

If you plan to submit a bid directly to the Department of Transportation

PREQUALIFICATION

Any contractor who desires to become pre-qualified to bid on work advertised by IDOT must submit the properly completed pre-qualification forms to the Bureau of Construction no later than 4:30 p.m. prevailing time twenty-one days prior to the letting of interest. This pre-qualification requirement applies to first time contractors, contractors renewing expired ratings, contractors maintaining continuous pre-qualification or contractors requesting revised ratings. To be eligible to bid, existing pre-qualification ratings must be effective through the date of letting.

REQUESTS FOR AUTHORIZATION TO BID

Contractors wanting to bid on items included in a particular letting must submit the properly completed "Request for Authorization to Bid/or Not For Bid Status" (BDE 124INT) and the ORIGINAL "Affidavit of Availability" (BC 57) to the proper office no later than 4:30 p.m. prevailing time, three (3) days prior to the letting date.

WHO CAN BID ?

Bids will be accepted from only those companies that request and receive written **Authorization to Bid** from IDOT's Central Bureau of Construction.

WHAT CONSTITUTES WRITTEN AUTHORIZATION TO BID?: When a prospective prime bidder submits a "Request for Authorization to Bid/or Not For Bid Status"(BDE 124INT) he/she must indicate at that time which items are being requested For Bidding purposes. Only those items requested For Bidding will be analyzed. After the request has been analyzed, the bidder will be issued an **Authorization to Bid or Not for Bid Report**, approved by the Central Bureau of Construction that indicates which items have been approved For Bidding. If **Authorization to Bid** cannot be approved, the **Authorization to Bid or Not for Bid Report** will indicate the reason for denial.

ABOUT AUTHORIZATION TO BID: Firms that have not received an authorization form within a reasonable time of complete and correct original document submittal should contact the department as to status. This is critical in the week before the letting. These documents must be received three days before the letting date. Firms unsure as to authorization status should call the Prequalification Section of the Bureau of Construction at the number listed at the end of these instructions.

ADDENDA AND REVISIONS: It is the contractor's responsibility to determine which, if any, addenda or revisions pertain to any project they may be bidding. Failure to incorporate all relevant addenda or revisions may cause the bid to be declared unacceptable.

Each addendum will be placed with the contract number. Addenda and revisions will also be placed on the Addendum/Revision Checklist and each subscription service subscriber will be notified by e-mail of each addendum and revision issued.

The Internet is the Department's primary way of doing business. The subscription server e-mails are an added courtesy the Department provides. It is suggested that bidders check IDOT's website at <http://www.dot.il.gov/desenv/delett.html> before submitting final bid information.

IDOT IS NOT RESPONSIBLE FOR ANY E-MAIL FAILURES.

Addenda Questions may be directed to the Contracts Office at (217)782-7806 or D&Econtracts@dot.il.gov

Technical Questions about downloading these files may be directed to Tim Garman (217)524-1642 or Timothy.Garman@illinois.gov.

WHAT MUST BE INCLUDED WHEN BIDS ARE SUBMITTED?: Bidders need not return the entire proposal when bids are submitted. That portion of the proposal that must be returned includes the following:

1. All documents from the Proposal Cover Sheet through the Proposal Bid Bond
2. Other special documentation and/or information that may be required by the contract special provisions

All proposal documents, including Proposal Guaranty Checks or Proposal Bid Bonds, should be stapled together to prevent loss when bids are processed by IDOT personnel.

ABOUT SUBMITTING BIDS: It is recommended that bidders deliver bids in person to insure they arrive at the proper location prior to the time specified for the receipt of bids. Any bid received at the place of letting after the time specified will not be accepted.

WHO SHOULD BE CALLED IF ASSISTANCE IS NEEDED?

Questions Regarding	Call
Prequalification and/or Authorization to Bid	217/782-3413
Preparation and submittal of bids	217/782-7806
Mailing of plans and proposals	217/782-7806

ADDENDUMS AND REVISIONS TO THE PROPOSAL FORMS

Planholders should verify that they have received and incorporated any addendum and/or revision prior to submitting their bid. Failure by the bidder to include an addendum or revision could result in a bid being rejected as irregular.

RETURN WITH BID

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Proposal Submitted By
Name
Address
City

Letting January 21, 2011

BIDDERS NEED NOT RETURN THE ENTIRE PROPOSAL
(See instructions inside front cover)

NOTICE TO PROSPECTIVE BIDDERS

This proposal can be used for bidding purposes by only those companies that request and receive written AUTHORIZATION TO BID from IDOT's Central Bureau of Construction.
(SEE INSTRUCTIONS ON THE INSIDE OF COVER)

**Notice to Bidders,
Specifications,
Proposal, Contract
and Contract Bond**



**Illinois Department
of Transportation**

Springfield, Illinois 62764

**Contract No. 62392
COOK County
Section 0102.1S
District 1 Construction Funds
Route FAI 190**

PLEASE MARK THE APPROPRIATE BOX BELOW:

- A Bid Bond is included.
- A Cashier's Check or a Certified Check is included.

Prepared by	
Checked by	S

(Printed by authority of the State of Illinois)

INSTRUCTIONS

ABOUT IDOT PROPOSALS: All proposals issued by IDOT are potential bidding proposals. Each proposal contains all Certifications and Affidavits, a Proposal Signature Sheet and a Proposal Bid Bond required for Prime Contractors to submit a bid after written **Authorization to Bid** has been issued by IDOT's Central Bureau of Construction. In addition, this proposal contains new statutory requirements applicable to the use of subcontractors and, in particular, includes the State Required Ethical Standards Governing Subcontractors to be signed and incorporated into all subcontracts.

WHO CAN BID?: Bids will be accepted from only those companies that request and receive written **Authorization to Bid** from IDOT's Central Bureau of Construction. To request authorization, a potential bidder must complete and submit Part B of the Request for Authorization to Bid/or Not For Bid Status form (BDE 124 INT) and submit an original Affidavit of Availability (BC 57).

WHAT CONSTITUTES WRITTEN AUTHORIZATION TO BID?: When a prospective prime bidder submits a "**Authorization to Bid or Not for Bid**" form, he/she must indicate at that time which items are being requested For Bidding purposes. Only those items requested For Bidding will be analyzed. After the request has been analyzed, the bidder will be issued a **Authorization to Bid or Not for Bid Report**, approved by the Central Bureau of Construction, that indicates which items have been approved For Bidding. If **Authorization to Bid** cannot be approved, the **Authorization to Bid or Not for Bid Report** will indicate the reason for denial. If a contractor has requested to bid but has not received a **Authorization to Bid or Not for Bid Report**, they should contact the Central Bureau of Construction in advance of the letting date.

WHAT MUST BE INCLUDED WHEN BIDS ARE SUBMITTED?: Bidders need not return the entire proposal when bids are submitted. That portion of the proposal that must be returned includes the following:

1. All documents from the Proposal Cover Sheet through the Proposal Bid Bond
2. Other special documentation and/or information that may be required by the contract special provisions

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Preparation and submittal of bids	217/782-7806

RETURN WITH BID



PROPOSAL

TO THE DEPARTMENT OF TRANSPORTATION

1. Proposal of _____

Taxpayer Identification Number (Mandatory) _____ a

for the improvement identified and advertised for bids in the Invitation for Bids as:

**Contract No. 62392
COOK County
Section 0102.1S
Route FAI 190
District 1 Construction Funds**

Removal and replacement of an existing storm water pump station draining I-190 at I-294 in Rosemont.

2. The undersigned bidder will furnish all labor, material and equipment to complete the above described project in a good and workmanlike manner as provided in the contract documents provided by the Department of Transportation. This proposal will become part of the contract and the terms and conditions contained in the contract documents shall govern performance and payments.

RETURN WITH BID

3. **ASSURANCE OF EXAMINATION AND INSPECTION/WAIVER.** The undersigned further declares that he/she has carefully examined the proposal, plans, specifications, addenda, form of contract and contract bond, and special provisions, and that he/she has inspected in detail the site of the proposed work, and that he/she has familiarized themselves with all of the local conditions affecting the contract and the detailed requirements of construction, and understands that in making this proposal he/she waives all right to plead any misunderstanding regarding the same.
4. **EXECUTION OF CONTRACT AND CONTRACT BOND.** The undersigned further agrees to execute a contract for this work and present the same to the department within fifteen (15) days after the contract has been mailed to him/her. The undersigned further agrees that he/she and his/her surety will execute and present within fifteen (15) days after the contract has been mailed to him/her contract bond satisfactory to and in the form prescribed by the Department of Transportation, in the penal sum of the full amount of the contract, guaranteeing the faithful performance of the work in accordance with the terms of the contract.
5. **PROPOSAL GUARANTY.** Accompanying this proposal is either a bid bond on the department form, executed by a corporate surety company satisfactory to the department, or a proposal guaranty check consisting of a bank cashier's check or a properly certified check for not less than 5 per cent of the amount bid or for the amount specified in the following schedule:

<u>Amount of Bid</u>		<u>Proposal Guaranty</u>	<u>Amount of Bid</u>		<u>Proposal Guaranty</u>	
Up to	\$5,000	\$150	\$2,000,000	to	\$3,000,000	\$100,000
\$5,000	to	\$10,000	\$3,000,000	to	\$5,000,000	\$150,000
\$10,000	to	\$50,000	\$5,000,000	to	\$7,500,000	\$250,000
\$50,000	to	\$100,000	\$7,500,000	to	\$10,000,000	\$400,000
\$100,000	to	\$150,000	\$10,000,000	to	\$15,000,000	\$500,000
\$150,000	to	\$250,000	\$15,000,000	to	\$20,000,000	\$600,000
\$250,000	to	\$500,000	\$20,000,000	to	\$25,000,000	\$700,000
\$500,000	to	\$1,000,000	\$25,000,000	to	\$30,000,000	\$800,000
\$1,000,000	to	\$1,500,000	\$30,000,000	to	\$35,000,000	\$900,000
\$1,500,000	to	\$2,000,000	over		\$35,000,000	\$1,000,000

Bank cashier's checks or properly certified checks accompanying proposals shall be made payable to the Treasurer, State of Illinois, when the state is awarding authority; the county treasurer, when a county is the awarding authority; or the city, village, or town treasurer, when a city, village, or town is the awarding authority.

If a combination bid is submitted, the proposal guaranties which accompany the individual proposals making up the combination will be considered as also covering the combination bid.

The amount of the proposal guaranty check is _____ \$(_____). If this proposal is accepted and the undersigned shall fail to execute a contract bond as required herein, it is hereby agreed that the amount of the proposal guaranty shall become the property of the State of Illinois, and shall be considered as payment of damages due to delay and other causes suffered by the State because of the failure to execute said contract and contract bond; otherwise, the bid bond shall become void or the proposal guaranty check shall be returned to the undersigned.

Attach Cashier's Check or Certified Check Here

In the event that one proposal guaranty check is intended to cover two or more proposals, the amount must be equal to the sum of the proposal guaranties which would be required for each individual proposal. If the guaranty check is placed in another proposal, state below where it may be found.

The proposal guaranty check will be found in the proposal for:

Item _____

Section No. _____

County _____

Mark the proposal cover sheet as to the type of proposal guaranty submitted.

RETURN WITH BID

6. **COMBINATION BIDS.** The undersigned further agrees that if awarded the contract for the sections contained in the following combination, he/she will perform the work in accordance with the requirements of each individual proposal comprising the combination bid specified in the schedule below, and that the combination bid shall be prorated against each section in proportion to the bid submitted for the same. If an error is found to exist in the gross sum bid for one or more of the individual sections included in a combination, the combination bid shall be corrected as provided in the specifications.

When a combination bid is submitted, the schedule below must be completed in each proposal comprising the combination.

If alternate bids are submitted for one or more of the sections comprising the combination, a combination bid must be submitted for each alternate.

Schedule of Combination Bids

Combination No.	Sections Included in Combination	Combination Bid	
		Dollars	Cents

7. **SCHEDULE OF PRICES.** The undersigned bidder submits herewith, in accordance with the rules and instructions, a schedule of prices for the items of work for which bids are sought. The unit prices bid are in U.S. dollars and cents, and all extensions and summations have been made. The bidder understands that the quantities appearing in the bid schedule are approximate and are provided for the purpose of obtaining a gross sum for the comparison of bids. If there is an error in the extension of the unit prices, the unit prices shall govern. Payment to the contractor awarded the contract will be made only for actual quantities of work performed and accepted or materials furnished according to the contract. The scheduled quantities of work to be done and materials to be furnished may be increased, decreased or omitted as provided elsewhere in the contract.

8. **AUTHORITY TO DO BUSINESS IN ILLINOIS.** Section 20-43 of the Illinois Procurement Code (30 ILCS 500/20-43) provides that a person (other than an individual acting as a sole proprietor) must be a legal entity authorized to do business in the State of Illinois prior to submitting the bid.

9. **The services of a subcontractor will or may be used.**

Check box Yes
 Check box No

For known subcontractors with subcontracts with an annual value of more than \$25,000, the contract shall include their name, address, and the dollar allocation for each subcontractor.

ILLINOIS DEPARTMENT OF TRANSPORTATION
 SCHEDULE OF PRICES
 CONTRACT
 NUMBER - 62392

State Job # - C-91-057-02
 PPS NBR - 1-72189-0700
 County Name - COOK--
 Code - 31 - -
 District - 1 - -
 Section Number - 0102.1S

Project Number

Route
 FAI 190

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
X0301028	PUMP STA SCADA EQUIP	L SUM	1.000				
X0325162	CH LK CANT SL GT 8X20	EACH	1.000				
X0335700	P.S. GENERAL WORK	L SUM	1.000				
X0783300	P.S. ELECTRICAL WORK	L SUM	1.000				
X0783500	P.S. MECHANICAL WORK	L SUM	1.000				
X2020502	BRACED EXCAVATION	CU YD	12,000.000				
X6640570	CH LK FENCE 8 SPL	FOOT	500.000				
X8040305	ELECT SERV CONNECT	L SUM	1.000				
20200100	EARTH EXCAVATION	CU YD	1,100.000				
35102400	AGG BASE CSE B 12	SQ YD	2,060.000				
40600100	BIT MATLS PR CT	GALLON	206.000				
40603080	HMA BC IL-19.0 N50	TON	290.000				
40603310	HMA SC "C" N50	TON	175.000				
50300225	CONC STRUCT	CU YD	3,200.000				
50500405	F & E STRUCT STEEL	POUND	3,000.000				

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 CONTRACT
 NUMBER - 62392

State Job # - C-91-057-02
 PPS NBR - 1-72189-0700
 County Name - COOK- -
 Code - 31 - -
 District - 1 - -
 Section Number - 0102.1S

Project Number

Route
 FAI 190

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
50800205	REINF BARS, EPOXY CTD	POUND	434,500.000				
51603000	DRILLED SHAFT IN SOIL	CU YD	45.000				
66400305	CH LK FENCE 6	FOOT	420.000				
66404600	CH LK GATE 8X3 SINGL	EACH	1.000				
66408200	CH LK GATES 6X24 DBL	EACH	1.000				
66409800	CH LK GATES 8X20 DBL	EACH	1.000				
67000400	ENGR FIELD OFFICE A	CAL MO	24.000				
67100100	MOBILIZATION	L SUM	1.000				

CONTRACT NUMBER 62392

THIS IS THE TOTAL BID \$ _____

NOTES:

1. Each PAY ITEM should have a UNIT PRICE and a TOTAL PRICE.
2. The UNIT PRICE shall govern if no TOTAL PRICE is shown or if there is a discrepancy between the product of the UNIT PRICE multiplied by the QUANTITY.
3. If a UNIT PRICE is omitted, the TOTAL PRICE will be divided by the QUANTITY in order to establish a UNIT PRICE.
4. A bid may be declared UNACCEPTABLE if neither a unit price nor a total price is shown.

RETURN WITH BID

STATE REQUIRED ETHICAL STANDARDS GOVERNING CONTRACT PROCUREMENT: ASSURANCES, CERTIFICATIONS AND DISCLOSURES

I. GENERAL

A. Article 50 of the Illinois Procurement Code establishes the duty of all State chief procurement officers, State purchasing officers, and their designees to maximize the value of the expenditure of public moneys in procuring goods, services, and contracts for the State of Illinois and to act in a manner that maintains the integrity and public trust of State government. In discharging this duty, they are charged by law to use all available information, reasonable efforts, and reasonable actions to protect, safeguard, and maintain the procurement process of the State of Illinois.

B. In order to comply with the provisions of Article 50 and to carry out the duty established therein, all bidders are to adhere to ethical standards established for the procurement process, and to make such assurances, disclosures and certifications required by law. Except as otherwise required in subsection III, paragraphs J-M, by execution of the Proposal Signature Sheet, the bidder indicates that each of the mandated assurances have been read and understood, that each certification is made and understood, and that each disclosure requirement has been understood and completed.

C. In addition to all other remedies provided by law, failure to comply with any assurance, failure to make any disclosure or the making of a false certification shall be grounds for the chief procurement officer to void the contract, or subcontract, and may result in the suspension or debarment of the bidder or subcontractor.

II. ASSURANCES

The assurances hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder.

A. Conflicts of Interest

1. The Illinois Procurement Code provides in pertinent part:

Section 50-13. Conflicts of Interest.

(a) Prohibition. It is unlawful for any person holding an elective office in this State, holding a seat in the General Assembly, or appointed to or employed in any of the offices or agencies of state government and who receives compensation for such employment in excess of 60% of the salary of the Governor of the State of Illinois, or who is an officer or employee of the Capital Development Board or the Illinois Toll Highway Authority, or who is the spouse or minor child of any such person to have or acquire any contract, or any direct pecuniary interest in any contract therein, whether for stationery, printing, paper, or any services, materials, or supplies, that will be wholly or partially satisfied by the payment of funds appropriated by the General Assembly of the State of Illinois or in any contract of the Capital Development Board or the Illinois Toll Highway authority.

(b) Interests. It is unlawful for any firm, partnership, association or corporation, in which any person listed in subsection (a) is entitled to receive (i) more than 7 1/2% of the total distributable income or (ii) an amount in excess of the salary of the Governor, to have or acquire any such contract or direct pecuniary interest therein.

(c) Combined interests. It is unlawful for any firm, partnership, association, or corporation, in which any person listed in subsection (a) together with his or her spouse or minor children is entitled to receive (i) more than 15%, in the aggregate, of the total distributable income or (ii) an amount in excess of 2 times the salary of the Governor, to have or acquire any such contract or direct pecuniary interest therein.

(d) Securities. Nothing in this Section invalidates the provisions of any bond or other security previously offered or to be offered for sale or sold by or for the State of Illinois.

(e) Prior interests. This Section does not affect the validity of any contract made between the State and an officer or employee of the State or member of the General Assembly, his or her spouse, minor child or any combination of those persons if that contract was in existence before his or her election or employment as an officer, member, or employee. The contract is voidable, however, if it cannot be completed within 365 days after the officer, member, or employee takes office or is employed.

The current salary of the Governor is \$177,412.00. Sixty percent of the salary is \$106,447.20.

RETURN WITH BID

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-13, or that an effective exemption has been issued by the Board of Ethics to any individual subject to the Section 50-13 prohibitions pursuant to the provisions of Section 50-20 of the Code and Executive Order Number 3 (1998). Information concerning the exemption process is available from the Department upon request.

B. Negotiations

1. The Illinois Procurement Code provides in pertinent part:

Section 50-15. Negotiations.

(a) It is unlawful for any person employed in or on a continual contractual relationship with any of the offices or agencies of State government to participate in contract negotiations on behalf of that office or agency with any firm, partnership, association, or corporation with whom that person has a contract for future employment or is negotiating concerning possible future employment.

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-15, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

C. Inducements

1. The Illinois Procurement Code provides:

Section 50-25. Inducement. Any person who offers or pays any money or other valuable thing to any person to induce him or her not to bid for a State contract or as recompense for not having bid on a State contract is guilty of a Class 4 felony. Any person who accepts any money or other valuable thing for not bidding for a State contract or who withholds a bid in consideration of the promise for the payment of money or other valuable thing is guilty of a Class 4 felony.

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-25, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

D. Revolving Door Prohibition

1. The Illinois Procurement Code provides:

Section 50-30. Revolving door prohibition. Chief procurement officers, State purchasing officers, procurement compliance monitors, their designees whose principal duties are directly related to State procurement, and executive officers confirmed by the Senate are expressly prohibited for a period of 2 years after terminating an affected position from engaging in any procurement activity relating to the State agency most recently employing them in an affected position for a period of at least 6 months. The prohibition includes, but is not limited to: lobbying the procurement process; specifying; bidding; proposing bid, proposal, or contract documents; on their own behalf or on behalf of any firm, partnership, association, or corporation. This Section applies only to persons who terminate an affected position on or after January 15, 1999.

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-30, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

E. Reporting Anticompetitive Practices

1. The Illinois Procurement Code provides:

Section 50-40. Reporting anticompetitive practices. When, for any reason, any vendor, bidder, contractor, chief procurement officer, State purchasing officer, designee, elected official, or State employee suspects collusion or other anticompetitive practice among any bidders, offerors, contractors, proposers, or employees of the State, a notice of the relevant facts shall be transmitted to the Attorney General and the chief procurement officer.

2. The bidder assures the Department that it has not failed to report any relevant facts concerning the practices addressed in Section 50-40 which may involve the contract for which the bid is submitted.

F. Confidentiality

1. The Illinois Procurement Code provides:

Section 50-45. Confidentiality. Any chief procurement officer, State purchasing officer, designee, or executive officer who willfully uses or allows the use of specifications, competitive bid documents, proprietary competitive information, proposals, contracts, or selection information to compromise the fairness or integrity of the procurement, bidding, or contract process shall be subject to immediate dismissal, regardless of the Personnel code, any contract, or any collective bargaining agreement, and may in addition be subject to criminal prosecution.

2. The bidder assures the Department that it has no knowledge of any fact relevant to the practices addressed in Section 50-45 which may involve the contract for which the bid is submitted.

RETURN WITH BID

G. Insider Information

1. The Illinois Procurement Act provides:

Section 50-50. Insider information. It is unlawful for any current or former elected or appointed State official or State employee to knowingly use confidential information available only by virtue of that office or employment for actual or anticipated gain for themselves or another person.

2. The bidder assures the Department that it has no knowledge of any facts relevant to the practices addressed in Section 50-50 which may involve the contract for which the bid is submitted.

III. CERTIFICATIONS

The certifications hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder. Section 50-2 of the Illinois Procurement Code provides that every person that has entered into a multi-year contract and every subcontractor with a multi-year subcontract shall certify, by July 1 of each fiscal year covered by the contract after the initial fiscal year, to the responsible chief procurement officer whether it continues to satisfy the requirements of Article 50 pertaining to the eligibility for a contract award. If a contractor or subcontractor is not able to truthfully certify that it continues to meet all requirements, it shall provide with its certification a detailed explanation of the circumstances leading to the change in certification status. A contractor or subcontractor that makes a false statement material to any given certification required under Article 50 is, in addition to any other penalties or consequences prescribed by law, subject to liability under the Whistleblower Reward and Protection Act for submission of a false claim.

A. Bribery

1. The Illinois Procurement Code provides:

Section 50-5. Bribery.

(a) Prohibition. No person or business shall be awarded a contract or subcontract under this Code who:

(1) has been convicted under the laws of Illinois or any other state of bribery or attempting to bribe an officer or employee of the State of Illinois or any other state in that officer's or employee's official capacity; or

(2) has made an admission of guilt of that conduct that is a matter of record but has not been prosecuted for that conduct.

(b) Businesses. No business shall be barred from contracting with any unit of State or local government, or subcontracting under such a contract, as a result of a conviction under this Section of any employee or agent of the business if the employee or agent is no longer employed by the business and:

(1) the business has been finally adjudicated not guilty; or

(2) the business demonstrates to the governmental entity with which it seeks to contract, or which is signatory to the contract which the subcontract relates, and that entity finds that the commission of the offense was not authorized, requested, commanded, or performed by a director, officer, or high managerial agent on behalf of the business as provided in paragraph (2) of subsection (a) of Section 5-4 of the Criminal Code of 1961.

(c) Conduct on behalf of business. For purposes of this Section, when an official, agent, or employee of a business committed the bribery or attempted bribery on behalf of the business and in accordance with the direction or authorization of a responsible official of the business, the business shall be chargeable with the conduct.

(d) Certification. Every bid submitted to and contract executed by the State, and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the contractor or the subcontractor, respectively, that the contractor or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any certifications required by this Section are false. A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

2. The contractor or subcontractor certifies that it is not barred from being awarded a contract under Section 50.5.

B. Felons

1. The Illinois Procurement Code provides:

Section 50-10. Felons. Unless otherwise provided, no person or business convicted of a felony shall do business with the State of Illinois or any State agency, or enter into a subcontract, from the date of conviction until 5 years after the date of completion of the sentence for that felony, unless no person held responsible by a prosecutorial office for the facts upon which the conviction was based continues to have any involvement with the business.

2. Certification. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder or contractor or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any of the certifications required by this Section are false.

RETURN WITH BID

C. Debt Delinquency

1. The Illinois Procurement Code provides:

Section 50-11 and 50-12. Debt Delinquency.

The contractor or bidder or subcontractor, respectively, certifies that it, or any affiliate, is not barred from being awarded a contract or subcontract under the Procurement Code. Section 50-11 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it knows or should know that it, or any affiliate, is delinquent in the payment of any debt to the State as defined by the Debt Collection Board. Section 50-12 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it, or any affiliate, has failed to collect and remit Illinois Use Tax on all sales of tangible personal property into the State of Illinois in accordance with the provisions of the Illinois Use Tax Act. The bidder or contractor or subcontractor, respectively, further acknowledges that the chief procurement officer may declare the related contract void if this certification is false or if the bidder, contractor, or subcontractor, or any affiliate, is determined to be delinquent in the payment of any debt to the State during the term of the contract.

D. Prohibited Bidders, Contractors and Subcontractors

1. The Illinois Procurement Code provides:

Section 50-10.5 and 50-60(c). Prohibited bidders, contractors and subcontractors.

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-10.5 that no officer, director, partner or other managerial agent of the contracting business has been convicted of a felony under the Sarbanes-Oxley Act of 2002 or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953 or if in violation of Subsection (c) for a period of five years from the date of conviction. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder, contractor, or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer shall declare the related contract void if any of the certifications completed pursuant to this Section are false.

E. Section 42 of the Environmental Protection Act

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-12 that the bidder, contractor, or subcontractor, is not barred from being awarded a contract or entering into a subcontract under this Section which prohibits the bidding on or entering into contracts with the State of Illinois or a State agency, or entering into any subcontract, that is subject to the Procurement Code by a person or business found by a court or the Pollution Control Board to have committed a willful or knowing violation of Section 42 of the Environmental Protection Act for a period of five years from the date of the order. The bidder or contractor or subcontractor, respectively, acknowledges that the chief procurement officer may declare the contract void if this certification is false.

F. Educational Loan

1. Section 3 of the Educational Loan Default Act provides:

§ 3. No State agency shall contract with an individual for goods or services if that individual is in default, as defined in Section 2 of this Act, on an educational loan. Any contract used by any State agency shall include a statement certifying that the individual is not in default on an educational loan as provided in this Section.

2. The bidder, if an individual as opposed to a corporation, partnership or other form of business organization, certifies that the bidder is not in default on an educational loan as provided in Section 3 of the Act.

G. Bid-Rigging/Bid Rotating

1. Section 33E-11 of the Criminal Code of 1961 provides:

§ 33E-11. (a) Every bid submitted to and public contract executed pursuant to such bid by the State or a unit of local government shall contain a certification by the prime contractor that the prime contractor is not barred from contracting with any unit of State or local government as a result of a violation of either Section 33E-3 or 33E-4 of this Article. The State and units of local government shall provide the appropriate forms for such certification.

- (b) A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

A violation of Section 33E-3 would be represented by a conviction of the crime of bid-rigging which, in addition to Class 3 felony sentencing, provides that any person convicted of this offense or any similar offense of any state or the United States which contains the same elements as this offense shall be barred for 5 years from the date of conviction from contracting with any unit of State or local government. No corporation shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation and: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract and that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent in behalf of the corporation.

RETURN WITH BID

A violation of Section 33E-4 would be represented by a conviction of the crime of bid-rotating which, in addition to Class 2 felony sentencing, provides that any person convicted of this offense or any similar offense of any state or the United States which contains the same elements as this offense shall be permanently barred from contracting with any unit of State or local government. No corporation shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation and: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract and that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent in behalf of the corporation.

2. The bidder certifies that it is not barred from contracting with the Department by reason of a violation of either Section 33E-3 or Section 33E-4.

H. International Anti-Boycott

1. Section 5 of the International Anti-Boycott Certification Act provides:

§ 5. State contracts. Every contract entered into by the State of Illinois for the manufacture, furnishing, or purchasing of supplies, material, or equipment or for the furnishing of work, labor, or services, in an amount exceeding the threshold for small purchases according to the purchasing laws of this State or \$10,000.00, whichever is less, shall contain certification, as a material condition of the contract, by which the contractor agrees that neither the contractor nor any substantially-owned affiliated company is participating or shall participate in an international boycott in violation of the provisions of the U.S. Export Administration Act of 1979 or the regulations of the U.S. Department of Commerce promulgated under that Act.

2. The bidder makes the certification set forth in Section 5 of the Act.

I. Drug Free Workplace

1. The Illinois "Drug Free Workplace Act" applies to this contract and it is necessary to comply with the provisions of the "Act" if the contractor is a corporation, partnership, or other entity (including a sole proprietorship) which has 25 or more employees.

2. The bidder certifies that if awarded a contract in excess of \$5,000 it will provide a drug free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensation, possession or use of a controlled substance, including cannabis, is prohibited in the contractor's workplace; specifying the actions that will be taken against employees for violations of such prohibition; and notifying the employee that, as a condition of employment on such contract, the employee shall abide by the terms of the statement, and notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction.

(b) Establishing a drug free awareness program to inform employees about the dangers of drug abuse in the workplace; the contractor's policy of maintaining a drug free workplace; any available drug counseling, rehabilitation, and employee assistance programs; and the penalties that may be imposed upon employees for drug violations.

(c) Providing a copy of the statement required by subparagraph (1) to each employee engaged in the performance of the contract and to post the statement in a prominent place in the workplace.

(d) Notifying the Department within ten (10) days after receiving notice from an employee or otherwise receiving actual notice of the conviction of an employee for a violation of any criminal drug statute occurring in the workplace.

(e) Imposing or requiring, within 30 days after receiving notice from an employee of a conviction or actual notice of such a conviction, an appropriate personnel action, up to and including termination, or the satisfactory participation in a drug abuse assistance or rehabilitation program approved by a federal, state or local health, law enforcement or other appropriate agency.

(f) Assisting employees in selecting a course of action in the event drug counseling, treatment, and rehabilitation is required and indicating that a trained referral team is in place.

(g) Making a good faith effort to continue to maintain a drug free workplace through implementation of the actions and efforts stated in this certification.

RETURN WITH BID

J. Disclosure of Business Operations in Iran

Section 50-36 of the Illinois Procurement Code, 30ILCS 500/50-36 provides that each bid, offer, or proposal submitted for a State contract shall include a disclosure of whether or not the Company acting as the bidder, offeror, or proposing entity, or any of its corporate parents or subsidiaries, within the 24 months before submission of the bid, offer, or proposal had business operations that involved contracts with or provision of supplies or services to the Government of Iran, companies in which the Government of Iran has any direct or indirect equity share, consortiums or projects commissioned by the Government of Iran, or companies involved in consortiums or projects commissioned by the Government of Iran and either of the following conditions apply:

- (1) More than 10% of the Company's revenues produced in or assets located in Iran involve oil-related activities or mineral-extraction activities; less than 75% of the Company's revenues produced in or assets located in Iran involve contracts with or provision of oil-related or mineral-extraction products or services to the Government of Iran or a project or consortium created exclusively by that government; and the Company has failed to take substantial action.
- (2) The Company has, on or after August 5, 1996, made an investment of \$20 million or more, or any combination of investments of at least \$10 million each that in the aggregate equals or exceeds \$20 million in any 12-month period, which directly or significantly contributes to the enhancement of Iran's ability to develop petroleum resources of Iran.

The terms "Business operations", "Company", "Mineral-extraction activities", "Oil-related activities", "Petroleum resources", and "Substantial action" are all defined in the Code.

Failure to make the disclosure required by the Code shall cause the bid, offer or proposal to be considered not responsive. The disclosure will be considered when evaluating the bid, offer, or proposal or awarding the contract. The name of each Company disclosed as doing business or having done business in Iran will be provided to the State Comptroller.

Check the appropriate statement:

Company has no business operations in Iran to disclose.

Company has business operations in Iran as disclosed the attached document.

K. Apprenticeship and Training Certification (Does not apply to federal aid projects)

In accordance with the provisions of Section 30-22 (6) of the Illinois Procurement Code, the bidder certifies that it is a participant, either as an individual or as part of a group program, in the approved apprenticeship and training programs applicable to each type of work or craft that the bidder will perform with its own forces. The bidder further certifies for work that will be performed by subcontract that each of its subcontractors submitted for approval either (a) is, at the time of such bid, participating in an approved, applicable apprenticeship and training program; or (b) will, prior to commencement of performance of work pursuant to this contract, begin participation in an approved apprenticeship and training program applicable to the work of the subcontract. The Department, at any time before or after award, may require the production of a copy of each applicable Certificate of Registration issued by the United States Department of Labor evidencing such participation by the contractor and any or all of its subcontractors. Applicable apprenticeship and training programs are those that have been approved and registered with the United States Department of Labor. The bidder shall list in the space below, the official name of the program sponsor holding the Certificate of Registration for all of the types of work or crafts in which the bidder is a participant and that will be performed with the bidder's forces. Types of work or craft work that will be subcontracted shall be included and listed as subcontract work. The list shall also indicate any type of work or craft job category that does not have an applicable apprenticeship or training program. **The bidder is responsible for making a complete report and shall make certain that each type of work or craft job category that will be utilized on the project as reported on the Construction Employee Workforce Projection (Form BC-1256) and returned with the bid is accounted for and listed.**

The requirements of this certification and disclosure are a material part of the contract, and the contractor shall require this certification provision to be included in all approved subcontracts. In order to fulfill this requirement, it shall not be necessary that an applicable program sponsor be currently taking or that it will take applications for apprenticeship, training or employment during the performance of the work of this contract.

TO BE RETURNED WITH BID

L. Political Contributions and Registration with the State Board of Elections

Sections 20-160 and 50-37 of the Illinois Procurement Code regulate political contributions from business entities and any affiliated entities or affiliated persons bidding on or contracting with the state. Generally under Section 50-37, any business entity, and any affiliated entity or affiliated person of the business entity, whose current year contracts with all state agencies exceed an awarded value of \$50,000, are prohibited from making any contributions to any political committees established to promote the candidacy of the officeholder responsible for the awarding of the contracts or any other declared candidate for that office for the duration of the term of office of the incumbent officeholder or a period 2 years after the termination of the contract, whichever is longer. Any business entity and affiliated entities or affiliated persons whose state contracts in the current year do not exceed an awarded value of \$50,000, but whose aggregate pending bids and proposals on state contracts exceed \$50,000, either alone or in combination with contracts not exceeding \$50,000, are prohibited from making any political contributions to any political committee established to promote the candidacy of the officeholder responsible for awarding the pending contract during the period beginning on the date the invitation for bids or request for proposals is issued and ending on the day after the date of award or selection if the entity was not awarded or selected. Section 20-160 requires certification of registration of affected business entities in accordance with procedures found in Section 9-35 of The Election Code.

By submission of a bid, the contractor business entity acknowledges and agrees that it has read and understands Sections 20-160 and 50-37 of the Illinois Procurement Code, and that it makes the following certification:

The undersigned business entity certifies that it has registered as a business with the State Board of Elections and acknowledges a continuing duty to update the registration in accordance with the above referenced statutes. A copy of the certificate of registration shall be submitted with the bid. The bidder is cautioned that the Department will not award a contract without submission of the certificate of registration.

These requirements and compliance with the above referenced statutory sections are a material part of the contract, and any breach thereof shall be cause to void the contract under Section 50-60 of the Illinois Procurement Code. This provision does not apply to Federal-aid contracts.

M. Lobbyist Disclosure

Section 50-38 of the Illinois Procurement Code requires that any bidder or offeror on a State contract that hires a person required to register under the Lobbyist Registration Act to assist in obtaining a contract shall:

- (i) Disclose all costs, fees, compensation, reimbursements, and other remunerations paid or to be paid to the lobbyist related to the contract,
- (ii) Not bill or otherwise cause the State of Illinois to pay for any of the lobbyist's costs, fees, compensation, reimbursements, or other remuneration, and
- (iii) Sign a verification certifying that none of the lobbyist's costs, fees, compensation, reimbursements, or other remuneration were billed to the State.

This information, along with all supporting documents, shall be filed with the agency awarding the contract and with the Secretary of State. The chief procurement officer shall post this information, together with the contract award notice, in the online Procurement Bulletin.

