alarm Set-points Screen: contains Operator adjustable variables for low and high current limits for each Pump used for alarming and maintenance purposes (pumps will not stop based on these entered values). This may be included on the Individual Pump Screen of space permits. Icon of all other Screens shall be provided for jump to that specific screen.
7) Electrical one-line Diagram Screen: containing status of circuit breakers (green = breaker open, red = breaker closed) as seen by the PLC in a graphical power one-line schematic representation. A legend shall also be included indicating color representation. Each power service shall indicate voltage (A-B, A-C, B-C, and each leg with respect to ground), amps of each leg, frequency, power (kW), and power factor. Icon of all other Screens shall be provided for jump to that specific screen.
8) Generator Screen: containing status of Generator equipment. See Drawings for specific requirements (total runtime hours, total number of starts, on/off/under maintenance status, fuel tank level, level low, not in auto, e-stop, leak detection, common alarm, etc.). Icon of all other Screens shall be provided for jump to that specific screen.
9) Analog Level Element Set-point Screen: contains Operator adjustable variables for Pump on/off level operation. A default level setting matrix shall also be included as the default Pump Station settings, with a reset-to-defaults selection available. A graphical representation of wet-well, with pumps listed at various levels (Lead, Lag, etc.) on the left side of wet-well in order of operation. The numerical level of each level element with floats also represented as reference to the analog level. An Operator adjustable set-point (initially set at 18") shall be provided whereby a level differential between level sensor in the Screen Chamber and the level sensor in the Inlet Chamber shall cause an alarm. Icon of all other Screens shall be provided for jump to that specific screen.
10) Station Status Screen: contains depiction of all PLC's and their status with regards to power and communications. Also contains the following: status of each supply and exhaust fan, gas monitor status, fire alarm panel status, AEGIS alarm status, key switch box position, and pump room lighting status, etc. Icon of all other Screens shall be provided for jump to that specific screen.
11) Alarm Screens: contains all alarms in a LED style depiction with status of each (normal = green, alarm = red). Any device, equipment, or PLC generated alarm shall be represented with time and date stamp.
12) AEGIS Common Alarm Screen: There is a SCADA Common Alarm that is transmitted to the AEGIS Panel for alerting outside entities of possible alarms in the Pump Station (from Pump Failure, lights on, etc.). Provide an alarm selection screen whereby the Operator may select which Pump Station alarm conditions will be part of the SCADA Common Alarm that is transmitted to the AEGIS Panel. This screen shall have each alarm condition listed and a check box selection matrix. This screen is provided as a means to de-select possible nuisance alarm conditions.
13) Trend Screen: Operator adjustable points for trending. Provide trending capability for all analog inputs at PLC. 96 hours retained data minimum.

h) Operator and Engineering screens shall be segregated to allow password protection of engineering-entered values.

i) There shall be pick-fields on all screens that will allow for return to main menu or to adjacent process flow screen (continuation of all process flow paths, either entering or existing).
j) Pick-fields shall be activated by placing mouse cursor on object or text and clicking left mouse button, or by selection of associated function key (F1-F12).

2.35.2. Data Input:

a) Data entry areas shall be provided at HMI for adjustment of process and alarm set-points. Data entry areas shall be password protected.
b) Upper and lower limits shall be provided for all data entry values. Entry of values outside of limits shall not be accepted and shall generate appropriate error message on screen. Upper and lower limit values shall be adjustable at HMI and shall be password protected.
c) Upper and lower limits shall be provided for all logged analog input values. Logged values outside of limits shall generate appropriate alarm. Upper and lower limit values shall be adjustable at HMI and shall be password protected.
d) Upper and lower limits shall determine range of analog input value. Value shall be scaled in standard Engineering Units.
e) Password protection shall consist of alpha-numeric sequence and shall be intended for Plant Supervisor and Head Operator entry only.
f) Unless otherwise specified process points shall be scanned as follows:

1) Critical Alarm points and analog input process points shall be scanned continuously.
2) General Alarm points shall be scanned only on change of state into alarm condition.
3) All other points scanned only when required for display at HMI.

g) All dynamic screen displays shall be updated every 2 seconds, minimum.

2.35.3. Display Objects – General

a) Process piping and pumps/fans/mixers may be animated with color to show active/non-active status.
b) Use graphic symbology for rendering of objects.

2.35.4. Display Objects – Process Lines and Inline Device Symbology

a) Where inline devices are dynamic in nature, their equipment symbols shall be formatted as Display Objects to change color based upon feedback. Coordinate color use with Department's existing HMI configuration. Recommended color use:

1) Off – Red.
2) On – Green.
3) Fail/Alarm – Red, Flashing.
4) Status – Amber.

b) Inline devices shall have alphanumeric tag identified near them, adjacent to associated symbol.

c) Arrow heads shall be used as pointers for flow direction at all points of entrance to equipment, at all points where process lines change direction and at points of merger.
d) Process lines entering or leaving screen shall have points of continuation identified by boxed text, indicating From/To screen. One end of box shall form arrow to show direction of flow and act as pick-field for selection of screen of continuation. Color shall be same as associated process line.
e) Process lines shall be identified with flow stream abbreviation as listed in standard symbolic table and as shown on Drawings, where convenient.

2.35.5. Display Objects – Data Fields

a) Analog process data not conducive to graphic symbology shall be formatted as rectangular Data Fields:
b) Process values (i.e. Flow, Elapsed Time) shall be displayed as Data Fields near associated device symbol and shall consist of: alphanumeric tag, green in color; data value, white in color, right justified; engineering unit, green in color. Entire field shall be grouped as one block.
c) Data Fields shall be configured with high and low limits (adjustable) as described above.

2.35.6. Display Objects – Status Displays

a) Status Displays shall be similar to Data Fields but shall be linked to discrete data points or status bits:
b) Discrete equipment parameters (i.e. Run, Fail, On/Off, Open/Close) shall be indicated as rectangular Status Displays and shall consist of: alphanumeric tag, green in color; single or dual-state equipment value, white in color, center justified. Entire field shall be grouped as one block.
c) Displays shall be classified as Alarms or Events (see below).

2.35.7. Data Entry Field:

a) Similar to Data Display Field described above. Allows Operator entry of process values such as set-points.

1) Pop-up activation for dynamic control of equipment shall be by pick-fields associated with symbol of device to be controlled. Pop-up shall be small window or graphic overlay on current screen in location that will not interfere with current operation. Pop-up will contain necessary symbolism for dynamic control and worded prompts as necessary.

2.35.8. Alarming Requirements:

a) Alarms and Events shall be logged to data file.
b) Critical alarms shall alert AEGIS system (See selection matrix above).
c) Alarms shall fall within one of following categories.

1) Critical: Alarms displayed and annunciated at AEGIS and broadcast to IDOT District 1, IDOT TSC, and Maintenance Contractor Facility.

2) General: Alarms displayed and annunciated at local HMI and logged to alarm event file.

d) Provide alarm summary screen(s) at HMI.
e) Display only current alarms. Acknowledged alarms which are no longer active shall not be displayed.
f) Allow operator to acknowledge alarms using single keystroke or cursor pick at alarm summary screen.
g) Alarm Display shall include following information:

1) Time and date alarm initially occurred.
2) Alarm point identification.
3) Alarm value and engineering units for alarms generated from analog process points.
4) Description of alarm (up to 40 characters).

h) Events shall be logged to separate data file. Events shall not be displayed unless evoked and shall not be annunciated.
i) In addition to the above, an alarm matrix shall be developed for expanding upon basic FactoryTalk alarming features which allow the Operator to select which alarms shall transmit to AEGIS when active (described in greater detail above).
j) The Operator shall have the ability to silence alarms.
k) The alarm silence feature shall also have a manual override.

2.35.9. Data Logging requirements – Analog and Discrete

a) All input process points shall be logged to the hard disk of the HMI computer.
b) Procedure for data collection and storage shall be as follows:

1) HMI I/O driver shall poll process points as specified on I/O list and transfer data to image table.
2) HMI shall scan image table for analog process points once every second, and log value to data base.
3) HMI shall calculate minimum, maximum and average for each analog process point and log to data base.
4) HMI shall scan image table for discrete process points on status change only, and log value to data base.

2.35.10. Trend Display Requirements

a) Configure HMI computer to display logged data in graphical trend format.
b) Trend Display Requirements:

1) Identification of process point being displayed. Use same nomenclature as used on HMI screens.
2) Start and end time of data being displayed.
3) Display shall incorporate movable vertical cursor along time axis. Parameter values at cursor date and time shall be displayed digitally.
4) Initial configuration of displays shall display data from present time back to 96 hrs prior to present time. Provide capability for operator to enter new

start time for data being displayed to view parameter trend more than 96 hrs old. System shall be capable of retrieving 1 year of stored data.

5) Displays shall include y-axis range identification, including values and engineering units.
6) Configure trend displays to use maximum of computer screen area possible for purpose of increased resolution.
7) Trend displays shall be accessible, via single keystroke, from graphic screen displaying trended point.

c) Organize graphics screens for trend displays into categories by process:

1) Provide separate graphic screen within each category to display each process point trend. Provide different color for each process point.
2) Provide separate category for manually entered data from HMI computer.

3. EXECUTION:

3.1 Inspection

3.1.1 Verify that field conditions are acceptable and are ready to receive work.

3.2 Installation

3.2.1 Install devices and equipment in accordance with manufacturer's instructions.

3.2.2 All wires and cables shall be labeled and identified at both ends. This includes spares.

3.3 HMI Screen Development and PLC Programming

3.3.1 Two meetings are required to include: Contractor, System Integrator, IDOT, and Phase 3 Engineer in attendance.

a) The first meeting shall be limited to 4 hours and shall consist of a formal review of HMI Screens which shall be provided [48 hours in advance] in color hardcopy for all attendees by Contractor. Review shall be an opportunity to provide creative input to the development and artistic representation for Screens. All requested changes/alterations shall be documented and a formal response to each alteration by the Contractor presented prior to the second meeting. PLC programming and operational strategies are also discussed and input provided. Site of meeting shall be at the discretion of IDOT.
b) The second meeting shall be limited to 4 hours and shall consist of a formal review of HMI Screens which shall be provided [48 hours in advance] in color hardcopy for all attendees by Contractor. Review shall be an opportunity to provide creative input to the development and artistic representation for Screens. All requested changes/alterations shall be documented and a formal response to each alteration by the Contractor presented within 3 weeks of meeting. PLC programming and operational strategies are also discussed and input provided. Site of meeting shall be at the discretion of IDOT.

3.4 System Testing:

3.4.1 System testing and Start-up including the following, shall include provisions of Section 1A, and 15D.

3.4.2 System Shop Tests:

a) The System Integrator shall be able to simulate the SCADA system within his shop. Shop testing shall include, but not necessarily be limited to, the following:

1) Manually fill-in required additions to PLC data base.
2) Manual forcing of outputs.
3) Operation of the control programs.
4) Forcing redundant transfer from primary PLC to secondary as a bump-less transfer.
5) Recall of simulated data points on the HMI display.
6) Recall of all reports with partial fill-in data and manual fill-in data at time of testing.
7) Routing testing of logger, AEGIS alarm, and HMI display based upon manual input data.
8) Change of alarm and limit set-points, etc., and observation of results.
9) Any additional testing which may be found to be necessary at the time the above is observed.
10) All necessary contact and analog inputs must be provided to permit satisfactory testing of the above. If analog instrument switch over from one test to another is required, it shall be done in a most expeditious predetermined manner so as to permit nearly continuous testing during final shop acceptance.
11) Prior to such acceptance tests, the System Integrator shall submit the detailed procedures of the proposed shop tests and a time schedule within which such tests can be run, both subject to acceptance and approval by the Engineer. The System Integrator will be expected to do all necessary pretrial testing and debugging to ascertain that the system is in running order. After the System Integrator has confirmed that the proper responses can be achieved, the date for final shop test may be established.
12) During shop testing, the System Integrator shall generate hard copy printouts of all reports and graphics, indexes and point I.D.'s on both printer and LCD monitor for submittal, review and correction. A certified letter that the listed shop tests have been performed, and all panels meet contract requirements shall be submitted. IDOT reserves the right to be present when shop tests are run.

3.4.3 System Field Tests

a) The pre-acceptance test procedures, as outlined in the preceding paragraphs, shall apply. Acceptance testing shall include the following:

1) Acknowledge receipt of all analog and contact inputs, their reliability value and range.
2) Transmission of contact and analog signals to perform their intended tasks.
3) Any additional testing which may be found necessary at the time the above

is observed.

3.4.4 Start-up and Operational Testing:

a) The start-up services and Operational Test for the following equipment shall be coordinated with IDOT and IDOT shall be notified at least two weeks in advance:

1) SCADA System complete.
2) Float Control System
3) Pumping System
4) Combustible Gas System
5) Outside Communications

b) Shall include detailed written description of each test performed, parameters for each test, interlocks and prerequisites for each test, and results of each test preformed and room for initials and date for each witness of test. Testing procedures shall be made available in hardcopy two weeks prior, and also during Operational Testing.

c) IDOT and Engineer shall both be given the opportunity to witness all Operational Testing. Contractor shall coordinate schedules of all parties.

3.5 Operational Testing:

3.5.1 Pump operational testing shall verify both manual and automatic modes of operation of equipment confirming flow rates, and electrical characteristics are within equipment manufacturer's recommendations.

3.5.2 Automatic pump operational testing under both modes of control shall be performed based on the rising water and falling water conditions.

3.5.3 Operational testing shall include verification of local indication, HMI indication, and District 1, IDOT TSC, and at Maintenance Contractor's facility indication.

3.5.4 Prior to Operational Testing, the Contractor shall coordinate with the IDOT Maintenance Contractor and complete all work at remote locations at District 1, IDOT TSC, and at Maintenance Contractor's facility.