Pursuant to Subsection (c) of this Section, no person or entity shall retain a person or entity to attempt to influence the outcome of a procurement decision made under the Procurement Code for compensation contingent in whole or in part upon the decision or procurement. Any person who violates this subsection is guilty of a business offense and shall be fined not more than \$10,000.

Bidder acknowledges that it is required to disclose the hiring of any person required to register pursuant to the Illinois Lobbyist Registration Act (25 ILCS 170) in connection with this contract.

Bidder has not hired any person required to register pursuant to the Illinois Lobbyist Registration Act in connection with this contract.

Or

Bidder has hired the following persons required to register pursuant to the Illinois Lobbyist Registration Act in connection with the contract:

Name and address of person: _____
All costs, fees, compensation, reimbursements and other remuneration paid to said person: _____

RETURN WITH BID

IV. DISCLOSURES

- A. The disclosures hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder. The bidder further certifies that the Department has received the disclosure forms for each bid.

The chief procurement officer may void the bid, contract, or subcontract, respectively, if it is later determined that the bidder or subcontractor rendered a false or erroneous disclosure. A contractor or subcontractor may be suspended or debarred for violations of the Procurement Code. Furthermore, the chief procurement officer may void the contract and the surety providing the performance bond shall be responsible for completion of the contract.

B. Financial Interests and Conflicts of Interest

1. Section 50-35 of the Illinois Procurement Code provides that all bids of more than \$25,000 shall be accompanied by disclosure of the financial interests of the bidder. This disclosed information for the successful bidder, will be maintained as public information subject to release by request pursuant to the Freedom of Information Act, filed with the Procurement Policy Board, and shall be incorporated as a material term of the contract. Furthermore, pursuant to Section 5-5, the Procurement Policy Board may review a proposal, bid, or contract and issue a recommendation to void a contract or reject a proposal or bid based on any violation of the Procurement Code or the existence of a conflict of interest as provided in subsections (b) and (d) of Section 50-35.

The financial interests to be disclosed shall include ownership or distributive income share that is in excess of 5%, or an amount greater than 60% of the annual salary of the Governor, of the bidding entity or its parent entity, whichever is less, unless the contractor or bidder is a publicly traded entity subject to Federal 10K reporting, in which case it may submit its 10K disclosure in place of the prescribed disclosure. If a bidder is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. The disclosure shall include the names, addresses, and dollar or proportionate share of ownership of each person making the disclosure, their instrument of ownership or beneficial relationship, and notice of any potential conflict of interest resulting from the current ownership or beneficial interest of each person making the disclosure having any of the relationships identified in Section 50-35 and on the disclosure form.

The current annual salary of the Governor is \$177,412.00

In addition, all disclosures shall indicate any other current or pending contracts, proposals, leases, or other ongoing procurement relationships the bidding entity has with any other unit of state government and shall clearly identify the unit and the contract, proposal, lease, or other relationship.

2. Disclosure Forms. Disclosure Form A is attached for use concerning the individuals meeting the above ownership or distributive share requirements. Subject individuals should be covered each by one form. In addition, a second form (Disclosure Form B) provides for the disclosure of current or pending procurement relationships with other (non-IDOT) state agencies. **The forms must be included with each bid.**

C. Disclosure Form Instructions

Form A Instructions for Financial Information & Potential Conflicts of Interest

If the bidder is a publicly traded entity subject to Federal 10K reporting, the 10K Report may be submitted to meet the requirements of Form A. If a bidder is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. If a bidder is not subject to Federal 10K reporting, the bidder must determine if any individuals are required by law to complete a financial disclosure form. To do this, the bidder should answer each of the following questions. A "YES" answer indicates Form A must be completed. If the answer to each of the following questions is "NO", then the NOT APPLICABLE STATEMENT on Form A must be signed and dated by a person that is authorized to execute contracts for the bidding company. Note: These questions are for assistance only and are not required to be completed.

1. Does anyone in your organization have a direct or beneficial ownership share of greater than 5% of the bidding entity or parent entity? YES ___ NO ___
2. Does anyone in your organization have a direct or beneficial ownership share of less than 5%, but which has a value greater than 60% of the annual salary of the Governor? YES ___ NO ___
3. Does anyone in your organization receive more than 60% of the annual salary of the Governor of the bidding entity's or parent entity's distributive income? YES ___ NO ___

(Note: Distributive income is, for these purposes, any type of distribution of profits. An annual salary is not distributive income.)

4. Does anyone in your organization receive greater than 5% of the bidding entity's or parent entity's total distributive income, but which is less than 60% of the annual salary of the Governor? YES ___ NO ___

(Note: Only one set of forms needs to be completed per person per bid even if a specific individual would require a yes answer to more than one question.)

A "YES" answer to any of these questions requires the completion of Form A. The bidder must determine each individual in the bidding entity or the bidding entity's parent company that would cause the questions to be answered "Yes". Each form must be signed and dated by a person that is authorized to execute contracts for your organization. **Photocopied or stamped signatures are not acceptable.** The person signing can be, but does not have to be, the person for which the form is being completed. The bidder is responsible for the accuracy of any information provided.

If the answer to each of the above questions is "NO", then the NOT APPLICABLE STATEMENT of Form A must be signed and dated by a person that is authorized to execute contracts for your company.

RETURN WITH BID

Form B: Instructions for Identifying Other Contracts & Procurement Related Information

Disclosure Form B must be completed for each bid submitted by the bidding entity. *Note: Checking the NOT APPLICABLE STATEMENT on Form A does not allow the bidder to ignore Form B. Form B must be completed, checked, and dated or the bidder may be considered nonresponsive and the bid will not be accepted.*

The Bidder shall identify, by checking Yes or No on Form B, whether it has any pending contracts (including leases), bids, proposals, or other ongoing procurement relationship with any other (non-IDOT) State of Illinois agency. If "No" is checked, the bidder only needs to complete the check box on the bottom of Form B. If "Yes" is checked, the bidder must do one of the following:

Option I: If the bidder did not submit an Affidavit of Availability to obtain authorization to bid, the bidder must list all non-IDOT State of Illinois agency pending contracts, leases, bids, proposals, and other ongoing procurement relationships. These items may be listed on Form B or on an attached sheet(s). Do not include IDOT contracts. Contracts with cities, counties, villages, etc. are not considered State of Illinois agency contracts and are not to be included. Contracts with other State of Illinois agencies such as the Department of Natural Resources or the Capital Development Board must be included. Bidders who submit Affidavits of Availability are suggested to use Option II.

Option II: If the bidder is required and has submitted an Affidavit of Availability in order to obtain authorization to bid, the bidder may write or type "See Affidavit of Availability" which indicates that the Affidavit of Availability is incorporated by reference and includes all non-IDOT State of Illinois agency pending contracts, leases, bids, proposals, and other ongoing procurement relationships. For any contracts that are not covered by the Affidavit of Availability, the bidder must identify them on Form B or on an attached sheet(s). These might be such things as leases.

**ILLINOIS DEPARTMENT
OF TRANSPORTATION**

**Form A
Financial Information &
Potential Conflicts of Interest
Disclosure**

Contractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Code (30 ILCS 500). Vendors desiring to enter into a contract with the State of Illinois must disclose the financial information and potential conflict of interest information as specified in this Disclosure Form. This information shall become part of the publicly available contract file. This Form A must be completed for bids in excess of \$25,000, and for all open-ended contracts. **A publicly traded company may submit a 10K disclosure (or equivalent if applicable) in satisfaction of the requirements set forth in Form A. See Disclosure Form Instructions.**

The current annual salary of the Governor is \$177,412.00.

DISCLOSURE OF FINANCIAL INFORMATION

1. Disclosure of Financial Information. The individual named below has an interest in the BIDDER (or its parent) in terms of ownership or distributive income share in excess of 5%, or an interest which has a value of more than 60% of the annual salary of the Governor. **(Make copies of this form as necessary and attach a separate Disclosure Form A for each individual meeting these requirements)**

FOR INDIVIDUAL (type or print information)	
NAME:	_____
ADDRESS	_____
Type of ownership/distributable income share:	
stock _____ sole proprietorship _____ Partnership _____ other: (explain on separate sheet):	
% or \$ value of ownership/distributable income share:	_____

2. Disclosure of Potential Conflicts of Interest. Check "Yes" or "No" to indicate which, if any, of the following potential conflict of interest relationships apply. If the answer to any question is "Yes", please attach additional pages and describe.

- (a) State employment, currently or in the previous 3 years, including contractual employment of services. Yes ___ No ___

If your answer is yes, please answer each of the following questions.

- Are you currently an officer or employee of either the Capitol Development Board or the Illinois State Toll Highway Authority? Yes ___ No ___
- Are you currently appointed to or employed by any agency of the State of Illinois? If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, provide the name the State agency for which you are employed and your annual salary. _____

RETURN WITH BID

3. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of two times the salary of the Governor?
Yes ___ No ___

(b) State employment of spouse, father, mother, son, or daughter, including contractual employment services in the previous 2 years.

Yes ___ No ___

If your answer is yes, please answer each of the following questions.

1. Is your spouse or any minor children currently an officer or employee of the Capitol Development Board or the Illinois State Toll Highway Authority?
Yes ___ No ___

2. Is your spouse or any minor children currently appointed to or employed by any agency of the State of Illinois? If your spouse or minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, provide the name of your spouse and/or minor children, the name of the State agency for which he/she is employed and his/her annual salary. _____

3. If your spouse or any minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, as of 7/1/07 are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If your spouse or any minor children are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 2 times the salary of the Governor?
Yes ___ No ___

(c) Elective status; the holding of elective office of the State of Illinois, the government of the United States, any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois currently or in the previous 3 years.
Yes ___ No ___

(d) Relationship to anyone holding elective office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(e) Appointive office; the holding of any appointive government office of the State of Illinois, the United States of America, or any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois, which office entitles the holder to compensation in excess of the expenses incurred in the discharge of that office currently or in the previous 3 years.
Yes ___ No ___

(f) Relationship to anyone holding appointive office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(g) Employment, currently or in the previous 3 years, as or by any registered lobbyist of the State government.
Yes ___ No ___

RETURN WITH BID/OFFER

(h) Relationship to anyone who is or was a registered lobbyist in the previous 2 years; spouse, father, mother, son, or daughter. Yes ___ No ___

(i) Compensated employment, currently or in the previous 3 years, by any registered election or reelection committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

(j) Relationship to anyone; spouse, father, mother, son, or daughter; who was a compensated employee in the last 2 years by any registered election or re-election committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

2. Communication Disclosure.

Disclose the name and address of each lobbyist and other agent of the bidder or offeror who is not identified in Section 2 of this form, who is has communicated, is communicating, or may communicate with any State officer or employee concerning the bid or offer. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the process and throughout the term of the contract. If no person is identified, enter "None" on the line below:

Name and address of person(s): _____

RETURN WITH BID

4. Debarment Disclosure. For each of the persons identified under Sections 2 and 3 of this form, disclose whether any of the following has occurred within the previous 10 years: debarment from contracting with any governmental entity; professional licensure discipline; bankruptcies; adverse civil judgments and administrative findings; and criminal felony convictions. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the procurement process and term of the contract. If no person is identified, enter "None" on the line below:

Name of person(s): _____

Nature of disclosure: _____

APPLICABLE STATEMENT

This Disclosure Form A is submitted on behalf of the INDIVIDUAL named on previous page. Under penalty of perjury, I certify the contents of this disclosure to be true and accurate to the best of my knowledge.

Completed by: _____ Date _____
Signature of Individual or Authorized Representative

NOT APPLICABLE STATEMENT

Under penalty of perjury, I have determined that no individuals associated with this organization meet the criteria that would require the completion of this Form A.

This Disclosure Form A is submitted on behalf of the CONTRACTOR listed on the previous page.

_____ Date _____
Signature of Authorized Representative

The bidder has a continuing obligation to supplement these disclosures under Sec. 50-35 of the Procurement Code.

RETURN WITH BID

ILLINOIS DEPARTMENT OF TRANSPORTATION

Form B Other Contracts & Procurement Related Information Disclosure

Contractor Name, Legal Address, City, State, Zip, Telephone Number, Email Address, Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Act (30 ILCS 500). This information shall become part of the publicly available contract file. This Form B must be completed for bids in excess of \$25,000, and for all open-ended contracts.

DISCLOSURE OF OTHER CONTRACTS AND PROCUREMENT RELATED INFORMATION

1. Identifying Other Contracts & Procurement Related Information. The BIDDER shall identify whether it has any pending contracts (including leases), bids, proposals, or other ongoing procurement relationship with any other State of Illinois agency: Yes ___ No ___

If "No" is checked, the bidder only needs to complete the signature box on the bottom of this page.

2. If "Yes" is checked. Identify each such relationship by showing State of Illinois agency name and other descriptive information such as bid or project number (attach additional pages as necessary). SEE DISCLOSURE FORM INSTRUCTIONS:

THE FOLLOWING STATEMENT MUST BE CHECKED

Signature of Authorized Representative, Date

RETURN WITH BID

SPECIAL NOTICE TO CONTRACTORS

The following requirements of the Illinois Department of Human Rights' Rules and Regulations are applicable to bidders on all construction contracts advertised by the Illinois Department of Transportation:

CONSTRUCTION EMPLOYEE UTILIZATION PROJECTION

- (a) All bidders on construction contracts shall complete and submit, along with and as part of their bids, a Bidder's Employee Utilization Form (Form BC-1256) setting forth a projection and breakdown of the total workforce intended to be hired and/or allocated to such contract work by the bidder including a projection of minority and female employee utilization in all job classifications on the contract project.
- (b) The Department of Transportation shall review the Employee Utilization Form, and workforce projections contained therein, of the contract awardee to determine if such projections reflect an underutilization of minority persons and/or women in any job classification in accordance with the Equal Employment Opportunity Clause and Section 7.2 of the Illinois Department of Human Rights' Rules and Regulations for Public Contracts adopted as amended on September 17, 1980. If it is determined that the contract awardee's projections reflect an underutilization of minority persons and/or women in any job classification, it shall be advised in writing of the manner in which it is underutilizing and such awardee shall be considered to be in breach of the contract unless, prior to commencement of work on the contract project, it submits revised satisfactory projections or an acceptable written affirmative action plan to correct such underutilization including a specific timetable geared to the completion stages of the contract.
- (c) The Department of Transportation shall provide to the Department of Human Rights a copy of the contract awardee's Employee Utilization Form, a copy of any required written affirmative action plan, and any written correspondence related thereto. The Department of Human Rights may review and revise any action taken by the Department of Transportation with respect to these requirements.

RETURN WITH BID

**Contract No. 62392
COOK County
Section 0102.1S
Route FAI 190
District 1 Construction Funds**

PART II. WORKFORCE PROJECTION - continued

- B. Included in "Total Employees" under Table A is the total number of **new hires** that would be employed in the event the undersigned bidder is awarded this contract.

The undersigned bidder projects that: (number) _____ new hires would be recruited from the area in which the contract project is located; and/or (number) _____ new hires would be recruited from the area in which the bidder's principal office or base of operation is located.

- C. Included in "Total Employees" under Table A is a projection of numbers of persons to be employed directly by the undersigned bidder as well as a projection of numbers of persons to be employed by subcontractors.

The undersigned bidder estimates that (number) _____ persons will be directly employed by the prime contractor and that (number) _____ persons will be employed by subcontractors.

PART III. AFFIRMATIVE ACTION PLAN

- A. The undersigned bidder understands and agrees that in the event the foregoing minority and female employee utilization projection included under **PART II** is determined to be an underutilization of minority persons or women in any job category, and in the event that the undersigned bidder is awarded this contract, he/she will, prior to commencement of work, develop and submit a written Affirmative Action Plan including a specific timetable (geared to the completion stages of the contract) whereby deficiencies in minority and/or female employee utilization are corrected. Such Affirmative Action Plan will be subject to approval by the contracting agency and the **Department of Human Rights**.
- B. The undersigned bidder understands and agrees that the minority and female employee utilization projection submitted herein, and the goals and timetable included under an Affirmative Action Plan if required, are deemed to be part of the contract specifications.

Company _____ Telephone Number _____

Address _____

NOTICE REGARDING SIGNATURE

The Bidder's signature on the Proposal Signature Sheet will constitute the signing of this form. The following signature block needs to be completed if revisions are required.

Signature: _____ Title: _____ Date: _____

Instructions: All tables must include subcontractor personnel in addition to prime contractor personnel.

Table A - Include both the number of employees that would be hired to perform the contract work and the total number currently employed (Table B) that will be allocated to contract work, and include all apprentices and on-the-job trainees. The "Total Employees" column should include all employees including all minorities, apprentices and on-the-job trainees to be employed on the contract work.

Table B - Include all employees currently employed that will be allocated to the contract work including any apprentices and on-the-job trainees currently employed.

Table C - Indicate the racial breakdown of the total apprentices and on-the-job trainees shown in Table A.

RETURN WITH BID
Contract No. 62392
COOK County
Section 0102.1S
Route FAI 190
District 1 Construction Funds

PROPOSAL SIGNATURE SHEET

The undersigned bidder hereby makes and submits this bid on the subject Proposal, thereby assuring the Department that all requirements of the Invitation for Bids and rules of the Department have been met, that there is no misunderstanding of the requirements of paragraph 3 of this Proposal, and that the contract will be executed in accordance with the rules of the Department if an award is made on this bid.

(IF AN INDIVIDUAL)

Firm Name _____

Signature of Owner _____

Business Address _____

(IF A CO-PARTNERSHIP)

Firm Name _____

By _____

Business Address _____

Name and Address of All Members of the Firm:

(IF A CORPORATION)

Corporate Name _____

By _____

Signature of Authorized Representative

Typed or printed name and title of Authorized Representative

Attest _____

Signature

(IF A JOINT VENTURE, USE THIS SECTION FOR THE MANAGING PARTY AND THE SECOND PARTY SHOULD SIGN BELOW)

Business Address _____

(IF A JOINT VENTURE)

Corporate Name _____

By _____

Signature of Authorized Representative

Typed or printed name and title of Authorized Representative

Attest _____

Signature

Business Address _____

If more than two parties are in the joint venture, please attach an additional signature sheet.



Return with Bid

Division of Highways
Proposal Bid Bond
(Effective November 1, 1992)

Item No.
Letting Date

KNOW ALL MEN BY THESE PRESENTS, That We

as PRINCIPAL, and

as SURETY, are held jointly, severally and firmly bound unto the STATE OF ILLINOIS in the penal sum of 5 percent of the total bid price, or for the amount specified in Article 102.09 of the "Standard Specifications for Road and Bridge Construction" in effect on the date of invitation for bids, whichever is the lesser sum, well and truly to be paid unto said STATE OF ILLINOIS, for the payment of which we bind ourselves, our heirs, executors, administrators, successors and assigns.

THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH, that whereas, the PRINCIPAL has submitted a bid proposal to the STATE OF ILLINOIS, acting through the Department of Transportation, for the improvement designated by the Transportation Bulletin Item Number and Letting Date indicated above.

NOW, THEREFORE, if the Department shall accept the bid proposal of the PRINCIPAL; and if the PRINCIPAL shall, within the time and as specified in the bidding and contract documents, submit a DBE Utilization Plan that is accepted and approved by the Department; and if, after award by the Department, the PRINCIPAL shall enter into a contract in accordance with the terms of the bidding and contract documents including evidence of the required insurance coverages and providing such bond as specified with good and sufficient surety for the faithful performance of such contract and for the prompt payment of labor and material furnished in the prosecution thereof; or if, in the event of the failure of the PRINCIPAL to make the required DBE submission or to enter into such contract and to give the specified bond, the PRINCIPAL pays to the Department the difference not to exceed the penalty hereof between the amount specified in the bid proposal and such larger amount for which the Department may contract with another party to perform the work covered by said bid proposal, then this obligation shall be null and void, otherwise, it shall remain in full force and effect.

IN THE EVENT the Department determines the PRINCIPAL has failed to comply with any requirement as set forth in the preceding paragraph, then Surety shall pay the penal sum to the Department within fifteen (15) days of written demand therefor. If Surety does not make full payment within such period of time, the Department may bring an action to collect the amount owed. Surety is liable to the Department for all its expenses, including attorney's fees, incurred in any litigation in which it prevails either in whole or in part.

In TESTIMONY WHEREOF, the said PRINCIPAL and the said SURETY have caused this instrument to be signed by their respective officers this day of A.D.,

PRINCIPAL SURETY
(Company Name) (Company Name)
By (Signature & Title) By: (Signature of Attorney-in-Fact)

Notary Certification for Principal and Surety

STATE OF ILLINOIS,
County of
I, , a Notary Public in and for said County, do hereby certify that
and
(Insert names of individuals signing on behalf of PRINCIPAL & SURETY)

who are each personally known to me to be the same persons whose names are subscribed to the foregoing instrument on behalf of PRINCIPAL and SURETY, appeared before me this day in person and acknowledged respectively, that they signed and delivered said instrument as their free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notarial seal this day of A.D.
My commission expires

Notary Public

In lieu of completing the above section of the Proposal Bid Form, the Principal may file an Electronic Bid Bond. By signing the proposal and marking the check box next to the Signature and Title line below, the Principal is ensuring the identified electronic bid bond has been executed and the Principal and Surety are firmly bound unto the State of Illinois under the conditions of the bid bond as shown above.

Electronic Bid Bond ID# Company / Bidder Name Signature and Title

(1) Policy

It is public policy that disadvantageded businesses as defined in 49 CFR Part 26 and the Special Provision shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with Federal or State funds. Consequently the requirements of 49 CFR Part 26 apply to this contract.

(2) Obligation

The contractor agrees to ensure that disadvantageded businesses as defined in 49 CFR Part 26 and the Special Provision have the maximum opportunity to participate in the performance of contracts or subcontracts financed in whole or in part with Federal or State funds. The contractor shall take all necessary and reasonable steps in accordance with 49 CFR Part 26 and the Special Provision to ensure that said businesses have the maximum opportunity to compete for and perform under this contract. The contractor shall not discriminate on the basis of race, color, national origin or sex in the award and performance of contracts.

(3) Project and Bid Identification

Complete the following information concerning the project and bid:

Route _____	Total Bid _____
Section _____	Contract DBE Goal _____ (Percent) _____ (Dollar Amount)
Project _____	
County _____	
Letting Date _____	
Contract No. _____	
Letting Item No. _____	

(4) Assurance

I, acting in my capacity as an officer of the undersigned bidder (or bidders if a joint venture), hereby assure the Department that on this project my company : (check one)

Meets or exceeds contract award goals and has provided documented participation as follows:
Disadvantaged Business Participation _____ percent

Attached are the signed participation statements, forms SBE 2025, required by the Special Provision evidencing availability and use of each business participating in this plan and assuring that each business will perform a commercially useful function in the work of the contract.

Failed to meet contract award goals and has included good faith effort documentation to meet the goals and that my company has provided participation as follows:

Disadvantaged Business Participation _____ percent

The contract goals should be accordingly modified or waived. Attached is all information required by the Special Provision in support of this request including good faith effort. Also attached are the signed participation statements, forms SBE 2025, required by the Special Provision evidencing availability and use of each business participating in this plan and assuring that each business will perform a commercially useful function in the work of the contract.

Company

By _____

Title _____

Date _____

The "as read" Low Bidder is required to comply with the Special Provision.

Submit only one utilization plan for each project. The utilization plan shall be submitted in accordance with the special provision.

Bureau of Small Business Enterprises **Local Let Projects**
2300 South Dirksen Parkway Submit forms to the
Springfield, Illinois 62764 Local Agency



Illinois Department of Transportation

DBE Participation Statement

Subcontractor Registration _____

Letting _____

Participation Statement

Item No. _____

(1) Instructions

Contract _____

This form must be completed for each disadvantaged business participating in the Utilization Plan. This form shall be submitted in accordance with the special provision and will be attached to the Utilization Plan form.. If additional space is needed complete an additional form for the firm.

(2) Work

Pay Item No.	Description	Quantity	Unit Price	Total
Total				

(3) Partial Payment Items

For any of the above items which are partial pay items, specifically describe the work and subcontract dollar amount:

(4) Commitment

The undersigned certify that the information included herein is true and correct, and that the DBE firm listed below has agreed to perform a commercially useful function in the work of the contract item(s) listed above and to execute a contract with the prime contractor. The undersigned further understand that no changes to this statement may be made without prior approval from the Department's Bureau of Small Business Enterprises and that complete and accurate information regarding actual work performed on this project and the payment therefore must be provided to the Department.

Signature for Prime Contractor

Signature for DBE Firm

Title _____

Title _____

Date _____

Date _____

Contact _____

Contact _____

Phone _____

Phone _____

Firm Name _____

Firm Name _____

Address _____

Address _____

City/State/Zip _____

City/State/Zi _____

E _____

WC _____

The Department of Transportation is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under the state and federal law. Disclosure of this information is **REQUIRED**. Failure to provide any information will result in the contract not being awarded. This form has been approved by the State Forms Management Center.

PROPOSAL ENVELOPE



PROPOSALS

for construction work advertised for bids by the
Illinois Department of Transportation

Item No.	Item No.	Item No.

Submitted By:

Name:
Address:
Phone No.

Bidders should use an IDOT proposal envelope or affix this form to the front of a 10" x 13" envelope for the submittal of bids. If proposals are mailed, they should be enclosed in a second or outer envelope addressed to:

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

NOTICE

Individual bids, including Bid Bond and/or supplemental information if required, should be securely stapled.

CONTRACTOR OFFICE COPY OF CONTRACT SPECIFICATIONS

NOTICE

None of the following material needs to be returned with the bid package unless the special provisions require documentation and/or other information to be submitted.

Contract No. 62392
COOK County
Section 0102.1S
Route FAI 190
District 1 Construction Funds



Illinois Department of Transportation

SUBCONTRACTOR DOCUMENTATION

Public Acts 96-0795 and 96-0920, enacted substantial changes to the provisions of the Illinois Procurement Code (30 ILCS 500). Among the changes are provisions affecting subcontractors. The Contractor awarded this contract will be required as a material condition of the contract to implement and enforce the contract requirements applicable to subcontractors approved in accordance with article 108.01 of the Standard Specifications for Road and Bridge Construction.

If the Contractor seeks approval of subcontractors to perform a portion of the work, and approval is granted by the Department, the Contractor shall provide a copy of the subcontract to the Chief Procurement Officer within 20 calendar days after execution of the subcontract.

The subcontract shall contain the certifications required to be made by subcontractors pursuant to Article 50 of the Illinois Procurement Code. This Notice to Bidders includes a document incorporating all required subcontractor certifications and disclosures for use by the Contractor in compliance with this mandate. The document is entitled State Required Ethical Standards Governing Subcontractors.

STATE ETHICAL STANDARDS
GOVERNING SUBCONTRACTORS

Article 50 of the Illinois Procurement Code establishes the duty of all State chief procurement officers, State purchasing officers, and their designees to maximize the value of the expenditure of public moneys in procuring goods, services, and contracts for the State of Illinois and to act in a manner that maintains the integrity and public trust of State government. In discharging this duty, they are charged by law to use all available information, reasonable efforts, and reasonable actions to protect, safeguard, and maintain the procurement process of the State of Illinois.

The certifications hereinafter made by the subcontractor are each a material representation of fact upon which reliance is placed should the Department approve the subcontractor. The chief procurement officer may terminate or void the subcontract approval if it is later determined that the bidder or subcontractor rendered a false or erroneous certification.

Section 50-2 of the Illinois Procurement Code provides that every person that has entered into a multi-year contract and every subcontractor with a multi-year subcontract shall certify, by July 1 of each fiscal year covered by the contract after the initial fiscal year, to the responsible chief procurement officer whether it continues to satisfy the requirements of Article 50 pertaining to the eligibility for a contract award. If a contractor or subcontractor is not able to truthfully certify that it continues to meet all requirements, it shall provide with its certification a detailed explanation of the circumstances leading to the change in certification status. A contractor or subcontractor that makes a false statement material to any given certification required under Article 50 is, in addition to any other penalties or consequences prescribed by law, subject to liability under the Whistleblower Reward and Protection Act for submission of a false claim.

A. Bribery

1. The Illinois Procurement Code provides:

Section 50-5. Bribery.

(a) Prohibition. No person or business shall be awarded a contract or subcontract under this Code who:

- (1) has been convicted under the laws of Illinois or any other state of bribery or attempting to bribe an officer or employee of the State of Illinois or any other state in that officer's or employee's official capacity; or
- (2) has made an admission of guilt of that conduct that is a matter of record but has not been prosecuted for that conduct.

(b) Businesses. No business shall be barred from contracting with any unit of State or local government, or subcontracting under such a contract, as a result of a conviction under this Section of any employee or agent of the business if the employee or agent is no longer employed by the business and:

- (1) the business has been finally adjudicated not guilty; or
- (2) the business demonstrates to the governmental entity with which it seeks to contract, or which is signatory to the contract to which the subcontract relates, and that entity finds that the commission of the offense was not authorized, requested, commanded, or performed by a director, officer, or high managerial agent on behalf of the business as provided in paragraph (2) of subsection (a) of Section 5-4 of the Criminal Code of 1961.

(c) Conduct on behalf of business. For purposes of this Section, when an official, agent, or employee of a business committed the bribery or attempted bribery on behalf of the business and in accordance with the direction or authorization of a responsible official of the business, the business shall be chargeable with the conduct.

(d) Certification. Every bid submitted to and contract executed by the State, and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the contractor or the subcontractor, respectively, that the contractor or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any certifications required by this Section are false. A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

2. The contractor or subcontractor certifies that it is not barred from being awarded a contract under Section 50.5.

B. Felons

1. The Illinois Procurement Code provides:

Section 50-10. Felons. Unless otherwise provided, no person or business convicted of a felony shall do business with the State of Illinois or any State agency, or enter into a subcontract, from the date of conviction until 5 years after the date of completion of the sentence for that felony, unless no person held responsible by a prosecutorial office for the facts upon which the conviction was based continues to have any involvement with the business.

2. Certification. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder or contractor or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any of the certifications required by this Section are false.

C. Debt Delinquency

1. The Illinois Procurement Code provides:

Section 50-11 and 50-12. Debt Delinquency.

The contractor or bidder or subcontractor, respectively, certifies that it, or any affiliate, is not barred from being awarded a contract or subcontract under the Procurement Code. Section 50-11 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it knows or should know that it, or any affiliate, is delinquent in the payment of any debt to the State as defined by the Debt Collection Board. Section 50-12 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it, or any affiliate, has failed to collect and remit Illinois Use Tax on all sales of tangible personal property into the State of Illinois in accordance with the provisions of the Illinois Use Tax Act. The bidder or contractor or subcontractor, respectively, further acknowledges that the chief procurement officer may declare the related contract void if this certification is false or if the bidder, contractor, or subcontractor, or any affiliate, is determined to be delinquent in the payment of any debt to the State during the term of the contract.

D. Prohibited Bidders, Contractors and Subcontractors

1. The Illinois Procurement Code provides:

Section 50-10.5 and 50-60(c). Prohibited bidders, contractors and subcontractors.

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-10.5 that no officer, director, partner or other managerial agent of the contracting business has been convicted of a felony under the Sarbanes-Oxley Act of 2002 or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953 or if in violation of Subsection (c) for a period of five years from the date of conviction.. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder, contractor, or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer shall declare the related contract void if any of the certifications completed pursuant to this Section are false.

E. Section 42 of the Environmental Protection Act

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-12 that the bidder, contractor, or subcontractor, is not barred from being awarded a contract or entering into a subcontract under this Section which prohibits the bidding on or entering into contracts with the State of Illinois or a State agency, or entering into any subcontract, that is subject to the Procurement Code by a person or business found by a court or the Pollution Control Board to have committed a willful or knowing violation of Section 42 of the Environmental Protection Act for a period of five years from the date of the order. The bidder or contractor or subcontractor, respectively, acknowledges that the chief procurement officer may declare the contract void if this certification is false.

The undersigned, on behalf of the subcontracting company, has read and understands the above certifications and makes the certifications as required by law.

<hr/>		
Name of Subcontracting Company		
<hr/>		<hr/>
Authorized Officer		Date

RETURN WITH SUBCONTRACT
SUBCONTRACTOR DISCLOSURES

I. DISCLOSURES

- A.** The disclosures hereinafter made by the subcontractor are each a material representation of fact upon which reliance is placed. The subcontractor further certifies that the Department has received the disclosure forms for each subcontract.

The chief procurement officer may void the bid, contract, or subcontract, respectively, if it is later determined that the bidder or subcontractor rendered a false or erroneous disclosure. A contractor or subcontractor may be suspended or debarred for violations of the Procurement Code. Furthermore, the chief procurement officer may void the contract or subcontract.

B. Financial Interests and Conflicts of Interest

1. Section 50-35 of the Illinois Procurement Code provides that all subcontracts with a total value of \$25,000 or more from subcontractors identified in Section 20-120 of the Illinois Procurement Code, shall be accompanied by disclosure of the financial interests of the subcontractor. This disclosed information for the subcontractor, will be maintained as public information subject to release by request pursuant to the Freedom of Information Act, filed with the Procurement Policy Board, and shall be incorporated as a material term of the Prime Contractor's contract. Furthermore, pursuant to this Section, the Procurement Policy Board may recommend to allow or void a contract or subcontract based on a potential conflict of interest.

The financial interests to be disclosed shall include ownership or distributive income share that is in excess of 5%, or an amount greater than 60% of the annual salary of the Governor, of the subcontracting entity or its parent entity, whichever is less, unless the subcontractor is a publicly traded entity subject to Federal 10K reporting, in which case it may submit its 10K disclosure in place of the prescribed disclosure. If a subcontractor is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. The disclosure shall include the names, addresses, and dollar or proportionate share of ownership of each person making the disclosure, their instrument of ownership or beneficial relationship, and notice of any potential conflict of interest resulting from the current ownership or beneficial interest of each person making the disclosure having any of the relationships identified in Section 50-35 and on the disclosure form.

The current annual salary of the Governor is \$177,412.00.

In addition, all disclosures shall indicate any other current or pending contracts, subcontracts, proposals, leases, or other ongoing procurement relationships the subcontracting entity has with any other unit of state government and shall clearly identify the unit and the contract, subcontract, proposal, lease, or other relationship.

2. Disclosure Forms. Disclosure Form A is attached for use concerning the individuals meeting the above ownership or distributive share requirements. Subject individuals should be covered each by one form. In addition, a second form (Disclosure Form B) provides for the disclosure of current or pending procurement relationships with other (non-IDOT) state agencies.

C. Disclosure Form Instructions

Form A Instructions for Financial Information & Potential Conflicts of Interest

If the subcontractor is a publicly traded entity subject to Federal 10K reporting, the 10K Report may be submitted to meet the requirements of Form A. If a subcontractor is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. If a subcontractor is not subject to Federal 10K reporting, the subcontractor must determine if any individuals are required by law to complete a financial disclosure form. To do this, the subcontractor should answer each of the following questions. A "YES" answer indicates Form A must be completed. If the answer to each of the following questions is "NO", then the **NOT APPLICABLE STATEMENT** on the second page of Form A must be signed and dated by a person that is authorized to execute contracts for the subcontracting company. Note: These questions are for assistance only and are not required to be completed.

1. Does anyone in your organization have a direct or beneficial ownership share of greater than 5% of the bidding entity or parent entity? YES ___ NO ___
2. Does anyone in your organization have a direct or beneficial ownership share of less than 5%, but which has a value greater than 60% of the annual salary of the Governor? YES ___ NO ___
3. Does anyone in your organization receive more than 60% of the annual salary of the Governor of the subcontracting entity's or parent entity's distributive income? YES ___ NO ___

(Note: Distributive income is, for these purposes, any type of distribution of profits. An annual salary is not distributive income.)

4. Does anyone in your organization receive greater than 5% of the subcontracting entity's or parent entity's total distributive income, but which is less than 60% of the annual salary of the Governor? YES ___ NO ___

(Note: Only one set of forms needs to be completed per person per subcontract even if a specific individual would require a yes answer to more than one question.)

A "YES" answer to any of these questions requires the completion of Form A. The subcontractor must determine each individual in the subcontracting entity or the subcontracting entity's parent company that would cause the questions to be answered "Yes". Each form must be signed and dated by a person that is authorized to execute contracts for your organization. **Photocopied or stamped signatures are not acceptable.** The person signing can be, but does not have to be, the person for which the form is being completed. The subcontractor is responsible for the accuracy of any information provided.

If the answer to each of the above questions is "NO", then the **NOT APPLICABLE STATEMENT** on page 2 of Form A must be signed and dated by a person that is authorized to execute contracts for your company.