3.5.5 With the H-O-A switch at the MCC in "Hand", each Pump shall be started, stopped, and bumped from the Local Control Station and the MCC individually. Pump time delays shall be tested for accuracy. Flow rates and pump motor current shall be documented during running. All associated pump pilot lights shall be tested for function. All pump interlocks (leak, overtemp, overload, etc.) shall be tested on each pump (this may require jumpers installed/removed in electrical circuits or manually initiating the fault condition). Motor protection relays and intended functionality shall be tested during this time. Elapsed time meters, number of starts, voltage meter, and motor current shall be confirmed. Low Flow Pump and one Main Pump shall be run concurrently for testing. Two Main Pumps shall be run concurrently for testing. Testing shall utilize both power sources, assuring functional testing of the ATS and Generator. During testing, Contractor shall assure

minimum pump submergence is observed at all times. During pump operational testing, Discharge Gate shall be confirmed closed, while and the Recirculation Gate is confirmed open.

3.5.6 With the H-O-A switch at the MCC in "Auto", pump operational testing shall include SCADA system with analog level element signals as control variable, and also the float system using hardwired control circuitry. These tests shall be performed separately, then concurrently.

3.5.7 SCADA Pump testing shall be performed as follows:

a) Confirm wet-well level is above Low Level Alarm Float Switch (FS1), and no pumps are running.
b) Place CONTROL MODE selector switch in "AUTO" mode position.
c) Open Recirculation Gate and receive confirmation.
d) Close Discharge Gate and receive confirmation.
e) Fill water in the wet well – Contractor shall be responsible for providing water.
f) For each rising water level benchmark shown on Drawings, verify operation of respective pump. Verify on/off operation. Verify a maximum of two Main Pumps running at a time. Verify HMI pump sequencer operation. Verify Lead/Lag/Standby configuration for all six possible scenarios of pump sequencer. Verify pilot light functionality and SCADA HMI operation for each signal and respective status of equipment.
g) Place Lead Pump in "under maintenance" mode and verify Standby Pump Operation. Repeat operation with Lag Pump "under maintenance".
h) Force Lead Pump MPR into alarm (this may require an electrical jumper) and verify Standby Pump Operation. Force Lag Pump MPR into alarm and verify continued operation.
i) Verify analog level sensor accuracy and functionality. Intentionally fail primary level signal and verify SCADA system seamlessly transfers control of pumps to secondary analog level element as level control variable. Repeat in reverse with at least one pump running.
j) Verify wetwell High Level alarm. (at this point, it is suggested to immediately perform Float System Operational Testing, and then return to this point).
k) Reverse Gate positions.
l) For each falling water level benchmark shown on Drawings, verify operation of respective pump. Verify pilot light functionality and SCADA HMI operation for each signal and respective status of equipment.
m) Verify wetwell Low Level alarm. This may require the use of temporary portable pumping equipment, and shall be provided by Contractor.
n) Verify and document all equipment changes of state with respect to water level during functional testing and submit.
o) Verify all alarms at District 1, IDOT TSC, and at Maintenance Contractor's facility.
p) During testing, Contractor shall assure minimum pump submergence is observed during pump operation.
q) Verify Float mode is activated by each of the following events:

    1) High Level Float (FS8) Activated.
    2) Low Level Float (FS1) Activated.
    3) Primary and secondary level element failure.

4) PLC dual-processor Failure.

r) Verify Float mode is deactivated and the PLC reassumes automatic control of pumping operations when CONTROL MODE selector switch is moved to "RESET" and then back to "AUTO" position.
s) Verify alarm condition is the result when CONTROL MODE selector switch is moved to "RESET" position and left there.

3.5.8 Float System Pump testing shall be performed as follows:

a) Wetwell Float switch trip levels shall be tested /confirmed during SCADA test (see above) and adjusted to elevations shown on Drawings as required prior to beginning this test.
b) Place CONTROL MODE selector switch in "FLOATS" mode position.
c) Open Recirculation Gate and receive confirmation.
d) Close Discharge Gate and receive confirmation.
e) Fill water in the wet well – Contractor shall be responsible for providing water.
f) For each rising water level benchmark shown on Drawings, verify operation of respective pump. Verify on/off operation. Verify a maximum of two Main Pumps running at a time. Verify pilot light functionality for each signal and respective status of equipment.
g) Put Lead Pump (Main Pump 1) in Fail mode (may require jumper of electrical circuit) and verify Standby Pump (Main Pump 3) Operates at FS7 elevation. Repeat test with Lag Pump (Main Pump 2) in Fail mode.
h) Verify wetwell High Level Float alarm.
i) Reverse Gate positions.
j) For each falling water level benchmark shown on Drawings, verify operation of respective pump. Verify pilot light functionality for each signal and respective status of equipment.
k) Verify wetwell Low Level Float alarm. This may require the use of temporary portable pumping equipment, and shall be provided by Contractor.
l) Verify and document all equipment changes of state with respect to water level during functional testing and submit.
m) Verify all alarms at District 1, IDOT TSC, and at Maintenance Contractor's facility.
n) During testing, Contractor shall assure that the required minimum pump submergence is observed during pump operation.

3.5.9 Analog Level sensors shall be performed as follows:

a) Verify 4-20mA output and respective wet-well level at HMI from empty to full wet-well conditions.
b) Verify Operator adjustable level differential between Screen Chamber and Inlet Chamber causes SCADA system to give a "Bar Screen Clogged" alarm. Verify Operator adjustable HMI differential level functionality for this alarm.
c) Demonstrate failure of primary level element with bump-less transfer of control to the secondary.

3.5.10 Combustible Gas System shall be tested in accordance with manufacturer's written procedures on testing and calibration.

a) Output relays shall be verified for operation at specified gas testing levels.
b) Pump Station alarms verified.
c) System reset verified.
d) Ventilation System coordinated and tested for functionality (all supply and exhaust fans shall operate during a Combustible Gas System alarm plus an additional 15 minutes via an off-delay timer – exception is the Electrical Control Room ventilation equipment.
e) Verify all alarms at HMI, and District 1, IDOT TSC, and at Maintenance Contractor's facilities.

3.5.11 Communications:

a) Verify each alarm represented on Drawings at AEGIS panel is transmitted and received at District 1, IDOT TSC, and at Maintenance Contractor's facilities.

3.5.12 Additional Testing:

a) Each of the testing requirements shall include formal written test procedure, test verification, commentary on discovered anomalies and formal submittal in accordance with submittal procedures.
b) Verify each SCADA input and output is tested and verified for functionality, document and submit.
c) PLC's shall be tested for bumpless transfer on primary processor failure.
d) PLC I/O rack redundant power supplies shall be tested for bumpless transfer upon failure.
e) PLC I/O rack shall be tested for ring topology redundancy with the processors.
f) Demonstrate a complete SCADA computer failure (by removing power from computer), with PLC maintaining control of the Pump Station. Resumption of power shall bring each HMI back to their respective "Home" screens.
g) Demonstrate UPS failure for each UPS, alarming, and bypass contactors.
h) Demonstrate power failure for each 120Vac power circuit to SCADA panel, and alarming.
i) Demonstrate 24Vdc power supply failure and alarming.
j) Demonstrate "Float Failure" when a float fails to activate. Verify for each wet-well float.
k) Verify Pumps are inhibited from running (in Auto) with both gates confirmed closed.
l) Electrical Systems in accordance with procedures as described in relevant Sections (Fire/smoke detection, AEGIS, Intrusion Switches, Generator, ATS, Surge Protection, Grounding, etc.).
m) Mechanical Systems in accordance with procedures as described in relevant Sections (Supply fans, exhaust fans, dampers, heating, air conditioning, etc.).

3.5.13 Final Acceptance

a) Satisfactory operation of the work by IDOT shall be interpreted to mean that the work is sufficiently advanced to form a reliable system for system operation; the I/O control loops, software, control programs and peripheral equipment are operating properly; the necessary debugging programs have been performed; data output is reliable and control loops are operational. Equipment which was found to be ineffective or inoperable has been returned or replaced, and

checking and calibrating of systems has been completed, and complete training of all systems has been accomplished.

b) All punch list items have been resolved to the satisfaction of Engineer and IDOT.
c) All O&M manuals, Record Drawings, and record documents shall be delivered to and approved by IDOT.
d) All contractual spare parts delivered to IDOT.
e) All training completed or scheduled (if off-site).
f) Final acceptance test will be run for 30 days within which cumulative major component down time, consisting of the computer systems and the PLC's does not exceed 4 hours. Repeat test if 4-hour limit is exceeded.
g) Written acceptance by IDOT shall be the start date of the guarantee/warranty period. Warranty shall commence from the Final Acceptance of the Pump Station.

4. TRAINING:

4.1. Operator Training:

4.1.1. Operator training shall be provided at IDOT facility (on-site) concurrently with system installation on a prearranged formalized basis and shall include the necessary training aids in conjunction with actual work on the equipment supplied. Work shall include complete review of all operating and training manuals and physical application. Training shall include project-specific examples.

4.1.2. Training shall include operation of the SCADA system, changes of control logic and set-points, initiation of diagnostic routine, set up and revisions of graphic and report format, how to perform system shutdown and restart, etc. It shall also include care and maintenance of the equipment.

4.1.3. Upon completion of training, the Operators shall be capable of operating the processor equipment, peripherals and I/O equipment to monitor and control the process, system shutdown and restart, diagnose system failure and to initiate routine switch over procedures and component replacement.

4.1.4. This training shall consist of a minimum of two 1-day (16 hours total) classes for 5 persons in each class. Training materials and manuals shall be provided for each participant.

4.2. Maintenance Training:

4.2.1. The Contractor shall provide two 1-day (16 hours total) maintenance training classes for 5 persons in each class. The maintenance training may be combined with the Operator Training.

4.3. Programmer Training:

4.3.1. The Contractor shall make arrangement for two persons from IDOT District 1 to attend software manufacturers' regular programming classes held by the manufacturer or their representative. The class shall not be less than 4 days in total for SCADA HMI software FactoryTalk SE and Historian. The training course

attendance fees shall be paid by the Contractor. If IDOT declines the training, full credit shall be issued to IDOT.

5. GUARANTEE AND ADDITIONAL SERVICES:

5.1. Except where noted, all hardware and software furnished under this contract including but not limited to the accessory peripherals, discrete devices, analog instruments and control devices shall be unconditionally guaranteed for one year from the date of final acceptance.

6. VISITING JOB SITES:

6.1. Prospective bidders are urged to visit the job sites in order to familiarize themselves with the extent and the conditions under which the work must be completed. It is the intent that all work requiring additions, revisions, relocation and/or removals of equipment and facilities be fully included in the original bidding; later claims for extra work will not be approved, occasioned by the failure to comply with this disclaimer.

END OF THIS SECTION

SECTION 16E - PACKAGED ENGINE GENERATOR SYSTEMS

1. GENERAL:

1.1 Description

1.1.1 Major electrical equipment shall be the items of equipment specified herein.

1.1.2 The manufacturer of each specified item shall provide not less than four (4) hard-cover operation and maintenance manuals for the respective equipment item furnished. The manuals shall contain final, approved shop drawings and product data sheets (including any field additions or modifications), as well as recommended installation, testing, operation and maintenance procedures.

1.1.3 The manufacturer shall provide one set of any special tools, as applicable, required for the maintenance of the equipment, housed in a metal tool box.

1.1.4 Equipment furnished under this section shall be complete with anchor bolts and associated hardware required to anchor equipment to concrete. Anchor bolts and all hardware shall be galvanized steel.

1.1.5 For each specified item, a representative of the manufacturer shall check the installation and submit, to the Engineer, three (3) certified, signed statements, addressed to the Engineer, that the equipment has been properly installed and is in good working order.

1.1.6 Section Includes:

(a) Engine generator set.
(b) Cooling system.
(c) Fuel system.
(d) Starting system.
(e) Weatherproof housing.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.
1.2.2 Section 16A - General Electrical Provisions.
1.2.3 Section 16C - Basic Electrical Materials and Methods.
1.2.4 Section 16D - Supervisory Control and Data Acquisition (SCADA) Equipment.
1.2.5 Section 16F - Motor Control Center.

1.3 References

1.3.1 Codes and Standards referred to in this Section are:

(a) The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The

generator set shall include necessary features to meet the requirements of these standards:

1) IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

2) NFPA37 – Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines.

3) NFPA70 – National Electrical Code.

4) NFPA110 Emergency and Standby Power Systems.

(b) The generator set and supplied accessories shall meet the requirements of the following standards:

1) NEMA MG1-1998 part 32.

2) UL142 – Sub-base Tanks.

3) UL1236 – Battery Chargers.

4) UL2200 - Stationary Engine Generator assemblies.

(c) The control system for the generator set shall comply with the following requirements:

1) CSA C22.2, No. 14 – M91 Industrial Control Equipment.

2) EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.

3) EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

4) FCC Part 15, Subpart B.

5) IEC8528 part 4. Control Systems for Generator Sets.

6) IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

7) UL508. Safety Standard for Industrial control Equipment.

8) UL1236 –Battery Chargers.

(d) The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality

assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.4 Submittals

1.4.1 Provide shop drawings and product data under provisions of Section 1A.

(a) Show connections, mounting, and support details, access and working space requirements, and plan layouts.
(b) Schematic and wiring Diagrams for Systems: Show power and control connections and distinguish between factory-installed and field-installed wiring.
(c) Interface drawing detailing connections between generator, motor control center and SCADA panel.
(d) Manufacturer's sizing report detailing the starting KVA, voltage and frequency drops and individual loads on each step.

1.4.2 Product Data:

(a) Include data of features, components, ratings, and performance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components.
(b) Bill of material with technical descriptions, data sheets and nameplate details.

1.4.3 Test Results:

(a) Certified Summary of Prototype Unit Test Report: Submit certified copies of actual prototype unit test report.
(b) Certified Test Reports of Components and Accessories: Submit for devices that are equivalent, but not identical, to those tested on.
(c) Exhaust Emissions Test Report: Include proof of compliance with applicable requirements.
(d) Certification of Torsional Vibration Compatibility: Conform to NEMA 110.
(e) Factory Project-Specific Equipment Test Reports: For units to be shipped for this Project showing evidence of compliance with specified requirements.
(f) Certified copies of the Factory and Field Test Reports shall be submitted for Engineer review.

1.4.3 Operation and Maintenance Manual:

(a) Detailed Operating Instructions: Describe operation under both normal and abnormal conditions.
(b) Lists: Tools, test equipment, spare parts, and replacement items recommended to be stored at site for ready access. Include part and drawing numbers, current unit prices, and source of supply.
(c) Comply with Section 1A paragraph 1.12.

1.5 Warranty

1.5.1 All electrical equipment shall be provided with a warranty from all defects of material and workmanship for the manufacturer's standard length of warranty or for 1 year from the date of final acceptance of Pump Station, which is longer.

1.6 Delivery, Storage and Handling

1.6.1 Delivery, storage and handling shall be in accordance with the provisions of Section 1A.

1.7 Basis of Payment

1.7.1 The major electrical equipment work shall be paid for at the contract lump sum price for

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which shall be payment in full for the work described herein.

1.7.2 Refer to 1.22 of Section 1A for Method of Measurement.

1.8 Definitions

1.8.1 Emergency or Standby Rating: Power output rating equal to power that generator set delivers continuously under normally varying load factors for duration of power outage with capability of 36 continuous operating hours.

1.8.2 Operational Bandwidth: Total variation from lowest to highest value of parameter over range of conditions indicated, expressed as percentage of nominal value of parameter.

1.8.3 Power Output Rating: Gross electrical power output to generator set minus total power requirements of electric motor-driven accessories normally constituting part of engine assembly.

1.8.4 Steady-State Voltage Modulation: Uniform cyclical variation of voltage within operational bandwidth, expressed in Hz or cycles per second.

1.9 System Description

1.9.1 Design Requirements:

(a) System Includes: Standby-rated, automatically started diesel engine coupled to ac generator unit. Engine and generator are factory-mounted and factory-aligned on structural steel skid. Subsystems and auxiliary components and equipment are as indicated.

(b) Environmental Conditions: Engine generator system withstands following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1) Ambient Temperature: -30°C to +50°C.
2) Altitude: Sea level to 1,000 ft (300m).

1.9.2 Performance Requirements:

(a) Functional Description: Switching "On-Off" switch on generator control to "On" position starts generator set. "Off" position of same switch initiates shutdown of unit. When unit is running, specified system or equipment failures or derangements automatically shut down unit and initiate alarms. Operation of remote emergency stop switch also shuts down unit.

(b) System Performance:

1) Steady-State Voltage Operational Bandwidth: 1% of rated output voltage from no load to full load.
2) Steady-State Voltage Modulation: Less than 0.25 Hz.
3) Transient Voltage Performance: Not more than 10% variation for 50% step-load increase or decrease. Voltage recovers to remain within steady-state operating band within 2 sec.
4) Steady-State Frequency Operational Bandwidth: 0.5% of rated frequency from no load to full load.
5) Steady-State Frequency Stability: When system is operating at constant load within rated load, there are no random speed variations outside steady-state operational band and no regular or cyclical hunting or surging of speed.
6) Transient Frequency Performance: Less than 3 Hz variation for 50% step-load increase or decrease. Frequency recovers to remain within steady-state operating band within 3 sec.
7) Output Waveform: At no load, harmonic content measures line-to-line or line-to-neutral does not exceed 5% total and 3% for single harmonics. Telephone influence factor determined according to NEMA MG1 does not exceed 50.
8) Sustained Short-Circuit Current: For 3-ph bolted short circuit at system output terminals, system will supply minimum of 300% of rated full-load current for not less than 10 sec and then clear fault automatically, without damage to any generator system component.
9) Temperature Rise of Generator: Within acceptable limits for insulation systems used according to NEMA MG1 when operating continuously at standby rating conditions. Temperature rise not to exceed 80°C over 40°C ambient.
10) Nonlinear Load Performance: System performance is not degraded from that specified in this Article by continuous operation, with load current having minimum total harmonic content of 15% rms, and minimum single harmonic content of 10% rms.
11) Starting Time: Maximum total time period for cold start, with ambient temperature at low end of specified range, is 10 sec. Time

period includes output voltage and frequency settlement within specified steady-state bands.

1.10 Quality Assurance

1.10.1 Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capabilities indicated that have record of successful in-service performance.

(a) Emergency Service: System manufacturer maintains service center capable of providing training, parts, and emergency maintenance and repairs at Project site within 4 hrs maximum response time.

1.10.2 Comply with NFPA 70.

1.10.3 Engine Exhaust Emissions and Fuel System: Comply with applicable Federal, State, and local government requirements.

1.10.4 Permits: Provide required air permitting and fuel system permitting required in accordance with applicable Federal, State, and local government requirements.

1.10.5 Single-Source Responsibility: Obtain engine generator system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Engine Generator Sets:

(a) Cummins Power Generation.
(b) MTU Onsite Energy.
(c) Caterpillar.

2.1.2 Engine Generator System:

(a) System is coordinated assembly of compatible components.

(b) Ratings: 3-ph, 4-wire 277/480v, 60 Hz, 175 kW, 219 KVA.

(c) Motor starting KVA of 791 minimum required to start and operate following load steps without exceeding 20% maximum voltage dip and 10% maximum frequency dip and with return to steady state in less than 2 sec.

1) Step No.1 30 KVA lighting transformer.
2) Step No.1 7.5 KW Unit Heater.
3) Step No.1 7.5 KW Unit Heater.
4) Step No.1 7.5 KW Unit Heater.

5) Step No.2 1.5 HP Exhaust Fan.
6) Step No.2 0.5 HP Exhaust Fan.
7) Step No.2 3.0 HP Supply Fan.
8) Step No.2 0.5 HP Supply Fan.
9) Step No.2 1.1 HP Slide Gate.
10) Step No.2 1.2 HP Slide Gate.

11) Step No.3 44 HP Pump (53 FLA) on across the line starter.

12) Step No.4 44 HP Pump (53 FLA) on across the line starter.

(d) Safety Standard: Comply with ASME B15.1

(e) Nameplates: Equip each major system component with conspicuous nameplate of component manufacturer. Nameplate identifies manufacturer of origin and address, and model and serial number of item.

2.1.3 Engine Generator Set:

(a) Power Output Rating: Nominal ratings as indicated, with capacity as evidenced by records of prototype testing.

(b) Skid: Welded steel base securely mounted with anchored mounting bolts. Adequate strength and rigidity to maintain alignment of mounted components without dependence on concrete foundation. Free from sharp edges and corners. Lifting attachments arranged to facilitate lifting with slings without damaging components.

(c) Vibration Isolation: In accordance with manufacturers recommendations: Integral vibration isolators may be provided. When integral isolators are not provided, provide 95% efficient spring type vibration isolators. Mount isolators between steel base and concrete pad.

(d) Rigging Diagram: Inscribed on metal plate permanently attached to skid. Diagram indicated location and lifting capacity of each lifting attachment and location of center of gravity.

2.1.4 Engine:

(a) Comply with NFPA 37.

(b) Fuel: Diesel fuel oil grade DF-2.

(c) Maximum Speeds:

1) Engine: 1,800 rpm.
2) Piston speed 4-cycles engines: 2,250 ft/min.

(d) Lubrication Systems: Pressurized by positive displacement pump driven from engine crankshaft. Mount following items on engine or skid:

1) Filter and Strainer: Rated to remove 90% of particles 5 microns and smaller while passing full flow.
2) Oil Cooler: Maintains lubricating oil at manufacturer's recommended optimum temperature.
3) Thermostatic Control Valve: Controls flow in system to maintain optimum oil temperature. Unit is capable of full flow and is designed to be fail-safe.
4) Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps or siphons or special tools or appliances.

(e) Engine Fuel System: Comply with NFPA 30.

1) Integral Injection Pumps: Driven by engine crankshaft. Pumps are adjustable for timing and cylinder pressure balancing.
2) Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
3) Parallel Fuel Oil Filters: Ahead of injection pumps. Changeover valves allow independent use of either filter.
4) Relief/Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
5) Flexible fuel line connections for supply and return lines.
6) Shut-off fuel solenoid valve field mounted at tank.

(f) Jacket Coolant Heater: Electric immersion type, factory-installed in jacket coolant system. Unit is rated and thermostatically controlled to maintain an engine temperature of 25°C at low end of specified ambient temperature range.

1) Voltage: 120.
2) Watts: 1,500.
3) Quantity: 1.

(g) Speed Governor: Adjustable isochronous type, with speed sensing.

2.1.5 Engine Cooling System:

(a) Closed-loop, liquid-cooled, with radiator factory-mounted on engine generator set skid and integral engine-driven coolant pumping.

(b) Radiator Core Tubes: Nonferrous metal construction other than aluminum.

(c) Size of Radiator: Adequate to contain expansion of total system coolant from start to 100% load condition.

(d) Coolant: Solution of 50% ethylene glycol and 50% water.

(e) Temperature Control: Self-contained thermostatic control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer. Features include:

1) Thermostatic Elements: Interchangeable and nonadjustable.
2) Actuator Design: Normally-open valves to return to open position when actuator fails.

(f) Coolant Hose: Flexible assembly with nonporous rubber inside surface and aging, ultraviolet, and abrasion-resistant fabric outer covering:

1) Rating: 50 psi (345 kPa) maximum working pressure with 180°F (82°C) coolant, and noncollapsible under vacuum.
2) End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.1.6 Fuel Supply System:

(a) Dual Wall Subbase Tank: Factory-fabricated assembly or NRTL-listed fuel tank with integral, float-controlled transfer pump and features described below.

1) Tank Capacity: Adequate to supply fuel to engine for uninterrupted period of 36 hrs operation at 100% of rated power output of engine generator system without being refilled.

(b) Generator Access: Generator manufacturer's access catwalks and stairs accessory for generators mounted on sub-base fuel tanks. Provide aluminum catwalk and stair made with grating and not steel plates on each side on generator for access to generator mounted on top of sub-base fuel tank. Catwalk and stair configurations shall be coordinated with generator and sub-base fuel tank size and height.

(c) Manual over-fill protection.

(d) Internally baffled to prevent immediate resupply of heated return fuel.

(e) Lockable 2 in. fill cap.

(f) Fuel level gauge.

1) Provide 4-20mA output for remote indication of fuel tank level.

(g) Electrical stub-in area with detachable end panel.

(h) Multiple top entry customer-select ports.

(i) Tank to foundation ground clearance for visual secondary leak detection.

(j) Load bearing vertical "C" channel at generator set mounting points.

(k) Vertically accessible primary vent.

(l) Venting to UL142 in both primary and secondary containments.

(m) Weatherproof secondary containment.

(n) Mounted directly to generator set skid.

(o) 8 ga aluminized steel top.

(p) 12 ga aluminized steel sides and bottom.

(q) 4 in. "C" channel side and bottom load bearing structure.

(r) Symmetrical to 1,500 kW generator set footprint.

(s) Baked enamel finish.

(t) Listed to UL142 under Label No. 48-24-2 "Secondary Containment Generator Base Tank."

(u) Low fuel level alarm.

(v) Leak detection alarm.

(w) Initial Fill: Diesel fuel oil grade DF-2.

2.1.7 Engine Exhaust System:

(a) Muffler: Industrial-type, sized as recommended by engine manufacturer. Measured sound level in 20-75 Hz frequency band, according to "DEMA Test Code for Measurement of Sound from Heavy-Duty Reciprocating Engines" at distance of 25 ft from exhaust discharge, is 87 dB or less.

(b) Connections from Engine to Exhaust System: Furnish flexible section on corrugated stainless steel pipe with generator set.

(c) Insulation for mufflers.

(d) Supports for Muffler and Exhaust Piping: Vibrations isolating-type.

2.1.8 Starting System:

(a) Description: 24 v electric with negative ground and including following items:

1) Components: size so they will not be damaged during full engine-cranking cycle with specified maximum ambient temperature.
2) Cranking Motor: Heavy-duty unit that automatically engaged and releases from engine flywheel without binding.
3) Cranking Cycle: 60 sec.
4) Battery complies with SAE J537 and has adequate capacity within ambient temperature range specified in Part 1 to provide specified cranking cycle series at least twice without recharging.

5) Battery Cable: Size as recommended by generator set manufacturer for cable length required for connection to battery. Include required interconnecting conductors and connection accessories.

6) Battery Compartment: Factory-fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controller heater is arranged to maintain battery above 10°C regardless of external ambient temperature within range specified in Part 1. Include accessories required to support and fasten batteries in place.

7) Battery-Charging Alternator: Factory-mounted on engine with solid-state voltage-regulation and 35 amp minimum continuous rating.

8) Battery Charger: Current limiting, automatic equalizing and float charging-type designed for operation from 120 v 60 Hz supply source. Unit complies with UL 508 and includes following features:

   i. Operation: Equalizing charging rate of 10 amps is initiated automatically after battery has lost charge until adjustable equalizing voltage is achieved at battery terminals. Until then automatically switches to lower float-charging mode, and continues operating in that mode until battery is discharged again.

   ii. Automatic Temperature Compensation: Adjusts float and equalizes voltages for variations in ambient temperature from -40°C to +60°C to prevent overcharging at high temperatures and undercharging at low temperatures.

   iii. Automatic Voltage Regulation: Maintains output voltage constant regardless of input voltage variations up to +10%.

   iv. Ammeter and Voltmeter: Flush mounted in door. Meters indicate charging rates.

   v. Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing "low battery voltage" indication on control and monitoring panel. Also include sensing of high battery voltage and loss of ac input or dc output of battery charger. Either of these conditions closes contacts that provide "battery charger malfunction" indication at system control and monitoring panel.

   vi. Enclosure and Mounting: NEMA Class 1 wall-mounted cabinet.

2.1.9 Control and Monitoring:

(a) Operating and safety indications, protective devices, basic system controls, and engine gages are grouped on common control and monitoring panel mounted on generator set. Mounting method isolates control panel from generator set vibration.

1) Generator Circuit Breaker: Molded case type conforming to Section 16H. Trip rating based on generator full load current.
2) Shunt Trip Device: For generator breaker, connected to trip breaker when generator set is shut down by protective devices.
3) Current and Potential Transformers: Instrument accuracy class.