RETURN WITH SUBCONTRACT

Form B: Instructions for Identifying Other Contracts & Procurement Related Information

Disclosure Form B must be completed for each subcontract submitted by the subcontracting entity. *Note: Checking the NOT APPLICABLE STATEMENT on Form A does not allow the subcontractor to ignore Form B. Form B must be completed, checked, and dated or the subcontract will not be approved.*

The Subcontractor shall identify, by checking Yes or No on Form B, whether it has any pending contracts, subcontracts, leases, bids, proposals, or other ongoing procurement relationship with any other (non-IDOT) State of Illinois agency. If "No" is checked, the subcontractor only needs to complete the check box on the bottom of Form B. If "Yes" is checked, the subcontractor must list all non-IDOT State of Illinois agency pending contracts, subcontracts, leases, bids, proposals, and other ongoing procurement relationships. These items may be listed on Form B or on an attached sheet(s). Contracts with cities, counties, villages, etc. are not considered State of Illinois agency contracts and are not to be included. Contracts or subcontracts with other State of Illinois agencies such as the Department of Natural Resources or the Capital Development Board must be included.

RETURN WITH SUBCONTRACT

ILLINOIS DEPARTMENT OF TRANSPORTATION

Form A Subcontractor: Financial Information & Potential Conflicts of Interest Disclosure

Subcontractor Name, Legal Address, City, State, Zip, Telephone Number, Email Address, Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Code (30 ILCS 500). Subcontractors desiring to enter into a subcontract of a State of Illinois contract must disclose the financial information and potential conflict of interest information as specified in this Disclosure Form. This information shall become part of the publicly available contract file. This Form A must be completed for subcontracts with a total value of \$25,000 or more, from subcontractors identified in Section 20-120 of the Illinois Procurement Code, and for all open-ended contracts. A publicly traded company may submit a 10K disclosure (or equivalent if applicable) in satisfaction of the requirements set forth in Form A. See Disclosure Form Instructions.

The current annual salary of the Governor is \$177,412.00.

DISCLOSURE OF FINANCIAL INFORMATION

1. Disclosure of Financial Information. The individual named below has an interest in the SUBCONTRACTOR (or its parent) in terms of ownership or distributive income share in excess of 5%, or an interest which has a value of more than 60% of the annual salary of the Governor. (Make copies of this form as necessary and attach a separate Disclosure Form A for each individual meeting these requirements)

FOR INDIVIDUAL (type or print information) NAME: ADDRESS Type of ownership/distributable income share: stock sole proprietorship Partnership other: (explain on separate sheet): % or \$ value of ownership/distributable income share:

2. Disclosure of Potential Conflicts of Interest. Check "Yes" or "No" to indicate which, if any, of the following potential conflict of interest relationships apply. If the answer to any question is "Yes", please attach additional pages and describe.

(a) State employment, currently or in the previous 3 years, including contractual employment of services. Yes ___ No ___

If your answer is yes, please answer each of the following questions.

- 1. Are you currently an officer or employee of either the Capitol Development Board or the Illinois State Toll Highway Authority? Yes ___ No ___
2. Are you currently appointed to or employed by any agency of the State of Illinois? If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, provide the name the State agency for which you are employed and your annual salary.

RETURN WITH SUBCONTRACT

3. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of two times the salary of the Governor?
Yes ___ No ___

(b) State employment of spouse, father, mother, son, or daughter, including contractual employment services in the previous 2 years.

Yes ___ No ___

If your answer is yes, please answer each of the following questions.

1. Is your spouse or any minor children currently an officer or employee of the Capitol Development Board or the Illinois Toll Highway Authority?
Yes ___ No ___

2. Is your spouse or any minor children currently appointed to or employed by any agency of the State of Illinois? If your spouse or minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, provide the name of your spouse and/or minor children, the name of the State agency for which he/she is employed and his/her annual salary. _____

3. If your spouse or any minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, as of 7/1/07 are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If your spouse or any minor children are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of two times the annual salary of the Governor?
Yes ___ No ___

(c) Elective status; the holding of elective office of the State of Illinois, the government of the United States, any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois currently or in the previous 3 years.
Yes ___ No ___

(d) Relationship to anyone holding elective office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(e) Appointive office; the holding of any appointive government office of the State of Illinois, the United States of America, or any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois, which office entitles the holder to compensation in excess of the expenses incurred in the discharge of that office currently or in the previous 3 years.
Yes ___ No ___

(f) Relationship to anyone holding appointive office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(g) Employment, currently or in the previous 3 years, as or by any registered lobbyist of the State government.
Yes ___ No ___

RETURN WITH SUBCONTRACT

(h) Relationship to anyone who is or was a registered lobbyist in the previous 2 years; spouse, father, mother, son, or daughter. Yes ___ No ___

(i) Compensated employment, currently or in the previous 3 years, by any registered election or reelection committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

(j) Relationship to anyone; spouse, father, mother, son, or daughter; who was a compensated employee in the last 2 years by any registered election or re-election committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

3. Communication Disclosure.

Disclose the name and address of each lobbyist and other agent of the bidder or offeror who is not identified in Section 2 of this form, who is has communicated, is communicating, or may communicate with any State officer or employee concerning the bid or offer. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the process and throughout the term of the contract. If no person is identified, enter "None" on the line below:

Name and address of person(s): _____

RETURN WITH SUBCONTRACT

4. Debarment Disclosure. For each of the persons identified under Sections 2 and 3 of this form, disclose whether any of the following has occurred within the previous 10 years: debarment from contracting with any governmental entity; professional licensure discipline; bankruptcies; adverse civil judgments and administrative findings; and criminal felony convictions. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the procurement process and term of the contract. If no person is identified, enter "None" on the line below:

Name of person(s): _____

Nature of disclosure: _____

APPLICABLE STATEMENT

This Disclosure Form A is submitted on behalf of the INDIVIDUAL named on previous page. Under penalty of perjury, I certify the contents of this disclosure to be true and accurate to the best of my knowledge.

Completed by: _____ Date _____
Signature of Individual or Authorized Officer

NOT APPLICABLE STATEMENT

Under penalty of perjury, I have determined that no individuals associated with this organization meet the criteria that would require the completion of this Form A.

This Disclosure Form A is submitted on behalf of the SUBCONTRACTOR listed on the previous page.

_____ Date _____
Signature of Authorized Officer

RETURN WITH SUBCONTRACT

ILLINOIS DEPARTMENT
OF TRANSPORTATION

Form B
Subcontractor: Other Contracts &
Procurement Related Information
Disclosure

Subcontractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Act (30 ILCS 500). This information shall become part of the publicly available contract file. This Form B must be completed for subcontracts with a total value of \$25,000 or more, from subcontractors identified in Section 20-120 of the Illinois Procurement Code, and for all open-ended contracts.

DISCLOSURE OF OTHER CONTRACTS, SUBCONTRACTS, AND PROCUREMENT RELATED INFORMATION

1. Identifying Other Contracts & Procurement Related Information. The SUBCONTRACTOR shall identify whether it has any pending contracts, subcontracts, including leases, bids, proposals, or other ongoing procurement relationship with any other State of Illinois agency: Yes ___ No ___

If "No" is checked, the subcontractor only needs to complete the signature box on the bottom of this page.

2. If "Yes" is checked. Identify each such relationship by showing State of Illinois agency name and other descriptive information such as bid or project number (attach additional pages as necessary). SEE DISCLOSURE FORM INSTRUCTIONS:

THE FOLLOWING STATEMENT MUST BE CHECKED

<input type="checkbox"/>	_____	_____
	Signature of Authorized Officer	Date



- 1. TIME AND PLACE OF OPENING BIDS.** Sealed proposals for the improvement described herein will be received by the Department of Transportation at the Harry R. Hanley Building, 2300 South Dirksen Parkway, in Springfield, Illinois until 10:00 o'clock a.m., January 21, 2011. All bids will be gathered, sorted, publicly opened and read in the auditorium at the Department of Transportation's Harry R. Hanley Building shortly after the 10:00 a.m. cut off time.
- 2. DESCRIPTION OF WORK.** The proposed improvement is identified and advertised for bids in the Invitation for Bids as:

**Contract No. 62392
COOK County
Section 0102.1S
Route FAI 190
District 1 Construction Funds**

Removal and replacement of an existing storm water pump station draining I-190 at I-294 in Rosemont.

- 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

Gary Hannig,
Secretary

INDEX
 FOR
 SUPPLEMENTAL SPECIFICATIONS
 AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2011

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

ERRATA Standard Specifications for Road and Bridge Construction (Adopted 1-1-07) (Revised 1-1-11)

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STATE OF ILLINOIS
SPECIAL PROVISIONS

The following Special Provisions supplement the "Standard Specifications for Road and Bridge Construction," adopted January 1, 2007, the latest edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways," 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 of FAI 190 (I-190(Kennedy Expressway)), Section 0102.1S, in Cook County, Contract 62392, 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 at the existing State of Illinois Storm Water Pump Station No. 24 located at the southeast corner of I-190 and Canadian National Railroad (CNRR) tracks in the Village of Rosemont, Illinois, Cook County.

DESCRIPTION OF IMPROVEMENT

This improvement shall consist of the relocation of the pump station including but not limited to, concrete work, reinforcement bars, glass block and masonry work, doors and frame, metal works, single ply roofing, sheet metal work, painting and site work, as specified herein. Further, the improvement shall include mechanical work consisting of pumps including motors, fabricated metal, bowls, and impellers and heating and ventilating equipment, piping for pump and recirculation system and electrical distribution, control, instrumentation, intrusion and fire alarm, lighting, equipment, conduit and wiring, all in the new pump station, packaged engine generator system, electrical service connection and Supervisory Control and Data Acquisition (SCADA) System.

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 Requirements, 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 construction 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 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 and new pumps; maintenance of pumping capacity as specified in the Contract Documents; protection of existing and new equipment during all relocation work; 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. 24 on or before February 28, 2013. This completion is based upon an expedited work schedule.

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 of \$3,325.00, 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 new Pump Station No. 24 site will be open for Contractor's inspection on Friday, January 7, 2011, between 9:00 A.M. to 12:00 P.M. local time. 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 Gholer 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.

FINE AGGREGATE FOR HOT- MIX ASPHALT (HMA) (D-1)

Effective: May 1, 2007

Revised: January 15, 2010

Add the following to the gradation tables of Article 1003.01(c) of the Standard Specifications:

FINE AGGREGATE GRADATIONS					
Grad No.	Sieve Size and Percent Passing				
	3/8	No. 4	No. 8	No. 16	No. 200
FA 22	100	6/	6/	8±8	2±2

FINE AGGREGATE GRADATIONS (metric)					
Grad No.	Sieve Size and Percent Passing				
	9.5 mm	4.75 mm	2.36 mm	1.16 mm	75 µm
FA 22	100	6/	6/	8±8	2±2

6/ For the fine aggregate gradations FA 22, the aggregate producer shall set the midpoint percent passing, and the Department will apply a range of ± ten percent. The midpoint shall not be changed without Department approval.

Revise Article 1003.03(a) of the Standard Specifications to read:

“(a) Description. Fine aggregate for HMA shall consist of sand, stone sand, chats, slag sand, or steel slag sand. For gradation FA 22, uncrushed material will not be permitted.”

Revise Article 1003.03 (c) of the Standard Specifications to read:

“(c) Gradation. The fine aggregate gradation for all HMA shall be FA1, FA 2, FA 20, FA 21 or FA 22. When Reclaimed Asphalt Pavement (RAP) is incorporated in the HMA design, the use of FA 21 Gradation will not be permitted.

Gradation FA 1, FA 2, or FA 3 shall be used when required for prime coat aggregate application for HMA.”

COARSE AGGREGATE FOR HOT-MIX ASPHALT (HMA) (D-1)

Effective: March 16, 2009

Revise Article 1004.03 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	Gravel Crushed Gravel Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag Crushed Concrete
HMA All Other	Stabilized Subbase or Shoulders	Gravel Crushed Gravel Crushed Stone Crushed Sandstone Crushed Slag Crushed Concrete The coarse aggregate for stabilized subbase, if approved by the Engineer, may be produced by blending aggregates according to Article 1004.04(a).
HMA High ESAL Low ESAL	IL-25.0, IL-19.0, or IL-19.0L	Crushed Gravel Crushed Stone Crushed Sandstone Crushed Slag (ACBF)

<p>HMA High ESAL Low ESAL</p>	<p>C Surface IL-12.5,IL-9.5, or IL-9.5L</p>	<p>Gravel (only when used in IL-9.5L) Crushed Gravel Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag (except when used as leveling binder)</p>
<p>HMA High ESAL</p>	<p>D Surface IL-12.5 or IL-9.5</p>	<p>Crushed Gravel Crushed Stone (other than Limestone) Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag (except when used as leveling binder)</p> <p>Limestone may be used in Mixture D if blended by volume in the following coarse aggregate percentages: Up to 25% Limestone with at least 75% Dolomite. Up to 50% Limestone with at least 50% any aggregate listed for Mixture D except Dolomite. Up to 75% Limestone with at least 25% Crushed Slag (ACBF) or Crushed Sandstone.</p>
<p>HMA High ESAL</p>	<p>E Surface IL-12.5 or IL-9.5</p>	<p>Crushed Gravel Crushed Stone (other than Limestone and Dolomite) Crushed Sandstone</p> <p>No Limestone.</p> <p>Dolomite may be used in Mixture E if blended by volume in the following coarse aggregate percentages: Up to 75% Dolomite with at least 25% Crushed Sandstone, Crushed Slag (ACBF), or Crushed Steel Slag. When Crushed Slag (ACBF) or Crushed Steel Slag are used in the blend, the blend shall contain a minimum of 25% to a maximum of 75% of either Slag by volume. Up to 50% Dolomite with at least 50% of any aggregate listed for Mixture E.</p> <p>If required to meet design criteria, Crushed Gravel or Crushed Stone (other than Limestone or Dolomite) may be blended by volume in the following coarse aggregate percentages: Up to 75% Crushed Gravel or Crushed Stone (other than Limestone or Dolomite) with at least 25% Crushed Sandstone, Crushed Slag (ACBF), or Crushed Steel Slag. When Crushed Slag (ACBF) or Crushed Steel Slag are used in the blend, the blend shall contain a minimum of 25% to a maximum of 50% of either Slag by volume.</p>

HMA High ESAL	F Surface IL-12.5 or IL-9.5	Crushed Sandstone No Limestone. Crushed Gravel, Crushed Concrete, or Crushed Dolomite may be used in Mixture F if blended by volume in the following coarse aggregate percentages: Up to 50% Crushed Gravel, Crushed Concrete or Crushed Dolomite with at least 50% Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or any Other Crushed Stone (to include Granite, Diabase, Rhyolite or Quartzite). When Crushed Slag (ACBF) or Crushed Steel Slag are used in the blend, the blend shall contain a minimum of 50% to a maximum of 75% of either Slag by volume.
------------------	-----------------------------------	--

(b) Quality. For surface courses and binder courses when used as surface course, the coarse aggregate shall be Class B quality or better. For Class A (seal or cover coat), other binder courses, and surface course IL-9.5L (Low ESAL), the coarse aggregate shall be Class C quality or better. For All Other courses, the coarse aggregate shall be Class D quality or better.

(c) Gradation. The coarse aggregate gradations shall be as listed in the following table.

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-25.0 IL-19.0 IL-12.5 IL-9.5	CA 7 ^{1/} or CA 8 ^{1/} CA 11 ^{1/} CA 16 and/or CA 13 CA 16
HMA Low ESAL	IL-19.0L IL-9.5L	CA 11 ^{1/} CA 16
HMA All Other	Stabilized Subbase or Shoulders	CA 6 ^{2/} , CA 10, or CA 12

1/ CA 16 or CA 13 may be blended with the gradations listed.

2/ CA 6 will not be permitted in the top lift of shoulders.

TEMPERATURE CONTROL FOR CONCRETE PLACEMENT (DISTRICT ONE)

Effective: May 1, 2007

Delete the second and third sentences of the second paragraph of Article 1020.14(a) of the Standard Specifications.

USE OF RAP (DIST 1)

Effective: January 1, 2007

Revised: September 15, 2010

In Article 1030.02(g) of the Standard Specifications, delete the last sentence of the first paragraph in (Note 2).

Revise Section 1031 of the Standard Specifications to read:

“SECTION 1031. RECLAIMED ASPHALT PAVEMENT

1031.01 Description. Reclaimed asphalt pavement (RAP) results from the cold milling or crushing of an existing hot-mix asphalt (HMA) pavement. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction. The contractor can also request that a processed pile be tested by the Department to determine the aggregate quality as described in Article 1031.04, herein.

1031.02 Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. No additional RAP shall be added to the pile after the pile has been sealed. Stockpiles shall be sufficiently separated to prevent intermingling at the base. Stockpiles shall be identified by signs indicating the type and size as listed below (i.e. “Homogenous Surface”).

Prior to milling or removal of an HMA pavement, the Contractor may request the District to provide verification of the existing mix composition to clarify appropriate stockpile.

- (a) Homogeneous. Homogeneous RAP stockpiles shall consist of RAP from Class I, Superpave (High ESAL), HMA (High ESAL), or equivalent mixtures and represent: 1) the same aggregate quality, but shall be at least C quality; 2) the same type of crushed aggregate (either crushed natural aggregate, ACBF slag, or steel slag); 3) similar gradation; and 4) similar asphalt binder content. If approved by the Engineer, combined single pass surface/binder millings may be considered “homogenous” with a quality rating dictated by the lowest coarse aggregate quality present in the mixture.
- (b) Conglomerate 5/8. Conglomerate 5/8 RAP stockpiles shall consist of RAP from Class I, Superpave (High ESAL), HMA (High 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 5/8 RAP shall be processed prior to testing by crushing to where all RAP shall pass the 5/8 in. (16 mm) or smaller screen.
- (c) Conglomerate 3/8. Conglomerate 3/8 RAP stockpiles shall consist of RAP from Class I, Superpave (High ESAL), HMA (High 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 B quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate 3/8 RAP shall be processed prior to testing by crushing to where all RAP shall pass the 3/8 in (9.5 mm) or smaller screen.
- (d) Conglomerate Variable Size. Conglomerate variable size RAP shall consist of RAP from Class I, Superpave (High ESAL), HMA (High 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 B quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate variable size RAP shall be processed prior to testing by crushing and screening to where all RAP is separated into various sizes. All the conglomerate variable size RAP shall pass the 3/4 in. (19 mm) screen and shall be a minimum of two sizes.

- (e) Conglomerate "D" Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from Class I, Superpave (High or Low ESAL), HMA (High or Low Esal), or equivalent mixtures. 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.
- (f) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as "Non-Quality".

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

1031.03 Testing. When used in HMA, the RAP shall be sampled and tested either during or after 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).

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 pile either in-situ or by restocking. 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 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.

- (a) Testing Conglomerate 3/8 and Conglomerate Variable Size. In addition to the requirements above, conglomerate 3/8 and variable size RAP shall be tested for maximum theoretical specific gravity (G_{mm}) at a 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).
- (b) Evaluation of Test Results. All of the extraction results shall be compiled and averaged for asphalt binder content and gradation and, when applicable G_{mm} . Individual extraction test results, when compared to the averages, will be accepted if within the tolerances listed below.

Parameter	Homogeneous/ Conglomerate	Conglomerate "D" Quality
1 in. (25 mm)		± 5%
3/4 in. (19 mm)		
1/2 in. (12.5 mm)	± 8%	± 15%
No. 4 (4.75 mm)	± 6%	± 13%
No. 8 (2.36 mm)	±5%	
No. 16 (1.18 mm)		± 15%
No. 30 (600 μm)	± 5%	
No. 200 (75 μm)	± 2.0%	± 4.0%
Asphalt Binder	± 0.4% ^{1/}	± 0.5%
G _{mm}	±0.02 ^{2/}	
G _{mm}	±0.03 ^{3/}	

- 1/ The tolerance for conglomerate 3/8 shall be ± 0.3 %.
- 2/ Applies only to conglomerate 3/8. When variation of the G_{mm} exceeds the ± 0.02 tolerance, a new conglomerate 3/8 stockpile shall be created which will also require an additional mix design.
- 3/ Applies only to conglomerate variable size. When variation of the G_{mm} exceeds the ± 0.03 tolerance, a new conglomerate variable size stockpile shall be created which will also require an additional mix design.

If more than 20 percent of the individual sieves are out of the gradation tolerances, or if more than 20 percent of the asphalt binder content test results fall outside the appropriate tolerances, the RAP shall not be used in HMA unless the RAP representing the failing tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the Illinois Test Procedure, "Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)".

1031.04 Quality Designation of Aggregate in RAP. The quality of the RAP shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

- (a) RAP from Class I, Superpave (High ESAL), or HMA (High ESAL) surface mixtures are designated as containing Class B quality coarse aggregate.
- (b) RAP from Superpave (Low ESAL)/HMA (Low ESAL) IL-19.0L binder and IL-9.5L surface mixtures are designated as Class D quality coarse aggregate.
- (c) RAP from Class I, Superpave (High ESAL), or HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.
- (d) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

Aggregate Quality Testing of RAP:

The processed pile shall have a maximum tonnage of 5,000 tons (4500 metric tons). The pile shall be crushed and screened with 100 percent of the material passing the 3/4 in. (19 mm) sieve. The pile shall be tested for AC content and gradation and shall conform to all requirements of Article 1031.03 Testing, herein. Once the uniformity of the gradation and AC content has been established, the Contractor shall obtain a representative sample with district oversight of the sampling. This sample shall be no less than 50 lbs (25 kg) and this sample shall be delivered to a Consultant Lab, prequalified by the Department for extraction testing according to Illinois Modified AASHTO T 164. After the AC has been extracted, the Consultant Lab shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid directly by the Contractor. The District will forward the sample to the BMPR Aggregate Lab for MicroDeval Testing, according to Illinois Modified AASHTO T 327. A maximum loss of 15.0 percent will be applied for all HMA applications.

1031.05 Use of RAP in HMA. The use of RAP in HMA shall be as follows.

- (a) Coarse Aggregate Size. The coarse aggregate in all RAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.
- (b) Use in HMA Surface Mixtures (High and Low ESAL). RAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall be either homogeneous or conglomerate 3/8 or variable size in which the coarse aggregate is Class B quality or better.
- (c) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. RAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be homogeneous, conglomerate 5/8, or conglomerate 3/8, conglomerate variable size, in which the coarse aggregate is Class C quality or better.
- (d) Use in Shoulders and Subbase. RAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be homogeneous, conglomerate 5/8, conglomerate 3/8, conglomerate variable size, or conglomerate DQ.
- (e) The use of RAP shall be a contractor's option when constructing HMA in all contracts. When the Contractor chooses the RAP option, the percentage of RAP shall not exceed the amounts indicated in the table for a given N Design.

Maximum Mixture RAP Percentage

HMA Mixtures ^{1/3/}		Maximum % RAP	
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified
30	30/40 ^{2/}	30	10
50	25/40 ^{2/ 4/}	15/25 ^{2/}	10 ^{4/}
70	25/30 ^{2/}	10/20 ^{2/}	10
90	25/30 ^{2/}	10/15 ^{2/}	10
105	25/30 ^{2/}	10/15 ^{2/}	10

- 1/ For HMA Shoulder and Stabilized Sub-Base (HMA) N-30, the amount of RAP shall not exceed 50 percent of the mixture.
- 2/ Value of Max percent RAP if 3/8 Rap or conglomerate variable size RAP is utilized.

- 3/ When RAP exceeds 20 percent the AC shall be PG58 -22. However, when RAP exceeds 20 percent and is used in full depth HMA pavement the AC shall be PG58 -28.
- 4/ Polymerized Leveling Binder, IL-4.75 is 15 percent

1031.06 HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing RAP material meeting the above detailed requirements.

RAP designs shall be submitted for volumetric verification. If additional RAP stockpiles are tested and found that no more than 20 percent of the results, as defined under "Testing" herein, are outside of the control tolerances set for the original RAP stockpile and HMA mix design, and meets all of the requirements herein, the additional RAP stockpiles may be used in the original mix design at the percent previously verified.

1031.07 HMA Production. The coarse aggregate in all RAP used shall be equal to or less than the nominal maximum size requirement for the HMA mixture being produced.

To remove or reduce agglomerated material, a scalping screen, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAP feed system to remove or reduce oversized material. If material passing the sizing device adversely affects the mix production or quality of the mix, the sizing device shall be set at a size specified by the Engineer.

If the RAP control tolerances or QC/QA test results require corrective action, the Contractor shall cease production of the mixture containing RAP and either switch to the virgin aggregate design or submit a new RAP design. When producing mixtures containing conglomerate 3/8 or conglomerate variable size RAP, a positive dust control system shall be utilized.

HMA plants utilizing RAP shall be capable of automatically recording and printing the following information.

(a) Drier Drum Plants

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA Mix number assigned by the Department
- (3) Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton)
- (4) Accumulated dry weight of RAP in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton)
- (5) Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.
- (6) Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.
- (7) Residual asphalt binder in the RAP material (per size) as a percent of the total mix to the nearest 0.1 unit.

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

(b) Batch Plants

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA mix number assigned by the Department.
- (3) Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram)
- (4) Mineral filler weight to the nearest pound (kilogram).
- (5) Individual RAP Aggregate weight to the nearest pound (kilogram).
- (6) Virgin asphalt binder weight to the nearest pound (kilogram)
- (7) Residual asphalt binder of each RAP size 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.

1031.08 RAP in Aggregate Surface Course and Aggregate Shoulders. The use of RAP 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 "Other". The testing requirements of Article 1031.03 shall not apply.
- (b) Gradation. One hundred percent of the RAP material shall pass the 1 1/2 in. (37.5 mm) sieve. The RAP material shall be reasonably well graded from coarse to fine. RAP material that is gap-graded or single sized will not be accepted."

USE OF RAS (D-1)

Effective: August 15, 2010

Revised: October 25, 2010

Description. Reclaimed asphalt shingles (RAS) meeting Type I or Type 2 requirements will be permitted in HMA mixtures as specified herein for overlay applications only. RAS shall not be used in full depth HMA pavement. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable materials, as defined in Bureau of Materials and Physical Research Policy Memorandum 28-10.0, by weight of RAS. All RAS used shall come from a BMPR approved processing facility.

Definitions. RAS shall meet either Type I or Type 2 requirements as specified herein.

- (a) Type I. Type I RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.
- (b) 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).

Stockpiles. RAS shall be ground and processed to 100 percent passing the 3/8 in. sieve and 93 percent passing the #4 sieve based on a dry shake gradation.

RAS shall be uniform in gradation and asphalt binder content and shall meet the testing requirements specified herein. Type 1 and Type 2 RAS shall be stockpiled separately and shall not be intermingled. Each stockpile shall be signed indicating what type of RAS is present.

Unless otherwise approved by the Engineer, mechanically blending a maximum of 5.0 percent by weight of the aggregate blend in HMA design, manufactured sand (FM20 or FM 22) with the processed RAS will be permitted to improve workability. The sand shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The sand shall be 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 filed by Department contract number and kept for a minimum of 3 years.

Testing. RAS shall be sampled and tested during stockpiling.

For testing during stockpiling, washed extraction, G_{mm} 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 250 tons (225 metric tons) thereafter. A minimum of five tests are required to establish an average gradation and asphalt cement content of the RAS for use in an HMA mix design. A Bulk Specific Gravity value of 2.300 shall be used for RAS when used in an HMA mix design. Other Gravity Values maybe used in an HMA design but shall be verified by the Department.

Before testing, each field sample shall be split to obtain two samples. 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.

Evaluation of Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content, gradation and G_{mm} . Individual test results, when compared to the averages, 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)	± 2.0 %
Asphalt Binder Content	± 1.5 %
G_{mm}	± 0.04

If more than 20 percent of the individual sieves are out of the gradation tolerances, or if more than 20 percent of the asphalt binder content, or G_{mm} test results fall outside the specified tolerance, or if the percent unacceptable materials exceeds 0.5 percent by weight of material retained on the #4 sieve, the RAS shall not be used in Department projects. All test data and acceptance ranges shall be sent to the District for evaluation.

Use of RAS in HMA. Type 1 or Type 2 RAS may be used in All HMA Mixtures as follows:

- (a) SMA and High ESAL Surface Mixes:

(1) The maximum allowable RAS usage in SMA and IL 4.75 shall be as follows:

- a. RAS shall not exceed 5.0 percent by weight of total mix.
- b. If used in conjunction with Reclaimed Asphalt Pavement (RAP) the contribution of asphalt binder from the RAS and RAP combined shall not exceed 20 percent of the total asphalt binder.

(2) The virgin asphalt binder grade shall be as follows:

Mix Type	Percent RAS/RAP Asphalt Binder Replacement			
	< 10%		10-20%	
	Type 1	Type 2	Type 1	Type 2
SMA and High ESAL Surface Mixes	No grade ^{1/} bump	No grade ^{1/} bump	Reduce high temperature by one grade ^{1/}	Reduce high temperature by one grade ^{1/}

1/ One asphalt binder grade bump represents a change of 6° Celsius.

b) High ESAL Binder and Leveling Binder Mixes:

(1) The maximum allowable RAS usage in HMA High ESAL Binder and Leveling Binder Mixes shall be as follows:

- a. RAS shall not exceed 5.0 percent by total weight of mix.
- b. If used in conjunction with RAP the contribution of asphalt binder from the RAS and RAP combined shall not exceed 30 percent of the total asphalt binder.

(2) Virgin asphalt binder grade shall be as follows:

Mix Type	Percent RAS/RAP Asphalt Binder Replacement			
	10-19%		20-30%	
	Type 1	Type 2	Type 1	Type 2
High ESAL Binder and Leveling Binder Mixes	No grade ^{1/} bump	Reduce high temperature by one grade ^{1/}	Reduce high & low temperature by one grade ^{1/}	Reduce high & low temperature by one grade ^{1/}

1/ One asphalt binder grade bump represents a change of 6° Celsius.

2/ No grade bump necessary for percent RAS/RAP/FRAP asphalt binder replacement less than 10 percent

c) HMA Low ESAL and HMA “All Other”

(1) The maximum allowable RAS usage in HMA Low ESAL and HMA “All Other” mixtures shall be as follows:

- a. RAS shall not exceed 5.0 percent by total weight of mix.

- b. If used in conjunction with RAP the contribution of asphalt binder from the RAS and RAP combined shall not exceed 40 percent of the total asphalt binder.

(2) Virgin asphalt binder grade shall be as follows:

Mix Type	Percent RAS/RAP Asphalt Binder Replacement			
	< 20%		20-40%	
	Type 1	Type 2	Type 1	Type 2
HMA Low ESAL and HMA "All Other"	No grade ^{1/} bump	Reduce low temperature by one grade ^{1/}	Reduce high & low temperature by one grade ^{1/}	Reduce high & low temperature by one grade ^{1/}

1/ One asphalt binder grade bump represents a change of 6° Celsius.

HMA Mix Designs. RAS and RAS/RAP designs shall be submitted for volumetric verification. Type 1 and Type 2 RAS are not interchangeable in a mix design.

HMA Production. 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 mixture production is halted when RAS flow is interrupted.

When producing HMA containing RAS, a positive dust control system shall be utilized.

HMA plants utilizing RAS shall be capable of automatically recording and printing the following information.

(a) Dryer Drum Plants.

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA mix number assigned by the Department.
- (3) Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- (4) Accumulated dry weight of RAS in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- (5) Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.
- (6) Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

- (7) Residual asphalt binder in the RAS material as a percent of the total mix to the nearest 0.1 percent.
- (8) Aggregate and RAS moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS are printed in wet condition.)

(b) Batch Plants.

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA mix number assigned by the Department.
- (3) Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).
- (4) Mineral filler weight to the nearest pound (kilogram).
- (5) RAS weight to the nearest pound (kilogram).
- (6) Virgin asphalt binder weight to the nearest pound (kilogram).
- (7) Residual asphalt binder in the RAS 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.”

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.
- 1.1.2 The Pump Station General Work shall include, but not be limited to, the following:
 - (a) All existing pump station maintenance during construction and continuous operation as described and specified in Division 1, General Requirements.
 - (b) All site work consisting of earth excavation, braced excavation and backfill as indicated on the Drawings and as specified in Section 2A, Site Work.
 - (c) All general demolition work as indicated on the Drawings as described in Section 2B, Demolition.
 - (d) All grout as indicated on the Drawings and as specified in Section 3B, Grout.

- (e) 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.
- (f) All miscellaneous metal work as indicated on the Drawings and as specified in Division 5, Metals.
- (g) All carpentry work as indicated on the Drawings and as specified in Section 6A, Rough Carpentry.
- (h) All roofing work as indicated on the Drawings and as specified in Section 7A, Elastomeric Sheet Roofing- Fully Adhered/Ballasted Cover.
- (i) All sheet metal work as indicated on the Drawings and as specified in Section 7B, Sheet Metal Flashing and Trim.
- (j) All sealant work as indicated on the Drawings and as specified in Section 7C, Joint Sealers.
- (k) All board insulation work as indicated on the Drawings and as specified in Section 7D, Board Insulation.
- (l) All doors and hardware as indicated on the Drawings and as specified in Division 8, Doors and Windows.
- (m) All painting as indicated on the Drawings and as specified in Section 9A, Painting.
- (n) The station identification plate, shop desk, pump dolly, bulletin board, staff gauges, first aid kit, fire extinguishers, electric clock and trash can as indicated on the Drawings and as specified in Section 10A, Specialties.
- (o) 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) Earth Excavation Section 202
- (b)) Furnishing and Erecting
Structural Steel Section 505
- (c) Drilled Shaft Section 516
- (d) Chain Link Fence Section 664
- (e) Engineer's Field Office, Type A Section 670

- 1.1.4 Mobilization shall be paid for with a separate pay item and shall be in accordance with the requirements of Standard Specifications for Road and Bridge.

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:

- (a) Piping and appurtenances as indicated on the Drawings and as specified in all Contract Documents.
- (b) Storm water pumps, complete with all appurtenances.
- (c) Ventilation system including, but not limited to, exhaust fans with motorized louver/damper combination, supply units, duct work, louvers, controls and all appurtenances.
- (d) Flow recirculation system including, but not limited to, slide gate, piping, actuator and all appurtenances.
- (e) Miscellaneous mechanical items consisting of cable support, stilling well and compression bell.
- (f) Hoist equipment as indicated on the Drawings and as specified in Section 14A, Hoisting Equipments.

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:

- (a) Installation and connection of new electric services including all metering in accordance with Commonwealth Edison Requirements.
- (b) Motor control centers with reduced voltage soft starters, automatic transfer switch, and generator.
- (c) Disconnect switches and motor starters.
- (d) Control and SCADA panels.
- (e) Lighting fixtures, lighting panel board, lighting transformer and wiring devices.

- (f) Power, lighting, control and signal wires and cables.
- (g) Conduit and raceway system.
- (h) Electric heaters, complete.
- (i) Float type level sensing control system.
- (j) Combustible gas detectors, smoke detectors and intrusion alarm system.
- (k) 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.
- (l) Testing.
- (m) See Section 16A paragraph 3.4.7 for electrical service constraints.

1.3.3 SCADA equipment and panel shall be paid under pay item Pump Station SCADA Equipment.

1.3.4 Electric service connection shall be paid under pay item Electric Service Connection.

1.4 Scope of Work

1.4.1 It is the intent of the Contract Drawings and referenced Standard Specifications, to define the work required for the construction of the new Pump Station 24 and to maintain operations of the existing pump station facility during construction. No portion of the work required to provide a coordinated complete installation may be omitted even though not expressly specified or indicated.

1.4.2 These Contract Specifications for work on Pump Station 24 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 first day the Contractor begins work at the site until the day of final acceptance by the Engineer, the Contractor shall be fully responsible for maintenance of the existing Pump Station 24. Maintenance shall be in full compliance with the District 1 Electrical Maintenance Contract, 2008/2009 or the most recent contract from the date of BID.

1.5.2 If the new pump station is complete and the inflow and outflow main sewers are not complete, the existing pump station shall remain in operation.

The Contractor shall transfer the maintenance of the existing and new Pump Station 24 to the Department at the day of final acceptance by the Engineer.

1.5.3 If the new pump station is complete and the inflow and outflow main sewers are complete, the existing pump station will be abandoned and demolished by others under highway contractor. The Contractor shall transfer the maintenance of the new Pump Station 24 to the Department at the day of final acceptance by the Engineer.

1.5.4 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.

1.5.5 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", "Water on Pavement Alarm" or "High 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.

1.5.6 Routine Maintenance Requirements:

Ongoing maintenance activities are required to maintain the existing Pump Station 24 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.

1.5.7 The Contractor shall ensure that two sets of construction lock and entry keys for all construction facilities are provided to the IDOT engineer and IDOT Bureau of Electrical Operations (two sets each).

1.5.8 All surrounding landscaping of the existing Pump Station 24 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.

1.5.9 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 the exact amount of the pay item as outlined in the Electrical Maintenance Contract plus an additional administrative cost equal to five (5) percent of the first \$10,000 and one (1) percent of any amount over \$10,000 of the total approved costs of such work. If the item is not covered under the Electrical Maintenance Contract, extra work shall be paid as outlined in the Standard Specifications for Road and Bridge Construction.

1.5.10 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.

1.6 Continuous Operation

1.6.1 The existing Pump Station 24 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.

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 111,000 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 (1) existing 6,000 gpm low flow pump and six (6) 17,500 gpm main pumps. The total installed pumping capacity is 111,000 gpm.