(b) Indicating and Protective Devices, and Controls: Include those required by NFPA 110 for Level 2 system plus following:

1) Number of Starts Counter.
2) Ac Voltmeter.
3) Ac Ammeter.
4) Ac Frequency Meter.
5) Dc Voltmeter (Alternator Battery Charging).
6) Engine Coolant Temperature Gage.
7) Engine-Lubricating Oil Pressure Gage.
8) Running Time Meter (non-resetable).
9) Ammeter/Voltmeter Phase Selector Switch or Switches.
10) Generator Voltage-Adjusting Rheostat.
11) Frequency Adjusting Rheostat.

(c) Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.

(d) Common Remote Alarms: Conform to NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1) High Engine Temperature Shutdown.
2) Low-Lube Oil Pressure Shutdown.
3) Overspeed Shutdown.
4) Remote Emergency Stop Shutdown.
5) High Engine Temperature Pre-alarm.
6) Low-Lube Oil Pressure Pre-alarm.
7) Low Fuel Tank Level.

(e) External Signals:

1) Provide dry contact for remote indication of generator run status.
2) Provide dry contact for remote indication of fuel tank leak detected.
3) Provide dry contact for remote indication of generator ESTOP active.
4) Provide dry contact for remote indication of generator common alarm.
5) Provide dry contact for remote indication of generator not in auto.
6) Provide dry contact for remote indication of fuel tank level low.
7) Provide 4-20mA signal for fuel tank level.
8) Ability to accept remote start and stop signals.

9) Ability to send ready to load signal to transfer switch.
10) Number of generator start and total runtime hours for SCADA monitoring.

(f) Connection to Data Link: Status indication for transmission of generator status and alarms by data link to remote data terminals. Generator control panel shall be provided with Modbus TCP/IP communication capability. Data system connections to terminals are covered in another Section.

2.1.10 Generator, Exciter, and Voltage Regulator:

(a) Comply with NEMA MG 1 and specified performance requirements.

(b) Drive: Generator shaft is directly coupled to engine shaft. Exciter is rotated integrally with generator rotor.

(c) Electrical Insulation: Class H or Class F.

(d) Stator Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

(e) Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125% of rating, and heat during operation at 100% of rated speed.

(f) Excitation uses no-slip or collector rings, or brushes, and is arranged to sustain generator output under short circuit conditions as specified.

(g) Enclosure: Dripproof.

(h) Instrument Transformers: Mounted within generator enclosure.

(i) Voltage Regulator: Solid-state-type, separate from exciter, providing performance as specified:

1) Adjusting rheostat on control and monitoring panel provided +5% adjustment of output voltage operating band.

(j) Surge Protection: Conform to UL 1449. Mount suppressors in generator enclosure and connect to load terminals.

(k) Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.1.11 Outdoor Generator Set Enclosure:

(a) Description: Weatherproof steel housing. Multiple panels are lockable and provide adequate access to components requiring maintenance. Panels are removable by one person without tools.

(b) Fixed Louvers: At air inlet and discharge. Louvers prevent entry of rain and snow.

(c) Automatic Dampers: At air inlet and discharge. Dampers are closed to reduce engine and battery heat loss in cold weather when unit is not operating.

(d) Air Flow Through Housing: Adequate to maintain temperature rise of system components within required limits.

(e) Muffler/Silencer mounted inside of enclosure.

(f) A minimum of two GFCI receptacles mounted near access panel within enclosure.

2.1.12 Finishes:

(a) Outdoor Enclosures: Polyurethane enamel over corrosion-resistant pretreatment and manufacturer's compatible standard primer.

2.1.13 Source Quality Control:

(a) Factory Tests: Include prototype testing and Project-specific equipment tests (equipment manufactured specifically for this Project).

(b) Prototype Testing: Performed on separate engine generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1) Tests: Conform to those required by Level 1 energy converters in paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2 of NFPA 110.
2) Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype have been acceptable tested to demonstrate compatibility and reliability.

(c) Project-Specific Factory Equipment Tests: Test engine generator set and other system components and accessories prior to shipment. Test items individually and assembled and connected as complete system at factory in manner equivalent to that required at Project site. Record and report test data. Conform to SAE 8528 and following:

1) Test Equipment: Use instruments calibrated within previous 12 mos and with accuracy directly traceable to National Institute of Standards and Technology (NIST).
2) Hydrostatic Test: Perform on radiator, heat exchanger, and engine water jacket.
3) Generator Tests: Conform to IEEE 115.
4) Complete System Continuous Operation Test: Includes nonstop operation for minimum standard factory test, including at least 1 hr at 50% and 75%, and 2 hrs at 100% of full load. If unit stops during standard factory test, repeat complete test. Record

following minimum data at start and end of each load run, at 15 min intervals between those times and at 15 min intervals during balance of test:

i. Fuel consumption.
ii. Exhaust temperature.
iii. Jacket water temperature.
iv. Lubricating oil temperature and pressure.
v. Generator load current and voltage, each phase.
vi. Generator system gross and net output kW.
vii. Generator intake air (in cubic feet per minute).
viii. Generator exhaust (in cubic feet per minute).

5) Complete System Performance Tests: Include following to demonstrate conformance to specified performance requirements:

i. Single-step load pickup.
ii. Transient and steady-state governing.
iii. Transient and steady-state voltage performance.
iv. Safety shutdown devices.

6) Observation of Factory Test: Provide 2 wk advance notice of tests and opportunity for observation of test by Engineer.

7) Report test results within 10 days of completion of tests. Results shall be certified that the equipment supplied meets contract requirements otherwise highlights areas where equipment falls shorts or fails to meet specified requirements.

2.1.14 Special Tools and Spare Parts to be Furnished:

(a) One set of all special tools that are required for the normal operation and maintenance of the engine generator unit.

(b) Two complete spare replacement sets of all filter elements required for the generator unit.

(c) Three complete replacement sets of each type and size of fuses.

(d) Two complete replacement sets of each type of indicating lamps.

3. EXECUTION:

3.1 Examination

3.1.1 Verify location and layout of Engine Generator Set.

3.1.2 Verify that electrical power is available and of correct characteristics.

3.2 Preparation

3.2.1 Install concrete bases after dimensions of equipment are confirmed by equipment manufacturers.

3.3 Installation

3.3.1 Anchor generator set and other system components on concrete bases as indicated. Provide anchorage and vibration isolation according to manufacturer's recommendations.

3.3.2 Maintain minimum working space around components according to manufacturer's approved submittals and NEC.

3.3.3 Ground generator as shown on Drawings.

3.4 Cleaning

3.4.1 Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 Field Quality Control

3.5.1 Manufacturer's Field Services:

(a) The services of a qualified representative of the manufacturer shall be provided to instruct on proper installation of the equipment, inspect the completed installation, make any necessary adjustments, participate in the startup of the equipment, participate in the field testing of the equipment, place the equipment in trouble-free operation, and instruct operating personnel in its operation and maintenance. Include minimum:

i. 1 manday for Installation Services.
ii. 1/2 manday for Instructional Services.
iii. 1/2 manday for Post Startup Services.

(b) Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas.
(c) In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration.
(d) The start-up services for the following equipment shall be coordinated with IDOT and IDOT shall be notified at least one week in advance:

Engine Generator System.

3.5.2 Tests: Provide services of qualified testing agency to perform tests listed below according to manufacturer's recommendations upon completion of installation of system. Use instruments bearing records of calibration within last 12 mos, traceable to NIST standards, and adequate for making positive observation of test results. Include following tests:

(a) Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of connectors.

(b) Battery Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

(c) System Integrity Tests: Verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.

(d) Simulation of malfunctions to verify proper operation of local and remote protective, alarm, and monitoring devices.

(e) Load Test: Use variable load bank capable of simulating kVA, kW, and power factor of load for which unit is rated. Run unit at 25, 50, and 75% of rated capacity for 30 min each, and at 100% for 1 hrs. Record voltage, frequency, load current, battery-charging current, power output, oil pressure, and coolant temperature during test.

(f) Exhaust System Back-Pressure Test: Use manometer with scale exceeding 40 in. of water. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's published allowable limits for engine.

(g) Exhaust Emissions Test: Conform to applicable government test criteria.

3.5.3 Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.5.4 Report test results within 10 days of completion of tests. Results shall be certified that the equipment installed meets contract requirements otherwise highlights areas where equipment falls shorts or fails to meet specified requirements.

END OF THIS SECTION

SECTION 16F - MOTOR CONTROL CENTER

1. GENERAL:

1.1 Description

1.1.1 Motor control center equipment shall be the items of equipment specified herein.

1.1.2 The manufacturer shall provide one set of any special tools, as applicable, required for the maintenance of the equipment, housed in a metal tool box.

1.1.3 Equipment furnished under this section shall be complete with anchor bolts and associated hardware required to anchor equipment to concrete. Anchor bolts and all hardware shall be galvanized steel.

1.1.4 For each specified item, a representative of the manufacturer shall check the installation and submit, to the Engineer, three (3) certified, signed statements, addressed to the Engineer, that the equipment has been properly installed and is in good working order.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.
1.2.2 Section 15D - Pumping Equipment
1.2.3 Section 15E - Ventilation
1.2.4 Section 15F - Miscellaneous Mechanical Items
1.2.5 Section 16A - General Electrical Provisions.
1.2.6 Section 16B - Electrical Power System Studies.
1.2.7 Section 16C - Basic Electrical Materials and Methods.
1.2.8 Section 16D - Supervisory Control and Data Acquisition (SCADA) Equipment.
1.2.9 Section 16E - Packaged Engine Generator Systems
1.2.10 Section 16H - Major Electrical Equipment

1.3 References

1.3.1 Codes and Standards referred to in this Section are:

(a) NEMA ICS-1 General Standards for Industrial Control and Systems.

(b) UL 845 Motor Control Centers.

(c) ISA Standards and Recommended Practices for Instrumentation and Control.

(e) NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum.)

1.4 Submittals

1.4.1 Provide shop drawings and product data under provisions of Section 1A.

1.4.2 Submittals of shop drawings and product data shall be particularly detailed and complete. Submittals shall be complete with the manufacturer's guarantee. Piecemeal submittals will be returned without review.

1.4.3 Submittal information shall include one-line diagram, bill of materials, MCC front of panel views and elevations, schematic diagrams, point-to-point internal wiring diagrams, point-to-point field wiring diagrams, and other necessary diagrams and installation requirements for the motor starters, motor control center, and automatic transfer switch and other components and systems that are interfaced to these systems.

1.4.4 The manufacturer of each specified item shall provide not less than four (4) hard-cover operation and maintenance manuals for the respective equipment item furnished. The manuals shall contain final, approved shop drawings and product data sheets (including any field additions or modifications), as well as recommended installation, testing, operation and maintenance procedures. Refer to Section 1A for further requirements.

1.5 Warranty

1.5.1 All electrical equipment shall be provided with a warranty from all defects of material and workmanship for 1 year from the date of final acceptance of Pump Station, which is longer.

1.6 Delivery, Storage and Handling

1.6.1 Delivery, storage and handling shall be in accordance with the provisions of Section 1A.

1.6.2 Motor control center and switchgear sections shall be delivered in shipping splits that can be moved past obstructions in delivery path.

1.7 Basis of Payment

1.7.1 The major electrical equipment work shall be paid for at the contract lump sum price for

PUMP STATION MOTOR CONTROL CENTER

which shall be payment in full for the work described herein.

1.7.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Motor Control Centers

2.1.1 Manufacturers

(a) Square D Co.

(b) Eaton/Cutler-Hammer.

(c) Allen-Bradley.

2.1.2 Coordination Study

(a) Where coordination study specified in Section 16B recommends changes in types, classes, features or ratings of equipment or devices from those indicated, make written request for instruction. Obtain instructions from ENGINEER before ordering equipment or devices recommended to be changed.

2.1.3 Motor Control Centers

(a) Wiring: NEMA ICS 3, Class I, Type B.

1) Factory installed wiring shall include conductor labels which correspond to approved shop drawings. Each wiring shall have a clear label at terminal strip and termination points.

(b) Enclosures: Surface-mounted cabinets as indicated. NEMA 250, Type 1 gasketed, unless otherwise indicated to meet environmental conditions at installed location.

2) Compartments: Modular; individual doors have concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units require disconnect means in off position before door can be opened or closed, except by consciously operating permissive release device.

3) Interchange ability: Compartments are constructed to remove units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in control center. Units requiring same size compartment are interchangeable, and compartments are constructed to permit ready rearrangement of units, such as replacing 3 single units with unit requiring 3 spaces, without cutting or welding.

4) Wiring Spaces: Each vertical section of structure with horizontal and vertical wiring has spaces for wiring to each unit compartment in each section, with supports holding wiring in place.

(c) Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.

2.1.4 Buses

(a) Material: Tin plated copper.

(b) Ampacity Ratings:

1) As indicated on horizontal buses.

2) 300 amp min for vertical main buses or larger as required for installed units.

(c) Neutral Buses: Full size in service entrance section only.

(d) Equipment Ground Bus: Noninsulated, horizontal copper bus 2 by 1/4 in. (50 by 6 mm), min.

(e) Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections.

(f) Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.1.5 Functional Description

(a) Description: Modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center as indicated.

(b) Motor-Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.

1) Units with full-voltage, across-the-line, magnetic controllers up to and including Size 3 are installed on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

2) Units have short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.

3) Units in motor-control centers with Type B wiring are equipped with pull-apart terminal strips or drawout terminal boards for external control connections.

(c) Overcurrent Protective Devices: Types of devices with features, ratings, and circuit assignments indicated. Individual feeder-tap units through 225-A rating shall be installed on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

(d) Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

(e) Spare Units: Type, size, and ratings as indicated, and installed in compartments indicated "spare".

2.1.6 Magnetic Motor Controllers

(a) Description: NEMA ICS 2, Class A, full voltage, non-reversing, across-the-line, unless otherwise indicated.

(b) Control Circuit: 120V; obtained from integral control power transformer, unless otherwise indicated. Include control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100% spare capacity.