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 accept, 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 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.

1.8.7 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.

1.8.8 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.

1.8.9 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 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.
- (c) An 8-inch by 3-inch blank space shall be provided for CONTRACTOR and ENGINEER stamps.
- (d) Three blue line or black line prints or two reverse sepia reproducible and 1 blue or black line print shall be submitted. One reproducible or one print will be returned.
- (e) 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. Five additional copies shall be marked with the date of approval and forwarded to the ENGINEER for use in field and for OWNER'S records.

1.8.10 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 show such information is not applicable.
- (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 is for information and record, and to determine that products, materials, and systems comply with Contract Documents. Submittal shall be final when returned by ENGINEER marked "Approved".
- (d) Four submittal copies, in addition to the number the Contractor requires returned, including those required for Operation and Maintenance Manuals, shall be submitted to the Engineer. An additional submittal copy shall be submitted to the Design Engineer:

AB&H, A Donohue Group
125 South Wacker Drive, Suite 1850
Chicago, Illinois 60606
Attn: Kou H. Chang

- (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.

1.8.11 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.

1.8.12 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.

1.8.13 Miscellaneous Submittals

(a) Inspection and Test Reports

- 1) Each inspection and test report shall be classified as either "Shop Drawings" or "product data", depending on whether report is specially prepared for Project or standard publication of workmanship control testing at point of production. Inspection and test reports shall be processed accordingly.

(b) 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.

(c) 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. 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.

(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.
- 4) One or more neat and substantial steel wall cases or cabinets shall be furnished and erected with flat key locks and clips or hooks to hold each special tool in a convenient arrangement.

1.8.14 Operation and Maintenance Manuals

- (a) Operation and Maintenance Manuals shall be submitted in accordance with Subsection 1.12, Operation and Maintenance Manuals, in this Section.

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" or "Approved Subject to Corrections Marked", 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. Re-submittal is not required.
- 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.
- 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 mylar tracing 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, one set of clearly readable, reproducible mylar Contract Drawings reflecting all changes made during construction shall be delivered to the ENGINEER. The drawings shall each be stamped "RECORD DRAWING", and shall be marked with the contractor's stamp, the date, and the signature of the contractor's representative. Refer to individual sections for addition requirements.

1.10.3 The Record Drawings must be submitted and must be acceptable to the Engineer prior to final acceptance.

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 OWNER.

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.

- 1.12.2 Prior to the Work Reaching 50 Percent Completion, one copy of the manual shall be submitted to the ENGINEER for approval with all specified material. The approval copies shall be submitted with the partial payment request for the specified completion. Within 30 days after the ENGINEER's approval of the two-copy submittal, the remaining 3 copies of the manual shall be furnished to the ENGINEER. Space shall be provided in the manual for additional material. Any missing material for the manual shall be submitted prior to requesting certification of substantial completion.
- 1.12.3 Each copy of the manual shall consist of the following and shall be prepared and arranged as follows:
- (a) A section of an equipment data summary (see sample form at end of section) for each item of equipment.
 - (b) A section of an equipment preventive maintenance data summary (see sample form at end of section) for each item of equipment.
 - (c) 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.
 - (d) List of electrical relay settings and control and alarm contact settings.
 - (e) Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.
 - (f) One valve schedule giving valve number, location, fluid, and fluid destination for each valve installed. All valves in same piping systems shall be grouped together in the schedule. A sample of the valve numbering system shall be obtained from the ENGINEER.
 - (g) All O&M Manual material shall be on 8-1/2 inch by 11 inch commercially printed or typed forms or an acceptable alternative format.
- 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. Large 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.

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STORMWATER PUMP STATION NO. 24

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:

- 1.12.6 Binders shall be labeled Volume 1, 2, 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 Owner. 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 OWNER and 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 OWNER. 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 The OWNER and the OWNER's Authorized Representatives have the right to reject materials and workmanship which are defective or require correction. Rejected work and materials shall be promptly removed from the site.
- 1.16.4 Failure or neglect on the part of the OWNER or the OWNER's Authorized Representatives 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 OWNER or the OWNER's Authorized Representatives 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.

- 1.16.5 Should it be considered necessary or advisable by the OWNER or the OWNER's Authorized Representatives, at any time before final acceptance of the Work, to make examinations of portions of the Work already completed, by removing or tearing out such portions, all necessary facilities, labor, and material to make such an examination shall be promptly furnished. If such Work is found to be defective in any respect, all expenses of such examination and of satisfactory reconstruction shall be paid for by the CONTRACTOR. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the Work will be considered a change in the Work to be paid for in accordance with applicable provisions of the Contract.
- 1.16.6 Proper operation of equipment during tests and instruction periods shall be the full responsibility of the CONTRACTOR. The CONTRACTOR shall make no claim for damage which may occur to equipment prior to the time when the OWNER accepts the Work.
- 1.16.7 If at any time prior to the expiration of any applicable warranties or guarantees, equipment is rejected by the OWNER, all sums of money received for the rejected equipment on progress certificates or otherwise on account of the Contract lump sum prices shall be repaid to the OWNER. Upon the receipt of the sum of money, OWNER will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. The equipment shall not be removed from the premises of the OWNER until the OWNER obtains, from other sources, equipment to take the place of that rejected. The OWNER hereby agrees to obtain other equipment within a reasonable time and the CONTRACTOR agrees that the OWNER may use the equipment furnished by the CONTRACTOR without rental or other charge until the other new equipment is obtained.
- 1.16.8 Notice shall be given in writing to the ENGINEER sufficiently in advance of the commencement of manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. When required, notice shall include a request for inspection, the date of commencement, and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, ENGINEER will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, or will notify CONTRACTOR that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. These provisions shall be complied with before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.
- 1.16.9 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.

- 1.16.10 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.
- 1.16.11 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.
- 1.16.12 Cooperate with the ENGINEER and laboratory testing representatives. At least 24 hours 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.
- 1.16.13 Equipment test procedures shall be coordinated and demonstrated as specified in the Contract Documents or as otherwise required during the formal tests.
- 1.16.14 Test procedures and requirements for pipelines and other testing shall conform to that specified in the appropriate Specification Sections.
- 1.16.15 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.

- 1.16.16 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
- 1.16.17 Initial inspection and testing of materials furnished under this Contract will be performed by the OWNER or his authorized Representatives or inspection bureaus without cost to the CONTRACTOR, unless otherwise expressly specified. If subsequent testing is necessary due to failure of the initial tests or because of rejection for noncompliance, the OWNER shall be reimbursed by the CONTRACTOR for expenditures incurred in making such tests.
- 1.16.18 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.
- 1.16.19 Materials and equipment submitted by the CONTRACTOR as the equivalent to those specifically named in the Contract may be tested by the OWNER for compliance. The OWNER shall be reimbursed for expenditures incurred in making such tests on materials and equipment which are rejected for noncompliance.
- 1.16.20 The OWNER shall be reimbursed for the costs of any job site inspection between the hours of 7:00 p.m. and 6:00 a.m. and any work on Saturdays, Sundays or Holidays.
- 1.16.21 The OWNER shall be reimbursed for all costs associated with Witness Tests which exceed 5 Calendar Days per kind of equipment.
- 1.16.22 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.
- 1.16.23 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.

- 1.16.24 All labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests shall be furnished by the CONTRACTOR.
- 1.16.25 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
- 1.16.26 Work or portions of work shall be operated for a minimum of 100 hours or 14 days continuous service, whichever comes first. Test on those systems which require load produced by weather (heating or cooling) exercise shall be conducted only when weather will produce proper load.
- 1.16.27 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 OWNER, 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.
- 1.16.28 If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, said material or equipment shall not be delivered, or if delivered it shall be promptly removed from the site or from the Work and replaced with acceptable material without additional cost to the OWNER. All obligations under the terms and conditions of the Contract shall be fulfilled even though the OWNER or the OWNER's Authorized Representatives fail to ascertain noncompliance or notify the CONTRACTOR of noncompliance.

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	<i>American Society for Testing and Materials</i>
AWG	<i>American Wire Gauge</i>
ICEA	<i>Insulated Power Cable Engineers Association</i>
IEEE	<i>Institute of Electrical and Electronic Engineers</i>
IES	<i>Illuminating Engineering Society of North America</i>
NEC	<i>National Electrical Code</i>
NEMA	<i>National Electrical Manufacturer's Association</i>
NESC	<i>National Electrical Safety Code</i>
UL	<i>Underwriters' Laboratories</i>
ACI	<i>American Concrete Institute</i>
FM	<i>Factory Mutual</i>
SSPC	<i>Steel Structures Painting Council</i>

1.18.2 Standard Specifications

Where used in these Special Provisions, this term shall mean the "Standard Specifications for Road and Bridge Construction", published by the Illinois Department of Transportation dated January 1, 2007.

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 Article 101.42 of the Standard Specifications.

1.18.4 Supplements

Where used in these Special Provisions, this term shall mean the "Supplemental Specifications and Recurring Special Provisions" published by the Illinois Department of Transportation dated January 1, 2009.

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, including any required connection and testing".

1.18.7 Owner

Where used in these Special Provisions, this term shall mean The State of Illinois.

1.18.8 Engineer

See Article 101.15 of the Standard Specifications.

1.19 Referenced Specifications and Standards

1.19.1 The referenced specifications and standards 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

1.20.1 A Schedule of Values shall be submitted as payment basis for 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 and IDOT's District One, Bureau Electrical Operations, 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 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 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 item. Round off figures to the nearest ten (10) dollars. The "value" for each item listed shall be the supplied, installed and operational start-up cost incurred to the Contractor for that item (overhead and profit included). No items shall be listed as calendar units (i.e. per month). The sum total of all items in the Schedule shall be equal to the payment item total.

1.21 Start-Up

1.21.1 Items to be checked on start-up include, but not limited to, the following:

- (a) Demonstration of back-up float controls
- (b) Gas detection calibration kit shall be always stored on site
- (c) Demonstration of transfer switch operation and maintenance
- (d) Check potable water operation if applicable
- (e) Check alarm operation SCADA and Aegis system

1.21.2 The contractor shall be prepared to demonstrate operation and maintenance procedures for all equipment installed.

2. PRODUCTS:

Not Used

3. EXECUTION:

Not Used

END OF THIS SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 1B - MEASUREMENT AND PAYMENT

1. GENERAL:

1.1 Description

- 1.1.1 The work under this Contract for the construction of Pump Station 24 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 EARTH EXCAVATION shall be paid for at the unit contract unit price per cubic yard as specified in Section 2A, Site Work.
- 1.1.3 BRACED EXCAVATION shall be paid for at the contract unit price per cubic yard as specified in Section 2A, Site Work.
- 1.1.4 AGGREGATE BASE COURSE, TYPE B 12" shall be paid for at the contract unit price per square yard as specified in Section 2A, Site Work.
- 1.1.5 BITUMINOUS MATERIALS (PRIME COAT) shall be paid for at the contract unit price per gallon as specified in Section 2A, Site Work.
- 1.1.6 HOT-MIX ASPHALT SURFACE COURSE, MIX "C", N50 shall be paid for at the contract unit price per ton as specified in Section 2A, Site Work.
- 1.1.7 HOT-MIX ASPHALT BINDER COURSE, IL-19.0, N50 shall be paid for at the contract unit price per ton as specified in Section 2A, Site Work.
- 1.1.8 CONCRETE STRUCTURES shall be paid for at the contract unit per cubic yard as specified in Section 3A, Cast-In-Place Concrete.
- 1.1.9 CHAIN LINK FENCE, 6' shall be paid for at the contract unit price per lineal foot as specified in Section 2A, site Work.
- 1.1.10 CHAIN LINK FENCE 8' (SPECIAL) shall be paid for at the contract unit price per lineal foot as specified in Section 2A, Site Work.
- 1.1.11 CHAIN LINK GATES, 8'X3' SINGLE shall be paid for at the contract unit price per each as specified in Section 2A, Site Work.
- 1.1.12 CHAIN LINK GATES, 6'x20' DOUBLE shall be paid for at the contract unit price per each as specified in Section 2A, Site Work.
- 1.1.13 CHAIN LINK GATES, 8'X20' DOUBLE shall be paid for at the contract unit price per each as specified in Section 2A, Site Work.

- 1.1.14 CHAIN LINK CANTILEVER SLIDE GATE, 8'X20' shall be paid for at the contract unit price per each as specified in Section 2A, Site Work.
- 1.1.15 REINFORCEMENT BARS, EPOXY COATED A shall be paid for at the contract unit price per pound as specified in Section 3A, Cast-In-Place Concrete.
- 1.1.16 FURNISHING AND ERECTING STRUCTURAL STEEL shall be paid for at the contract unit price per pound as specified in Section 5A, Structural Steel.
- 1.1.17 PUMPING STATION SCADA EQUIPMENT shall 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.
- 1.1.18 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.
- 1.1.19 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.
- 1.1.20 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.
- 1.1.21 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 requirements of Section 670 of the Standard Specifications for Road and Bridge Construction.
- 1.1.22 ELECTRIC SERVICE CONNECTION shall consist of charges of the electric utility for both the temporary and permanent electrical service, if any, to be paid to utility by the Contractor. For bidding purposes, this item shall be estimated at \$300,000. The Contractor will be reimbursed the exact amount of the charges by utility.
- 1.1.23 DRILLED SHAFT IN SOIL shall be paid for at the contract unit price per cubic yard as specified in Section 2A, Site Work.
- 1.1.24 MOBILIZATION shall be paid for at the contract lump sum price and shall be in accordance with the requirements of Standard Specifications for Road and Bridge Construction.

2. PRODUCTS:

Not used.

3. EXECUTION:

Not used.

END OF THIS SECTION

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) Site Cleaning.
- (b) Earth excavation for access road and site pavement.
- (c) Braced support system for excavation.
- (d) Drilled shaft in soil.
- (e) Storm sewer system.
- (f) Hot-mix asphalt bituminous pavement.
- (g) New fence and gate.
- (h) Footing drain system.
- (i) ComEd transformer foundation.
- (j) Topsoiling and seeding.

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 Guarantee

1.3.1 Provide guarantee 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 Earth excavation for access road and site pavement shall be paid for at the contract unit price per cubic yard for EARTH EXCAVATION.
 - 1.6.2 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.

- 1.6.3 Aggregate base course shall be paid for at the contract unit price per square yard for AGGREGATE BASE COURSE, TYPE B, 12" which price shall be considered as payment in full for this item.
- 1.6.4 Chain link fence will be measured for payment in lineal foot of the respective height of fence. The length paid for will be the overall length along the top of the fence from center to center of end posts, excluding the length occupied by gates.
- 1.6.5 This work will be paid for at the contract unit price per lineal foot for CHAIN LINK FENCE of the height specified on the Contract Drawings, and measured as specified herein, which price shall include payment for all excavation and backfilling.
- 1.6.6 The Contract unit price for CHAIN LINK FENCE, 8' SPECIAL shall also include the cost of furnishing all materials and installing the complete fence. No additional compensation will be allowed the Contractor for clearing, encasing the posts with concrete, for furnishing and installing protective electrical grounds.
- 1.6.7 The Contract unit prices for CHAIN LINK GATES shall also include the cost of furnishing all materials and installing the complete gate including the gate posts and fittings and accessories for the gate and gate posts as specified. No additional compensation will be allowed the Contractor for clearing or for encasing the posts with concrete.
- 1.6.8 Site clearing, excavation and backfill shall be included for payment under the Item, PUMP STATION GENERAL WORK
- 1.6.9 The work specified under this Section and as required for bituminous material shall be paid for at the contract unit price per gallon for BITUMINOUS MATERIAL (PRIME COAT), which price shall be considered as payment in full for this item.
- 1.6.10 The work specified under this Section and as required for bituminous binder course shall be paid for at the contract unit price per ton for HOT-MIX ASPHALT BINDER COURSE, IL-19.0, N50, which price shall be considered as payment in full for this item.
- 1.6.11 The work specified under this Section and as required for bituminous surface course shall be paid for at the contract unit price per ton for HOT-MIX ASPHALT SURFACE COURSE, MIX "C", N50, which price shall be considered as payment in full for this item.
- 1.6.12 Drilled shaft in soil shall be paid for at the contract unit price per cubic yard for DRILLED SHAFT IN SOIL.
- 1.6.13 Storm sewer system consists of inlet, outfall, storm sewer system with tumbling basin and temporary bulkhead shall be included for payment under the Item, PUMP STATION GENERAL WORK.

- 1.6.14 Footing drain system consists of pipe, filter fabric and granular fill for pump station shall be included for payment under the Item, PUMP STATION GENERAL WORK.
- 1.6.22 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.
- 1.6.23 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.

2. PRODUCTS:

2.1 Chain Link Fence Materials

- 2.1.1 Posts and fence are specified according to Section 664 of the Standard Specifications. Horizontal braces shall be all pipe type A per DEPARTMENT Standard 664001-01. Swing gate posts shall be 4" with 8.65 lb/ft steel pipe. Line post shall be 2 3/8" with 3.65 lb/ft and terminal (end, corner or pull) posts shall be 2 7/8" with 5.79 lb/ft steel pipe. All steel pipe shall be galvanized per ASTM F 669.
- 2.1.2 Concrete is Class SI conforming to the applicable portions of Sections 503 and 664 of the Standard Specifications.
- 2.1.3 Top rail shall be 1 5/8" with 2.27 lb/ft galvanized steel pipe per ASTM F 669.
- 2.1.4 Fabric shall be woven in 2" mesh 9 gauge with 0.148" diameter wire with Type II, aluminum –coated per Section 1006.27 of the Standard Specifications. The fabric shall be knuckled selvage on top and twisted and barbed selvage on bottom.
- 2.1.5 The 8' high fence shall consist of a 7' high chain link fence plus 1' of three stands of barb wire.

2.2 Cantilever Sliding Gate and Swing Gate

2.2.1 Gate posts:

Steel pipe posts meeting requirements of ASTM F1184, Type II, and requirements for steel pipe framework specified in the Standard Specifications, 4.0 inches outside diameter, 9.11 pounds per linear foot for Group 1A pipe, or 6.56 pounds per linear foot for Group 1C pipe minimum.

2.2.2 Cantilever:

ASTM F1184, Type II, heavy duty, top rail gate incorporating a track for top roller and with framing, supports, bracing, hardware and accessories as required for a complete and operational assembly. Brace frame to prevent sagging and apply fabric to entire gate. Provide bar latch and two padlocks to enable both inside or outside padlock to open latch.

2.2.3 Framing

Steel pipe frame shall meet requirements of ASTM F1184 and requirements for steel pipe framework specified in this Section. Minimum weight of pipe specified in ASTM F1184 shall be for Group 1A pipe.

2.2.4 Fabrication

Fabricate perimeter frames of gate from metal and finish to match fence framework. Assemble gate frames by welding or with special fittings and rivets for rigid connections, providing security against removal or breakage connections. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware and accessories. Space frame members maximum of 8 feet apart, except as otherwise required.

2.2.5 Fabric

Provide same fabric as required for adjacent fence, except as otherwise required. Install fabric with tension bars at vertical edges and at top and bottom edges. Attach tension bands to gate frame at 15 inch centers maximum.

2.2.6 Bracing

Install diagonal cross bracing consisting of 3/8 inch diameter adjustable length truss rods on gate to ensure frame rigidity without sag or twist.

2.2.7 Locking Device

Locking device shall be as shown on the drawing.

2.3 Barbed Wire

2.3.1 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.

- 2.3.2 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.

2.4 Storm Sewer System

- 2.4.1 Inlet storm sewer pipe shall be 84" diameter RCCP, Class V, Wall B. Outfall storm sewer pipes shall be 72" diameter and 84" diameter RCCP, Class III, Wall B. 12" diameter storm sewer shall be RCCP, Class III, Wall B and 18" diameter storm sewer shall be ductile iron pipe, Class 50 per AWWA C150. All storm sewer pipes shall be in accordance with Section 1042 of the Standard Specifications. RCCP joint shall be rubber gasket meeting the requirement of ASTM C443. Ductile iron pipe joint shall be push-on type joint with rubber gasket and conform to AWWA C111.
- 2.4.2 Pre-cast concrete section for catch basins and manholes shall conform to the ASTM C478, Precast Reinforced Concrete Manhole Sections. Joint gasket shall be rubber gasket meeting the requirement of ASTM C443.
- 2.4.3 Pre-cast concrete section for tumbling basin shall conform to the ASTM C76, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, Table 5, Wall B. Joint gasket shall be rubber gasket meeting the requirement of ASTM C443.

2.5 Footing Drain System

- 2.5.1 Footing drain system pipe shall be 6" diameter ductile iron pipe Class 50 per AWWA C150. The joint shall be push on open joint. Bolts shall be all 316 stainless steel for mechanical joint for bends.

3. EXECUTION:

3.1 Site Clearing

- 3.1.1 Unless otherwise specifically indicated, this work shall consist of clearing and grubbing within the existing site.

3.2 Excavation and Backfill

- 3.2.1 Excavation and backfill shall be in accordance with Section 502 of the Standard Specifications.

3.3 Storm Sewer System

- 3.3.1 Storm sewer shall be installed and constructed in accordance with Section 550 of the Standard Specifications.

3.4 Hot-Mix Asphalt Bituminous Pavement

- 3.4.1 Work shall be in accordance with Sections 311 and 406 of the Standard Specifications.

3.8 Topsoiling and Seeding

- 3.8.1 Work shall be in accordance with Section 221 and 260 of the Standard Specifications.

END OF THIS SECTION

DIVISION 2 - SITE WORK

SECTION 2B - DEMOLITION

1. GENERAL:

1.1 Description

- 1.1.1 The extent and location of the Demolition works shall be as specified herein. The work includes the requirements for the removal, and satisfactory disposal of all materials except materials approved by the Engineer to be reused in the work.

- 1.1.2 The Demolition work is included in the G Drawings for guidance only to indicate typical general construction features of the various types of construction and shall not be constructed 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 1A - Summary of Work.
1.3.2 Section 1B - Measurement and Payment.
1.3.3 Section 2A - Site Work.

1.4 Submittal

- 1.4.1 Submit under provisions of Section 1A.

1.5 Basis of Payment

- 1.5.1 Scope of work shall be as shown and specified in the prospective divisions and include, but not limited to, the following major items:

- (a) Removal and disposal of the existing fence and gate.

(b) Removal and disposal of the existing bituminous pavement.

(c) Removal and disposal of the existing Jersey barrier block.

(d) Removal and disposal of the existing storm sewer system.

1.5.2 Payment

(a) The work specified under this Section and as required for the removal and disposal of the existing fence and gate shall be included in the contract lump sum price for the Item, PUMP STATION, GENERAL WORK.

(b) The work specified under this Section and as required for the removal and disposal of the existing bituminous pavement shall be included in the contract lump sum price for the Item, PUMP STATION, GENERAL WORK.

(c) The work specified under this Section and as required for the removal and disposal of the existing Jersey barrier block shall be included in the contract lump sum price for the Item, PUMP STATION, GENERAL WORK.

(d) The work specified under this Section and as required for the removal and disposal of the existing storm sewer system shall be included in the contract lump sum price for the Item, PUMP STATION, GENERAL WORK.

2. PRODUCTS:

Not used.

3. EXECUTION:

3.1 Demolition

3.1.1 Demolition work to be included under the Item, PUMP STATION DEMOLITION shall include, but not be limited to, the following:

- (a) Fence and gate removal.
- (b) Bituminous pavement.
- (c) Jersey barrier block.
- (d) Storm sewer system to include catch basin, manhole and sewer.
- (e) Abandoned electrical control box and pole.

3.2 Disposal

3.2.1 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. Sod will be placed to match the surrounding area by others. Contractor shall coordinate with overall requirements for final site requirements.

END OF THIS SECTION

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 January 1, 2007, 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.

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 AASHTO M-31, M-42 or M-53 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) Reinforcing bars shown to be welded on Drawings shall be Designation ASTM A706, Grade 60.
 - (d) 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 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.

- (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.

2.4.3 Gasket Type Waterstop: 1" by 3/4" Waterstop-Rx by American Colloid Co. or SikaSwell S-Sealant by Sika Corp.

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

- (a) Form surfaces shall be smooth and free from any imperfections which would cause objectionable roughness on the finished surface of the concrete.
- (b) 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.
- (c) All necessary inserts in form work such as rods, bolts, anchorages, fillets, and other devices shall be installed as required.
- (d) Forms shall not be treated with material that will adhere to or discolor the concrete.
- (e) 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 sub-structure concrete until the concrete has developed sufficient strength to support safely the load thereon.
- (f) For all exposed concrete edges a 3/4 inch chamfer strip shall be provided.

3.1.2 Form Removal

- (a) Forms shall be removed in such manner and at such a time as to insure the complete safety of the structure. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to support safely their weight and load thereon. The results of suitable control tests shall be used as evidence that the concrete has attained the required strength.
- (b) Removal of forms shall conform to Section 503.06 of the Standard Specifications.

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) Concreting in freezing weather 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 Ili-Mod (Sikastix 370), or approved equal. Application shall be in strict conformity with the manufacturer's recommendations, with particular attention given to temperature requirements. Applicable provisions of Article 503.09 (a) (2) of the Standard Specifications shall be followed. 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 interior and exterior surfaces that will be exposed to view after completion of the work shall be given a normal finish in accordance with Section 503.16(a) of the Standard Specifications.
- (g) 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.
- (h) 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.
- (i) All concrete shall be cured for a minimum of 7 days in accordance with Section 1020.13, "Curing and Protection" of Portland Cement Concrete.

END OF THIS SECTION

DIVISION 3 - CONCRETE

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.
- 1.1.4 Grout for slide gate frame.

1.2 Related Sections

- 1.2.1 Section 3A - Cast-In-Place Concrete.
- 1.2.2 Section 5C – 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.

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 Five Star Epoxy Grout by U.S. Grout Corporation.

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.

2.4 Manufacturers - Non-Shrink, Non-Metallic, Cementitious Grout

2.4.1 Sika Grout 212 by Sika Chemical Company.

2.4.2 Masterflow 928 by Master Builders Company.

2.4.3 Sealtight 588 grout by W. R. Meadows, Inc.

2.4.4 Substitutions: Under provisions of Division 1.

2.5 Materials - Cement-Sand Grout

2.5.1 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.

2.5.2 Cement: ASTM C150, Type 2.

2.5.3 Sand: ASTM C33.

2.5.4 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

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 - Structural Steel.
- 1.2.3 Section 5B - Metal Fabrications.
- 1.2.4 Section 6A – 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 - Aluminum Doors and Frames.
- 1.2.10 Section 8B – Steel Doors and Frames.
- 1.2.11 Section 8C – Overhead Coiling Doors.
- 1.2.11 Section 8D - Door Hardware.
- 1.2.12 Section 9A - Painting

1.2.13 Section 10A – Specialties.

1.2.14 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 2006: 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

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which shall be payment in full for the work described herein.

2. PRODUCTS:

2.1 Brick Units

2.1.1 Manufacturers:

- (a) Belden.
- (b) Darlington, A General Shale Company.
- (c) Hanley Brick, A Glen-Gery Brick Company.
- (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 cream with matte texture. Contractor shall submit the sample brick for Engineer's approval. Do not start Work until Engineer/Owner has accepted sample. The Owner or Engineer's brick chosen shall be provided by the Contractor at no additional cost to Owner.

2.2 Concrete Block (Standard and Glazed Type CMU)

- 2.2.1 Manufacturers:
- 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.
- 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/Owner has accepted sample. The Owner or Engineer's block chosen shall be provided by the Contractor at no additional cost to Owner.
- 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 an approved equal:
- Pittsburgh Corning Corp.: Vistabrick Type, Saint-Gobain
- 2.3.2 The glass block shall be solid, transparent blocks with smooth outer faces made by fusing together two solid slabs of clear, colorless glass with manufacturer's standard coating factory-applied on edge surfaces. Sizes shall be either 3 inch thick by 7-3/4 inch square actual size, or 3 inch thick by 3 inch by 7-3/4 inch 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 utilizing 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.

2.8 Water

- 2.8.1 Water shall be free of deleterious quantities of acids, alkalis and organic materials and shall come from a domestic supply.

2.9 Reinforcing Steel

- 2.9.1 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.

- 2.9.2 Reinforcement shall be clean and free from loose rust, scale, dirt, and any coatings that reduce bond.
 - 2.9.3 Mechanical splice anchors for reinforcing bars: submit product data and information for review.
- 2.10 Horizontal Joint Reinforcement and Metal Accessories
- 2.10.1 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.
 - 2.10.2 Manufacturer - Subject to compliance with requirements, provide horizontal joint reinforcement of one of the following, or an approved equal:
 - (a) A. A. Wire Products Co.
 - (b) "Dur-O-Wall" by Dayton Superior
 - (c) Blok-Lok, A Hohmann and Bernard Company
 - 2.10.3 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 Blok-Trus Corner-Lok, standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R. Intersection between walls and partitions shall be reinforced horizontally with Blok-Trus Partition-Lok, standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R, or equal, 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 Blok-Trus AA600, (AA610) Standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R or equal, spaced at 16-inch centers vertically.
- 2.11 Flashing
- 2.11.1 Rubberized asphalt sheet flashing with metal drip edge.
 - 2.11.2 Sheet Flashing:
 - (a) "Perm-A-Barrier VP" as manufactured by W. R. Grace & Co.
 - (b) "Dur-O-Barrier" as manufactured by Dayton Superior.
 - (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.

2.12 Accessories

2.12.1 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. Sure Klean No. 600 Detergent; ProSoCo. Inc.
 - 2. Approved equal.
- (b) Cleaners for brick subject to metallic staining:
 - 1. Sure Klean Vana Trol; ProSoCo. Inc.
 - 2. 202V Vana-Stop; Diedrich Technologies, Inc.
 - 3. Approved equal.
- (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.

2.12.2 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 Break; Advanced Building Products, Inc.
- (b) Mortar Net; Mortar Net U.S.A. Ltd.

2.12.3 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.

2.13 Dovetail Anchor Slots and Anchors

2.13.1 20 gauge galvanized dovetail foam filled anchor slots compatible with anchors.

2.13.2 16 gauge by 1 in. galvanized corrugated, dovetailed metal anchor straps.

2.13.3 Zinc coated in accordance with ASTM A153, Class B2.

2.14 Weephole Material

2.14.1 1/4 in. dia plastic or rubber tube.

2.14.2 Cotton sash cord.

2.15 Limestone Sill

2.15.1 Furnish Indiana (oolitic) limestone complying with ASTM C568, Category II (medium density), and as follows.

2.15.2 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 course 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 manner 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. Non load-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 2 courses solid (16 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 42 inches wide: Place two (2) No. 5 bars 1 inch from bottom web.
 - (b) Openings from 42 inches up to 78 inches wide: Place two (2) No. 5 bars 1 inch from bottom web.
 - (c) 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 and indicated on Contract Drawings.
 - (c) Lap splices minimum 40 bar diameters.
 - (d) Support and secure reinforcing bars from displacement. Maintain position within 1/2 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 7E 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 1/2 inch in 20 feet or more.
- (c) Maximum variation from plumb: 1/4 inch per story non-cumulative; 1/2 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; 1/2 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.
- 3.5.4 Fully adhere sheet flashing to top of metal drip edge and cut off sheet flashing 1/2 inch back from exterior face.
- 3.5.5 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.

3.5 Clean-Up

- 3.5.1 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.
- 3.5.2 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.

- 3.5.3 After mortar is thoroughly set and cured, remove large mortar particles by hand with wooden paddles and non-metallic scrape holes or chisels.
- 3.5.4 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

SECTION 5A - STRUCTURAL STEEL

1. GENERAL:

1.1 Section Includes

- 1.1.1 Monorail hoist beams.

1.2 Related Sections

- 1.2.1 Section 3A - Cast-In-Place Concrete.
- 1.2.2 Section 9A - Painting.

1.3 References

All reference standards shall be from the latest edition.

- 1.3.1 AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- 1.3.2 ASTM A36 - Structural Steel.
- 1.3.3 ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- 1.3.4 ASTM A325 - High Strength Bolts for Structural Steel Joints.
- 1.3.5 ASTM A 992 – Structural Steel Shapes
- 1.3.6 AWS A2.0 - Standard Welding Symbols.
- 1.3.7 AWS D1.1 - Structural Welding Code.
- 1.3.8 SSPC - Steel Structures Painting Council.

1.4 Design Requirements

- 1.4.1 Where final design of members and connections for any portion of the structure is not indicated, perform final design of such members and connections in accordance with AISC Specification and as Specified herein, at no additional cost.
 - 1.4.2 Members and connections shall be designed by a structural engineer registered in the place of the project.
 - 1.4.3 Unless otherwise indicated, design connections in accordance with American Institute of Steel Construction "Manual of Steel Construction, Latest Edition".
- 1.5 Submittals
- 1.5.1 Shop Drawings
 - (a) Indicate profiles, sizes, and locations of structural members, attachments and fasteners.
 - (b) Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths and size.
 - (c) Review of shop drawings in no way affects the Contractor's responsibility for carrying out the Work to Contract Drawings and specifications.
 - (d) Shop drawings shall be approved prior to fabrication.
 - 1.5.2 Manufacturer's Mill Certificate: Submit under provisions of Division 1 certifying that products meet or exceed specified requirements.
 - 1.5.3 Welders' Certificates: Submit under provisions of Division 1 Manufacturer's Certificates, certifying welders employed on the Work, verifying AWS qualifications within the previous 12 months in the position in which they will be carrying out the welding.
 - 1.5.4 Substitutions of sections or modifications of details and the reasons for these changes shall be submitted by letter with shop drawings for review by the Engineer. Changes in related portions of the Work shall be coordinated by the Contractor.
- 1.6 Quality Assurance
- 1.6.1 Fabricate structural steel members in accordance with AISC-Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- 1.7 Basis of Payment
- 1.7.1 The work specified under this Section and as required shall be paid for at the Contract unit price per kilogram (pound) for FURNISHING AND ERECTING STRUCTURAL STEEL, which price shall be payment in full for all labor, materials, tools, equipment and incidentals required to complete this Item.

2. PRODUCTS:

2.1 Materials

2.1.1 Structural Steel Members: ASTM A36 or A 992.

2.1.2 Bolts, Nuts, and Washers: ASTM A325.

2.1.3 Welding Materials: AWS D1.1; type required for materials being welded.

2.1.4 Materials shall meet the requirements of the Standard Specifications, Section 505.

2.2 Fabrication

2.2.1 Fabricate all members as indicated on Drawings and as outlined in AISC.

2.2.2 Perform welding in accordance with AWS D1.1.

2.2.3 Fabricating tolerances for finished parts shall comply with AISC Code of Standard Practice.

2.3 Finish

2.3.1 Prepare structural component surfaces in accordance with SSPC-SP6 - Commercial Blast Cleaning.

2.3.2 Hot-dip galvanized conforming to ASTM A123 and AHDGA Specifications.

2.3.3 Galvanizing repair paint: High zinc-dust content paint complying with MIL-P-21035.

2.4 Source Quality Control and Tests

2.4.1 Testing and analysis of components will be performed under provisions of Division 1.

3. EXECUTION:

3.1 Examination

3.1.1 Verify that field conditions are acceptable and are ready to receive work.

3.2 Erection

3.2.1 Erect structural steel in compliance with AISC Code of Standard Practice and Specification.

3.2.2 Do not field cut or alter structural members without approval of Engineer.

3.3 Field Quality Control

3.3.1 Field inspection will be performed under provisions of Division 1.

END OF THIS SECTION

DIVISION 5 - METALS

SECTION 5B - 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.

Stairs.
Lintels.
Metal frames.
Floor access hatches.
Roof access hatches.
Stair Nosings.
Aluminum handrails and railings.
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 5C - 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.

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.
- Do not coat ferrous metal surfaces embedded in concrete.
Coating of cast iron or ductile iron floor access hatches and pressure relief valves not required.
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.
Coat aluminum surfaces in contact with concrete with bituminous coating. Under no circumstances shall aluminum contact dissimilar metal.
- 2.2.8 Galvanizing:
- Galvanize after fabrication.
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 Stair

- 2.4.1 Construct stairs and platforms of steel channel stringers and framing members to support uniform live load of 100 psf or a moving concentrated load of 1000 lbs, whichever produces the greatest stress.
- 2.4.2 Close exposed ends of stringers with plates, continuously welded to main member.
- 2.4.3 Grating treads and landing platforms.
- (a) Provide shop-fabricated grating and accessories such as frames, support angles, fasteners, and treads.
 - (b) Grating and treads shall be galvanized steel.
 - (c) Treads and exposed edges of grating platforms shall have corrugated or cast iron abrasive nosing.
 - (d) Provide fastening devices to firmly anchor grating and treads to supports.
 - 1. Min of 4 per panel.
 - 2. Saddle clip type.
 - 3. "G" clip type.
 - 4. Clamp type.
 - 5. Min 1/4 in. bolts or self tapping screws.
 - 6. 316 stainless steel.
 - (e) Provide trim banding or load carrying banding on edges welded to grating.
 - 1. Bearing bars not resting on supports shall have load carrying banding sized to span opening.
 - 2. Min banding thickness shall match bearing bar thickness.
 - 3. Banding shall be flush with top of grating.
 - 4. Banding depth shall be 1/4 in. less than bearing bar depth at supports.
 - (f) Cross bars shall not extend more than 1/8 in. past bearing bars at panel edges.
 - (g) Panels shall bear on supports a min length equal to bearing bar depth.
 - (h) Minimum width of panels shall be 16 in. except for locations requiring a single piece.
 - (i) Max width of panels shall be 48 in.
 - (j) Bearing bars: 1 3/4" x 1 3/16" @ 1 3/16" on center. Cross bars: 1/4" x 1/4" twisted bar @ 4" on center.

- 2.4.4 Hot-dip galvanize after fabrication.
- 2.5 Lintels
- 2.5.1 Provide steel lintels over openings in masonry walls as noted and wherever reinforced masonry or concrete lintels are not provided.
 - 2.5.2 Fabricate lintels from structural steel shapes as detailed, selected for straightness of section, with minimum of 8 in bearing each side of opening.
 - 2.5.3 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.
 - 2.5.4 Hot-dip galvanize after fabrication.
- 2.6 Metal Frames
- 2.6.1 Provide door, hatch, grille, louver, and other frames fabricated from structural shapes or plates.
 - 2.6.2 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.
 - 2.6.3 Miter or cope and join members with continuous welds.
 - 2.6.4 Provide temporary spreader bars to prevent springing frames out of shape prior to and during erection.
- 2.7 Floor Access Hatches
- 2.7.1 Prefabricated Standard Type:
 - (a) Manufacturers:
 - (1) Bilco Type K or KD.
 - (2) Halliday Type S1S or S2S.
 - (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.

2.7.2 Prefabricated Drainage Channel Type:

(a) Manufacturers:

- (1) Bilco Type J or JD.
 - (2) Halliday Type W1S or W2S.
- (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) Door leaves for roof hatches shall be insulated with 3 in. rigid insulation. Insulation shall be covered with 18 ga. aluminum plate.
 - (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.

2.8 Safety Gate

2.8.1 Where noted on Drawings provide retractable safety grate across access hatch openings.

2.8.2 Metal Grating Type:

- (a) Halliday Retro-Grate.
- (b) Aluminum construction with safety orange powder coat.

- (c) Spring loaded lifting handle.
- (d) Stainless steel hold open arm with aluminum latch.
- (e) Stainless steel hardware through out.
- (f) Load rated at 300 psf.

2.9 Roof Access Hatches

2.9.1 Prefabricated Ladder Access Type S:

- (a) Manufacturers: Bilco Type S.
- (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.

2.9.2 Prefabricated Double Leaf Scuttle Type D:

- (a) Manufacturers: Bilco Type D
- (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.

2.10 Stair Nosings

2.10.1 Manufacturers:

- (a) Wooster Products, Inc.: Supergrit Type 131.
- (b) American Safety Tread Co., Inc.: Type 3511 or 3551.
- (c) Balco, Inc.: Type R-305P.
- (d) Safe T Metal Co., Inc.: Type BF131.

2.10.2 Nosings shall be exterior type aluminum safety treads; 3-in. wide by ¼-in. thick, with 5 abrasive fitted ribs.

2.10.3 Provide aluminum stair nosings for setting in concrete for interior concrete stairs.

2.10.4 Nosings shall be 8-in. shorter than width of tread or landing.

2.11 Aluminum Handrails and Railings

2.11.1 Manufacturers:

- (a) ConnectoRail by Julius Blum Co., Inc.
- (b) Wesrail by Moultrie Manufacturing Co.
- (c) Series 500 by Superior Aluminum Products, Inc.
- (d) Or equal.

2.11.2 Pipe handrail and railing shall conform to OSHA and local building code requirements.

2.11.3 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.

2.11.4 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.

2.11.5 Chain gates shall be 3/16 in. stainless steel link chain with stainless steel clasp capable of withstanding 250 lbs load.

2.11.6 Mechanical fasteners shall be stainless steel.

2.11.7 Clear satin anodized finish:

(a) Extruded Components: 0.7 mil.

(b) Cast Components: 0.4 mil.

2.11.8 Use materials of size, thickness, and type required to produce required strength and durability.

2.11.9 Form connections and changes in direction by using prefabricated fittings or radius bends.

2.11.10 Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces.

2.11.11 Close pipe ends using prefabricated fittings.

2.11.12 Fabricate joints of exterior units to exclude water or provide weep holes where water may accumulate.

2.11.13 Provide base flange or side mounted base plate.

2.11.14 Coat surfaces to be in contact with concrete with bituminous paint.

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

Clean and strip primed steel items to bare metal where site welding is required.

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 as produced by Rust-Oleum Corp. or ZRC Chemical Company, Quincy, Mass.

END OF THIS SECTION

DIVISION 5 - METALS

SECTION 5C - 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:

- (a) Piping.
- (b) Hangers and brackets.
- (c) Equipment.
- (d) Electrical, plumbing and HVAC work.
- (e) Pump base.
- (f) Miscellaneous fasteners.

1.2 Related Sections

- 1.2.1 Section 4A - Unit Masonry.
- 1.2.2 Section 5B - 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

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which shall be payment in full for the work described herein.

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 by Powers Fasteners (Rawl).
 - (2) Kwik Bolt II by Hilti Corp.
 - (3) Liebig Wedge Anchor by Liebig.
 - (4) Ankr-Tite Wedge Anchor by Ankr-Tite Fastening Systems.
 - (5) Wedge-All by Simpson Strong-Tie Co., Inc.
- (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 Powers Fasteners (Rawl).
- (2) HSL Heavy Duty Sleeve Anchor by Hilti Corp.
- (3) Liebig Anchor by Liebig.

(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 by Powers Fasteners (Rawl).
- (2) HLC Sleeve Anchor by Hilti Corp.
- (3) Sleeve Anchors by Ankr-Tite Fastening Systems.
- (4) Sleeve-All Anchor by Simpson Strong-Tie Co., Inc.

(b) Usage: In masonry:

- (1) 316 stainless steel.

2.4.4 Undercut Anchors:

(a) Manufacturers:

- (1) Maxi-Bolt by Drillco Devices Ltd.
- (2) HDA Undercut Anchor by Hilti Corp.
- (3) Liebig Ultraplus by Liebig.

(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:

(a) Manufacturers:

- (1) HIT RE 500 Epoxy Adhesive Anchor by Hilti Corp.
- (2) AC100 Plus or Power-Fast + by Powers Fasteners (Rawl).
- (3) Inject-Tite Two-Part Epoxy by Ankr-Tite Fastening Systems.
- (4) ET, SET or ETF Epoxy Adhesive System by Simpson Strong-Tie Co., Inc.

(b) Epoxy adhesive with 316 stainless steel stud assembly.

(c) Usage:

- (1) In concrete, submerged.
- (2) In masonry, provide tube screen inserts.
- (3) Do not use in overhead applications.

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

SECTION 6A - ROUGH CARPENTRY

1. GENERAL:

1.1 Section Includes

- 1.1.1 Wood nailers at parapet
- 1.1.2 Blocking and cant strip 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.

- A. Northeastern Lumber Manufacturers Association, Inc. (NELMA).
- B. Southern Pine Inspection Bureau (SPIB).
- C. West Coast Lumber Inspection Bureau (WCLIB).
- D. Western Wood Products Association ((WWPA).
- E. 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.
 - A. S-Dry: Maximum 19 percent moisture content.
 - B. MC-5 or KD: Maximum 15 percent moisture content.
 - C. 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.

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

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

1.3.1 ASTM D412 - Rubber Properties in Tension.

1.3.2 ASTM D746 - Brittleness Temperatures of plastics and Elastomers by Impact.

1.3.3 ASTM D624 - Rubber Property-Tear Resistance.

1.3.4 ASTM D822 - Practice for Operating Light-and-Water-Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products.

1.3.5 ASTM D1004 - Initial Tear Resistance of Plastic Film and Sheeting.

1.3.6 ASTM D2240 - Rubber Property - Durometer Hardness.

1.3.7 ASTM E96 - Water Vapor Transmission of Materials.

1.3.8 NRCA (National Roofing Contractors Association) - Roofing and Waterproofing Manual.

1.3.9 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:

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.

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.

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.

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.

2.1.2 Substitutions: Under provisions of Division 1.

2.2 Membrane System

2.2.1 Fully adhered 0.060 inch (60 mil) thick EPDM system.

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
 - (b) "Duo-Pad" roof traffic and vibration protection pads by W.R. Meadows, Inc. P.O. Box 338; Hampshire, Illinois

2.7 Manufacturers - Roofing Insulation Materials

- 2.7.1 Firestone Building Products Co.
- 2.7.2 Atlas Roofing Corporation.
- 2.7.3 Apache ISO Products, LLC.
- 2.7.4 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 Owner or 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

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

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: Provide manufacturer's for fabricators detail drawings showing:
 - a. Scuppers and downspouts
 - b. Coping
 - c. Flashing and counterflashing
 - d. All associated accessories

The drawings and manufacturer's product data shall indicate type of material(s) used, 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.

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: Stainless Steel- 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: Stainless Steel. Fabricate to dimensions as shown on drawings.
- 2.3.8 Downspout: Stainless Steel. 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

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

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 - Aluminum Doors and Frames.
 - 1.2.6 Section 8B – Steel Doors and Frames.
 - 1.2.7 Section 8C – Overhead Coiling Doors
 - 1.2.8 Section 8D – Hardware
 - 1.2.9 Section 8E – Glass and Glazing
 - 1.2.10 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.
- 2. PRODUCTS:
 - 2.1 Sealants

- 2.1.1 Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25 (100/50), 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); product: Spectrem 1 manufactured by Tremco.

Color Schedule:

- (a) Exterior wall joints: match mortar joint color.
- (b) Sheet metal coping: match sheet metal color
- (c) Exterior doors: match aluminum anodized 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

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

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 to 4'-6" below grade.

1.2 Related Section

1.2.1 Division 3 - Concrete.

1.2.2 Section 4A - Unit Masonry System.

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.

2. PRODUCTS:

2.1 Manufacturers - Insulation Materials

2.1.1 The Apache Products Company: Polyisocyanurate Insulation

2.1.2 Celotex Corporation

2.1.3 Johns Manville Corporation

2.1.4 Substitutions: Under provisions of Division 1.

2.2 Insulation Materials

2.2.1 Polyisocyanurate Insulation: ASTM C591 rigid, cellular type, conforming to the following:

(a) Thermal Resistance: R-value of 6 per inch.

(b) Compressive Strength: 20 psi minimum per ASTM D1621.

(c) Water Absorption: In accordance with ASTM C2842, less than 1.5 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.

(f) Board Density: (2.0 lbs/cu. ft.)

2.3 Adhesive Materials

2.3.1 Adhesive: Type recommended by insulation manufacturer for application.

2.4 Accessories

2.4.1 A 1/2" 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 impale 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

SECTION 8A - ALUMINUM DOORS AND FRAMES

1. GENERAL:

1.1 Section Includes

1.1.1 Exterior aluminum doors

1.1.2 Exterior aluminum frames, with transom frame where indicated on drawings.

1.1.3 Exterior aluminum insulated infill panels (to match type of construction and 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 5B - Metal Fabrications.
- 1.2.4 Section 8D - Door Hardware.
- 1.2.5 Section 15A - General Mechanical Provisions: Louver and Damper coordination.

1.3 References

- 1.3.1 AAMA 1503-09 – Thermal Transmission and Condensation Resistance of Windows, Doors and Glazed Wall Sections (Formerly AAMA 1502.7).
- 1.3.2 AAMA 701/702-04 – Pile Weatherstripping and Replaceable Fenestration Weatherseals.
- 1.3.3 ANSI/ASTM A36 - Structural Steel.
- 1.3.4 ANSI/ASTM B209 - Aluminum and Aluminum - Alloy Sheet and Plate.
- 1.3.5 ANSI/ASTM B221 - Aluminum - Alloy Extruded Bar, Rod, Wire, Shape and Tube.
- 1.3.6 ASTM D2287 – Non rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
- 1.3.7 ASTM E283 – Rate of Air Leakage Through Exterior Windows, Curtainwalls and Doors
- 1.3.8 ASTM E330 – Structural Performance of Exterior Windows, Doors and Skylights.

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.

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 Delivery, Storage and Protection

1.6.1 Deliver, store, protect and handle products to site under provisions of Division 1.

1.6.2 Provide strippable coating to protect pre-finished aluminum surfaces.

1.7 Basis of Payment

1.7.1 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.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Cross Aluminum Products, Inc.

2.1.2 United States Metals & Manufacturing Corp.

2.1.3 Kawneer Company, Inc.

2.1.4 Special Lite, Inc.

2.1.5 Substitutions: Under provisions of Division 1.

2.2 Materials

2.2.1 Extruded Aluminum: ANSI/ASTM B221; 6063-T5 alloy.

2.2.2 Sheet Aluminum: ASTM B209; 5005 - H134 alloy.

2.2.3 Fasteners: Stainless steel.

- (a) Do not use exposed fasteners except where unavoidable. Match finish of adjoining metal.
- (b) Provide Phillips flat head machine screws for exposed fasteners.

- 2.2.4 Concealed Flashing: Dead soft stainless steel, 26 ga. minimum or extruded aluminum, 0.62 inch minimum of alloy and type selected by manufacturer for compatibility with other components.
- 2.2.5 Brackets and Reinforcements: Manufacturer's high strength aluminum units where feasible, otherwise, non-magnetic stainless steel or hot dip galvanized steel complying with ASTM A123.
- 2.2.6 Concrete/Masonry Inserts: Cast iron, malleable iron, or hot dip galvanized steel complying with ASTM A123.
- 2.2.7 Bituminous Coatings: Cold applied asphalt mastic.
- 2.2.8 Compression Weatherstripping: Manufacturer's standard replaceable stripping of either molded neoprene gaskets complying with ASTM D2000 or molded PVC gaskets complying with ASTM D2287.
- 2.2.9 Sliding Weatherstripping: Manufacturer's standard replaceable stripping of wool, polypropylene, or nylon woven pile with nylon fabric or aluminum strip backing, complying with AAMA 701/702-04.
- 2.2.10 Substitutions: Under provisions of Division 1.

2.3 Doors and Frames

- 2.3.1 Doors (Flush Type): 1-3/4 inches thick: Frame: tubular frame members fabricated with reinforced mechanical or welded joints in accordance with manufacturer's standard methods. Limit frame exposure to $\frac{3}{4}$ inch maximum width on door faces. Face: aluminum sheet of 0.064 inch minimum thickness, mechanically interlocked with frame members or laminated to core and framing with waterproof glue to form door thickness of 1-3/4 inch. Core insulation material as specified.

Face sheet shall be fluted pattern.
- 2.3.2 Frames: 0.125 inch minimum wall thickness, extruded aluminum. Frame tubular cross-section dimensions: head and jambs shall be nominal 2 inches deep; width shall be as indicated on drawings.
- 2.3.3 Insulated Panel: Construction of insulated panel (adjacent to louver and damper in door transom area) to match door construction.

2.4 Door and Insulated Panel Core

- 2.4.1 Core: Polyurethane foam.
- 2.4.2 Insulated door insulation R-value of 11.0 minimum.

2.5 Accessories

2.5.1 Rubber Silencers: Resilient rubber.

2.6 Fabrication

2.6.1 Fabricate doors and frames allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation.

2.6.2 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.

2.6.3 Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline and weatherproof.

2.6.4 Fabricate frames and doors with hardware reinforcement. Reinforcements to be aluminum alloy 6061-T6, minimum 0.25 inch thickness.

2.6.5 Thermal Break Construction: Fabricate aluminum framing system with integrally concealed, low conductance, thermal barrier located between exterior materials and exposed interior members eliminating direct metal to metal contact.

2.6.6 Prepare components to receive anchor devices. Fabricate anchorage items.

2.6.7 Arrange fasteners, attachments, and jointing to ensure concealment from view.

2.6.8 Prepare frame for silencers. Provide three single rubber silencers for single doors and two single silencers on frame head at double doors.

2.6.9 Fabricate frames with 4 inch head member, or as indicated on drawings.

2.6.10 Welding: Comply with AWS recommendations to avoid discoloration. Grind exposed welds smooth and restore mechanical finish.

2.6.11 Reinforcing: Install reinforcing as necessary for performance requirements. Separate dissimilar metal with bituminous paint or other separator preventing corrosion.

2.6.12 Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

2.6.13 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.

2.7 Finish

- 2.7.1 Extruded Aluminum Surfaces: Clear Anodized Finish.
- 2.7.2 Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A123 to 2.0 oz/sq ft primed with iron oxide paint.
- 2.7.3 Apply one coat of bituminous paint to concealed aluminum and 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 Install doors, frames, glazing and hardware in accordance with manufacturer's instructions.
- 3.2.2 Coordinate installation of doors with masonry and concrete construction for anchor placement.
- 3.2.3 Coordinate installation of frames with louvers and dampers.
- 3.2.4 Use anchorage devices to securely attach frame assembly to structure.
- 3.2.5 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- 3.2.6 Install hardware using templates provided. Refer to Section 8D for 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 Remove protective material from pre-finished aluminum surfaces.

- 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.

END OF THIS SECTION

DIVISION 8 - DOORS AND WINDOWS

SECTION 8B - STEEL DOORS AND FRAMES

1. GENERAL:

1.1 Section Includes

- 1.1.1 Steel doors.
- 1.1.2 Steel frames.
- 1.1.3 B-Label: fire-rated door and frame assemblies.
- 1.1.4 Steel window frames.
- 1.1.5 Fire rated glazing

1.2 Related Section

- 1.2.1 Section 3A - Cast-In-Place Concrete.
- 1.2.2 Section 4A - Unit Masonry.
- 1.2.3 Section 5B - Metal Fabrications.
- 1.2.4 Section 8D - Door Hardware.
- 1.2.5 Section 8E – Glass and Glazing

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 Erection 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 Steel, Sheet, 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 Steel Sheet, 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 Hip Dip Process.
 - 1.3.10 DHI A115.1G – Door Hardware Institute, Installation Guide for Doors and Hardware.
 - 1.3.11 NFPA80 & NFPA 252 - Fire-Rated Door Assemblies.
 - 1.3.12 SDI 117 – Steel Door Institute, Manufacturing Tolerances for Steel Doors and Frames.
 - 1.3.13 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 and glazing requirements.
 - (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.
 - 1.6.2 Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
- 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.
- 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 Hot Rolled Steel Sheets: ASTM A568.
 - 2.2.2 Cold Rolled Steel Sheets: ASTM A1008.
 - 2.2.3 Metallic-Coated Steel Sheets: ASTM A653, an A60 zinc-iron-alloy (galvannealed) coating.
- 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 Fire rated door assemblies: Materials and construction shall comply with NFPA 80 requirements.
- 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, electrolytic zinc-coated or metallic coated steel sheet.
- 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. Where zinc-coated items are to be built into exterior walls, comply with ASTM A153, Class C or D as applicable.

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 from 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 Interior Construction: For interior locations, fabricate doors and frames from cold rolled steel sheet or metallic coated steel sheet.
- 2.6.3 Clearances for Fire Rated Doors: As required by NFPA 80.
- 2.6.4 Single-Acting, Door Edge Profile: Square Edge.
- 2.6.5 Tolerances: comply with SDI 117.
- 2.6.6 Fabricate concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold or hot rolled steel sheet.
- 2.6.7 Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- 2.6.8 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.
 - (b) For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.
- 2.6.9 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.

- 2.6.10 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.
 - 2.6.11 Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied hardware may be done at project site.
 - 2.6.12 Locate hardware as indicated on Shop Drawings, or, if not indicated, according to ANSI A250.8.
 - 2.6.13 Glazing Stops: Manufacturer's standard, formed from 0.032 inch thick steel sheet.
 - 2.6.14 Prepare frame for silencers. Provide three single rubber silencers for single doors and two single silencers on frame head at double doors.
 - 2.6.15 Fabricate frames with 4 inch head member or as indicated.
- 2.7 Finish
- 2.7.1 Prime Finish: Manufacturer's standard, factory applied coat of rust inhibiting primer complying with ANSI A250.10 for acceptance criteria.
 - 2.7.2 Final Finish: Conform to Section 9A Painting. Color as selected by OWNER.
 - 2.7.3 Apply one coat of bituminous paint to concealed aluminum and 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) Install fire-rated frames according to NFPA 80.
- (g) 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 fire rated glazing and frame.

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) Install Fire-Rated doors within clearances specified in NFPA 80.
- (d) 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 8D 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.

3.4.5 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.

3.4.6 Prime Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air drying primer.

3.5 Schedule

3.5.1 See Drawings and refer to Shop Drawings.

END OF THIS SECTION

DIVISION 8 - DOORS AND WINDOWS

SECTION 8C - OVERHEAD COILING DOORS

1. GENERAL:

1.1 Section Includes

1.1.1 Overhead Coiling Doors.

1.1.2 Manual Operated Assemblies including insulated door curtains, guides, counterbalance mechanism, hardware, operators and installation accessories.

1.1.3 System Description: (Design Requirements)

Wind Loading: Design and reinforce overhead coiling doors to withstand 20 lbs/sq ft wind loading pressure unless otherwise indicated.

1.2 Related Section

1.2.1 Section 3A – Cast-In-Place Concrete.

1.2.2 Section 4A – Unit Masonry.

1.2.3 Section 5B - Metal Fabrications.

1.3 References

1.3.1 ANSI/ASTM A123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.3.2 ANSI/ASTM A36 - Structural Steel.

1.3.3 ANSI/ASTM A653 – Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3.4 ANSI/ASTM B209 - Aluminum and Aluminum - Alloy Sheet and Plate.

1.3.5 ANSI/ASTM B221 - Aluminum - Alloy Extruded Bar, Rod, Wire, Shape and Tube.

1.3.6 ANSI/ASTM D3363 – Standard Test Method for Film Hardness by Pencil Test.

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 type and size of overhead coiling door.
- (b) Details of overhead door assembly, including door curtain and door slats, bottom door astragal, hood, counterbalancing mechanism and operator.
- (c) Frame details for jamb and head mounting conditions, guide tracks and mounting details, weather seals, 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) Installation instructions (and roughing-in wiring diagrams if applicable) for each type of overhead door assembly.

1.4.3 Manufacturer's Installation Instructions: Indicate special installation instructions.

1.4.4 Manufacturer's Operation and Maintenance (O&M) Data.

1.4.5 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 Delivery, Storage and Protection

1.6.1 Deliver, store, protect and handle products to site under provisions of Division 1.

1.6.2 Provide strippable coating to protect pre-finished aluminum surfaces.

1.7 Basis of Payment

1.7.1 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.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Cornell Iron Works.

- 2.1.2 Overhead Door Corporation.
- 2.1.3 Cookson Company
- 2.1.4 Substitutions: Under provisions of Division 1.
- 2.2 Materials
 - 2.2.1 Extruded Aluminum: ANSI/ASTM B221; 6063-T5 alloy.
 - 2.2.2 Sheet Aluminum: ASTM B209; 5005 - H34 alloy.
 - 2.2.3 Fasteners: Stainless steel.
 - 2.2.4 Galvanized Sheet Steel: Grade 40 steel, ASTM A653 galvanized steel zinc coating.
 - 2.2.5 Structural and Miscellaneous Steel: ASTM A36 Structural Steel, and reference Section 5A Structural Steel and Section 5B Metal Fabrications.
- 2.3 Curtain
 - 2.3.1 Door Slats: 0.050 inch aluminum sheet metal.
 - 2.3.2 Slat Insulation: Polyurethane foam insulation filled inside door slat shell.
 - 2.3.3 Bottom Bar: two 2x2x1/8 inch stainless steel angles. Or two 2x2x1/8 inch aluminum angles.
 - 2.3.3 Fabrication: fabricate door curtain in manufacturer's standard double wall, "S" configuration, flat slats with foamed in place polyurethane insulation. Fabricate interlocking sections with high strength endlocks on alternate slats secured with fasteners. Provide windlocks as required to meet specified wind load.
- 2.4 Guides and Windlocks
 - 2.4.1 Structural steel, stainless steel, aluminum angles.
 - 2.4.2 Miscellaneous steel, structural steel, stainless steel or aluminum angles, bar stock and shapes as required by manufacturer to meet fabrication requirements and specified wind load.
- 2.5 Counterbalance Shaft Assembly
 - 2.5.1 Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.
 - 2.5.2 Spring Balance: Oil tempered, heat treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (or per manufacturers requirements). Provide wheel for applying and adjusting spring torque.

2.6 Brackets

2.6.1 Brackets: Fabricate from minimum 3/16 inch steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form closures.

1. Finish:

- (a) Steel: Phosphate treatment followed by a light gray baked-on polyester powder coat: minimum 2.5 mils cured film thickness.
- (b) Phosphate treatment followed by a corrosion inhibitive baked-on zinc rich gray polyester powder coat; minimum 2.5 mils cured film thickness.
- (c) ASTM A123, Grade 85 zinc coating, hot-dip galvanized after fabrication.
- (d) Phosphate treatment followed by baked on polyester powder coat, color as selected by Owner from manufacturer's standard color range, minimum 32 colors; minimum 2.5 mils cured film thickness; ASTM D3363 pencil hardness: H or better.

2.7 Hood

2.7.1 Hood: Aluminum sheeting 0.040 inch minimum thickness with reinforced top and bottom edges. Provide minimum ¼ inch aluminum or galvanized steel intermediate support brackets as required to prevent excessive sag.

1. Finish:

- (a) Manufacturer's proprietary galvanized coating system consisting of a ASTM A653 galvanized base coating, treated with a rinsing agent for chemical bonding of a baked on polyester base coat and finish coat system as recommended by the manufacturer.
- (b) Or Stainless steel: No 4 finish.
- (c) Or Aluminum dark bronze anodized finish.

2.8 Weatherstripping

2.8.1 Bottom Bar: Replaceable, bulb style, compressible EPDM gasket extending into guides.

2.8.2 Bottom Bar: Motor operated doors: weather/sensing edge within neoprene or rubber astragal extending full width of door bottom bar.

2.8.3 Guides: Vinyl strip sealing against fascia side of curtain.

2.8.4 Hood: Neoprene/rayon baffle to impede air flow above coil.

2.8.5 Lintel Seal: Nylon brush seal filled at door header to impede air flow.

2.9 Accessories

2.9.1 Locking:

- a. Manual Chain Hoist: Padlockable chain keeper on guide.
- b. Padlockable slide bolt on coil/fascia side of bottom bar at each jamb extending into slots in guides.
- c. Masterkeyable cylinder operable from coil/fascia/both sides of bottom bar.

2.10 Fabrication

- 2.10.1 Fabricate overhead door and frame assembly allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation.
- 2.10.2 Door Slat Fabrication: fabricate door curtain in manufacturer's standard double wall, "S" configuration, flat slats with foamed in place polyurethane insulation. Fabricate interlocking sections with high strength endlocks on alternate slats secured with fasteners. Provide windlocks as required to meet specified wind load.
- 2.10.3 Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline and weatherproof.
- 2.10.4 Fabricate frames with hardware reinforcement. Reinforcements to be aluminum alloy 6061-T6, minimum 0.25 inch thickness minimum and as recommended by manufacturer.
- 2.10.5 Prepare components to receive anchor devices. Fabricate anchorage items.
- 2.10.6 Arrange fasteners, attachments, and jointing to ensure concealment from view.
- 2.10.7 Manual Chain Hoist. Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide.

2.11 Finish

- 2.11.1 Extruded Aluminum Surfaces: Anodize to clear color or an anodic color as selected by Owner from manufacturer's standard available color selection. Provide coating in accordance with manufacturer's recommendations. Anodized color shall be Dark Bronze.
- 2.11.2 Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A123 to 2.0 oz/sq ft primed with iron oxide paint.
- 2.11.3 Apply one coat of bituminous paint to concealed aluminum and 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 Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers and equipment supports in accordance with shop drawings, manufacturer's instructions, and as specified herein.

3.2.2 Coordinate installation of door assembly with masonry and concrete construction for anchor placement.

3.2.3 Furnish and use inserts and anchorage devices which must be set in concrete or built into masonry for installation of units. Secure door assembly and securely attach frame and guide rail assembly to structure.

3.2.5 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

3.2.6 Install door manual or electric operating hardware in accordance with manufacturer's instructions, and using templates were provided.

3.2.7 Adjust operating mechanism so curtain can be easily stopped at any point in its travel and remain in position until movement is reactivated.

3.2.8 Install weatherstripping and seals; ensure weathertight fitting in accordance with manufacturer's 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 Upon completion of installation, including Work by other trades, lubricate, test, and adjust door for smooth and balanced door movement. Ensure door assembly is free from warp, twist of distortion, and fitting weathertight for entire perimeter.

3.4.3 Remove protective material from pre-finished aluminum surfaces.

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.

END OF THIS SECTION

DIVISION 8 - DOORS AND WINDOWS

SECTION 8D - DOOR HARDWARE

1. GENERAL:

1.1 Section Includes

1.1.1 Hardware for aluminum and steel doors.

1.1.2 Fire rated hardware for fire-rated doors.

1.1.3 Thresholds.

1.1.4 Weatherstripping.

1.2 Products Furnished but not Installed Under This Section

1.2.1 Section 8A - Aluminum Doors and Frames.

1.2.2 Section 8B – Steel Doors and Frames.

1.3 Related Sections

1.3.1 Section 4A - Unit Masonry.

1.3.2 Section 5B - Metal Fabrications.

1.3.3 Section 8A - Aluminum Doors and Frames.

1.3.4 Section 8B – 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.
 - (b) NFPA 101.
- 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 Owner 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.
- 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.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 Exit Devices (Rim Type): Corbin Russwin, Adams Rite, Von Duprin.

2.1.2 Exit Devices (Vertical Rod Type): Corbin Russwin, Adams Rite, Von Duprin.

2.1.3 Mortise Lockset: Corbin Russwin, Schlage, and Yale.

2.1.4 Mortise Latchset: Corbin Russwin, Schlage, and Yale.

2.1.5 Dummy Trim: Corbin Russwin, Schlage and Yale.

2.1.6 Hinges: Hager, Stanley, and Lawrence.

2.1.7 Closers: Corbin Russwin, LCN, and Norton.

2.1.8 Flush Bolts: Corbin Russwin, Hager, Rockwood, Baldwin, Ives.

2.1.9 Weatherstripping: National Guard Products, Hager, Penko, Reese Enterprises.

2.1.10 Thresholds: National Guard Products, Hager, Pemko, Reese Enterprises.

2.1.11 Astragals: National Guard Products, Reese Enterprises, Pemko.

2.1.12 Door Sweeps: National Guard Products, Pemko.

2.1.13 Kick plates: National Guard Products, Hiawatha, Ives, Brookline, Rockwood.

2.1.14 Wall stops: Ives, Rockwood.

2.1.15 IDOT Standard Surface Mounted Outside Deadbolt: American Lock

2.1.16 Substitutions: Under provisions of Division 1.

2.2 Keying

2.2.1 Supply 5 keys for each lock.

2.2.2 Keys shall match Owner'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 fire-rated hardware to match B-label door and frame as required to provide a fully operation fire-rated 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. Von Duprin Model CRE

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. Von Duprin Model CRE

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 Owner. 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

3.5.4 Mortise Latchset (Passage Set Type): Wrought bronze, visible parts US32D finish, non-ferrous internal parts, with minimum 3/4" throw on latch bolt. No locking device shall be provided for the handles (Passage Set Type)

- a. Corbin Russwin Model ML2010 x LSM
- b. Schlage Model L9010x03
- c. Yale Model 8801 CRE

3.5.5 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 3/4" 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

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

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

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. Corbin Russwin Model 2849 W/ No. 70-1/2M Strike
- b. Hager Model 282D x 26D
- c. Rockwood Model 555 x 26D
- d. Baldwin Model 0600 x 26D
- e. Ives Model FB458 X 26D

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 412S x AL
- c. Pemko Model 332 CR
- d. Reese Enterprises Model DS 69C

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

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

Doors with two active leafs:

- a. National Guard Products Model 137NA (set)
- b. Pemko Model 303CS

3.5.12 Door Sweep: Nylon brush gasketing, clear aluminum finish.

- a. National Guard Products Model 600A
- b. Pemko Model 18137CNB

3.5.13 Kick Plate: Ives Model 8400 10"x34" US32D x 16GA, or equal selected from manufacturers listed below.

- a. National Guard Products
- b. Hiawatha
- c. Ives
- d. Brookline
- e. Rockwood

3.5.14 Wall Stop: Masonry type wall mount, US 32D with rubber bumper.

- a. Ives Model 406/407 Convex
- b. Rockwood Model 406

3.5.15 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. Chrome Plated Finish; hardened steel.

- a. American Lock Model A895 (Chrome Plated)
- b. Approved Equal

Heavy duty padlock for the doors will be provided by IDOT.

3.6 Hardware Schedule per Door

<u>Door</u>	<u>Hardware Req'd</u>
D1 (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.
D2 (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.
D3 (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.
D4 (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.

D5	(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.
D6	(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.
D7	(interior door)	Mortise latchset (passage type set), hinges, closer, wall stop, (all hardware to be compatible with this B-Label fire-rated door assembly).
D8	(interior door)	Mortise latchset (passage type set), hinges, closer, wall stop, (all hardware to be compatible with this B-Label fire-rated door assembly).
D9	(interior door)	Mortise latchset (passage type set), hinges, closer, wall stop, (all hardware to be compatible with this B-Label fire-rated door assembly).
D10	(interior door)	Mortise latchset (passage type set), hinges, closer, wall stop, (all hardware to be compatible with this B-Label fire-rated door assembly).
D11	(interior door)	Mortise latchset (passage type set), hinges, closer, wall stop, (all hardware to be compatible with this B-Label fire-rated door assembly).

END OF THIS SECTION

DIVISION 8 - DOORS AND WINDOWS

SECTION 8E - GLASS AND GLAZING

1. GENERAL:

1.1 Section Includes

1.1.1 Glass and glazing for fire rated steel door assemblies.

1.2 Related Section

1.2.1 Section 8B - Steel Doors and Frames.

1.3 References

1.3.1 ANSI Z97.1 – Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

- 1.3.2 ASTM D1667 – Standard Specification for Flexible Cellular Materials – Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
 - 1.3.3 ASTM D2000 – Standard Classification System for Rubber Products in Automotive Applications.
 - 1.3.4 ASTM D2287 – Standard Specifications for Non-rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
 - 1.3.5 ASTM E84 – Surface Burning Characteristics of Building Materials.
 - 1.3.6 FS DD-G-451 – Glass, Float or Plate, Sheet, Figured (Flat, for Glazing, Mirrors, and Other Uses).
 - 1.3.7 FS DD-G-1403 – Glass, Plate (Float), Sheet, Figured, and Spandrel (Heat Strengthened & Fully Tempered).
 - 1.3.5 NFPA80 & NFPA 252 Fire-Rated Door Assemblies.
 - 1.3.6 FGMA – Glazing Manual. Glazing Sealing Systems Manual.
- 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 glazing size and type for each door and frame using same reference numbers for details and openings as those on Drawings:
 - (a) Elevations of each door that will include a fire rated window.
 - (b) Details of glazing frames and stops showing glazing and glazing requirements.
 - (c) Fire-resistance ratings.
 - 1.4.3 Manufacturer's Data: Glass:
 - (a) Manufacturer's specifications and installation instructions for each type of glass required.
 - (b) Include test data substantiating that glass complies with specified requirements.
 - 1.4.4 Manufacturer's Data: Glazing Materials:
 - (a) Manufacturer's specifications and installation instructions for each type of glazing sealant and compound, gasket and associated miscellaneous material. Include manufacturer's published data, or letter of certification, or certified test laboratory report indicating that each material complies with project specifications and is suitable for the applications shown.

- 1.4.5 Samples: Glass:
 - (a) Submit 3, samples of each type of glass specified.
 - (b) Insulating glass samples need not be hermetically sealed, but edge construction shall be included.
- 1.4.6 Manufacturer's Installation Instructions: Indicate special installation instructions.
- 1.4.7 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 Conform to Flat Glass Marketing Association (FGMA) Glazing Manual for glazing installation methods.
- 1.6.2 Provide ten year manufacturer's warranty under provisions of Division 1.

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 glass and glazing to door manufacturer in accordance with each manufacturer's instructions. Protect in cardboard wrapped containers, crated, or other manufacturer's protection method to provide protection during transit and job storage. Provide additional protection to prevent damage to glass and glazing.
- 1.7.3 Remove and replace damaged items that cannot be repaired as directed.

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.