(c) Controller shall be equipped with a transmitter for providing motor current configured as a 4-20mA signal.

(d) Combinational Controller: Factory-assembled combination controller and disconnect switch with or without overcurrent protection as indicated.

1) Circuit-Breaker Disconnect: NEMA AB 1, motor-circuit protector with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.

(e) Overload Relay:

1) Provide NEMA Class 20 heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle; provide with auxiliary contact to monitor overload relay. Solid state overloads not acceptable.
2) Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 or better tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing.

(f) When power factor correction capacitors are indicated provide termination lugs on line side of overload relays.

(g) Time Delay Restart Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection.

1) Provide in starter enclosure for Size 2 and larger starters.
2) Delay initial motor start.
3) Delay motor restart due to starter dropout caused by undervoltage or starter coil circuit interruption for maintained control circuits.
4) Adjustable on delay from 0.15 to 30.0 sec set at 10.0 sec.
5) Connect control relay in motor starter coil circuit.

6) Coordinate control relay section with motor starter to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

2.1.7 Feeder Overcurrent Protection

(a) Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.

1) Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2) Application Listing: Appropriate for application, including Type HACR for heating, air-conditioning, and refrigeration equipment.
3) Circuit Breakers, 200A and Larger: Trip units interchangeable within frame size.
4) Circuit Breakers, 400A and Larger: Field-adjustable, instantaneous, short-time, long-time and continuous-current settings.
5) Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
6) Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
7) Shunt Trip: Where indicated or required for ground fault protection trip.

2.1.8 Automatic Transfer Switch

(a) ASCO, Russelectric, or equal.

(b) Air breaker, double throw interrupter type, electrically operated and mechanically held in both the normal and emergency positions. The switch operators shall be single solenoid or single motor operated and shall be momentarily energized by the sources to which the load is transferred.

(c) Separate arcing contacts, with magnetic blowouts shall be provided. Interlocked molded case circuit breakers or interlocked contactors will not be accepted.

(d) UL 1008 listed.

(e) Switch shall be 3-pole, 800 amp, 480 volt rated with 65,000 amp withstand current rating (WCR) for 3 cycles at 480 volt. Upstream main breakers shall be coordinated with ATS manufacturer to achieve WCR rating.

(f) Provide fully rated, solid, unswitched neutral terminal.

(g) Manual switch operation: manually operated under load with door closed with either or both sources energized. Transfer time is same for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

(h) Switching arrangement: switch operator has programmed neutral position arranged to provide midpoint between 2 working switch positions with an intentional, controlled, timed pause during transfer at midpoint. Midpoint pause shall be adjustable from 0.5 to 30.0 second minimum, factory set at 2.0 seconds. Time delay shall occur for both transfer directions.

(i) Solid state controls with repetitive accuracy setting of 2% or better over operating temperature range of -20°C to 60°C. Voltage sensing shall be true RMS type and shall be accurate to +/- 1% of nominal voltage. Frequency sensing shall be accurate to +/- 0.2%. A four line, 20 character LCD display and keypad shall be integral part of the controller for viewing all available data and setting desired operational parameters. Nominal line voltage and frequency, single or three phase sensing, operating parameter protection, and transfer operating mode configuration shall be the only parameters not adjustable through display/keypad and shall rather use integral DIP switches on the controller.

(j) Voltage sensing for each phase of normal source. Pick-up voltage adjustable from 85% to 100% nominal, and drop-out voltage adjustable from 75% to 98% pick-up value. Factory set for pick-up at 90% and drop-out at 85%.

(k) Time-delay override of normal source voltage sensing delay transfer and engine start signals. Adjustable 0 to 6 seconds, factory set at 1 second.

(l) Voltage/frequency lockout relay: prevents premature transfer. Voltage pick-up adjustable from 85% to 100%. Factory set to pick-up at 90%. Pick-up frequency adjustable from 90% to 100% nominal. Factory set to pick-up 95%.

(m) Retransfer time delay: adjustable from 0 to 30 minutes and factory set at 10 minutes. Provides automatic defeat of delay upon loss of voltage or sustained undervoltage of emergency source when normal supply has been restored.

(n) Test switch: simulates normal source failure.

(o) Switch-position pilot lights: indicate source to which load is connected and source available. Push to test, LED type in accordance with Section 16D.

(p) Transfer switch override switch: overrides automatic retransfer control so ATS remains connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

(q) Engine starting contacts: one isolated normally closed and 1 isolated normally open. Contacts shall be gold flashed or gold plated and rated 10 amps at 120 VAC minimum.

(r) Engine shut-down contacts: time delay adjustable from 0 to 5 minutes, factory set to 5 minutes.

(s) Switch components shall be easily maintainable from front without removal of switch from its bucket within motor control center and without disconnecting the main power cables. Adequate safety barriers and baffles shall be provided and all components shall be clearly identified with nameplates.

2.1.9 Micro Processor Based Metering Units

(a) Each incoming line shall have a microprocessor based electronic metering unit with digital readout and key pad. Metering unit shall monitor phase amperes, phase-to-phase voltages, and phase-to-neutral voltages with one percent accuracy. Metering system shall also monitor and indicate megawatts, megavars, power factor, megawatt demand and frequency. In addition, overvoltage/undervoltage, phase loss/ unbalance/reversal protective functions shall also be available and user programmable. Furnish two NO/NC alarms and two NO/NC trip contacts. Fused potential transformers shall be included. Current transformers shall be as shown. Metering units shall be equipped with data communications modules capable of communication with the SCADA panel using Modbus TCP protocol; data to be monitored shall be as shown on the Drawings. Coordinate with SCADA panel supplier through the Contractor to determine protocol type. Metering units shall be door mounted. Contractor shall transmit signals to the SCADA system from the metering units for the functions as detailed on Drawing E20.

2.1.10 Surge Protection Device

(a) SPD and connecting breaker shall be service entrance rated and provided by motor control center manufacturer located integral to motor control center.

(b) See Section 16H for external surge protection device requirements.

(c) IEEE C62.41, selected to meet requirements for category C3.

(d) Protection modes and UL 1449 clamping voltages coordinated with circuit system and circuit voltage.

(e) Factory mounted with UL listed and labeled mounting device.

(f) 200 kA per phase surge current capacity minimum.

(g) Dedicated flange mounted disconnect in common MCC bucket.

(h) Door mounted diagnostic lights.

(i) Audible alarm, with silencing switch, to indicate when protection has failed. Switch shall be accessible from outside of bucket and not require bucket door to be opened to access.

(j) Replaceable modular design.

(k) Mounted next to main incoming device in MCC.

(l) One form C contact to indicate suppressor is operational.

(m) Minimum of 10 year warranty. Warranty shall commence from the Final Acceptance of the Pump Station.

2.1.11 External Signals

Pump Motor Starter Buckets

(a) Provide dry contact for remote indication of motor overload.
(b) Provide dry contact for remote indication of selector switch in auto.
(c) Provide dry contact for remote indication of circuit breaker open.
(d) Provide dry contact for remote indication of pump running.
(e) Provide dry contact for remote indication of pump moisture.
(f) Provide dry contact for remote indication of pump overtemp.
(g) Provide isolated 4-20mA signal for remote indication of motor amps.
(h) Ability to accept call signal from SCADA.
(i) Ability to accept motor protection relay override signal from SCADA.
(j) Ability to accept and send signals to remote control stations on shown on Drawings.

Fan Motor Starter Buckets

(a) Provide dry contact for remote indication of fan running.
(b) Provide dry contact for remote indication of overload.

Gate Valves

(a) Ability to accept in remote position signal from actuator.
(b) Ability to accept confirmed open signal from actuator.
(c) Ability to accept operating signal from actuator.
(d) Ability to accept confirmed close from actuator.
(e) Ability to send call to open to actuator.
(f) Ability to send call to stop to actuator.
(g) Ability to send call to close to actuator.

Main Breakers

(a) Provide dry contact for remote indication of normal service (ComEd) main breaker closed.
(b) Provide dry contact for remote indication of normal service (ComEd) main breaker tripped.
(c) Provide dry contact for remote indication of normal service (ComEd) ground fault.
(d) Provide dry contact for remote indication of emergency source (Generator) main breaker closed.
(e) Provide dry contact for remote indication of emergency source (Generator) main breaker tripped.

(f) Provide dry contact for remote indication of emergency source (Generator) ground fault.

Automatic Transfer Switch

(a) Provide dry contact for remote indication of utility power available.
(b) Provide dry contact for remote indication of normal service (ComEd) failure.
(c) Provide dry contact for remote indication of emergency service (Generator) failure.
(d) Provide dry contact for remote indication of transfer switch in normal position.
(e) Provide dry contact for remote indication of transfer switch in emergency position.
(f) Provide dry contact for remote indication of transfer switch in test mode.
(g) Provide dry contact for remote indication of transfer switch ready to load.
(h) Provide ability to send start and stop signals to generator.
(i) Provide ability to accept ready to load signal from generator.

2.1.12 Accessories

(a) Factory install in controller enclosure, unless otherwise indicated.

1) Main and Low Flow Pumps: "Pump Run", "Pump Call", "Manual Operation", "Motor Moisture", "Motor High Temp", and "Off" Pilot Lights, LED type, push-to-test: NEMA ICS 2, heavy-duty type in accordance with Section 16D. Front of bucket mounted motor protection relay provided by pump manufacturer, installed by Contractor such that bucket does not need to be opened to access relay. If said relay does not have a means for reset, contractor shall provide a reset pushbutton on front of bucket.
2) Exhaust Fans: "On" and "Off" Pilot Lights, push-to-test: NEMA ICS 2, heavy-duty type.
3) Manual overload reset button on all motor starter and solid state reduced voltage controller buckets.
4) Non-resettable pump run timer indicating total run time in hours.
5) Non-resettable pump start counter indicating total number of starts.

(b) Furnish the following devices when indicated on Drawings.

1) Push-Button Stations and Selector Switches: NEMA ICS 2, heavy-duty type.
2) Stop and Lockout Push-Button Station: Momentary-break push-button station with factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
3) Control Relays: Auxiliary and adjustable time-delay relays.
4) Elapsed Time Meters: Heavy duty with digital readout in hours.

2.1.13 Nameplates

(a) Factory install for each bucket and each individual device. Nameplates shall include equipment description populated from drawings. Use a minimum of 1/2 inch high lettering on 1-1/2 inch high label. Nameplates shall be plastic laminate securing fastened to equipment with screws. Use black lettering on white field.

(b) Factory installed nameplate describing technical ratings of MCC including short circuit current rating. Nameplate to be located outside of the gear on front face of incoming section.

2.1.14 Fabrication

(a) Indoor enclosure: Steel.

(b) Finish: Manufacturer's standard gray exterior finish over rush-inhibiting primer on phosphatizing-treated metal surfaces. Interior finish shall be white.

3. EXECUTION:

3.1 Examination

3.1.1 Verify location and layout of Motor Control Centers equipment.

3.1.2 Verify that electrical power is available and of correct characteristics.

3.2 Preparation

3.2.1 Install concrete bases after dimensions of equipment are confirmed by equipment manufacturers.

3.3 Installation

3.3.1 Install system and components in accordance with manufacturer's specifications.

3.3.2 The installer shall provide all labor and perform all work to install and make operable all mechanical and electrical equipment necessary to assure safe and reliable operation.

3.4 Field Quality Control

3.4.1 Representative of the Manufacturer

(a) The services of a qualified representative of the manufacturer shall be provided to instruct on proper installation of the equipment, inspect the completed installation, make any necessary adjustments, participate in the startup of the equipment, participate in the field testing of the equipment, place the equipment in trouble-free operation, and instruct operating personnel in its operation and maintenance. This service shall include all equipment provided in this Section. Include:

i. 2 mandays for Installation Services for Motor Control Center.
ii. 2 manday for Instructional Services for Motor Control Center.

(b) The start-up services for the following equipment shall be coordinated with IDOT and IDOT shall be notified at least two weeks in advance:

Motor Control Center.

(c) Test in accordance with Section 16A.

3.5 Adjustments

3.5.1 Motor Control Centers

(a) Set field-adjustable pick-up time-sensitivity ranges in accordance with Section 16B.

3.6 Factory Acceptance Testing

3.6.1 The motor control center furnished under this Section shall be fully tested and documented by certified factory test reports, in accordance with Section 1A.

3.6.2 As a minimum, the following tests shall be conducted:

(a) The following factory standard tests shall be performed on the circuit breaker element (main breakers only) provided under this section. All tests shall be in accordance with the latest version of ANSI standards.

i. One-minute insulation-resistance test on each pole, phase-to-phase and phase-to-ground per ANSI standards.
ii. Final inspections and quality checks.

(b) The following production test shall be performed on each breaker housing:

i. Operation of wiring, relays and other devices verified by operational sequence test.
ii. Final inspections and quality checks.

(c) MCC ATS system shall be simulated for correct operation on loss of voltage, under/over-voltage, overcurrent, loss of phase, phase imbalance and under/over-frequency.
(d) Verification of circuit breaker interlocks.
(e) Verification of motor starter circuits and interlocks.
(f) Energize contactors using an auxiliary source.
(g) Verification of meter readouts through application of current and voltage to each analog input.
(h) The manufacturer shall provide three (3) certified copies of factory test reports.

END OF THIS SECTION

SECTION 16G - LIGHTING

1. GENERAL:

1.1 Description

1.1.1 Basic materials and methods specified herein shall be incorporated in the work wherever applicable unless specifically indicated otherwise.

1.1.2 The basic materials and methods specified herein are intended to define a minimum standard of quality and workmanship.

1.1.3 Refer to Division 1 for additional requirements.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.
1.2.2 Section 16A – General Electric Provisions.
1.2.3 Section 16C – Basic Electrical Equipment Materials and Methods.

1.3 References

Codes and Standards referred to in this Section are:

ANSI C82.2 - Fluorescent lamp ballasts, methods of measurement of.

UL 50 - Cabinets and boxes.

1.4 Submittals

1.4.1 Provide shop drawings and product data under provisions of Section 1A for the following items: Light Fixtures, Lamps, Ballasts, and Emergency Lighting Units, Panelboards, and Lighting Contactors.