2. PRODUCTS:

2.1 Manufacturers

- 2.1.1 PPG Industries, Inc.
- 2.1.2 Libby-Owens-Ford Co. (A Pilkington Glass Company)

2.1.3 AFG Industries. (AGC Flat Glass North America)

2.1.4 Substitutions: Under provisions of Division 1.

2.2 Glass Materials

2.3.1 Type G1: ¼" thick, clear polished square wire glass, for fire rated door assemblies.

2.3.6 Type G2: ¼" thick, clear, fully tempered, safety glass.

2.3 Glazing Sealants/Compounds

2.3.1 Preformed Butyl Rubber Glazing Sealant.

(a) Tape or ribbon (coiled on release paper) of polymerized butyl, of mixture of butyl and polyisobutylene, compounded with inert fillers and pigments, solvent based with minimum of 95% solids, with thread of fabric reinforcement, tack-free within 24 hours, paintable, non-staining.

(b) Provide combination tape and encased continuous rubber shim, of approximately 50 durometer hardness.

(c) Any caulking or window sealants which come in contact with the insulating glass sealants are to be compressible.

2.4 Glazing Gaskets

2.4.1 Provide glazing gaskets recommended by manufacturer.

2.4.2 Molded Neoprene Glazing Gaskets: Molded or extruded neoprene gaskets or profile and hardness shown for watertight construction; complying with ASTM D2000 designation 2BC 415 to 3BC 620, black.

2.4.3 Polyvinyl Chloride Glazing Gaskets: Extruded, flexible PVC gaskets of the profile and hardness shown; when not shown, for watertight construction comply with ASTM D2287.

2.4.4 Vinyl Foam Glazing Tape: Closed cell; flexible, self adhesive, non-extruding, polyvinyl chloride foam tape, recommended by manufacturer for exterior, exposed, watertight, installation of glass with only nominal pressure in the glazing channel, comply with ASTM D1667.

2.4.5 Miscellaneous Glazing Materials

(a) Settling Blocks: Neoprene, 70-90 durometer hardness with proven compatibility with sealants used.

(b) Spacers: Neoprene 40-50 durometer hardness, with proven compatibility with sealants used.

- (c) Compressible Filler Rod: Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 510 psi compression strength for 25% deflection.
- (d) Cleaners, Primers, and Sealants: Type recommended by sealant or gasket manufacturer.

3. EXECUTION:

3.1 Examination

- 3.1.1 Verify that opening dimensions and tolerances are acceptable.
- 3.1.2 Examine the framing and glazing surfaces, backing, and removable stop design, and the conditions under which the glazing will be installed on the doors.
- 3.1.3 Do not proceed with glazing until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer, and in accordance with specifications.

3.2 Job Requirements and Installation

- 3.2.1 General: Install glass and glazing in accordance with Shop Drawings, manufacturer's instructions, and as specified.
- 3.2.2 Coordinate installation of glass and framing with door manufacturer.
- 3.2.3 Provide watertight and airtight installation of each piece of glass. Each installation shall withstand normal temperature changes, wind loading, impact loading for doors, without failure of any kind including loss or breakage of glass, failure of sealants, or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.
- 3.2.4 Protect glass at all times during handling, installation and operation of the building.
- 3.2.5 Glazing dimensions shown provide for a minimum bite on the glass: minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. Be responsible for correct glass size for each opening, within tolerance for the dimensions established.
- 3.2.6 Comply with combined recommendations of glass manufacturer, manufacturer of sealants, manufacturer of doors and other materials used in glazing except where more stringent requirements are shown or specified, and except where manufacturer's technical representatives direct otherwise. Installation shall meet or exceed door manufacturer's requirements for a fire rated door assembly as indicated or specified.

- 3.2.7 Inspect each piece of glass immediately before installation, and eliminate all which have observable edge damage or face imperfections.

3.3 Glazing

- 3.3.1 Prepare and clean door glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.
- 3.3.2 Comply with ANSI Standard Z97.1-2004 Safety Glazing Code.
- 3.3.3 Install setting blocks of proper size at quarter points. Set blocks in thin course of the heelbead compound.
- 3.3.4 Glazing shall be set with equal bearing for entire width.
- 3.3.5 Provide minimum 1/8 inch bite of spacers on glass and use thickness equal to sealant width. Where sealant tape is used instead, use thickness slightly less than final compressed tape thickness.
- 3.3.6 Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in the channels at the heel of jambs and head (do not leave voids in the sill channels) except as otherwise indicated, depending on light size, thickness and type of glass and complying with manufacturer's recommendations.
- 3.3.7 Do not attempt to cut, seam, nip or abrade glass which is chemically strengthened, tempered, or heat strengthened.
- 3.3.8 Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- 3.3.9 Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from the glass. Install pressurized tapes and gaskets to protrude slightly out of the channel to eliminate dirt and moisture products.
- 3.3.10 Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discolorations.
- 3.3.11 Where wedge shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that the gasket will not "walk" out when subjected to dynamic movement. Anchor gasket to stop with matching ribs, or proven adhesive, including embedment of gasket tail in cured heel bead.

3.4 Cure, Protection, Adjusting and Cleaning

- 3.4.1 Adjust work under provisions of Division 1.

- 3.4.2 Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
- 3.4.3 Protect glass from breakage or damage during installation of door assembly. Do not apply markers to any type of glass surface.
- 3.4.7 Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during the construction period, including natural causes, accidents and vandalism.
- 3.4.8 Wash and polish glass on both sides not more than four days prior to acceptance of the work. Comply with glass manufacturer's recommendations. Washing shall be done in accordance with manufacturer's instructions.

3.5 Schedule

- 3.5.1 See Drawings and refer to Shop Drawings.

END OF THIS SECTION

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

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which shall be payment in full for the work described herein.

2. PRODUCTS:

2.1 Manufacturers

- 2.1.1 Tnemec Co., Inc.
- 2.1.2 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, stainless steel coping, and aluminum framing).
 - (g) Exterior piping and appurtenances (such as sluiceway 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. Wall and floor at wet well 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., 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 Society of 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. Nonferrous metal shall be treated with Oakite 747 LTS, as manufactured by Chemetel or equal before prime coat is applied.
- 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 Owner.

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

<u>Class of Work</u> <u>3rd</u>	Primer <u>Shop Coat</u>	<u>Field or Shop Finish Coats</u>		
		<u>1st</u>	<u>2nd</u>	<u>3rd</u>
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.

<u>Symbol</u>	<u>Product</u> <u>Number</u>	<u>Name</u>	<u>and</u>	<u>Volume</u> <u>Solids %</u>	<u>Dry Film Thickness</u> <u>Micrometers</u>	<u>Mils Per Coat</u>
A	Tnemec Series 69	Hi-Build Epoxoline II		69	51-76 um	(2.0-3.0 mils)
B	Tnemec Series 140-1225	Biege Pota-Pox Plus		69	102-152	(4.0-6.0)
C	Tnemec Series 74	Endura-Shield		54	51-76	(2.0-3.0)
D	Tnemec Series 69	Hi-Build Epoxoline II		69	76-127	(3.0-5.0)
E	Tnemec Series 90-97	Tneme-Zinc		63	64-89	(2.5-3.5)
F	Tnemec Series 140-WH02 (15BL)	Pota-Pox Plus		69	102-152	(4.0-6.0)
G	Tnemec Series 69	Hi-Build Epoxoline II		69	178-254	(7.0-10.0)
H	Tnemec Series 180	Acrylic Emulsion		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 69 Hi-Build Epoxoline II.
- (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 beige.
- (b) Interior Concrete Walls – matching light “beige” color: (Provide a selection of “Beige” colors that are an array of close matches to the selected color for glazed CMU walls. Final color to be selected by Engineer.)
- (c) Interior Concrete Ceiling – white: (Provide a selection of “White” colors for review. Final color to be selected by Engineer.)
- (d) Interior Grade Floor - gray.
- (e) Lower Level Concrete Wall – Tannery.
- (f) Interior Steel Frame and Metal Trim – light gray.
- (g) Exterior Metal Trim (except aluminum and stainless steel) – light gray.
- (h) Exterior piping and appurtenances – Turbine Blue.
- (i) Interior piping – Turbine blue.
- (j) Electrical Conduits – light gray.
- (k) Fire protection equipment – standard red.
- (l) Hoist Beams/Trolley – Safety red.
- (m) Bollards – Safety yellow.

Note: Contractor to submit manufacturer’s color chart for Engineer’s selection.

END OF THIS SECTION

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, 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 5C - 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 Guarantee
 - 1.5.1 Provide guarantee 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

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which shall be payment in full for work described herein.

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. Staff gauge range shall be from 0' to 12.5' for both wet well and discharge chamber.
- 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 two first aid kits with brackets for wall mounting as directed in the pump room and electrical room. The kit shall be Model No. 640135 as manufactured by Johnson and Johnson or equal.

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.

2.8 Trash Bins

- 2.8.1 The Contractor shall provide two (2) 428 gallons trash bins. Each trash bin shall have an interior dimension of 84" long x 42" width x 28" height. The overall height shall not exceed 34". The trash bin shall be designed for end dumping. Solid steel sides and platform shall have gray enamel finish. Two rigid and two swivel casters shall have 6" x 2" phenolic wheels. Casters shall be arranged in a diamond pattern with a 1/2" tilt. All material shall be welded construction. Provide lifting hooks for trash bin.

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.

3.3 Testing

- 3.3.1 The specialties shall be tested in place by the Contractor, and any defects in specialties or connections shall be corrected to the satisfaction of the Engineer.

END OF THIS SECTION

DIVISION 10 - SPECIALTIES

SECTION 10B - FIBERGLASS REINFORCED PLASTIC PRODUCTS AND FABRICATIONS

1. GENERAL:

1.1 Scope of Work

- 1.1.1 Design, fabrication and Furnishing all labor, materials, equipment and incidentals necessary to install the fiberglass reinforced plastic (FRP) products as specified herein.

- (a) Handrails.
- (b) Ladder.

1.2 Quality Assurance

- 1.2.1 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.

- 1.2.2 Substitution of any component or modification of system shall be made only when approved by the Engineer.
- 1.2.3 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.
- 1.2.4 In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.
- 1.2.5 Provide a written certification that the products have been installed in accordance with the requirements under this Section.
- 1.2.6 The installing contractor shall be approved by the FRP manufacturer.
- 1.3 Design Criteria
 - 1.3.1 The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.
- 1.4 Submittals
 - 1.4.1 Shop drawings of all FRP structural members, handrails, plate, ladders and appurtenances shall be submitted to the Engineer for review.
 - 1.4.2 Manufacturer's catalog data showing:
 - (a) Dimensions, spacings, and construction.
 - (b) Materials of construction.
 - (c) Chemical resistance table.
 - 1.4.3 Detail shop drawings showing:
 - (a) Dimensions.
 - (b) Sectional assembly.
 - (c) Location and identification mark.
 - (d) Size and type of supporting frames required.
- 1.5 Shipping and Storage Instructions
 - 1.5.1 All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
 - 1.5.2 Items shall be covered and protected from exposure to sun or ultra violet light during storage.
 - 1.5.3 All materials and equipment necessary for the fabrication and installation of the plate, handrails, and structural shapes 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.

1.5.4 Identify and match-mark all materials, items, and fabrications for installation and field assembly.

1.6 Basis of Payment

1.6.1 Specialties shall be paid for as part of the Contract lump sum price for

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which shall be payment in full for work described herein.

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.

(a) Resins shall be VINYL ESTER resin for ladders and other members that may be submerged in the wet well or discharge chamber and in continuous contact with sewage.

(b) 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:

(a) Strongwell-Chatfield Division, Chatfield, MN.

(b) Composite Structures International, Inc.

(c) Bedford Plastics, Inc.

(d) Augusta Fiberglass.

(e) Ultra, Inc.

(f) Or approved alternative manufacturer.

2.2 Handrail

2.2.1 All handrail systems shall be compliant to OSHA 1910.23

2.2.2 All posts, and rails are to be FRP structural shapes manufactured by the pultrusion process. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions specified in the Contract Documents.

2.2.3 Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

2.2.4 Resins shall be a fire-retardant isophthalic polyester resin with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

2.2.5 Posts, top and mid rails are to be 2"x2"x 0.25" wall square tube and kickplate is to be ½" x 4" with two reinforcing ribs. The bases of the posts are to be reinforced to a height of 10" using a high strength epoxy compound.

2.2.6 The handrail post/rail connection is to be fabricated such that the rails are unbroken and continuous through the post without the use of packs or splices. The mid rail is to be installed through the post at a prepared hole made to fit the outside dimensions of the rail. The top rail is to fit into a machined, u-shaped pocket formed into top of the post such that the rail is located at the center of the post. All exposed post corners are to be radiused to eliminate sharp edges. The rails are to be joined to the post through a combination of bonding and riveting. No sharp, protruding edges are to remain after assembly of the handrail. Spacing of the posts shall not exceed 5'-0".

2.2.7 All rails, posts, and kick plates are to be integrally pigmented yellow.

2.2.8 All fasteners used in the railing system are to be 316 Stainless steel. Rivets will be 18-8 metal.

2.3 Ladder

2.3.1 Ladder rails shall be 2"x2"x0.25" square tube. Ladder rungs shall be 1" diameter with non-skid surface.

2.3.2 Ladder support brackets are to be installed at a maximum of 4'-0" on center. All hardware is to be 316 Stainless steel.

2.3.3 Ladders are to be integrally pigmented yellow.

2.3.4 Where noted on Drawings provide Bilco LadderUP model LU-3 retractable safety post extension at top of ladder.

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.
- 3.1.2. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

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 Owner.
- 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

DIVISIONS 11, 12 & 13 - NONE REQUIRED

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	42
Trash Rack Room	0.5	56
Intermediate Floor	0.5	26

1.2 System Description

1.2.1 Design Requirements:

1.2.1.1 Design and fabrication of hoist shall be in accordance with the applicable requirements of HMI-200.

1.2.1.2 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:

1.4.1.1 Details of trolley hoists

1.4.1.2 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.

2. PRODUCTS:

2.1 Manufacturers

2.1.1 ACCO Wright.

2.1.2 Budgit Hoists.

2.1.3 CM Hoist.

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 finish.

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

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 Owner, 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, 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	<u>American Society of Mechanical Engineers</u>
ASTM	<u>American Society for Testing and Materials</u>
AWG	<u>American Wire Gauge</u>
AWWA	<u>American Water Works Association</u>
IPCEA	<u>Insulated Power Cable Engineers Association</u>
IES	<u>Illuminating Engineering Society of North America</u>
NEC	<u>National Electrical Code</u>
NEMA	<u>National Electrical Manufacturers Association</u>
NESC	<u>National Electrical Safety Code</u>
UL	<u>Underwriters' Laboratories</u>
HIS	<u>Hydraulic Institute Standard</u>
FM	<u>Factory Mutual</u>
ASHRAE	<u>American Society of Heating, Refrigerating and Air Conditioning Engineers</u>
SMACNA	<u>Sheet Metal and Air Conditioning Contractors' National Association</u>

- 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 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 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 107 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, graphite and engine oil, 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, 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.

- 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 Record Drawings

- 1.13.1 Alterations and additions to the mechanical installation depicted on the contract drawings 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 during the course of the work.
- 1.13.2 Record Drawings shall be prepared and submitted in accordance with Division 1.

1.14 Data to be Filed with the Owner

- 1.14.1 Certain data, as specified herein, shall be furnished to the Owner when installation and testing are complete, before final acceptance.
- 1.14.2 The data shall be compiled in 8-1/2 x 11-inch format in high-quality heavy-weight, hard cover binders with piano-style metal hinges or in an alternate approved format. Large 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.

1.14.3 Four sets of the data files shall be provided.

1.14.4 As a minimum, the data files 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) Manufacturer's maintenance manuals for all equipment furnished under this Division for which maintenance is recommended by the manufacturer.

1.14.5 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 will not be accepted.

1.14.6 See Division 1 for further requirements.

1.15 Final Acceptance Inspection

1.15.1 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.

1.15.2 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.

1.16 Guarantees

1.16.1 Guarantees shall be provided for equipment, materials and work provided under this Division as specified in Division 1.

1.17 Maintenance

1.17.1 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.

1.18 Basis of Payment

1.18.1 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.

2. PRODUCTS:

Not Used

3. EXECUTION:

Not Used

END OF THIS SECTION

DIVISION 15 - MECHANICAL

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.

1.5 Support and Anchors

1.5.1 This section includes requirements for 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.

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.

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.

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.

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.

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.

- 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.
- 1.5.12 Brackets shall be of welded steel and designed for the following load classifications:

<u>Load Classification</u>	<u>Maximum Load per Bracket</u>
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) Inserts shall be galvanized concrete. 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 When specified, hangers and supports shall be galvanized as specified in this Division.
- 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.

2. PRODUCTS:

Not Used

3. EXECUTION:

Not Used

END OF THIS SECTION

DIVISION 15 - MECHANICAL

SECTION 15 C - 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.

1.4 Delivery, Storage and Handling

1.4.1 Delivery, storage and handling shall be as specified under Section 1A.

1.5 Guarantee

1.5.1 Provide guarantee 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

PUMP STATION MECHANICAL WORK

which shall be payment in full for the work described herein.

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, gaskets, couplings, sleeves, cleanouts, harnessing, specials, and coatings in accordance with this Division.
 - 2) Welders' certifications.
- 2.1.8 Quality Assurance
- (a) Certified welders, having current certificates 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) An additional shop coat of liquid epoxy primer shall be provided on the interior of the middle ring.
 - 3) The exterior of sleeve-type couplings shall be finish coated after installation with the same coating specified in Division 9 for the pipeline of which it is a part.
 - 4) Shop coats and finish coats shall be compatible.

2.2 Motor Operated Actuator for Slide Gates (024-G-1, 024-G-2 & 024-G-3)

- ### 2.2.1 General:
- The electric actuator shall include a motor, operator unit gearing, limit switch gearing, limit switches, torque switches, stem nut, de-clutch lever, and auxiliary handwheel, 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 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 slide gate at the rate of 12 inches per minute.

2.2.2 Enclosures: The actuator motor and all electrical enclosures NEMA 4 for the outdoor slide gate.

2.2.3 Motor: The motor shall be 460 volts, 3 phase, 60 hertz specifically designed for valve gate actuator service and shall be of high starting torque, totally enclosed, non-ventilated construction non-explosion proof, Class B 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 slide gate from any position and under any condition of operation the slide gate 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 prelubricated and all bearings shall be of the anti-friction type. The motor speed shall not exceed 188.5 radian per second (1,800 rpm).

2.2.4 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.

2.2.5 Position Limit Switch: Position limit switches and associated gearing shall be an integral part of the valve gate 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.

2.2.6 Torque Switch: Each 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.

- 2.2.7 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.
- 2.2.8 Provide stem protector for rising stem in suitable length and diameter 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.
- 2.2.9 Hammerblow Device: The 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 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 gates used in inching, throttling, regulating, or modulating service.
- 2.2.10 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 open-close-stop pushbuttons and open-closed indicating lights shall be provided on the motor starter. A-O-H switch shall be remotely mounted on the motor control center. Terminal blocks shall be provided for all external wiring connections. Each terminal shall be properly marked. Provide motor in accordance with Section 16B-2.8.
- 2.2.11 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.
- 2.2.12 Power Input: The power input to the actuator shall be 480V, 3 phase, 60 Hertz.

2.3 Slide Gate

2.3.1 General

- (a) This section includes requirements for furnishing and installing the slide gate, operator and all appurtenances necessary for a complete installation.
- (b) Gate operator shall be complete, including a suitable enclosure, with all appurtenances necessary for the operator to perform its intended function as specified under subsection 2.4, Motor Operated Actuator for Valves, Slide Gates and Sluice Gates, of this Section.
- (c) Slide gate shall be stainless steel. Quantity of gate, guide, size, location and type shall be as shown or specified. Each gate shall be provided with the type of operator specified in the Slide Gate Schedule.
- (d) Slide gate shall be designed to limit deflection under maximum loading to 1/360 of the span. Slide gate shall be designed for the seating or unseating pressures specified, measured to the center of the gate.
- (e) Submittals
 - 1) Working drawings shall be submitted, including arrangement and erection drawings of the gate, operator and control equipment; structural design data, if requested; and operating characteristics.
 - 2) The following certifications shall be submitted:
 - i. Manufacturer's certified performance and material specifications, as specified.
 - ii. If requested, complete calculations shall be submitted for each size of motor operator indicating the force required to operate the gate, the operator force provided, full load and locked rotor current, and watts (horsepower).
 - 3) Operation and maintenance manuals shall be submitted for the slide gate and gate operator.

2.3.2 Stainless Steel Slide Gate

- (a) The self contained stainless steel slide gate shall be of ASTM A276, Type 304 stainless steel with a thickness of not less than 1/4 inches, reinforced with Type 304 stainless steel structural shapes, capable of withstanding the water pressure in either direction with the water level at maximum operating level. Provide tight water seal between frame and disc.

- (b) The gate guide self contained frame shall be fabricated of Type 304 stainless steel. Gate shall be reinforced as required to keep gate deflection within specified limits.
- (c) The gate shall be designed for flush bottom closure or flange mounted for all round openings. Bottom and side seals shall be resilient (50 ± 5 Durometer A) neoprene. The bottom seal shall be installed across the bottom of the gate or frame, mating with the side seals to keep leakage within specified limits. Provide replaceable seals, securely mounted with stainless steel retainer bars bolted to the gate with stainless steel bolts. Provide adaptor plate or spigot for flange mounted slide gate.
- (d) Guides shall consist of slotted side pieces with a flush type bottom cross piece. Fabricate pieces of castings or structures with integral anchoring ribs, shop assembled into a rigid assembly for embedment in concrete. Side slots shall be provided of the width and depth required for support and free operation of the gate without binding.
- (e) Bearing surfaces shall be 3/8-inch minimum thickness, installed in a recess or keyed into the guide, designed to hold the polymer bearing surface in position against the gate.
- (f) Where guides extend above concrete side walls, guides shall be supported by stainless steel structural members.

2.3.3 Slide Gate Operators And Lifting Stem

- (a) Operator shall be York mounted or torque tube mounted as shown on the drawing. Operator shall be rising stem, unless otherwise specified. Stem shall be securely fastened to the gate by means of a casting, mounting block or angles secured to the gate. Acme-threaded stem shall have 16 microfinish or better. Gate stem attachment shall be provided with provisions for keying or pinning the stem to the gate attachment.
- (b) Stem shall be designed for the maximum operating torque of the operator and the weight and service of the gate. The length over radius of gyration (l/r) ratio of the stem shall be limited to 200, and the stem diameter shall be limited to 1.50 inches. Stems shall be stainless steel meeting the following applicable standards.
 - 1) Stainless Steel ASTM A 276, Type 304 or
304L ASTM A 582, Type 303
- (c) Stem shall be provided with a stem cover of schedule 40, ASTM A53 galvanized pipe. The top of the stem cover shall be closed. The bottom end of the stem cover shall be mounted in a housing or adapter plate for easy field mounting.

- (d) Provide a freeze proof cold weather and corrosion-resistant chain for padlock to be installed through the handwheel operator and around the stem to prevent unauthorised operation of the slide gate. IDOT will provide padlock and keys. Padlock chain shall be heavy-duty flat-link, zinc-plated chain.

2.4 Pipe Supports and Anchors

- 2.4.1 Pipe supports and anchors shall be furnished and installed as shown on the Drawings or as specified in Division 15B.

2.5 Sleeve-Type Couplings

- 2.5.1 Couplings shall be provided with rolled steel followers, steel sleeves, rubber compound gasket and high strength bolts and nuts.
- 2.5.2 Use gaskets that are not affected by the fluid service of the pipeline.
- 2.5.3 Couplings shall have a minimum pressure rating equal to the test pressure of the pipeline.
- 2.5.4 Middle rings shall be provided without a pipe stop, and at least 5/16-inch thick and 5 inches wide for 4-inch through 8-inch pipe, and 3/8-inch thick and 7 inches wide for 10-inch through 30-inch pipe, with follower rings of the proper thickness.
- 2.5.5 Unless shown or specified otherwise, harnessing for sleeve-type couplings shall be designed, furnished and installed in accordance with the applicable portions of AWWA Manual M11, Chapter 13 - Supplementary Design Data and Details, 13.10 - Joint Harness. Harnessing shall have a design pressure equal to or greater than the test pressure of the pipeline on which it is installed.
- 2.5.6 All surfaces shall be shop coated with liquid epoxy primer. The inside coating of the middle ring shall be given an additional shop coat of liquid epoxy primer. Finish coat shall be as specified in Section 9A for the pipe of which it is a part.

2.6 PVC Ball Valve and Check Valve

- 2.6.1 PVC ball valve shall be trunnion ball design with Viton or EPDM O-rings. Ball valve shaft shall be reinforced with stainless steel rod.
- 2.6.2 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.

2.7 Stainless Steel Flap Valves

- 2.7.1 Flap valves shall be provided in the discharge chamber for each main pump.

- 2.7.2 Flap valves shall be fabricated and supplied with all the necessary parts specified or otherwise required for a complete, properly operating installation.
 - 2.7.3 Flap valves shall be constructed entirely of stainless steel. All hardware shall be stainless steel.
 - 2.7.4 The body frame shall be made of structural members or formed plate welded to form a rigid one-piece frame. The body material shall be stainless steel ASTM A-240, Type 304L. The frame shall be of the flange back design suitable for mounting on a standard flange. The flange shall be flat faced and drilled 125 lbs. Standard for pipe flange mounting.
 - 2.7.5 The cover, or flap, shall be stainless steel ASTM A-240, Type 304L structural members or formed plate.
 - 2.7.6 A resilient seat, EPDM ASTM D-2000 attached to the frame with a stainless steel retainer.
 - 2.7.7 The hinge arms shall be stainless steel ASTM A-240, Type 304L. Each hinge arm shall be made of structural members or formed plates and shall have a 2-hinge arm arrangement, with 2 pivot joints per arm, an adjustable lower pivot with limited rotation and an adjustable upper hinge lug arrangement to permit adjustment of the valve opening sensitivity.
 - 2.7.8 Hinge bushing shall be ultra high molecular weight polyethylene ASTM D-4020. Fasteners shall be ASTM F593 GR1 for Type 304.
 - 2.7.9 A stainless steel leaf spring attached to the body and extended over the cover shall be provided to safely limit the travel of the cover during pump discharge operation. A rubber pad shall be provided at the spring to cover the contact point.
- 2.8 Stainless Steel Pipe
- 2.8.1 Stainless steel pipe for compressor air service shall be Type 304 per ASTM A312. Joints shall be threaded joints.

3. EXECUTION:

3.1 Transportation and Delivery

- 3.1.1 Every precaution shall be taken to prevent injury 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 Owner 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 15A.

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". A certification of the welder's qualifications, in conformity with the requirements of this code, shall be submitted to the Engineer.

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 Where applicable, 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 Slide Gate

3.12.1 Slide gate shall be installed in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

3.12.2 Floor stand shall be accurately centered over the gate. Stand shall be solidly bolted to the floor or support structure, with through-bolts wherever possible. Approximately 3/4 inch of nonshrink cement grout shall be placed beneath stand mounted on concrete or similar construction to assure uniform support.

3.12.3 Field Tests

(a) After installation of the gate, control equipment and all appurtenances, the units shall be subjected to a field running test, as specified in Division 1, under actual operating conditions.

(b) Slide gate shall be tested for leakage, strength, and opening and closing against the maximum heads practicable to obtain under operating conditions. Any leaks around the frame or gate shall be stopped. The maximum allowable amount of seepage through any slide gate shall not exceed 0.2 gpm per foot of seating perimeter.

3.13 Installation of Pipe and Fittings

3.13.1 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.

3.14 Installation of Flap Valves

3.14.1 Installation of flap valves shall be in accordance with the manufacturer's recommendations and approved submittals.

3.15 Schedule

3.15.1 Valve Schedule

<u>Service</u>	<u>Valve Type</u>	<u>Size Inches</u>	<u>Type</u>	<u>Joint Type</u>	<u>Actuator Remarks</u>
Maintenance	Ball Valve	4		SW	
Pump Discharge	Flap Valve	18 & 36	F	NA	

Note:

(1) Abbreviations used in the schedule are as follows:

Joints

SW Solvent Welded
 F Flanged
 NA= Not Applicable

3.15.2 Slide Gate Schedule

<u>Remarks</u>	<u>Size WxH</u>	<u>Seating Head</u>		<u>Unseating Head</u>		<u>Actuator</u>
<u>Service</u>	(inches)	(feet)				
Recirculation	36x36	10	0		E	Flanged Mountin g
Discharge	72x72	10	0		E	Wall Mounted
Discharge	84x84	10	0		E	Flush Bottom

Note:

(1) Abbreviation used in the schedule is follows:

Actuator

E Electric Motor (Non-modulating)

3.15.3 Inside Piping Schedule

<u>Service</u> Remarks	<u>Size</u> (Inches)	Pipe Material ⁽¹⁾	<u>Protective</u> <u>Coatings</u> ⁽³⁾		Joints ⁽²⁾	<u>Test</u> <u>Pressure</u> (psig)	
			Int.	Ext.			
Pump Discharge	18, 36	DI	P	P	F	30	1.5 Times Max Pump Pressure
Recirculation	36	DI	P	P	F	NA	
Drain Pipe	6	DI	P	P	F	NA	
Maintenance	4	PVC	--	--	SW	NA	Schedule 80
Air Compressor	3/8, 1/2	SS	--	--	T	NA	Schedule 40

Notes:

- (1) DI Ductile Iron
 PVC Polyvinyl Chloride
 CA Cast Iron
 SS Stainless Steel
- (2) F Flanged
 H Hub & Spigot
 SW Solvent Welded
 RG Rubber Gasket
 T Threaded
- (3) P Shop Finish Painted
- 4) NA = Not Applicable

END OF THIS SECTION

DIVISION 15 - MECHANICAL

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, liquid level controls, 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 equipment including suction elbow shall be arranged for installation in the spaces shown without appreciable revision of the piping. The pumping units shall be designed for continuous and intermittent duty.
- 1.1.4 Unless otherwise indicated, all pumps of a specified type shall be identical, the product of the same manufacturer. Refer to Division 15A.

1.2 Operating Conditions

- 1.2.1 The main pump shall be capable of a draw down to a low water level at El. 602.00 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:

<u>Items</u>	<u>Requirements</u>	
	<u>Main Pump</u>	<u>Low Flow Pump</u>
	<u>(024-MP-1 thru 024-MP-7)</u>	<u>(024-LFP-1 & 024-LFP-2)</u>
Capacity at primary rating point (design point)	22,200 gpm	6,000 gpm
Total head at primary rating point (design point)	38.5 ft	40ft
Overall efficiency, wire to water, at rating point, minimum, percent	75	70
Shutoff head:		
Maximum	90 ft	80
Capacity at secondary rating point, Minimum	24,500 gpm	8,200 gpm
Total head at secondary rating point, feet	32 ft	25ft
Overall efficiency, wire to water, at secondary head, minimum, percent	70	65

Diameter of sphere that will pass through pump, minimum	4-1/4 inch	3 inch
Pump suction diameter, Minimum	24 inch	12 inch
Pump discharge diameter, minimum	24 inch	12 inch
Pump speed, maximum, rpm	710	1,160
Motor horsepower, maximum	325 hp	100 hp
Motor efficiency at full load, minimum, percent	90	87
Motor power factor at full load, minimum	0.8	0.8
Locked rotor kVa/hp, maximum, NEMA code letter	F	F
Maximum overall pump height including lifting eye	9'-6"	6'-0"

- 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.
- 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. I, 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 16C - Major Electrical Equipment
- 1.3.9 Section 16D - Supervisory Control and Data Acquisition (SCADA) 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 of 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 for all equipment including size, capacity, description and make of pumps.
 - (b) Complete description, illustrations, wiring diagrams of automatic controls and starting equipment.
 - (c) Complete motor data, as specified.
 - (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) Parts list with materials of construction identified.
 - (i) Motor performance characteristics.
 - (j) Spare parts list.
 - (k) Painting procedure.
 - (l) Pump testing procedure and setup.
 - (m) Six certified copies of the Shop Test results.

1.4.5 Submit copies of all manufacturers' guarantees and warranties obtained by the contractor to be transferred to the State of Illinois, Division of Highways, at the time of acceptance of this project by the State of Illinois.

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) Full load power factor
- (h) NEMA design letter
- (i) NEC code letter or inrush current
- (j) Insulation class
- (k) Service factor
- (l) Recommended starting restrictions, including allowable starts per hour
- (m) Recommended maximum KVAR rating of power factor correction capacitors.

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 1, Division I, 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 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 as specified and as provided or shown in the Drawings, it is the Contractor's sole responsibility, without additional cost to the Owner, 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 Owner.
- (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.

1.5.4 Data to be filed with the Owner

- (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 Owner at all times and shall be delivered to the Owner 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 shall be furnished to the Owner. Refer to Division 1.

1.5.5 Source Quality Control

- (a) Shop tests shall be performed on each pumping unit including spare pump in accordance with the test code of the Hydraulic Institute, except as modified herein. The pumps shall be tested in the position that they will be installed.
- (b) 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.
- (c) 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.
- (d) 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.

- (e) 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) A motor and cable insulation test for moisture content or insulation defects shall be made.
 - 3) Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
 - 4) The pump shall be run for 30 minutes submerged, a minimum of 6 ft. under water.
 - 5) After operational test 1.5.5(e)4, the insulation test 1.5.5.(e)2, is to be performed again. A written report, stating the foregoing steps have been done, shall be submitted prior to shipment.
 - 6) 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.
- (f) The Contractor shall provide transportation and reasonable expenses to and from all factory pump testing for two (2) representatives of the State to witness such testing. State of Illinois shall designate these individuals. The Contractor shall notify the State 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.
- (g) The pump tests shall be performed in the domestic United States. However, if this can't be done, the Contractor shall hire an approved witness and pay all necessary expenses if the test cannot be performed in the domestic United States.

1.6 Guarantee

1.6.1 Refer to Division 1.

1.6.2 Provide 3 years non-prorated guarantee or warranty from the date of final acceptance.

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 one set for the low flow pump:
- (a) One set of mechanical seals - upper and lower
 - (b) One set of cable entry grommets
 - (c) One set of motor bearings
 - (d) One set 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.
- 1.8.3 The spare parts and equipment shall not be delivered to the site until the project is ready for final inspection. The spare parts shall be securely packed for extended storage and provided with a complete list of parts. Each part shall be clearly identified and coordinated with the list.

1.9 Basis of Payment

- 1.9.1 The pumping equipment 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 unless otherwise noted.

2. PRODUCTS:

2.1 Pump Specifics

2.1.1 Design

- (a) 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.
- (b) 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.
- (c) 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 cast iron, with smooth surfaces devoid of blow holes or other casting irregularities.

2.1.4 Impellers

- (a) Pump impellers shall be stainless steel ASTM A744, Grade CD-4MCU and shall be statically and dynamically balanced, enclosed and non-clogging, designed with minimum clearances so as to preclude solids and stringy material from damaging the mechanical seal, on the back of the impeller. 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.

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.

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.

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 I location. Pump motor shall be Premium Energy Efficiency Motor for the main pumps and low flow pumps. Motor shall be 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 F (155 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. For application in Class I, Division 1 locations multiple power cables shall be used to limit conductor current to 215A for main pump and 64A for low flow pump at motor full load. 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.

- (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 16B-2.10.

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 shall be carbon steel or stainless steel material 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 equipped with a monitoring system to protect critical machine functions during operation.

- (b) Three thermostats, 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 devices shall be mounted in the control panel under Section 16D. The monitoring system shall be intrinsically safe, intrinsically safe barriers shall be provided where required.

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 bronze or 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 bronze or 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 Subsection 2.12, 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 installation.

- 3.1.2 The manufacturer shall have joint responsibility with the Contractor for the proper installation of the equipment, and jointly with the Contractor shall furnish a written statement to the Owner 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 Installed Testing

- (a) 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. Field tests shall be performed in the presence of 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.
- (b) The pumps shall be tested 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.
- (c) 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) Megger testing shall be performed and logged on all pumps.
 - 3) Pump controls and terminations shall be checked.
 - 4) At a minimum, each pump including all spare pumps, shall be run in recirculation a minimum of 30 minutes.

- 3.3 Painting
 - 3.3.1 All pumping equipment shall be painted as specified in Division 9.
- 3.4 Schedule
 - 3.4.1 Refer to Drawing M17.

END OF THIS SECTION

DIVISION 15 - MECHANICAL

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 5C - 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 NFPA 90A Installation of Air Conditioning and Ventilating Systems.
- 1.3.6 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- 1.3.7 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, Stairway, Intermediate Levels Wet Well and Trash Rack areas. The Electrical Control Room ventilation system will operate when temperature rises above setpoint 90° F (adjustable), while the Pump Room, Pump Levels, Stairs and Trash Rack ventilation system will operate whenever the building is occupied or combustion gas level rises above setting point or temperature rises in the space above setpoint 90°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, Stairway, Intermediate Floor, Wet Well and Trash Rack Room shall be rated for use in Class I, Division I 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 Guarantee

1.6.1 Provide guarantee 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 2,000 fpm.

(b) 1 inch WG positive or negative static pressure and velocities less than 2,500 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.