1.5 Warranty

1.5.1 Provide warranty under provisions of Section 1A.

1.6 Basis of Payment

1.6.1 The work shall be paid at the contract lump sum price for

PUMP STATION ELECTRICAL WORK

which shall be payment in full for the work described herein.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Lighting Fixtures

2.1.1 Fixtures and Fixture Components

(a) Metal Parts: Free from burrs, sharp corners, and edges.

(b) Sheet Metal Components: Steel, except as indicated. Form and support to prevent warping and sagging.

(c) Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

(d) Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:

1) White Surfaces: 85%.
2) Specular Surfaces: 83%.
3) Diffusing Specular Surfaces: 75%.
4) Laminated Silver Metallized Film: 90%.

(e) Lenses, Diffusers, Covers, and Globes: 100% virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated.

(f) Fixture Support Components: Comply with Section 16B paragraph 2.11.

1) Single-Stem Hangers: 1/2 in. (12 mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
2) Twin-Stem Hangers: Two, 1/2 in. (12 mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
3) Rod Hangers: 3/16 in. (5 mm) minimum diameter, zinc-plated, threaded steel rod.
4) Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

(g) High-Intensity-Discharge (HID) Fixtures: Conform to UL 1572.

(h) HID Ballasts: Conform to UL 1029 and ANSI C82.4. Include following features, except as otherwise indicated.

1) Metal Halide Ballasts:

i. Pulse start ballast.

2) Operating voltage: Match system voltage.

(i) Auxiliary, Instant-On, Quartz System: Automatically switches quartz lamp when fixture is initially energized and when momentary power outages occur. Turns quartz lamp off automatically when HID lamp reaches approximately 60% light output.

(j) Incandescent Fixtures: Conform to UL 1571.

(k) Light-emitting diode (LED) Fixtures: CSA verified, light engines IP 66 rated, luminaire IP 65 rated for non-hazardous locations and Class I, Division 2 rated for hazardous locations.

1) Class 1 electronic driver with power factor greater than 90%.
2) Total harmonic distortion less than 20%.
3) Expected life of 100,000 hours.
4) Fire year warranty. Warranty shall commence from the Final Acceptance of the Pump Station.
5) Rated for -40° C.

(l) Exit Signs: Conform to UL 924 and following:

1) Sign Colors: Conform to local code.
2) Minimum height of Letters: Conform to local code.
3) Arrows: Include as indicated.

(m) Emergency Lighting Units: Conform to UL 924.

1) Battery: Sealed, maintenance-free, lead-acid type with minimum 10 yr nominal life and special warranty. Warranty shall commence from the Final Acceptance of the Pump Station.
2) Charger: Minimum 2-rate, fully automatic, solid-state type, with sealed transfer relay.
3) Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80% of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. Relay disconnects lamps and battery and automatically recharges and floats on trickle charger when normal voltage is restored.
4) Wire Guard: Where indicated, provide heavy-chrome-plated wire guard arranged to protect lamp heads or fixtures.
5) Time-Delay Relay: Provide time-delay relay in emergency lighting unit control circuit arranged to hold unit ON for fixed interval after restoration of power after outage. Provide adequate time delay to permit HID lamps to restrike and develop adequate output.

2.1.2 Lamps

(a) Comply with ANSI C78 series that is applicable to each type of lamp.

(b) Fluorescent Color Temperature and Minimum Color-Rendering Index (CRI): 3500 K and 85 CRI, except as otherwise indicated.

(c) Noncompact Fluorescent Lamp Life: Rated average is 20,000 hrs at 3 hrs per start when used on rapid start circuits.

(d) Metal Halide Color Temperature and Minimum Color-Rendering Index (CRI): 3600 K and 70 CRI, except as otherwise indicated.

2.1.3 Finishes

(a) Manufacturer's standard, except as otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters, and similar defects.

2.2 Lighting Contactors

2.2.1 Manufacturer: Square-D Model 8903LXG30V02CR6, General Electric, or equal.

2.2.2 Description: NEMA ICS 2, magnetic lighting contactor, 100% rated.

2.2.3 Configuration: Mechanically held.

2.2.4 Coil Voltage: 120 volts, 60 Hertz.

2.2.5 Poles: Three.

2.2.6 Contact Rating: 30 amperes.

2.2.7 Enclosure: ANSI/NEMA ICS 6, Type 1.

2.2.8 Accessories:

(a) Selector Switch: ON/OFF/AUTOMATIC
(b) Pushbuttons and Selector Switches: NEMA ICS 2, general duty type.

2.2.9 Lighting Timer:
(a) Tork, Intermatic, or equal.
(b) Mechanical time switch type.
(c) 24 hour timer.
(d) Manual override.
(e) NEMA 1 steel enclosure.
(f) 120 VAC contact rating.
(g) UL listed.

3. EXECUTION:

3.1 Lighting Fixtures

3.1.1 Installation

(a) Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's written instructions and approved Shop Drawings. Support fixtures according to Section 16B-2.11.

(b) Supports for Recessed and Semi-recessed Grid-Type Fluorescent Fixtures: Support Units from suspended ceiling support system. Install ceiling support system rods or wires at minimum of 4 rods or wires for each fixture, located not more than 6 in. (150 mm) from fixture corners.

1) Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corner.

(c) Supports for Suspended Fixtures: Brace pendants and rods over 48 in. (1200 mm) long to limit swinging. Support stem-mounted, single-unit, suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.

(d) Lamping: Where specific lamp designations are not indicated, lamp units according to manufacturer's instructions.

3.1.2 Connections

(a) Ground lighting units. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.1.3 Field Quality Control

(a) Inspect each installed fixture for damage. Replaced damaged fixtures and components.

1) Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source.
2) Give advance notice of dates and times for field tests.
3) Provide instruments to make and record test results.
4) Interrupt electrical energy to demonstrate proper operation of emergency lighting installation. Include following information in tests of emergency lighting equipment:

i. Duration of supply.
ii. Low battery voltage shutdown.
iii. Normal transfer to battery source and retransfer to normal.
iv. Low supply voltage transfer.
v. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.
vi. Report results of tests.

(b) Replace fixtures that show evidence or corrosion during Project warranty period.

3.1.4 Adjusting and Cleaning

(a) Clean fixtures after installation. Use methods and materials recommended by manufacturer.

(b) Adjust aimable fixtures to provide required light intensities.

END OF THIS SECTION

SECTION 16H - MAJOR ELECTRICAL EQUIPMENT

1. GENERAL:

1.1 Description

1.1.1 Basic materials and methods specified herein shall be incorporated in the work wherever applicable unless specifically indicated otherwise.

1.1.2 The basic materials and methods specified herein are intended to define a minimum standard of quality and workmanship.

1.1.3 Refer to Division 1 for additional requirements.

1.2 Related Sections

1.2.1 Section 3A - Cast-In-Place Concrete.
1.2.2 Section 15E – Ventilation
1.2.3 Section 16A – General Electric Provisions.
1.2.4 Section 16B – Electrical Power System Studies
1.2.5 Section 16C – Basic Electrical Equipment Materials and Methods.
1.2.6 Section 16D – Supervisory Control and Data Acquisition (SCADA) Equipment.

1.3 References

Codes and Standards referred to in this Section are:

Fed. Spec W-P-115	-	Panel, power distribution.
NEMA KS1	-	Enclosed and miscellaneous distribution equipment switches (600 volt maximum).

1.4 Submittals

1.4.1 Provide shop drawings and product data under provisions of Section 1A for the following items: Panelboards, Disconnects and Safety Switches, Transformers, Motors, SPD units, Fire Alarm System and AEGIS Intrusion System.

1.5 Warranty

1.5.1 Provide warranty under provisions of Section 1A.

1.5 Payment

1.6.1 The work shall be paid at the contract lump sum price for

PUMP STATION ELECTRICAL WORK
FIRE DETECTION PANEL
AEGIS PANEL

which shall be payment in full for the work described herein.

1.6.2 Refer to 1.22 of Section 1A for Method of Measurement.

2. PRODUCTS:

2.1 Panelboards

2.1.1 Manufacturer's

(a) Cutler-Hammer.
(b) Square-D Co.

2.1.2 Panelboard Fabrication

(a) Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

(b) Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated.

(c) Directory Frame: Metal, mounted inside each panelboard door.

(d) Bus: Hard drawn copper of 98% conductivity.

(e) Main and Neutral Lugs: Compression type.

(f) Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

(g) Service Equipment Approval: Listed for use as service equipment for panelboards with main service disconnect.

(h) Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for overcurrent protective device ampere ratings indicated for future installation of devices.

(i) Special Features: Include following features for panelboards as indicated:

1) Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

(j) Extra Gutter Space: Dimensions and arrangement as indicated.

1) Subfeed: Overcurrent protective device or lug provision as indicated.

(k) Feed-through Lugs: Sized to accommodate feeders indicated.

2.1.3 Lighting and Appliance Branch Circuit Panelboards

(a) Branch Overcurrent Protection Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
(b) Doors: In panelboard front, with concealed hinges. Secure with flush catch and tumbler lock, keyed alike.
(c) Surge protection device:

7) Protection modes and UL 1449 third edition clamping voltages coordinated with circuit system and circuit voltage.
8) Factory mounted with UL listed and labeled mounting device.
9) 60 kA per phase surge current capacity minimum.
10) Door mounted diagnostic lights.
11) Audible alarm, with silencing switch, to indicate when protection has failed. Switch shall be accessible from outside of enclosure and not require door to be opened to access.
12) Replaceable modular design.
13) Mounted next to breaker in panelboard.
14) One form C contact to indicate suppressor is operational.
15) Minimum of 10 year warranty. Warranty shall commence from the Final Acceptance of the Pump Station.

2.1.4 Distribution Panelboards

(a) Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers, except circuit breakers 225-A frame size and greater may be plug-in type where individual positive-locking device requires mechanical release for removal.

2.1.5 Overcurrent Protective Devices

(a) Molded-Case Circuit Breakers: NEMA AB 1, handle lockable.

1) Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2) Application Listing: Appropriate for application, including Type SWD for switching fluorescent lighting loads, Type HACR for heating, air-conditioning, and refrigerating equipment and

Class B GFCI for pipeline and vessel fixed electrical heating equipment unless otherwise indicated.

3) Circuit Breakers, 200A and Larger: Trip units interchangeable within frame size.
4) Circuit Breakers, 400A and Larger: Field-adjustable short-time and continuous current settings.
5) Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
6) Current Limiters: Where indicated, integral fuse listed for circuit breaker.
7) Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
8) Shunt Trip: Where indicated.

2.2 Disconnects, Fuses, and Circuit Breakers

2.2.1 Manfacturer's

(a) Motor and Circuit Disconnects:

1) Square D Co.
2) Cutler-Hammer.

(b) Molded-Case Circuit Breakers:

1) Square D Co.
2) Cutler-Hammer.

2.2.2 Enclosed Switches

(a) Enclosed Nonfusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks.

(b) Enclosed Fusible Switch, 800 Amps and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in closed position.

1) Minimum Fault Current Rating: 200,000 symmetrical rms amperes.

2.2.3 Enclosed Circuit Breakers

(a) Enclosed Molded-Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks.

(b) Characteristics:

1) Frame size, trip rating, number of poles, and auxiliary devices as indicated.
2) Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amps minimum.

3) Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.

(c) Interchangeable Trips: Circuit breakers, 200 amps and larger, with trip units interchangeable within frame size.

(d) Field-Adjustable Trips: Circuit breakers, 400 amps and larger, with adjustable short time and continuous current settings.

(e) Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.

(f) Current Limiters: let-through ratings less than NEMA FU 1, Class RK-5.

(g) Molded-Case Switch: Where indicated, molded-case circuit breaker without trip units.

(h) Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

(i) Shunt Trip: Where indicated, 120 volts, 60 Hz.

(j) Accessories: As indicated on drawings.

2.2.4 Safety Switches

(a) NEMA heavy duty Type HD. Where indicated, 120 volts, 60 Hz.

(b) Dual cover interlock.

(c) Visible blades.

(d) Provisions for control circuit interlock.

(e) Pin type hinges.
(f) Tin plated current carrying parts.

(g) Quick make and break operator mechanism.

(h) Handle attached to box, not cover.

(i) Handle position indication, ON in up position and OFF in down position.

(j) Padlock provisions for up to 3 padlocks in OFF and ON positions.

(k) UL listed lugs for type and size of wire specified.

(l) Spring reinforced fuse clips for Class R fuses.

(m) Provisions for insulated or groundable neutral.

(n) UL listed short circuit rating 200,000 RMS amp with Class R fuses.

2.2.5 Three Phase Manual Motor Switch

(a) Quick make and break operator mechanism.

(b) Padlock provisions in OFF position.

(c) NEMA type.

2.2.6 Enclosures

(a) Enclosure: NEMA AB 1, Type 1, unless specified or required otherwise to meet environmental conditions of installed location.

1) Outdoor or Other Wet or Damp Indoor Locations: NEMA Type 4X 316 stainless steel.
2) Hazardous Areas Indicated on Drawings: NEMA Type 7C.

2.3 Transformers

2.3.1 Manufacturers

(a) Cutler-Hammer.

(b) Square D Co.

2.3.2 Transformers, General

(a) Factory-assembled and -tested, air-cooled units of types specified, designed for 60 Hz service.
(b) Cores: Grain-oriented, nonaging silicon steel.

(c) Coils: Continuous copper windings without splices, except for taps.

(d) Internal Coil Connections: Brazed or pressure type.

(e) Enclosure: Class complies with NEMA 250 for environment in which installed.

2.3.3 General-Purpose Distribution and Power Transformers

(a) Comply with NEMA ST 20 and list and label as complying with UL 1561.

(b) Efficiency: Efficiency equal to or greater than that stated in NEMA TP 1, for that type and rating of transformer.

(c) Cores: 1 leg per phase.

(d) Windings: One coil per phase in primary and secondary.

(e) Enclosure: Indoor, ventilated.

(f) Insulation Class: 220°C class 115°C maximum rise above 40°C for transformers 15 kVA or smaller; 220°C class 80°C maximum rise above 40°C for transformers larger than 15 kVA.

(g) Taps: 220°C class 115°C maximum rise above 40°C for transformers 15 kVA or smaller; 220°C class 80°C maximum rise above 40°C for transformers larger than 15 kVA.

1) Taps, 3 through 15 kVA: Two 5% taps below rated high voltage.
2) Taps, 15 through 500 kVA: Six 2.5% taps, 2 above and 4 below rated high voltage.

(h) K-Factor Rating: 220°C class 115°C maximum rise above 40°C for transformers 15 kVA or smaller; 220°C class 80°C maximum rise above 40°C for transformers larger than 15 kVA.

1) Transformer design prevents overheating when carrying full load with harmonic content corresponding to designated K-factor.
2) Nameplate states designated K-factor of transformer.

2.3.4 Finishes

(a) Indoor Units: Separate; marked "Shield" for grounding connection.

(b) Outdoor Units: Comply with ANSI C57.12.28.

2.3.5 Source Quality Control

(a) Factory Tests: Design and routine tests comply with referenced standards.

2.4 Electric Motors

2.4.1 Manufacturers

(a) Siemens.

(b) General Electric.

(c) Nidec – U.S. Motors.

(d) Toshiba.

2.4.2 General

(a) Requirements below apply to motors covered by this Section except as otherwise indicated.

(b) Motors 1/2 hp and larger: Polyphase.

(c) Motors Smaller Than 1/2 hp: Single-Phase.

(d) Frequency Rating: 60 Hz.

(e) Voltage Rating: Determined by voltage of circuit to which motor is connected for following motor voltage ratings (utilization voltages):

1) 120 V Circuit: 115 V - motor rating.
2) 208 V Circuit: 200 V - motor rating.
3) 240 V Circuit: 230 V - motor rating.
4) 480 V Circuit: 460 V - motor rating.

(f) Service factors indicated for motors are minimum values and apply at frequency and utilization voltage at which motor is connected. Provide motors which will not operate in service factor range when supply voltage is within 10% of motor voltage rating.

(g) Capacity: Sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence without exceeding nameplate ratings. Provide motors rated for continuous duty at 100% of rated capacity.

(h) Temperature Rise: Based on 40°C ambient except as otherwise indicated.

(i) Enclosure: Totally Enclosed Fan Cooled (TEFC) unless otherwise indicated in other sections and as required by NEC.

1) Explosion proof motors approved for specific hazard classifications covered by NEC.
2) Weather proof motors designed for outdoors and in wet areas.

(j) Copper Windings.

(k) Winding Insulation Class F.

2.4.3 Polyphase Motors

(a) Squirrel-cage induction-type conforming to following requirements except as otherwise indicated.

(b) NEMA Design Letter Designation: "B"

(c) Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading for application.

(d) Motor Efficiencies:

1) General purpose motors (not inverter duty/vector duty or explosion proof): NEMA Premium Energy Efficient Motors with nominal efficiency equal to or greater than that stated in NEMA MG 1 for NEMA Premium Energy Efficient Motors for that type and rating of motor.
2) Explosion proof motors: NEMA Energy Efficient/High Efficiency Motors with nominal efficiency equal to or greater than that stated in NEMA MG 1 for NEMA Energy Efficient/High Efficiency Motors for that type and rating of motor.

(e) Multi-Speed Motors: Separate windings for each speed.

(f) Internal thermal Overload Protection for Motors: For motors so indicated, protection automatically opens control circuit arranged for external connection. Protection operates when winding temperature exceeds safe value calibrated to temperature rating of motor insulation.

(g) Motors for Reduced Inrush Starting: Coordinate with indicated reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

(h) Torque:

1) Breakdown torque shall be 200% or more of maximum torque load placed on motor shaft.
2) Provide torque shall be 200% or more of maximum torque load placed on motor shaft.
3) Supply special motors where load requirements exceed standard design.

(i) Totally Enclosed Fan Cooled (TEFC) and Totally Enclosed Non Ventilated (TENV).

1) Energy Efficient.
2) 1.15 Service Factor, Class "F" Insulation.
3) Cast iron construction; frame, conduit box, end shields, fan cover, inner caps for 182T frames and larger.
4) Positive lubrication system.
5) Removable eyebolt.
6) Suitable for indoor and outdoor installations.
7) Diagonally split, neoprene gasketed, rotatable oversized conduit box with NPT threaded lead hole.
8) Conduit box mounted, UL approved clamp type grounding lug.
9) Permanently numbered non-wicking loads.

10) Rust inhibitive non-washing lubricant.
11) Stainless steel nameplate with:

i. NEMA nominal efficiency.
ii. AFBMA bearing numbers.
iii. Lubrication instructions.

(j) Explosion Proof.

1) Same features as TEFC.
2) Approved for NEC hazardous classified location as noted in equipment specification or as indicated on Drawings.
3) Automatic explosion proof breather drains.

(k) Submersible pump and mixer motors.

1) As explosion proof breather drains.
2) 1.15 service factor, unless otherwise indicated in equipment specification sections.

2.4.4 Single-Phase Motors

(a) One of the following types as selected to suit starting torque and other requirements of specific motor application:

1) Permanent Split Capacitor.
2) Split-Phase Start, Capacitor-Run.
3) Capacitor-Start, Capacitor-Run.

(b) Shaded-Pole Motors: Use only for motors smaller than 1/20 hp.

(c) Internal Thermal Overload Protection for Motors: For motors so indicated, protection automatically opens power supply circuit to the motor, or control circuit arranged for external connection. Protection operates when winding temperature exceeds safe value calibrated to temperature rating of motor insulation. Provide device that automatically resets when motor temperature returns to normal range except as otherwise indicated.

(d) Bearings, belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.

2.4.5 Source Quality Control

(a) Testing:

1) Perform belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.
2) Test shall be standard NEMA routine production test in accordance with NEMA MG 1.

2.5 External Surge Protection Device

2.5.1 Surge Protective Drives (SPD)

(a) Current Technology, ASCO, or equal.

(b) Surge suppressor shall have UL 1449 listed suppression ratings for each mode of protection, as follows:

1) 480/277 volt, 3 phase "WYE" – 800 volts.
2) 120/208 volt, 3 phase "WYE" – 400 volts.
3) 480 volt 3 phase "Delta" – 1500 volts.

(c) Provide protection in all modes. Ten modes for "WYE" systems, L-L, L-N, L-G and N-G, and six modes for "Delta" systems, L-L and L-G. (See NEMA 2.2.7 & IEEE Std. 1100-1992).

(d) Include a predetermined number of Selenium cells in parallel with arrays of non-linear voltage dependent metal oxide varistors to protect against system voltage swells.

(e) The Catastrophic Protection System shall provide temporary over voltage and voltage swell protection to the following:

1) TOV - should be capable of surviving and continue to protect critical loads against multiple TOV events (described as 200% nominal voltage by 8 mS.
2) Swell- should be capable of protection against swells up to 180% nominal for 0.7 ohms load >18,000 cycles.

(f) MOV's tested per ANSI/IEEE C62.33-1982.

(g) Minimum Single Pulse Surge Current Capacity per ANSI/IEEE C62041-1991's standard 8 X 20 microsecond current waveform, shall not be less than as follows:

150,000amps, L-N
150,000 amps, L-G min. amps per phase 300,000 (L-N plus L-G)
150,000 amps, N-G
150,000 amps, L-L

(h) Test system for repetitive sequential ANSI/IEEE C62.41 Category C3 waveforms. Minimum repetitive strikes of 1.2 X 50 microsecond, 20 KV open circuit voltage and 8 X 20 microsecond, 10 KA short circuit current with no more than 10% degradation of clamping voltage at the specified surge current.

(i) Provide an extended range noise tracking filter system between 50kHz and 100MHz with a minimum insertion loss ratio of 50:1 or 34 db over the entire range per NEMA LS-1, 1992, Section 2.2.11. UL 1283 Listed as an Electromagnetic Interference Filter. (Standard insertion loss data obtained utilizing MIL-STD-E220A 50 ohm insertion loss methodology).

(j) Minimum continuous operating voltage of any component shall not be less than 115% of nominal operating voltage.

(k) The primary suppression path shall be Line to Neutral.

(l) All surge current devices shall incorporate low impedance plated busbars. No small gauge round wire, printed circuit boards, silicon avalanche diodes or plug-in connections are acceptable.

(m) Each individual Selenium cell, MOV and capacitor shall be fused so that the failure of any component does not affect the operation or protection of the entire unit.

(n) Provide in PVC/Fiberglass or metal enclosure NEMA rated suitable for the installed location.

2.5.2 Accessories

(a) Monitoring. One set of status monitoring lights that will provide visual indication of voltage present to the SPD. The lights shall also indicate when any value of less than 50% suppression protection is available from the SPD.

1) An audible alarm with battery backup, indicating lights showing loss of power or with any value less than 50% suppression protection is available, a surge counter, and two sets of Form C contacts for remote monitoring.
2) Monitoring system shall include a local character display to provide a time, date, magnitude, and duration stamp for when the following power quality events occur: indication of the number of swells (voltage > 110% of nominal), surges (voltage > 130% of peak voltage), sags (voltage < 90% of nominal), and outages (power interruptions > 1 cycle) the device has encountered.

(b) High Performance Interconnect. Dual shielded, triple insulated multi-core power conductor, UL approved.

2.6 Fire Alarm System

2.6.1 Provide a complete fire alarm system for the station including an emergency power supply consisting of a battery (minimum 10 year nominal life expectancy and sized to operate complete alarm system for period of 24 hours), charger (solid-state, fully automatic, variable-charging-rate type that will completely charge fully discharged batteries in 4 hours or less), automatic transfer switch (transfers load to battery without loss of signals or status indications when normal power fails), and wall mounted control panel with 120 VAC power supply. The system shall be supervised and shall be provided with two dry contact outputs for both trouble and alarm status for remote connection to SCADA. Fire panel shall have the ability to provide alarm status output to the AEGIS system and receive a horn relay signal from the gas system.

2.6.2 The system shall be complete with four zones - the Electrical Control Room, the pump room, and the lower levels. Smoke detectors with heat elements shall be provided as indicated on the Contract Drawings and shall be of the ionization type. Electronic horn/strobes as manufactured by System Sensors or Edwards shall be provided as shown Plans. All appliances shall meet the NFPA-72 requirements. Heat detector units shall have be combination fixed-temperature and rate-of-rise with mounting plate arranged for outlet box mounting; 135° F (57° C) fixed temperature setting, except as indicated. Provide with enclosure suitable for environment listed on drawings (explosion proof, weather proof).

2.6.3 The system shall have terminals and space for receiving a signal from the gas system (Combustible gas monitor horn relay) per the Drawings. The contact closure shall activate the horn/strobes only, the other fire alarm system functions shall not be affected. The horns/strobes are common to the fire and gas detection systems. The audible horns and visual devices shall be configured to be re-settable and silenced from either the gas panel or fire panel.

2.6.4 Submittal shall include all necessary internal and external wiring diagrams and installation requirements. Complete system connection diagrams of all initiating devices, notification appliance and end of line resistors shall be included. A detail bill of material with technical descriptions and summary of quantities, project specific catalog cutsheets, one line riser diagram and applicable features of components shall be included.

2.6.5 The system shall be the product of a single manufacturer having local available service. The system shall be UL listed and Factory Mutual approved.

2.6.6 Horns: Electric-vibrating-polarized type, operating on 120 VAC, with provision for housing operating mechanism behind grille. Horns produce sound-pressure level of 90 dB, measures at 10 ft (3 m) from source. Sound-pressure shall be adjustable. Provide with red enclosure suitable for environment listed on drawings (explosion proof, weather proof).

(a) Provide with enclosure suitable for environment listed on drawings (explosion proof, weather proof).

2.6.7 Visual Alarm Devices: Xenon strobe lights with clear or nominal white polycarbonate lens operating on 120 VAC. Mount lenses on aluminum faceplate.

Word "FIRE" is engraved in minimum 1 in. (25 mm) high letters on lens. Provide with red enclosure suitable for environment listed on drawings (explosion proof, weather proof).

(b) Devices have candela reading as stated in NFPA 72.
(c) Provide with enclosure suitable for environment listed on drawings (explosion proof, weather proof).

2.6.8 Manual Pull Stations: Double-action type, fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.

(a) Break-Glass Feature: Stations requiring breaking of glass are unacceptable. Stations requiring breaking of concealed glass rod are acceptable.
(b) Station Reset: Key or wrench operated, double pole, double throw, switch rated for voltage and current at which it operates. Stations have screw terminals for connections.
(c) Provide with enclosure suitable for environment listed on drawings (explosion proof, weather proof).

2.7 AEGIS/Intrusion Alarm System

2.7.1 Intrusion detection systems shall be provided and utilize an ADEMCO Vista 20-P circuit board / digital dialer. The AEGIS (Abnormal Event Guidance and Information System) Intrusion system provides detection of unauthorized entry into the station including the pump room and Electrical Control Room. The system detection is monitored via explosion proof rated magnetic reed switches located at each door leading to the exterior; the Electrical Control Room door switches shall be non-explosion proof rated. The switches shall consist of two elements, the magnet mounted to the interior face of the door and the magnetically operated reed switch which mounts to the door frame. The switch contacts shall be closed when the door is open and open when the door is closed. Switch mounting shall be farthest point away from hinge located on top of door.

2.7.2 An 'intrusion' alarm condition shall be sent to the SCADA panels when a door is opened. The door switches can be disabled via an override switch located on the outside of the Electrical Control Room. The override switch shall be weatherproof and key operated, key to be coordinated with IDOT's existing key system (Medeco cylinder type, biaxial high security switch lock) and removable from both positions. The switch shall contain a LED status light to indicate open or closed position and include a tamper pushbutton to be held open by the cover plate and spring closed if the cover is removed. The override switch shall have two contacts, one contact for shutting the door switches and one contact for connection to the SCADA panel.