2.0 PRODUCTS:

2.1 Duct Work

2.1.1 General

- (a) Unless otherwise indicated all duct work shall be low pressure type (2 inch WG).
- (b) Unless otherwise indicated, all duct work shall be 316L stainless steel duct as specified herein. Flexible duct may be used where vibration isolation, such as at fan connections, is required.
- (c) Duct Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

2.1.2 Aluminum Duct

- (a) Aluminum duct shall conform to ANSI/ASTM Standard B209. The duct shall be non-combustible.
- (b) Aluminum used in duct work shall be alloy 3003-H14. Aluminum connectors and bar stock shall be alloy 6061-T6.

2.1.3 Flexible Duct Connections

- (b) Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, as indicated.
- (c) UL Listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 36 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.
- (d) Provide flexible duct connections wherever ductwork connects to vibration isolated equipment.
- (e) Provide adequate joint flexibility to allow for thermal axial, transverse and torsional movement, and also capable of absorbing vibrations of connected equipment.
- (f) Manufacturers – Subject to compliance with requirements provide flexible connections of one of the following:
 - 1. Ventabrics.
 - 2. Or equal.

2.1.4 Stainless Steel Duct

- (a) Stainless steel duct shall conform to ANSI/ASTM Standard A167.

- (b) Stainless steel duct shall be ANSI Type 316L with No. 2B finish for concealed work and No. 3 finish for exposed work.
- (c) Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

2.1.5 Duct Supports

- (a) Provide 316L stainless steel fasteners, anchors, rods, straps, trim and angles for support of stainless steel ductwork or aluminum ductwork.

2.1.6 Ductwork Fabrication and Assembly

- (a) Fabricate shop or manufactured duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings.
- (b) Except as otherwise indicated, fabricate elbows with centerline radius equal to 1.5 times associated duct width; fabricate mitered fittings to include turning vanes in elbows where shorter radius necessary.
- (c) Limit combined angular tapers to 45 degrees for contracting tapers and 30 degrees for expanding tapers.
- (d) Fabricate in 4-, 8-, 10-, or 12-ft lengths unless otherwise indicated or required to complete runs.
- (e) Pre-assemble Work in shop to greatest extent possible to minimize field assembly of systems.
- (f) Disassemble systems to extent necessary for shipping and handling.
- (g) Match mark sections for re-assembly and coordinated installation.
- (h) Fabricate of gauges and reinforcement complying with SMACNA - HVAC Duct Construction Standards.

2.1.7 Air Turning Devices

Multi-blade device with blades aligned in short dimension; stainless steel construction with mounting straps.

2.1.8 Duct Access Doors

- (a) Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

- (b) Review locations prior to fabrication.
- (c) Fabricate rigid and close-fitting doors of aluminum alloy 3003-H14. Provide sealing gaskets and quick fastening locking devices.
- (d) Access doors smaller than 12 inches square may be secured with sash locks.
- (e) Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches.
- (g) Access doors with sheet metal screw fasteners are not acceptable.
- (h) 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.

2.2 Dampers

2.2.1 General

- 1. No single damper shall be larger in size than 48-IN in either dimension. Where a larger damper is required , multiple 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.
- 3. Provide manual volume control dampers, gravity dampers and motorized dampers in locations shown on the Drawings.

2.2.2 Manual Volume Dampers (MVD)

(a) Performance

Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressures to 5" w.g., velocities to 3000 fpm and temperatures to 180 degrees F. Testing and ratings to be in accordance with AMCA Standard 500.

(b) Construction

Dampers shall consist of a heavy-gage aluminum in aluminum ductwork and stainless steel in stainless steel ductwork, channel frame with 5" depth; triple V type blades fabricated from heavy-gage aluminum; blades shall be completely symmetrical relative to their axle point, presenting identical resistance to airflow in either direction or pressure on either side of the damper. Provide insulated blade type for the dampers for all outside air louvers.

(c) Bearings and Linkages

1/2" diameter plated steel axles turning in synthetic (acetyl) sleeve bearings; external (out of the air stream) blade-to-blade linkages.

2.2.3 Motor Operated Damper (MOD)

Power for the motor shall be 120 VAC, single phase. All damper motors associated with the Electrical Control Room shall be chemical duty rated NEMA 4X. All damper motors associated with the Pump Room and Trash Rack Room shall be Explosion proof rated for use in Class I, Division I areas.

2.2.4 Fire Dampers

(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 fired dampers shall have 1-1/2-hr fire rating.

(d) Constructed casing of stainless steel.

(e) Provide with fusible link rated at 160°F to 165°F.

(f) Provide damper with positive lock in closed position.

2.2.5 Backdraft Dampers (BDD)

1. Manufacturers:

- a. Greenheck.
- b. Or equal.

2. Parallel blade, counterbalanced backdraft damper.

3. Provide in vertical or horizontal configuration as required by installation location.
4. 316 stainless steel construction with vinyl blade seals.
5. Units installed shall be set for 0.10 IN. W.C.

2.2.6 Control Dampers

- (a) Manufacturer:
 1. Greenheck model VCD-33.
 2. Or equal.
- (b) Ultra low leakage damper.
- (c) 16 gauge galvanized steel frame. Dampers installed in aluminum or stainless steel duct systems or unducted applications in areas specified to use aluminum or stainless steel ducts shall be provided with Hi-Pro polyester coating or be fabricated of 304 stainless steel frame and blades.
- (d) Airfoil shaped double skin blades completely symmetrical about the axle pivot point.
- (e) Blade axles in synthetic sleeve bearings.
- (f) Silicone blade seals.
- (g) Flexible stainless steel jamb seals.
- (h) External (out of the airstream) blade to blade linkage.
- (i) Suitable for pressures to 8-in. w.c. and velocities to 4,000-fpm with maximum AMCA leakage rate of 6 cfm/sq. ft at 4-in w.c.

2.2.7 Insulated Control Dampers:

- (a) Manufacturer:
 1. Greenheck model ICD-45.
 2. Or equal.
- (b) 0.125-in aluminum channel frame insulated with polystyrene on four sides and thermally broken with dual polyurethane resin gaps.
- (c) Aluminum airfoil blades internally insulated with polyurethane foam and thermally broken.
- (d) 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.
- (e) External (out of the airstream) blade to blade linkage.
- (f) 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.

2.2.8 Damper Actuators: See 2.2.3

- (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.
- (b) Actuators shall be fully modulating/proportional, pulse width, floating/tristate, or two position as indicated in the sequence of operation and be factory or field selectable. Actuators shall have visual position indicators and shall operate in sequence with other devices if required.
- (e) Provide actuators with end switches or position feedback as indicated in the sequences of operation.
- (f) Actuators shall have an operating range of -22° to 122° F.
- (g) Proportional actuators shall accept a 0-10 VDC or 0-20 mA input signal and provide a 2-10 VDC or 4-20 mA (with a 500 W load resistor) operating range.
- (h) Actuators shall be capable of operating on 24 or 120 VAC, or 24VDC and Class 2 wiring as dictated by the application. Power consumption shall not exceed 10 VA for AC, including 120VAC actuators, and 8 watts per actuator for DC applications. Power supply requirements are Contractors option.
- (i) Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation. End switches to deactivate the actuator at the end rotation or magnetic clutches are not acceptable.
- (j) 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. will 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.
- (k) 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.

- (l) 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.
- (m) Proportional actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable. Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload, mechanical travel and mechanical load limit. The actuators shall also provide actuator service data, at minimum, number of hours powered and number of hours in motion.
- (n) Proportional actuators shall be capable of digital communication, as built.
- (o) All damper operators shall be oil submerged, geartrain type, inherently positive positioning.
- (p) The actuators shall be mounted externally of ducts or air handling equipment wherever possible for ease of service and isolated from internal temperatures.
- (q) Actuator enclosure:
 - 1. Unless otherwise indicated, NEMA 4X.
 - 2. In areas designated as Class 1, Division 1 or 2 hazardous environment, provide explosion proof enclosure.
- (r) Fail Position:
 - 1. Outside Air Louvers/Intakes: Closed.
 - 2. Return Air Dampers: Open.
 - 3. Duct Mounted Control Dampers: Closed.

2.2.9 Manual Dampers: See 2.2.2

- (a) Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA standards:
- (b) Manual dampers shall be of aluminum construction.
- (c) Manufacturer – subject to compliance with requirements, provide dampers of one of the following:
 - 1. American Warming & Ventilating Inc.
 - 2. Arrow Louver and Damper Corp.
 - 3. Greenheck
 - 4. Louvers & Dampers
 - 5. Or equal

2.2.6 Duct Hardware

- (a) Manufacturers:
 - 1. Ventfabrics, Inc.
 - 2. Young Regulator Co.
 - 3. Or equal.

- (b) Quadrant Locks: Provide for each manual 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.

- 1) 2.3 Intake and Exhaust Louvers (024-OAL-1, 024-OAL-2, 024-OAL-3 and 024-EAL-
 - 2.3.1 General
 - Provide a fixed louver, with external insect screen where shown on the drawings.
 - 2.3.2 Fabrication
 - Frame shall be constructed of .080" 6063T5 extruded aluminum with .072" 6063T5 extruded aluminum blades. Provide 4" blade depth and drainable blade. Finish shall be clear anodized.
 - 2.3.3 Bird Screen
 - Provide an internally mounted bird screen. The screen shall be constructed of .051" x 3/4" diamond pattern expanded aluminum.
 - 2.3.4 Insect Screen
 - Provide an externally mounted insect screen. The screen shall be constructed of .0123" diameter aluminum, 18 x 14 mesh giving a free area ratio of 60%.
- 2.4 Grilles
 - 2.4.1 Type
 - Modular grilles of the sizes indicated on the plans. Grilles shall be double deflection type with two sets of fully adjustable 1-1/4" deep, blades space 1-1/2" on center.
 - 2.4.2 Frame
 - The outlets shall consist of multiple square double deflection grilles mounted to an stainless steel mounting frame with quick release fasteners.
 - 2.4.3 Fabrication
 - Blades and grille border shall be of heavy extruded stainless steel construction with factory clear anodized finish. The front set of blades shall run parallel to the short dimension of the outlet.

2.4.4 Dampers

Dampers shall be integral, installed behind each grille and shall be of all aluminum construction. Damper shall be lever operated from face, opposed blade type.

2.5 Inline Centrifugal Fans - Belt Drive (024-SF-1 & 024-EF-5)

2.5.1 General

- (a) Fans used shall not decrease motor size, increase noise or increase tip speed more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 15 percent of scheduled values.
- (b) Base performance on sea level conditions.
- (c) Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.
- (d) Fans shall be equipped with lifting lugs.

2.5.2 Performance Ratings

Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

2.5.3 Sound Ratings

Conform to AMCA 301, tested to AMCA 300 and bear the AMCA Certified Sound Rating Seal.

2.5.5 Wheel

The fan wheel shall be of non-overloading backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to grade G6.3 per ANSI S2.19. fan wheel level II of construction constructed. Wheel and fan inlets shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

2.5.6 Housing and outlets

Meet the AMCA type B spark resistance. The fan housing shall be continuously welded heavy gauge steel construction with integral inlet and outlet duct flanges. Duct bolt holes shall be no more than 4 inches apart on center. belt tubes shall be continuously welded. Housing and bearing supports shall be constructed of welded structural steel members and coated with Permatector coat. Fans shall be coated with a minimum of 2-4 mils of Polyester Urethane, electrostatically applied and baked.

The access panels must be of sufficient size to permit easy access to all interior components.

2.5.7 Finish

Factory finish before assembly with epoxy coating on fan and accessories.

2.5.8 Motors

Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the air stream. Motors shall be readily accessible for maintenance. Motor shall be Class 1, Div.1 Group D explosion proof. Provide motor in accordance with Section 16B – 2.10.

2.5.9 Shafts and Bearings

Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 400,000 hours at maximum cataloged operating speed. Bearing shall have extended lube lines with Zerk fittings. Bearing shall be fixed to fan shaft using concentric mounting locking collars. Bearing shall be 100% tested for noise and vibration by the manufacturer.

2.5.10 Drive and Pulleys

Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

2.5.11 Belt & Motor Guard

Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible; of 12 gage, 3/4 inch diamond mesh wire screen welded to aluminum angle frame or equivalent, prime coated. Secure to fan or fan supports with provision for adjustment of belt tension, lubrication and use of tachometer with guard in place.

2.5.12 Identification

Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

2.5.13 Vibration Isolation

Fans shall be isolated from the building structure by means of neoprene vibration isolators.

2.5.14 Accessories

- (a) Belt Guard shall be totally enclosed and meet OSHA guidelines
- (b) Aluminum motor cover and meet OSHA guidelines.
- (c) Inlet and outlet companion flanges with prepunched holes.
- (d) Inspection section/door in inlet and outlet of the fan, bolted type.
- (e) Isolators base and hanging isolators
- (f) Mounting rails for vertical mounting inline fans.

2.6 Sidewall Centrifugal Fans - Belt Drive (024-EF-2, 024-EF-3 & 024-EF-4)

2.6.1 General

- (a) Fans used shall not decrease motor size, increase noise or increase tip speed more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 10 percent.
- (b) Base performance on sea level conditions.
- (c) Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

2.6.2 Performance Ratings

Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

2.6.3 Sound Ratings

Conform to AMCA 301, tested to AMCA 300 and bear the AMCA Certified Sound Rating Seal.

2.6.4 Fabrication

Conform to AMCA 99.

2.6.5 Wheel and Inlet

The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

2.6.6 Housing

The fan housing shall be of the square design constructed of heavy gauge aluminum and shall include square duct mounting collars. Housing construction shall include remote accessible fan lubrication piping and drain. Provide aluminum bird screen and wall grille.

2.6.7 Finish

Factory finish before assembly.

2.6.8 Motors

Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the air stream. Motors shall be readily accessible for maintenance. Motor shall be Class 1, Div. 1 Group D explosion proof. Provide motor in accordance with Section 16B - 2.10.

2.6.9 Shafts and Bearings

Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.

2.6.10 Drive

Motor shall be securely attached to the fan shaft.

2.6.11 Disconnect Switch

Fan mounted UL safety disconnect switch complete with internal wiring between motor to switch shall be provided. Disconnect switch shall be explosion proof.

2.6.12 Identification

Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

2.6.13 Vibration Isolation

Fans shall be isolated from the building structure by means of neoprene vibration isolators.

2.7 Corrosion Resistant Electric Unit Heaters (024-EUH-5)

2.7.1 Manufacturers:

- (a) Marley.
- (b) Ruffneck.
- (c) Or equal.

2.7.2 Type: Propeller type, washdown corrosion resistant electric unit heater.

- 2.7.3 Construction: Unit casing shall be constructed of stainless steel with stainless steel universal type swivel mounting bracket. Provide with stainless steel louvered air outlet and inlet grille to act as fan guard.
- 2.7.4 Heating Element: Element shall be constructed of type 304 stainless steel finned tubular elements with stainless steel threaded fittings forming a water-tight seal between the elements and junction box. Provide units of voltages and capacities as scheduled.
- 2.7.5 Fans: Fan shall be constructed of epoxy coated aluminum. Provide with motors in accordance with Division 16.
- 2.7.6 Controls: Provide the following control devices prewired to unit.
 - (a) Power contactor.
 - (b) Fan Delay Relay: Provide fan delay relay to keep unit fan running until all heat is dissipated from the heating elements.
 - (c) Automatic overtemperature cutout.
 - (d) Transformer for 24-volt control circuit.
 - (e) NEMA-4X junction box to house built-in controls and element terminals.
 - (f) Unit mounted NEMA 4X thermostat.
- 2.7.7 Accessories: Provide unit heaters with the following accessories as scheduled:
 - (a) Factory wired NEMA 4X disconnect switch provided in accordance with Division 16.
 - (b) Epoxy coated unit.
- 2.8 Explosion-Proof Electric Unit Heaters (024-EUH-1, 024-EUH-2, 024-EUH-3, 024-EUH-4 & 024-EUH-6)
 - 2.8.1 Manufacturers:
 - (a) Marley.
 - (b) Ruffneck Heaters.
 - (c) Berko.
 - (d) Qmark.
 - 2.8.2 Type: Propeller type, spark resistant, explosion-proof electric unit heater, suitable for a Class 1, Division 1, Group D hazardous environment.
 - 2.8.3 Construction: Unit casing shall be constructed epoxy coated heavy gauge steel with 14-ga. heavy duty steel frame.
 - 2.8.4 Heating Element:
 - (a) Provide units of voltages and capacities as scheduled.

- (b) Heat exchanger shall have heavy duty immersion heating elements enclosed in a heat transfer fluid.
 - (c) Heating element shall be designed to ensure surface temperature does not exceed 320°F.
- 2.8.5 Fans: Fan shall have permanently lubricated explosion-proof motor with built-in overloads. Provide motors in accordance with Division 16.
- 2.8.6 Controls: Provide the following control devices prewired to unit.
- (a) Magnetic contactor.
 - (b) Automatic overtemperature cutout.
 - (c) Transformer for 24-volt control circuit.
 - (d) Unit mounted explosion-proof thermostat.
- 2.8.7 Accessories: Provide unit heaters with the following accessories as scheduled:
- (a) Factory wired explosion proof disconnect switch provided in accordance with Division 16.
 - (b) Epoxy coated unit.
- 2.9 Gravity Roof Ventilators (024-IH-1 & 024-RH-1)
- 2.9.1 Manufacturers:
- (a) Greenheck.
 - (b) Carnes Company.
 - (c) Cook Company.
 - (d) Or equal.
- 2.9.2 General: Provide gravity roof ventilators of types, sizes, and capacities as shown on drawings or schedules.
- 2.9.3 Type:
- (a) Hooded Low Silhouette: Aluminum hood with easily removable cover to allow access to damper assembly.
- 2.9.4 Construction: Ventilators shall be provided with pre-punched square curb cap for mounting to roof curb.
- 2.9.5 Accessories: Provide gravity ventilators with the following accessories as scheduled:
- (a) Dampers: Provide motor operated or gravity actuated dampers as scheduled.
 - (b) Birdscreen: Provide manufacturer's standard aluminum birdscreen.

- (c) Insect screen: Provide manufacturer's standard stainless steel insect screen as scheduled.
- (d) Insulation: Provide fiberglass insulation on underside of hooded low silhouette ventilators to prevent condensation as scheduled.
- (e) Roof Curb: Provide roof curb as scheduled.

2.10 Roof Curbs

2.10.1 Manufacturers:

- (a) Same manufacturer as fan.
- (b) Or equal.

2.10.2 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.

2.10.3 Fabricate units from aluminum.

2.10.4 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.

2.10.5 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.

2.11 Temperature Sensors

2.11.1 Temperature Sensors shall be of the type and have accuracy ratings as indicated and/or required for the application and shall permit accuracy rating of within 1% of the temperature range of their intended use. Sensors must be capable of being calibrated.

2.11.2 All duct sensors shall be electronic resistance type.

2.11.3 Sensors used for mixed air application shall be the averaging type of sufficient length to extend diagonally across the entire duct and have an accuracy of 1%.

2.11.4 Duct sensors shall protrude into the air stream far enough to sense any temperature differences due to stratification, etc.

2.11.5 Outside air sensors shall have a minimum range of -20 °F to 110 °F and an accuracy of within 1 °F in this temperature range. Sensors shall be provided with a water-tight fitting and adequate protection from the effects of solar radiation.

2.11.6 Space temperature sensors located in the Electrical room shall have digital space temperature and setpoint display with external setpoint adjustment and manual Occupied/Unoccupied override. Setpoint adjustment shall be software limited by OWS.

- 2.11.7 Space temperature sensors located in areas identified and Class 1, Division 1 or 2 shall be provided with an explosion proof enclosure with corrosion resistant elements. Sensors shall have no setpoint adjustment or display. Space temperature setpoint shall be made via the OWS.
- 2.11.8 Water temperature sensors shall be of the bulb type mounted within stainless steel wells filled with a heat conductive compound and in direct contact with the water within the pipe.
- 2.11.9 All field mounted sensors shall be labeled in accordance with the name or identification number used in the control program.
- 2.12 Low Temperature Protection Thermostats
 - 2.12.1 Provide low-temperature protection thermostats of manual-reset type with sensing elements 8'-0" or 20'-0" in length.
 - 2.12.2 Provide thermostat designed to operate in response to coldest 1'-0" length of sensing element, regardless of temperature at other parts of element.
 - 2.12.3 Support element properly to cover entire unit width. Provide separate thermostats for each 25 sq. ft. of coil face area or fraction thereof.
- 2.13 Line – Voltage / Low Voltage On – Off Thermostats
 - 2.13.1 Bi-metal actuated open contact, or bellows actuated enclosed snap-switch type.
 - 2.13.1 UL-listed at electrical rating comparable with application.
 - 2.13.2 Heat anticipation.
- 2.14 Line Voltage Thermostats With Fan Switch
 - 2.14.1 Provide thermostats as described above with three position manual switch labeled Manual-Off-Auto. Switch shall be integral part of thermostat and be capable of mounting on 2-gang switch box.
- 2.15 Temperature Control Panels (TCP)
 - 2.15.1 Provide control panels with suitable brackets for wall mounting where indicated and elsewhere as required. Locate panel as required.
 - 2.15.2 Provide standard NEMA 1 cabinets of size required to contain temperature controllers; relays; switches; and similar devices; except limit controllers and other devices excluded in sequence of operations.
 - 2.15.3 Mount required alarm lights, indicating devices and manual controls on face of panel.

2.16 Axial Wall Fans

2.16.1 General

- (a) Fans used shall not decrease motor size, increase noise or increase tip speed more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 10 percent.
- (b) Base performance on sea level conditions.
- (c) Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

2.16.2 Performance Ratings

Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

2.16.3 Sound Ratings

Conform to AMCA 301, tested to AMCA 300 and bear the AMCA Certified Sound Rating Seal.

2.16.4 Fabrication

Conform to AMCA 99.

2.16.5 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.

2.16.6 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.

2.16.7 Finish

Factory finish before assembly.

2.16.8 Motors

Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the air stream. Motors shall be readily accessible for maintenance. Motor shall be Class 1, Div. 1 Group D explosion proof. Provide motor in accordance with Section 16B - 2.10.

2.16.9 Shafts and Bearings

Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.

2.16.10 Drive

Motor shall be securely attached to the fan shaft.

2.16.11 Disconnect Switch

Fan mounted UL safety disconnect switch complete with internal wiring between motor to switch shall be provided. Disconnect switch shall be explosion proof.

2.16.12 Identification

Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

2.16.13 Vibration Isolation

Fans shall be isolated from the building structure by means of neoprene vibration isolators.

2.16.14 Accessories: Provide fans with the following accessories:

- a. Dampers: Provide motor operated or gravity actuated dampers as scheduled.
- b. Wall Housing: Provide manufacturer's standard wall housing for scheduled fan size. Housing shall be constructed of galvanized steel with pre-punched mounting holes. Provide housing with motor side guard of welded steel wire construction.
- c. Provide special coatings as scheduled.
- d. Weatherhood: Provide manufacturer's standard weatherhood constructed of galvanized steel with insect screen.

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.
- 3.3 Fan and Damper Schedule: See Sheet M18.

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 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
- 3.5.2 The contractor shall include the cost of new sheaves and belts if it becomes necessary to change the drives during balancing of system.
- 3.5.3 Patch holes in ductwork and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer.
- 3.5.4 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.

3.5.5 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.

3.5.6 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 Manufacturer to provide start-up services for fans and unit heaters.

3.7 Spare Parts

3.7.1 General- Furnish to Owner, 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 Owners' personnel. Training schedule shall be approved by Owner.

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

DIVISION 15 - MECHANICAL

SECTION 15F - TRASH RACK

1. GENERAL:

1.1 Section Includes

1.1.1 There shall be furnished as shown on the plans, one (1) vertical back-cleaned, back-return bar screen trash rack. The unit shall be placed in a channel 12'-0" wide x 44'-1" deep.

1.2 Related Sections

- 1.2.1 Section 3A - Cast-In-Place Concrete.
- 1.2.2 Section 3B – Grout.
- 1.2.3 Section 5C - Bolts, Anchor Bolts, Expansion Anchors.
- 1.2.4 Section 15A - General Mechanical Provisions.
- 1.2.5 Section 15B - Basic Mechanical Materials and Methods
Concrete Inserts.
- 1.2.6 Section 16A - General Electrical Provisions.
- 1.2.7 Section 16B - Basic Electrical Materials and Methods.
- 1.2.8 Section 16D - Supervisory Control and Data Acquisition
(SCADA) Equipment.

1.3 Guarantee

- 1.3.1 The equipment manufacturer shall guarantee the equipment against defects in design, material and workmanship for a period of four years after delivery or three and half year after plant start-up, whichever occurs sooner.

1.4 Submittals

- 1.4.1 Submit shop drawings and product data under provisions of Sections 1A and 15A.
- 1.4.2 Submit detailed drawings and design data.

1.5 Basis of Payment

- 1.5.1 The work required to comply with this Section shall be paid for as part of the contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for the work described herein.

2. PRODUCTS:

2.1 Trash Rack Specifics (024-TR-1)

2.1.1 General Design

- (a) The unit shall comprise a complete assembly consisting of a screen housing and support frame, drive, main chain, sprockets and shafts, bearings, rakes, screen sections, operating controls and anchorage.
- (b) The rake fingers of the unit shall operate on the downstream side of the vertical, cantilevered screen section with the fingers protruding through the screen bars to remove any obstruction jamming between or wrapping around the bars. The rake fingers shall discharge the screenings on to a sorting tray in the housing, which shall be placed on the operating floor. A roller-operated automatic wiping bar shall be provided with each screen to positively clean the load from the rake fingers.

A hinged discharge plate shall be built into each housing to prevent elevated screenings from falling back into the screen chamber while being discharged from the rakes onto the sorting tray.

- (c) The equipment shall be suitable for operation in NEC Class I, Division 1, Group D hazardous locations.
- (d) This specification is based, primarily, on the Back Cleaned Trash Rack, Model BCS, as supplied by Pro-Equipment, Inc. Other supplier products may be acceptable provided they can be demonstrated to meet all of the dimensional, functional/performance requirements of this specification.

2.1.2 Drive

- (a) Each drive shall include a helical gear reducer. The reducer shaft and drive sprocket shall be connected to the driven sprocket by a 1-1/4" pitch, Type 304 stainless steel, roller chain enclosed in a 12 gauge steel guard. Each drive shall be provided with a chain tightener consisting of a steel sprocket with shaft, mounted on an adjustable support.
- (b) Each motor shall be Nema Design B, totally enclosed explosion-proof with Class B insulation, include a sealed conduit box, not less than 1 HP, and designed to operate on 3 phase, 60 cycle, 480 volt current. Provide motor in accordance with Section 16B-2.8.
- (c) The output shaft of each gear reducer shall be fitted with an overload release clutch sized for drive and mechanism protection. The clutch shall trip an explosion-proof limit switch, sound an alarm, and stop the drive motor in the case of overload. When tripped, the limit switch shall otherwise indicate the rakes are "jammed".

2.1.3 Screen Housing

- (a) Each screen housing shall be constructed of structural steel shapes and plates having a minimum thickness of 1/4 inch. Each screen housing shall be provided with hinged doors and removable 12 gauge galvanized steel sections front and rear.

2.1.4 Screen Section

- (a) Each screen section shall consist of minimum 3" wide x 1/2" thick steel bars so spaced as to provide 1.5" clear openings between them. The bars shall cantilever from the bottom of the screen channel to a point above the normal high water level in the channel. The screen section shall be furnished with an adjustable guided entry to provide precision entry of the rake teeth. The screen bars shall be removable in groups of six or nine bars so that the entire screen section need not be removed from the channel. Structural design calculation shall be provided to show its structural stability and adequacy in design with appropriate factor of safety.

2.1.5 Rakes

- (a) The rakes for the unit shall be fabricated of structural steel members to which heavy steel fingers 2" x 1/2" are welded. The unit shall be furnished with enough cleaning rakes so that whenever the mechanism stops there will always be one or more cleaning rakes engaged in the screen bars to keep them properly spaced. In any event, the cleaning rakes shall be spaced on the main chain at not more than 5'-0" centers. The rakes shall be fastened to the rake bars by means of 316 stainless steel bolts with lock nuts.

2.1.6 Main Chain

- (a) Each main chain shall consist of Series 700-SS stainless steel chain with Type 410 stainless steel links having an average ultimate strength of 40,000 lbs. The chain shall weigh not less than 4.1 lbs/ft and have a 6" pitch. The links shall be connected with 9/16" dia. 410 stainless steel pins, held in place by 302 stainless steel cotter keys. Chain speed shall be approximately 10 feet per minute.
- (b) Two chain tighteners shall be provided for the unit, consisting of 6-tooth, 12.00" P.D. sprockets that will automatically keep the proper tension on the chains by means of an adjustable spring-loaded pivot assembly located in the screen housing.

2.1.7 Sprockets and Shafts

- (a) The unit shall be provided with 13-15/16" diameter solid steel head shaft 2-15/16" diameter and lower stub shafts. The head shaft shall be provided with take-up housings providing adjustment of the main chain. The head shaft shall also have two 23-tooth, 22.21" P.D. cast, split sprockets. Each lower stub shaft shall have a 6-tooth, 12.00" P.D. sprocket. All head shaft and lower stub shaft sprockets shall have a minimum Brinell hardness of 450 and a minimum 3/16" depth of chill.

2.1.8 Bearings

- (a) The head shaft bearings of the unit shall be of the self-aligning grease-lubricated type, mounted in a jack-screw adjustable housing to provide for main chain take up. The underwater bearings on the lower stub shafts shall consist of grease-lubricated grooved bronze bearing sleeves mounted in the sprocket hubs and lubricated from an opening in the shafts or a PTFE Composite bearing as furnished by SKF as Model PCM B. This bearing shall include a copper plated sheet steel backing onto which a 0.2-0.4 mm thick porous layer of tin bronze is sintered. The pores of the sintered layer shall be filled with a mixture of PTFE and lead by a rolling process. The sintered bronze layer shall be covered by a 5-30 micron thick running- in layer of the same mixture. This type of bearing shall require no external lubrication.

2.1.9 Operating Controls

- (a) Operating controls for the unit shall consist of the following:
- 1) An explosion-proof limit switch to assure unloading of the screen with every start of the mechanism. The switch shall be furnished and mounted on the screen housing by the equipment manufacturer, and wired by the Electrical Contractor. Sufficient actuators shall be provided so that unloading of the screen can be accomplished with a minimum amount of chain travel. When tripped, the limit switch shall indicate the rakes are in the "parked" position, with one (1) rake within the top 12" of the screen.
 - 2) A motor starter shall be furnished with the equipment for installation under Division 16C-2.1. The starter shall be 3 phase, 600 VAC magnetic, non-fusible disconnecting switch combination type, NEMA size 1 minimum, 480-120 V control transformer with fused primary and secondary 100 VA extra capacity ; 120 V control coil, ambient compensated overload relay; LED type pilot lights, control relays, time delay relay, and 7 day exercise time switch as shown on Plan and as required for proper operation and controls; explosion proof enclosure suitable for wall mounting in NEC Class I, Division 1, Group D hazardous locations.

2.1.10 Painting

- (a) All ferrous surfaces shall be cleaned in accordance with SSPC-SP10 and given one (1) shop coat of Tnemec 66-1211 primer or approved equal, 3.0 to 5.0 mils dry film thickness and shop finish coats in accordance with Section 9A.
- (b) Field touch-up of scratches mars and bruises to shop applied primer coatings, and shop finish painting shall be furnished and applied by the Contractor in accordance with Specification Section 9A.
- (c) All items such as motors, reducers and equipment completely shop assembled and ready for installation shall be factory painted with one (1) shop coat of the equipment manufacturer's machinery enamel and shop finish coat painting before shipment. Color charts shall be submitted for selection.

2.1.11 Anchorage

- (a) All wedge anchors, anchor bolts, nuts and washers shall be of galvanized steel and furnished by the equipment manufacturer. They shall be set by the Contractor in accordance with certified dimension prints furnished by the equipment manufacturer.

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 Division 1 and Section 15A. The manufacturer shall inspect the trash rack installation and shall certify that the trash rack has been installed properly. Information submitted for approval shall include a letter of intent to provide this certification. All mechanical installation and wiring shall be completed and all necessary adjustments to equipment shall be made to provide a complete operational pumping installation.

3.1.2 The manufacturer shall have joint responsibility with the Contractor for the proper installation of the equipment, and jointly with Contractor shall furnish a written statement to the Owner 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.

3.3 Start-Up Services

3.3.1 IDOT shall be notified at least two (2) weeks before start-up services are required.

3.3.1 The equipment manufacturer shall provide the services of a field service representative for a total of two (2) trips for a total of not more than two (2) working days for the purpose of instruction and assisting the Contractor and the IDOT's personnel in the start-up and proper operation of the equipment.

3.3.2 Operating and maintenance instructions for the equipment shall be furnished to the Contractor by the equipment manufacturer.

END OF THIS SECTION

DIVISION 15 - MECHANICAL

SECTION 15G - MISCELLANEOUS MECHANICAL ITEMS

1. GENERAL:

1.1 Section Description

1.1.1 This Section shall include all work required for the furnishing and installing complete, the Items indicated on the Drawings, as specified herein and as follows:

- (a) Cable Supports for Pump Cables.
- (b) Stilling Wells.
- (c) Compression Bell.
- (d) 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 Guarantee

1.5.1 Provide guarantee 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.

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 aluminum.

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 Compression Bell

2.3.1 Compression bells shall be provided for water level sensing in conjunction with separately mounted pressure sensing type level transmitters. The compression bell shall be fabricated with high strength non-corrosive plastics and shaped to provide a resistance to build up of foreign material. Stainless steel tube fitting shall be provided for air tube connection. Stainless steel straps shall be provided for mounting. Quantities, locations and mounting details are shown on drawings.

2.3.2 The compression bells shall be manufactured by TESCO or equal.

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

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
IES	Illuminating Engineering Society of North America
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Assoc.
NESC	National Electrical Safety Code
UL	Underwriters' 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 co-ordination 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. This cost shall be incidental to Pump Station Electrical.

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 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 Owner.
- 1.7.3 Tests may be made progressively as portions of the work are complete.
- 1.7.4 Tests shall be made in the presence of the Engineer.
- 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 3-phase 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 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) See paragraph 3.9 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 Data to be filed with the Owner
- 1.8.1 Submit shop drawings and product data under provisions of Section 1A. Certain data, as specified herein, shall be furnished to the Owner when installation and testing are complete, before final acceptance.
- 1.8.2 The data shall be compiled in 8-1/2 x 11 inch format in high-quality heavy-weight, hard cover binders with piano-style metal hinges or in an alternate format approved by the Engineer. Large 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.
- 1.8.3 Four sets of the data files shall be provided.
- 1.8.4 As a minimum, the data files 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) Manufacturer's maintenance manuals for all equipment furnished under this Division for which maintenance is recommended by the manufacturer.
 - (d) A tabulation of cable insulation tests.
 - (e) A tabulation of motor nameplate data.

- (f) A tabulation of required voltage tests.
- (g) A tabulation of required motor current tests.
- (h) A tabulation of relay and control device set points.
- (i) A tabulation of alarm set points.
- (j) A Study Report providing summary of results of power systems study under paragraph 3.8 of this Section including:
 - 1. Description, purpose, basis, and scope of study and 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/cm²) for each equipment location and recommended personal protective equipment (PPE).
- (k) Complete testing report for the testing of electrical systems under paragraph 3.9 of this Section utilizing NETA printed forms. Submit report no later than 30 days after testing is complete. Submit proof of testing agency qualification.

1.8.5 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 will not be accepted.

1.9 Record Drawings

- 1.9.1 Alterations and additions to the electrical 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.
- 1.9.2 When the work is complete, and before final acceptance, a set of Record Drawings shall be submitted to the Engineer for review and acceptance. The set shall include the marked field set and a set of reproducible drawings. A set of reproducible drawings will be supplied to the Contractor for use in preparing the Record Drawings. The drawings shall each be stamped "RECORD DRAWING", and shall be marked with the contractor's stamp, the date, and the signature of the contractor's supervising engineer or electrician.
- 1.9.3 The Record Drawings must be submitted and must be acceptable to the Engineer prior to final acceptance. There will be no deviation from this requirement.

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 item ELECTRIC SERVICE CONNECTION.

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 1, GROUP D): All spaces in the pump station including Pump Room, Intermediate Level, Wet Well and Stairwell, except otherwise indicated.

NEMA 1: Electrical Room.

NEMA 4: Outdoor area and other unspecified wet or damp area.

NEMA 12: Other area not defined.