2.7.3 The system shall be equipped with a wall mounted intrusion panel that houses a ADEMCO circuit board, digital dialer, 120 volt AC power source, 120 volt to 12 volt transformer, DC power supply with battery (sized for 24 hours of operation) and battery charger, panel mounted LED beacon, terminal strips for field wiring (factory installed wiring shall be clearly identified with conductor labels that match approved shop drawing) and various control relays. The panel will report alarms

via a dedicated telephone lines (shared with pump station telephone) as part of IDOT's system wide AEGIS alarm system, the following signals shall be monitored by the intrusion system setup to alarm on a contact closure:

1) Intrusion Alarm
2) Fire Alarm & Gas Alarms
3) Normal Electrical Service and/or Emergency Generator Service Failures
4) High Water Level on Pavement
5) High Wet Well Water Level
6) SCADA Alarm
7) Low Wet Well Water Level
8) Pump Alarm
9) Internal Battery Low
10) AEGIS Heartbeat

2.7.4 The systems primary function is intrusion detection and the secondary function is alarm reporting of above listed inputs at EMC Contractor's Maintenance Facility, IDOT TSC, and at IDOT District 1. Reporting is performed via telephone output in the event SCADA is lost or disrupted.

2.7.5 Submittal information shall include all necessary internal and external wiring diagrams and installation requirements. Complete system connection diagrams of all initiating devices and notification appliance A detail bill of material with technical descriptions and summary of quantities, project specific catalog cutsheets, one line riser diagram and applicable features of components shall be included.

3. EXECUTION:

3.1 Panelboards

3.1.1 Installation

(a) Install panelboards and accessory items according to NEMA PB 1.1.

(b) Mounting Heights: Top of trim 74 in. (1880 mm) above finished floor, unless otherwise indicated.

(c) Mounting: Plumb and rigid without distortion box. Mount flush panelboards uniformly flush with wall finish.

(d) Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing.

(e) Install filler plates in unused spaces.

(f) Provision for Future Circuits at Flush Panelboads: Stub four 1 in. (27 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 in.

(27 mm) empty conduits into raised floor space or below slab not on grade.

(g) Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.1.2 Identification

(a) Identify field-installed wiring and components and provide warning signs as specified in Section 16C.

(b) Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

3.1.3 Grounding

(a) Make equipment grounding connections for panelboards.

(b) Provide ground continuity to main electrical ground bus.

3.1.4 Connections

(a) Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.1.5 Field Quality Control

(a) Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.

(b) Make continuity tests of each circuit.

(c) Visual and Mechanical Inspection.

1) Check circuit breaker for proper mounting and compare nameplate data to drawings and specifications.
2) Operate circuit breaker to ensure smooth operations.
3) Inspect case for cracks or other defects.

(d) Balancing Loads: After Substantial Completion, conduct load-balancing measurements and make circuit changes as follows:

1) Perform measurements during period of normal working load as advised by Engineer.
2) Perform load-balancing circuit changes outside normal occupancy/working schedule of facility. Make special arrangements with Engineer to avoid disrupting critical 24 hr services.

3) Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.

4) Tolerance: Difference exceeding 10% between phase loads, within panelboard, is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

3.1.6 Adjusting

(a) Set field-adjustable pick-up and time-sensitivity ranges in accordance with Section 16B.

3.1.7 Cleaning

(a) On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.2 Disconnects, Fuses and Circuit Breakers

3.2.1 Examination

(a) Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.
(b) Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2.2 Installation

(a) Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

(b) Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

(c) Install enclosed switches and circuit breakers level and plumb.

(d) Install wiring between enclosed switches and circuit breakers and control/indication devices.

(e) Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.2.3 Identification

(a) Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

3.2.4 Coordination Study

(a) Where coordination study recommends changes in types, classes, features or ratings of equipment or devices specified in Section 16B from those indicated, make written request for instructions. Obtain instructions from ENGINEER before ordering equipment or devices recommended to be changed.

3.2.5 Field Quality Control

(a) Manufacturer's Field Services:

1) Supplier's or manufacturer's representative for equipment specified herein shall be present at job site of classroom designated by the Department for minimum mandays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of the Department's personnel for plant operation. Include minimum of:

i. 1/2 manday for Installation Services.
ii. 1/2 manday for Instructional Services / Training.

(b) Test in accordance with Section 16A.

(c) Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

2) Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for enclosed switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
3) Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

3.2.6 Adjusting

(a) Set field-adjustable pick-up and time-sensitivity ranges in accordance with Section 16B.

3.2.7 Cleaning

(a) Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.3 Transformers

3.3.1 Installation

(a) Comply with safety requirements of IEEE C2.

(b) Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

(c) Identify transformers and install warning signs according to Section 16B-2.3.

(d) Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3.2 Grounding

(a) Comply with NFPA 70 requirements separately derived systems for connecting to grounding electrodes and for bonding to metallic piping near transformer.

(b) Comply with Section 16C.

3.3.3 Field Quality Control

(a) Testing in accordance with Section 16A.

3.3.4 Cleaning

(a) On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.3.5 Adjusting

(a) After installing and cleaning, touch up scratches and mars on finish to match original finish.

(b) Adjust transformer taps and connections to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings or connections and submit with test results.

3.4 Electric Motors

3.4.1 Installation

(a) Field install motors in accordance with manufacturer's instructions and following:

1) Direct Connected Motors: Mount securely in accurate alignment.
2) Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts furnished by manufacturer and tension belts in accordance with manufacturer recommendations.

3.4.2 Commissioning

(a) Check operating motors, both factory and field-installed, for unusual conditions during normal operation. Coordinate with commissioning of equipment for which motor is part.

(b) Report unusual conditions.

(c) Correct deficiencies of field-installed units.

3.4.3 Alignment

(a) Installer of motor is responsible for alignment.

(b) Check alignment of motors prior to startup.

(c) Motors over 50 hp: operating motors, both factory and field-installed, for unusual conditions during normal operation. Coordinate with commissioning of equipment for which motor is part.

3.4.4 Field Quality Control

(a) Inspect wire and connections for physical damage and proper connection.

(b) Conduct insulation resistance (megger) test on each motor 25 hp and larger before energizing. Conduct test with 500 or 1,000 vdc megger. Test each phase separately and follow procedures listed below.

1) Disconnect voltage sources, lightning arrestors, capacitors, and other potential low insulation sources from motor before connecting megger to motor.
2) When testing phase, connect phases not under test to ground.
3) Apply test voltage, phase to ground on each phase being tested. Record resistance reading at 30 sec and at 1 min after test voltage is applied. Divide 1 min reading by 30 sec reading to obtain dielectric absorption ratio (DAR). DAR shall be 1.25 or greater for phase to pass test.
4) If phases have DAR of 1.25 or greater, attach tag to motor and mark tag "Insulation Resistance Test OK" and sign.
5) If phases have DAR of less than 1.25, attach tag to motor and mark tag "Insulation Resistance Test Failed" and sign. Provide new motor and retest. Notify ENGINEER of failure and actions taken to correct.
6) Connect equipment removed in Item 1 above.

(c) Before energizing motor, record motor's nameplate current on record drawing line diagram
(d) ms. Verify size motor starter overload heaters with approved drawing and starter manufacturer's recommendation for given motor nameplate current, service factor, and power factor correcting capacitors, is provided.

(e) Check rotation of motor before connecting to driven equipment; before couplings are bolted or belts installed. Before motor is started to check rotation, determine that motor is lubricated. When rotation is correct, mark insulation resistance test tag "Rotation OK". Sign or initial test tag by person who checked motor rotation.

(f) Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas.

(g) In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration.

3.5 Surge Protective Device

3.5.1 System Testing and Installation

(a) Factory test before shipment:

1) Testing shall include, but not be limited to production-line tests, quality assurance checks, MCOV, and benchmark clamping voltage tests.
2) A copy of the benchmark clamping tests for each individual SPD shall be included with each unit.

(b) Manufacturer's Field Services:

1) Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by the Department for minimum mandays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of the Department's personnel for plant operation. Include:

i. 1/2 man-day for Installation and Testing Services.
ii. 1/2 man-day for Instructional Services.

2) Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas.
3) Obtain the services of a factory-authorized local service representative to provide the following tests:

i. Voltage measurements from Line-to-Ground, Line-to-Neutral, Line-to-Line and Neutral-to-Ground (as applicable),

ii. Impulse injection to verify the system suppression voltage tolerances for all suppression paths. (Note: This testing is separate from any motor control center or other system tests. Completely disconnect the SPD from the motor control center prior to any motor control center or other system tests, including any hi pot testing.)

iii. Record and compare test results to factory benchmark test parameters supplied with each individual unit.

iv. Submit a copy of the start-up test results and the factory benchmark testing results to the Engineer for confirmation of proper system function.

3.5.2 Installation

(a) SPDs shall be installed on the load side of the main disconnects.

(b) SPDs shall have a dedicated circuit breaker disconnect at the connection point in the electrical distribution equipment. Low impedance (HPI) cable shall be used to connect the SPD to the electrical distribution equipment. The total cable length between the electrical distribution equipment and the SPD shall be less than 10 feet.

3.5.3 System Warranty

(a) The SPD system manufacturer shall warranty the entire system against defective materials and workmanship for a period of fifteen years following delivery from the manufacturer.

(b) The internal SPD protection suppression system shall be protected by a fifteen year warranty following delivery from the manufacturer providing the SPD system is installed per the manufacturer's specifications. Warranty shall commence from the Final Acceptance of the Pump Station.

3.6 Fire Alarm and Intrusion Systems

3.6.1 Verify location and layout of Aegis/Intrusion alarm equipment and Fire alarm equipment.

3.6.2 Verify that electrical power is available and of correct characteristics.

3.6.3 Install system and components in accordance with manufacturer's specifications.

3.6.4 The installer shall provide all labor and perform all work to install and make operable all mechanical and electrical equipment necessary to assure safe and reliable operation.

3.6.5 Representative of the Manufacturer

(a) The services of a qualified representative of the manufacturer shall be provided to instruct on proper installation of the equipment, inspect the completed installation, make any necessary adjustments, participate in the startup of the equipment, participate in the field testing of the equipment, place the equipment in trouble-free operation, and instruct operating

personnel in its operation and maintenance. This service shall include the Intrusion Alarm and Fire Alarm Systems. Include:

i. 1 manday for Installation Services for Intrusion Alarm Panel and Fire Alarm Panel.
ii. 1 manday for Instructional Services / Training for Intrusion Alarm Panel and Fire Alarm Panel.

(b) The start-up services for the following equipment shall be coordinated with IDOT and IDOT shall be notified at least two weeks in advance:

Intrusion Alarm Panel.
Fire Alarm Panel.

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding $10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection

for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants / Employees with Disabilities: The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurance Required by 49 CFR 26.13(b):

a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding $2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages

a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each

classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is utilized in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b. (1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency..

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. Subcontracts. The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility.

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

3. Withholding for unpaid wages and liquidated damages. The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term “perform work with its own organization” refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

(1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;

(2) the prime contractor remains responsible for the quality of the work of the leased employees;

(3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and

(4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.
2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost $25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1**. Instructions for Certification – First Tier Participants:**

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. **Instructions for Certification - Lower Tier Participants:**

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost $25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of

Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

ATTACHMENT A - EMPLOYMENT AND MATERIALS PREFERENCE FOR APPALACHIAN DEVELOPMENT HIGHWAY SYSTEM OR APPALACHIAN LOCAL ACCESS ROAD CONTRACTS

This provision is applicable to all Federal-aid projects funded under the Appalachian Regional Development Act of 1965.

1. During the performance of this contract, the contractor undertaking to do work which is, or reasonably may be, done as on-site work, shall give preference to qualified persons who regularly reside in the labor area as designated by the DOL wherein the contract work is situated, or the subregion, or the Appalachian counties of the State wherein the contract work is situated, except:

a. To the extent that qualified persons regularly residing in the area are not available.

b. For the reasonable needs of the contractor to employ supervisory or specially experienced personnel necessary to assure an efficient execution of the contract work.

c. For the obligation of the contractor to offer employment to present or former employees as the result of a lawful collective bargaining contract, provided that the number of nonresident persons employed under this subparagraph (1c) shall not exceed 20 percent of the total number of employees employed by the contractor on the contract work, except as provided in subparagraph (4) below.

2. The contractor shall place a job order with the State Employment Service indicating (a) the classifications of the laborers, mechanics and other employees required to perform the contract work, (b) the number of employees required in each classification, (c) the date on which the participant estimates such employees will be required, and (d) any other pertinent information required by the State Employment Service to complete the job order form. The job order may be placed with the State Employment Service in writing or by telephone. If during the course of the contract work, the information submitted by the contractor in the original job order is substantially modified, the participant shall promptly notify the State Employment Service.

3. The contractor shall give full consideration to all qualified job applicants referred to him by the State Employment Service. The contractor is not required to grant employment to any job applicants who, in his opinion, are not qualified to perform the classification of work required.

4. If, within one week following the placing of a job order by the contractor with the State Employment Service, the State Employment Service is unable to refer any qualified job applicants to the contractor, or less than the number requested, the State Employment Service will forward a certificate to the contractor indicating the unavailability of applicants. Such certificate shall be made a part of the contractor's permanent project records. Upon receipt of this certificate, the contractor may employ persons who do not normally reside in the labor area to fill positions covered by the certificate, notwithstanding the provisions of subparagraph (1c) above.

5. The provisions of 23 CFR 633.207(e) allow the contracting agency to provide a contractual preference for the use of mineral resource materials native to the Appalachian region.

6. The contractor shall include the provisions of Sections 1 through 4 of this Attachment A in every subcontract for work which is, or reasonably may be, done as on-site work.

Contract Provision - Cargo Preference Requirements

In accordance with Title 46 CFR § 381.7 (b), the contractor agrees—

"(1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

(2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract."

Provisions (1) and (2) apply to materials or equipment that are acquired solely for the project. The two provisions do not apply to goods or materials that come into inventories independent of the project, such as shipments of Portland cement, asphalt cement, or aggregates, when industry suppliers and contractors use these materials to replenish existing inventories.