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 of the NEC and with NEMA standards, 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 Owner'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 Owner. 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 Owner.
- 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 Owner.
- 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.
- 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. The Contractor will be reimbursed the exact amount of these charges under a separate pay item, ELECTRIC SERVICE CONNECTION. For bidding purposes, this item shall be estimated at \$300,000.
- 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.
- 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 service disruptions such that one service is in constant operation. The following constraints shall be followed:
- (a) The new Com Ed transformers, poles, and service extension shall be installed prior to disconnection of the existing Com Ed equipment. New equipment will not yet be energized.
 - (b) 480v switchgear, generator, and motor control centers shall be installed prior to the disconnection of the existing Com Ed equipment.
 - (c) Conduit and conductors from new Com Ed transformers to 480v switchgear shall be installed prior to disconnection of the existing Com Ed equipment. Coordinate with Com Ed for transformer terminations.
 - (d) Conduit shall be installed from the new Com Ed transformers to the Com Ed power poles. Contractor shall coordinate with Com Ed on conduit routing and stub up at power poles.
 - (e) One of the existing services shall be de-energized so that service can be extended from the existing Com Ed power poles to the new Com Ed transformers. Coordinate with Com Ed for transformer terminations. At this time, existing service will be connected to the existing and new Pump Stations.

- (f) Service shall be re-energized. Existing Pump Station is now be powered from existing dual Com Ed services and new Pump Station is powered from single Com Ed service.
- (g) Second existing service shall be de-energized so that service can be extended from the existing Com Ed power poles to the new Com Ed transformers. Coordinate with Com Ed for transformer terminations. At this time, second existing service will be connected to the existing and new Pump Stations.
- (h) Service shall be re-energized. Existing Pump Station is now powered from existing dual Com Ed services and new Pump Station is powered from existing dual Com Ed services.
- (i) Contractor shall perform necessary testing of equipment at new Pump Station to verify all equipment is operational prior to the disconnection of existing Com Ed equipment.
- (j) Existing Com Ed equipment that feeds existing Pump Station will be removed in separate contract. Existing dual services feeding existing Pump Station shall be disconnected. Service disconnection to existing Pump Station shall only occur after new Pump Station is constructed and operational, and inflow and outflow sewers are complete. See Section 1A paragraph 1.5 for further requirements.

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 SCADA system.
- 3.5.2 Charges by the telephone utility shall be paid to the utility by the Contractor under the pay item, PUMP STATION ELECTRICAL WORK. The installation and coordination of charges by the telephone utility shall be referred to Jack Ryder 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 Record Drawings have been reviewed and accepted by the Engineer, the Contractor shall schedule a Final Acceptance Inspection with the Engineer. The Contractor is cautioned to 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 Electrical Power Systems Studies

3.8.1 Section includes:

- (a) Short circuit analysis, protective device evaluation study, protective device coordination study, and arc flash study on entire power distribution system.
- (b) 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 study.
- (c) Contractor shall engage services of independent engineering firm for purpose of performing electric power systems studies as specified.

3.8.2 Studies

(a) Studies include following:

- 1. Utility Company incoming service lines.
- 2. Main switching station.
- 3. Power transformers.
- 4. Generator System.
- 5. Low voltage switchgear.
- 6. Motor control centers.
- 7. Power and lighting distribution panels.
- 8. Cable, wire, and conduit systems.

(b) Studies do not include equipment as shown on Drawings indicated as future.

3.8.3 Short Circuit Study

- (a) Provide complete report with printout data sheets using digital computertype programs as part of study.
- (b) Include utilities' short circuit contribution, resistance and reactance components of branch impedances, X/R ratios, base quantities selected, and other source impedances.
- (c) 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.

3.8.4 Equipment Device Evaluation Study

- (a) 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.

3.8.5 Equipment Device Coordination Study

- (a) 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.
- (b) 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.
- (c) 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.

- (d) 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.

3.8.6 Arc Flash Study

- (a) 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).
- (b) 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/cm². Provide suggested alternate equipment and settings to minimize incident energy levels.
- (c) Provide incident energy level (calories/cm²) for each equipment location and recommended PPE.
- (d) Based on the results of the incident energy study provide and install a warning label (orange <40 cal/cm²) or danger label (red > 40 cal/cm²) for each piece of equipment. The label must be readable in both indoor and outdoor environments and contain the following information:
 - 1. Arc hazard boundary (feet and inches).
 - 2. Working distance (feet and inches).
 - 3. Arc flash incident energy at the working distance (calories/cm²).
 - 4. PPE category and description including the glove rating.
 - 5. Voltage rating of the equipment.
 - 6. Limited approach distance (feet and inches).
 - 7. Restricted approach distance (feet and inches).
 - 8. Prohibited approach distance (feet and inches).
 - 9. Equipment/bus name.
 - 10. Date prepared.
- (e) Provide one day of arc flash safety training, travel time excluded and at jobsite or classroom designated by OWNER, 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:

1. Proper use of the system analysis data.
2. Interpretation of hazard labels.
3. Selection and utilization of personal protective equipment.
4. Safe work practices and procedures.

3.8.7 Protective Device Testing, Calibration, and Adjustment

- (a) Comply with Section 16A-3.9.

3.9 Testing Electrical Systems

3.9.1 Summary

- (a) Prior to energizing equipment, retain services of recognized independent testing laboratory for purpose of performing inspections and tests as herein specified.
- (b) Ensure electrical equipment supplied by Contractor and Owner 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, motor circuit protectors, and overcurrent devices. Make final adjustments of devices in accordance with paragraph 3.8.

3.9.2 General

- (a) 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. Correct defects found by Work of this Section.
 3. Cooperate with Power Company, supplier, and manufacturer representatives in order to achieve proper intended operation of equipment.
- (b) 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.
- (c) 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 20%.

3.9.3 Switchgear Assemblies

(a) Visual and Mechanical Inspections:

1. Inspect for physical damage.
2. Verify equipment supplied and connected in accordance with Specifications.
3. Inspect for proper alignment, anchorage, and grounding.
4. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper ft-lb levels.
5. Key interlock system shall be physically tested to ensure proper function.
6. Doors, panels, and sections shall be inspected for paint, scratches, and fit.
7. Mechanical operation of relays, switches, and other devices.

(b) Electrical Tests:

1. Insulation Resistance Test: Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for 1 min. Test voltage and minimum acceptable values in accordance with Paragraph 3.9.2-C.2.

(c) Test Values:

1. Bolt torque levels shall be in accordance with manufacturer's instructions.
2. Insulation resistance test shall be performed in accordance with following:

Insulation Resistance Test Voltage	
Voltage Rating	Test Voltage
150 – 600 v	1,000 v
601 – 5,000 v	2,500 v
5,001 v and above	5,000 v

3. Values of insulation resistance less than rated kv +1 in megohms shall be investigated and corrected.

3.9.4 Motor Control Centers

(a) Visual and Mechanical Inspections:

1. Inspect for physical damage.
2. Verify equipment supplied and connected in accordance with Specifications.
3. Inspect for proper alignment, anchorage, and grounding.
4. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper ft-lb levels.

5. Key interlock system shall be physically tested to ensure proper function.
6. Doors, panels, and sections shall be inspected for paint, scratches, and fit.
7. Mechanical operation of relays, switches, and other devices.

(b) Electrical Tests:

1. Insulation Resistance Test: Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for 1 min. Test voltage and minimum acceptable values in accordance with Paragraph 3.9.2-C.2.

(c) Test Values:

1. Bolt torque levels shall be in accordance with manufacturer's instructions.
2. Insulation resistance test shall be performed in accordance with following:

Insulation Resistance Test Voltage	
Voltage Rating	Test Voltage
150 – 600 v	1,000 v
601 – 5,000 v	2,500 v
5,001 v and above	5,000 v

3. Values of insulation resistance less than rated kv +1 in megohms shall be investigated and corrected.

3.9.5 Motor Controllers

(a) Visual and Mechanical Inspections: Include following inspections and related work:

1. Motor Control Device Ratings and Settings: Verify ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective device ratings and settings where differences found. Use accepted revised ratings or settings to make final system adjustments.
2. Inspect for defects and physical damage and nameplate compliance with Drawings.
3. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's written instructions.
4. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.
5. Clean devices using manufacturer's approved methods and materials.

6. Verify proper fuse types and ratings in fusible devices.

(b) Electrical Tests:

1. Perform following in accordance with manufacturer's written instructions.
 - i. Insulation resistance test of motor control devices conducting parts to extent permitted by manufacturer's written instructions. Insulation resistance less than 100 megohms not acceptable.
 - ii. Use primary current injection to check performance characteristics of motor circuit protectors and for overload relays of controllers for motors 15 hp and larger. Trip characteristics not within manufacturer's published time-current tolerances not acceptable.
 - iii. Make adjustments for final settings of adjustable trip devices.
 - iv. Test auxiliary protective features such as loss of phase, phase unbalance, and undervoltage to verify operation.
 - v. Check for improper voltages at terminals in controllers having external control wiring when controller disconnect opened. Voltage over 30 v unacceptable.
2. Correct deficiencies and retest motor control devices. Verify system tests that specified requirements are met.

3.9.6 Instrument Transformers

(a) Visual and Mechanical Inspection:

1. Inspect for physical damage and compliance with Drawings.
2. Check mechanical clearances and proper operations of disconnecting and grounding devices associated with potential transformers.
3. Verify proper operation of grounding or shorting devices.

(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.

3.9.7 Metering and Instrumentation

(a) Visual and Mechanical Inspection:

1. Examine devices for broken parts, indication of shipping damage, and wire connection tightness.
2. Verify meter connections in accordance with single line meter and relay diagram.

(b) Electrical Tests:

1. Calibrate meters at midscale. Calibration instruments shall have precision no more than 50% of instrument being testing.
2. Calibrate watt-hour meters to 1/2%.
3. Verify instrument multipliers.

3.9.8 Grounding System

(a) Testing:

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.

(b) 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.

(c) 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.

(d) 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.

3.9.9 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 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.

END OF THIS SECTION

DIVISION 16 - ELECTRICAL

SECTION 16B - 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 3A - Cast-In-Place Concrete.

1.2.2 Section 16A - General Electric Provisions.

1.2.3 Section 16C - Major Electric Equipment.

1.2.4 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 B-189 - Specification for lead-coated and lead-alloy-coated soft copper wire for electrical purposes.

IEEE 383 - Class 1E electric cables, field splices and connections for nuclear power generating stations, standard for type test for.

ASTM D 635 - Test method for rate of burning and/or extent and time of burning of self-supporting plastics in a horizontal position.

Fed. Spec.

HH-I-595 - Insulation tape, electrical, pressure sensitive adhesive, plastic.

Fed. Spec.

WC-596 - Electrical power connectors.

NEMA WD-1-1965 - General requirements for ac switches.

ANSI C82.2 - Fluorescent lamp ballasts, methods of measurement of.

Fed. Spec

W-P-115 - Panel, power distribution.

UL 50 - Cabinets and boxes.

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: Light Fixtures, Lamps, Ballasts, and Emergency Lighting Units, Panelboards, Disconnects and Safety Switches, Transformers, Motors, TVSS units, Cable Trays, Lighting Contactors, and Cabinets and Enclosures with NEMA classification higher than NEMA 1.

1.4.2 Raceway, Conductors and Cables, Electrical Identification, Grounding, Wiring Devices, Supporting Devices, and Cabinets and Enclosures with NEMA 1 classification submittals are not required if CONTRACTORS equipment submittals identified below are required.

(a) Product data.

(b) Submit in accordance with Section 1A.

1.5 Guarantee

1.5.1 Provide guarantee 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

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which shall be payment in full for the work described herein.

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: NEMA RN 1; rigid steel conduit system as specified with coated interior walls and external PVC coating, 40 mil (.1 mm) thick.

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.
- (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: 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. 0 to 50 ft Run From Panelboard to first outlet: No. 12 AWG minimum.
 - ii. 51 to 100 ft Run: Increase one wire size, i.e., No. 12 AWG becomes No. 10 AWG.
 - iii. 101 to 150 ft Run: Increase two wire sizes, i.e., No. 12 AWG becomes No. 8 AWG.
 - iv. 151 ft and above: 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: Above ground and underfloor conduits.
 - 2) No. 12 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, 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, Scotchlok, 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 equipment removed in Item 1 above. 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 NEX 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 Cat. No. EFS B175-2023M, Crouse-Hinds Cat. No. ENR 21201 with NEMA 5-20R.
- 2) Plugs: Match receptables. 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 Lighting Fixtures

2.6.1 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) Fluorescent Fixtures: Conform to UL 1570.

(h) Fluorescent Ballasts: Electronic integrate circuit, solid-state, full-light-output, energy-efficient type compatible with lamps and lamp combinations to which connected.

- 1) Certification by Electrical Testing Laboratory (ETL).
- 2) Labeling by Certified Ballast Manufacturers Association (CBM).
- 3) Type: Class P, high power factor, except as otherwise indicated.
- 4) Sound Rating: "A" rating, except as otherwise indicated.
- 5) Voltage: Match connected circuits.
- 6) Lamp Flicker: Less than 5%.
- 7) Minimum Power Factor: 90%.
- 8) Total Harmonic Distortion (THD) of Ballast Current: Less than 20%.
- 9) Conform to FCC Regulations Part 15, Subpart J for electromagnetic interference.
- 10) Conform to IEEE C62.41, Category A, for resistance to voltage surges for normal and common modes.
- 11) Multilamp Ballasts: Use 2, 3, or 4 lamp ballasts for multilamp fixtures where possible.
- 12) Lamp-ballast connection method does not reduce normal life of lamps.

(i) High-Intensity-Discharge (HID) Fixtures: Conform to UL 1572.

(j) 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.

(k) 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.

(l) Incandescent Fixtures: Conform to UL 1571.

(m) 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.

(n) Emergency Lighting Units: Conform to UL 924.

- 1) Battery: Sealed, maintenance-free, lead-acid type with minimum 10 yr nominal life and special warranty.
- 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.

2.6.2 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.

2.6.3 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.

2.7 Panelboards

2.7.1 Manufacturer's

- (a) Cutler-Hammer.
- (b) Square-D Co.

2.7.2 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.

2.7.3 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.

2.7.4 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.

2.7.5 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.

2.8 Disconnects, Fuses, and Circuit Breakers

2.8.1 Manufacturer'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.

2.8.2 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.

2.8.3 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.

2.8.4 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 position.
- (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.

2.8.5 Three Phase Manual Motor Switch

- (a) Quick make and break operator mechanism.
- (b) Padlock provisions in OFF position.
- (c) NEMA type.

2.8.6 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 stainless steel.
 - 2) Hazardous Areas Indicated on Drawings: NEMA Type 7C.

2.9 Transformers

2.9.1 Manufacturers

- (a) Cutler-Hammer.
- (b) Square D Co.

2.9.2 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.

2.9.3 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.

2.9.4 Finishes

- (a) Indoor Units: Separate; marked "Shield" for grounding connection.
- (b) Outdoor Units: Comply with ANSI C57.12.28.

2.9.5 Source Quality Control

- (a) Factory Tests: Design and routine tests comply with referenced standards.

2.10 Electric Motors

2.10.1 Manufacturers

- (a) Siemens.
- (b) General Electric.
- (c) U.S. Motors.
- (d) Toshiba.

2.10.2 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.

2.10.3 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) Open Drip Proof (ODP).
 - 1) Energy Efficient.
 - 2) Protected Openings.
 - 3) Class B Insulation.
 - 4) 1.15 Service Factor.
 - 5) Cast iron construction.
- (j) 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) Removeable 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.

(k) 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.

(l) Submersible pump and mixer motors.

- 1) As explosion proof breather drains.
- 2) 1.10 service factor, unless otherwise indicated in equipment specification sections.

2.10.4 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.

2.10.5 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.

2.11 Supporting Devices

2.11.1 Materials

- (a) Aluminum or Stainless Steel.

2.11.2 Coatings

- (a) Products for use outdoors.
- (b) Use PVC coating where indicated on Drawings.

2.11.3 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 features as follows:
- 1) Expansion Anchors: Carbon steel wedge or sleeve type.
 - 2) Toggle Bolts: All steel springhead type.
 - 3) Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for intended service.
 - 4) Nuts, Washers, and Bolts: Stainless steel.
- (c) Conduit Sealing Bushings: 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.

2.11.4 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.

2.11.5 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.

2.12 Transient Voltage Surge Suppression

2.12.1 Transient Voltage Surge Suppression (TVSS)

- (a) 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.

- (b) 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).
- (c) 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.
- (d) 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.
- (e) MOV's tested per ANSI/IEEE C62.33-1982.
- (f) 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:
 - 300,000 amps, L-N
 - 300,000 amps, L-G min. amps per phase 600,000 (L-N plus L-G)
 - 300,000 amps, N-G
 - 300,000 amps, L-L
- (g) 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.
- (h) 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).
- (i) Minimum continuous operating voltage of any component shall not be less than 115% of nominal operating voltage.
- (j) The primary suppression path shall be Line to Neutral.
- (k) 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.

- (l) 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.
- (m) Provide in Plastic or metal enclosure NEMA rated suitable for the installed location.

2.12.2 Accessories

- (a) **Monitoring.** One set of status monitoring lights, that will provide visual indication of voltage present to the TVSS. The lights shall also indicate when any value of less than 50% suppression protection is available from the TVSS.
 - 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) Visual status of suppression protection available, shown in a percentage from 0% to 100%, 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.

2.13 Cabinets, Boxes, and Fittings

2.13.1 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.

2.13.2 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.

2.13.3 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.

2.13.4 Pull and Junction Boxes

(a) General: Comply with UL 50 for boxes over 100 cu in. volume. Boxes shall have screwed or bolted on covers 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 304 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 or cast nonmetallic 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.

2.13.5 Terminal Strips

(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.

2.14 Cable Trays

2.14.1 Materials and Finishes

- (a) Cable Trays, Fittings, and Accessories: Fiberglass reinforced plastic (FRP) conforming to ASTM D635.
- (b) Fabricate cable tray products with rounded edges and smooth surfaces.

2.14.2 Sizes and Configurations

- (a) Conform to NEMA VE 1.
- (b) Ladder-Type Trays: Class 20C unless indicated.
- (c) Width: 12 in. (305 mm)
- (d) Inside Depth: 6 in. (152 mm)
- (e) Cross-Rung Spacing: 9 in. (229 mm)
- (f) Minimum Fitting Radius: 24 in. (610 mm)

2.14.3 Cable Tray Accessories

- (a) Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, manufactured with same materials and finishes as cable trays.
- (b) Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.14.4 Firestopping

- (a) Materials: NRTL listed and labeled for fire ratings consistent with penetrated barriers.
- (b) Sleeves: Schedule 40, welded, black steel pipe sleeves. Sizes as indicated or minimum NEC size for cable or cable group to be installed.
- (c) Sealing Fittings: Suitable for sealing cables in sleeves or core drilled holes.
- (d) Sealant: One-part compound for sealing cables, sleeves, and openings in fire barrier.

- (e) Fire Wall Penetration Fitting and Seals: Sized for maximum cable tray fill with unused penetrations sealed in accordance with manufactures recommendations.

2.14.5 Warning Signs

- (a) Lettering: 1-1/2 in. (40 mm) high, black or yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- (b) Materials and Fastening: Conform to Section 16B-2.3.

2.15 Lighting Contactors

- 2.15.1 Manufacturer: Square-D Model 8903LXG20V02CR6 or equal.
- 2.15.2 Description: NEMA ICS 2, magnetic lighting contactor, 100% rated.
- 2.15.3 Configuration: Mechanically held.
- 2.15.4 Coil Voltage: 120 volts, 60 Hertz.
- 2.15.5 Poles: Two.
- 2.15.6 Contact Rating: 30 amperes.
- 2.15.7 Enclosure: ANSI/NEMA ICS 6, Type 1.
- 2.15.8 Accessories:
 - (a) Selector Switch: ON/OFF/AUTOMATIC
 - (b) Pushbuttons and Selector Switches: NEMA ICS 2, general duty type.

2.16 Enclosure Purging System

- 2.16.1. An equipment purging system shall be provided to purge each of the power cable junction boxes for the seven main pumps and two low flow pumps. The system shall be Type X Bebcos EPS Purge System for Class I, Division 1 to non-hazardous area applications. UL, CUL & FM classified.
- 2.16.2. The system shall include a Bebcos EPS Model 2001A-STD-C1-FM Type X purge panels with alarm relays, an enclosure protection vent, supply and reference fittings and mounting kit for each of the nine (9) junction boxes, and other accessories necessary for proper functioning of the system.
- 2.16.3 A tank mounted duplex oil-less air compressor with tank, air filter, low pressure alarm switch, and duplex motor starters with disconnect switch shall be provided. The compressor motor shall be 3-phase 460 volt, 1.5hp. The compressor shall be sized to deliver a minimum of 4 cfm continuously.

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.

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) Damp or Wet Locations: PVC-Coated galvanized rigid steel.
 - 3) Concealed: Galvanized rigid steel.
 - 4) 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.
 - 5) Underground Power and Control, Grouped: Rigid nonmetallic (PVC) conduit.
 - i. Concrete encased except for area lighting branch circuits or as otherwise noted on Drawings.
 - 6) Underground Shielded Instrumentation Cables and Shielded Instrumentation Cables run in concrete slabs, Single Run or Grouped: Galvanized rigid steel.
 - 7) Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment):
- (b) Indoor 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: Galvanized rigid steel 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 16B-2.11.
 - (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.
- (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.

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 field 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 16B-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 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) Fire Suppression Supervisory and Control System: Red and yellow.
 - 3) Combined Fire Alarm and Security System: Red and blue.
 - 4) Security Fire Alarm and Security System: Red and blue.
 - 5) Mechanical and Electrical Supervisory System: Green and blue.
 - 6) Telecommunications System: Green and yellow.
- (h) 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.

(i) Identify 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.

(j) 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: White with non-green stripe.
v. Ground: Green.

(k) 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.

(l) 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.

(m) 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.

(n) 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, 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; Type 2 shielded cable.
- 2) 24 vdc discrete (e.g., field or LCP 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 LP or PP 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	White with non-green stripe
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 and proper connection in accordance with single-line diagram.
- 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. Single-phase motor or appliance branch circuits.
 - v. Three-phase motor or appliance branch circuits.
- 2) Busway Supply Circuits: Install separate equipment grounding conductors from grounding bus in switchgear or distribution panel to equipment grounding-bar terminal on busway.
- 3) 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.
- 4) 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 250-26.
- (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 manufacturers' 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-3.9.
- (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 6 in. above counters, counter back-splashes, and baseboard radiators in finished areas; 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 16B-2.3.
 - 1) Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 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 Lighting Fixtures

3.6.1 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.

3.6.2 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.

3.6.3 Field Quality Control

- (a) Inspect each installed fixture for damage. Replace 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 of corrosion during Project warranty period.

3.6.4 Adjusting and Cleaning

- (a) Clean fixtures after installation. Use methods and materials recommended by manufacturer.
- (b) Adjust aimable fixtures to provide required light intensities.

3.7 Panelboards

3.7.1 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 Panelboards: 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.

3.7.2 Identification

- (a) Identify field-installed wiring and components and provide warning signs as specified in Section 16B-2.3.
- (b) Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

3.7.3 Grounding

- (a) Make equipment grounding connections for panelboards.
- (b) Provide ground continuity to main electrical ground bus.

3.7.4 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.

3.7.5 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 OWNER.
- 2) Perform load-balancing circuit changes outside normal occupancy/working schedule of facility. Make special arrangements with OWNER to avoid disrupting critical 24 hr services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
- 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 20% between phase loads, within panelboard, is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

3.7.6 Adjusting

- (a) Set field-adjustable pick-up and time-sensitivity ranges in accordance with Section 16A-3.8.

3.7.7 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.

3.8 Disconnects, Fuses and Circuit Breakers

3.8.1 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.

3.8.2 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.

3.8.3 Identification

- (a) Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

3.8.4 Coordination Study

- (a) Where coordination study recommends changes in types, classes, features or ratings of equipment or devices specified in Section 16A-3.8 from those indicated, make written request for instructions. Obtain instructions from ENGINEER before ordering equipment or devices recommended to be changed.

3.8.5 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 Owner for minimum mandays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include minimum of:

- i. 1/2 manday for Installation Services.
- ii. 1/2 manday for Instructional Services.

- (b) Test in accordance with Section 16A-3.9.

- (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.

3.8.6 Adjusting

- (a) Set field-adjustable pick-up and time-sensitivity ranges in accordance with Section 16A-3.8.

3.8.7 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.

3.9 Transformers

3.9.1 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.

3.9.2 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 16B-2.4.

3.9.3 Field Quality Control

- (a) Testing: Perform field quality-control testing:
 - 1) Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to Contract Documents, and is suitable for energizing.
 - 2) Report: Submit written report of observations and tests. Report defective materials and installation.
 - 3) 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.

- i. 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.
- ii. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A.
- iii. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.

Minimum Test Voltage: 1000 V, dc.

Minimum Insulation Resistance: 500 megaohms.

Duration of Each Test: 10 min.

Temperature Correction: Correct results for test temperature deviation from 20°C standard.

- 4) Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.
- 5) Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance, field tests, and troubleshooting.
- 6) In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration.

3.9.4 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.

3.9.5 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.

3.10 Electric Motors

3.10.1 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.

3.10.2 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.

3.10.3 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.

3.10.4 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 diagrams. Size motor starter overload heaters with starter manufacturer's recommendation for given motor nameplate current, service factor, and power factor correcting capacitors, is provided.
- (d) 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.
- (e) Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process.
- (f) In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration.

3.11 Supporting Devices

3.11.1 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.

3.12 Transient Voltage Surge Suppression

3.12.1 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 TVSS 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 OWNER for minimum mandays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of OWNER'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 other than wastewater treatment process.
- 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 switchgear or other system tests. Completely disconnect the TVSS from the switchgear prior to any switchgear 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 and the owner for confirmation of proper system function.

3.12.2 System Warranty

- (a) The TVSS 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 TVSS protection suppression system shall be protected by a fifteen year warranty following delivery from the manufacturer providing the TVSS system is installed per the manufacturer's specifications.

3.13 Cabinets, Boxes and Fittings

3.13.1 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 16B-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.

3.13.2 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.

(d) Pull and Junction Boxes:

- 1) Interior Dry Locations: Sheet steel, NEMA type 1 for flush mounting and ferrous Type FS or FD cast boxes with threaded conduit hubs for surface mounting.
- 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.

3.13.3 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) Use handy boxes only where specifically indicated.
- (p) Provide outlet box divider barriers between 277/480 v and 120/240 v devices as required and per NEC.
- (q) Where emergency switches occur adjacent to normal light switches, install in separate boxes in accordance with NEC and device plate color coding separation.

3.13.4 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 considered incidental up to distance of 10 ft with no additional compensation, provided necessary instructions given prior to roughing in of outlet.

(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: 8 in. above mirrors or or 6 ft 6 in. above floor.
- 4) Pushbuttons: 48 in. above floor.
- 5) Disconnect Switches: 60 in. above floor

3.13.5 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. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed following:

Size of Largest Conductors in Box	Maximum No. of Conductors in Box
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

- 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.

3.13.6 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.

3.13.7 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.

3.14 Cable Trays

3.14.1 Examine surfaces to receive cable tray for compliance with installation tolerances and other required conditions. Do not proceed with installation until satisfactory conditions have been corrected.

3.14.2 Use cable tray of indicated types and sizes, complete with manufacturer's recommended covers, barrier strips, dropouts, fittings, conduit adapters, hold-down devices, grommets, and blind ends.

3.14.3 Install cable tray level and plumb according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards.

3.14.4 Remove burrs and sharp edges of cable trays.

3.14.5 Fasten cable tray supports securely to building structure as specified in Section 16B-2.11 unless otherwise indicated.

3.14.6 Make changes in direction and elevation using standard fittings.

3.14.7 Make cable tray connections using standard fittings.

3.14.8 Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.

3.14.9 Firestop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.

3.14.10 Working Space: Install cable trays with sufficient space to permit access for installing cables.

3.14.11 Connect cable trays to ground as instructed by manufacture. Tighten connections 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.

3.14.12 Electrically ground cable trays and ensure continuous electrical conductivity of cable tray system. Use trays as an equipment ground conductor for itself only, not for connected equipment.

3.14.13 After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.14.14 Grounding Field Quality Control: Test cable trays to ensure electrical continuity of bonding and grounding connections.

3.14.15 Correct malfunctioning units at site, where possible, and retest to demonstrate compliance, otherwise, remove and replace with new units and retest.

3.14.16 Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.

3.14.17 Provide final protection and maintain conditions in manner acceptable manufacturer and Installer to ensure that cable tray is without damage or deterioration at Substantial Completion.

3.15 Excavation and Backfill

3.15.1 Excavation and backfill for work under this Division shall be provided under this Division in conformance with Division 2.

3.16 Concrete

3.16.1 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.

3.17 Cutting and Patching

3.17.1 All cutting and patching of building materials required for work under this Division shall be provided under this Division.

3.17.2 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.

3.17.3 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.

3.17.4 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.

3.17.5 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 new construction.

END OF THIS SECTION

DIVISION 16 - ELECTRICAL

SECTION 16C - MAJOR ELECTRICAL EQUIPMENT

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 owner, 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 16A - General Electrical Provisions.

1.2.3 Section 16B - Basic Electrical Materials and Methods.

1.2.4 Section 16D - Supervisory Control and Data Acquisition (SCADA) 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 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, automatic transfer switch, intrusion alarm system, fire alarm panel, SCADA system, and other components and systems that are interfaced to these systems.

1.5 Guarantee

1.5.1 All electrical equipment shall be guaranteed from all defects of material and workmanship for the manufacturer's standard length of guarantee or for 1 year from the date of final acceptance, 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

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which shall be payment in full for the work described herein.

2. PRODUCTS:

2.1 Motor Control Centers

2.1.1 Manufacturers

(a) Square D Co.

(b) Cutler-Hammer/Westinghouse.

(c) Allen-Bradley.

2.1.2 Coordination Study

(a) Where coordination study specified in Section 16A-3.8 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.

(b) Enclosures: Surface-mounted cabinets as indicated. NEMA 250, Type 1 gasketed, unless otherwise indicated to meet environmental conditions at installed location.

1) 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.

2) 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.

3) 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) Combinational Controller: Factory-assembled combination controller and disconnect switch with or without overcurrent protection as indicated.
 - 1) Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses indicated. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by Nationally Recognized Testing Laboratory.
 - 2) Nonfusible Disconnect: NEMA KS 1, heavy-duty, nonfusible switch.
 - 3) Circuit-Breaker Disconnect: NEMA AB 1, motor-circuit protector with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.
- (d) Overload Relay:
 - 1) Electronic solid state type with inverse-time-current characteristic, phase loss and phase unbalance protection.
 - 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.
- (e) When power factor correction capacitors are indicated provide termination lugs on line side of overload relays.
- (f) 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.

- (g) Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
- 1) Adjustable acceleration rate control uses voltage or current ramp, and adjustable starting torque control has up to 500% current limitation for 20 sec.
 - 2) Surge suppressor in solid-state power circuits provides 3 phase protection against damage from supply voltage surges 10% or more above nominal line voltage.
 - 3) LED indicators show motor and control status, including following conditions:
 - i. Control power available.
 - ii. Controller on.
 - iii. Overload trip.
 - iv. Loss of phase.
 - v. Shorted silicon-controlled rectifier.
 - 4) Provide full voltage bypass contactor in addition to input contactor. Full voltage bypass contractor shall also serve as motor running contactor which operates automatically when full voltage is applied to motor. See Drawings for wiring diagrams.
 - 5) Enclosure shall be provided with adequate space for the installation of the moisture/temperature monitoring relay(s) provided by the pump manufacturer.

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, short-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 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 protocol. Coordinate with SCADA panel supplier through the Contractor to determine Modbus protocol type. Metering units shall be door mounted.

2.1.9 Accessories

- (a) Factory install in controller enclosure, unless otherwise indicated.
 - 1) Main and Low Flow Pumps: "Pump Run", "Pump Call", "Manual Operation", and "Off" Pilot Lights, push-to-test: NEMA ICS 2, heavy-duty type.
 - 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) Bypass-Off-Soft Start selector switch on solid state reduced voltage controller buckets. Selector switch must be physically switched in order to initiate bypass mode; changing automatically to bypass mode will not be allowed.
- (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.

2.2 Low Voltage Metal-Enclosed Drawout Switchgear

- 2.2.1 The Contractor shall furnish and install, where indicated on the drawings, a deadfront type, low voltage metal-enclosed switchgear assembly as specified herein and as shown on the contract drawings.

2.2.2 Ratings

- (a) Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum AC service.
- (b) The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 100,000 amperes symmetrical at rated voltage.
- (c) The bus system shall have a minimum ANSI 4-cycle short-circuit withstand rating of 100,000 amperes symmetrical.
- (d) All circuit breakers shall have a minimum symmetrical interrupting capacity of 100,000 amperes. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 100,000 amperes, regardless of whether equipped with instantaneous trip protection or not.
- (e) All ratings shall be tested to the requirements of ANSI C37.20.1, C37.50 and C37.51 and UL witnessed and approved.

2.2.3 Construction

- (a) The switchgear shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the top of the switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure. Hinged rear doors, complete with provisions for padlocking, shall be provided.
- (b) The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills. Provisions shall be made for jacking of shipping groups, for removal of skids or insertion of equipment rollers. Base of assembly shall be suitable for rolling directly on pipes without skids. The base shall be equipped with slots in the base frame members to accommodate the use of pry bars for moving the equipment to its final position.
- (c) Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment and a rear cable compartment. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections by means of steel barriers to the maximum extent possible. It shall be equipped with drawout rails and primary and secondary disconnecting contacts.

Removable hinge pins shall be provided on the breaker compartment door hinges. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells and be front accessible and removable.

- (d) The stationary part of the primary disconnecting devices for each power circuit breaker shall be breaker mounted and consist of a set of contacts extending to the rear through a glass polyester insulating support barrier; corresponding moving finger contacts, suitably spaced, shall be furnished on the power circuit breaker studs which engage in only the connected position. The assembly shall provide multiple silver-to-silver full floating high pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with insulated copper load extension buses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be silver-plated where outgoing terminals are attached.
- (e) The circuit breaker door design shall be such that the following functions may be performed without the need to open the circuit breaker door: lever circuit breaker between positions, operate manual charging system, close and open circuit breaker, examine and adjust trip unit, and read circuit breaker rating nameplate.
- (f) The secondary disconnecting devices shall consist of floating terminals mounted on the stationary unit and engaging mating contacts at the front of the breaker. The secondary disconnecting devices shall be gold-plated and engagement shall be maintained in the "connected" and "test" positions.
- (g) The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for drawout application. It shall have four positions, "connected," "test," "disconnected" and "removed." The breaker drawout element shall contain a worm gear levering "in" and "out" mechanism with removable lever crank. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering "in" or "out" of the cell. The breaker shall include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering.
- (h) An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

- (i) The switchgear shall be Square-D Co. PZ-4, Cutler-Hammer Magnum DS, or Enercon low voltage metal-enclosed drawout switchgear, utilizing Masterpact NW or Magnum DS low voltage power circuit breakers as herein specified or approved equal.
- (j) The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.
- (k) Provide a rear compartment barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.
- (l) Provide in the cell when the circuit breaker is withdrawn, a safety shutter which automatically covers the line and load stabs and protects against incidental contact.
- (m) Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment.
- (n) Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.
- (o) Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections for spaces labeled "BLANK" on drawings for provisions of future devices.

2.2.4 Bus

- (a) All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
- (b) Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
- (c) A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchgear. The ground bus short-time withstand rating shall meet that of the largest circuit breaker within the assembly.
- (d) All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with Belleville-type washers.
- (e) All horizontal and vertical phase bus bars shall be provided with insulation cover. Grounded metal barriers shall isolate the main bus and connections from cable compartments.

2.2.5 Wiring/Terminations

- (a) Small wiring, necessary fuse blocks and terminal blocks within the switchgear shall be furnished as required. Control components mounted within the assembly shall be suitably marked for identification corresponding to the appropriate designations on manufacturer's wiring diagrams.
- (b) Provide a front accessible, isolated vertical wireway for routing of factory and field wiring. Factory provisions shall be made for securing field wiring without the need for adhesive wire anchors.
- (c) Front access to all circuit breaker secondary connection points shall be provided for ease of troubleshooting and connection to external field connections without the need of removing the circuit breaker for access.
- (d) All control wire shall be type SIS. Control wiring shall be #14 AWG for control circuits and #12 AWG for shunt trip and current transformer circuits. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All current transformer secondary leads shall first be connected to conveniently accessible shorting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided. All groups of control wires leaving the switchgear shall be provided with terminal blocks with suitable numbering strips and provisions for #10 AWG field connections. Each control wire shall be marked to the origin zone/wire name/destination zone over the entire length of the wire using a UV cured ink process. Provide wire markers at each end of all control wiring. Plug-in terminal blocks shall be provided for all shipping split wires. Terminal connections to remote devices or sources shall be front accessible via doors above each circuit breaker.
- (e) NEMA 2-hole mechanical- type lugs shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size indicated on the drawings.
- (f) Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.
- (g) Reusable insulating boots shall be provided to cover all power cable terminations.

2.2.6 Circuit Breakers

- (a) All protective devices shall be low voltage power circuit breakers, Square-D Co. type Masterpact NW or Cutler-Hammer type Magnum DS or approved equal. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.
- (b) All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, UL 1066 and NEMA SG-3 standard. The breaker shall carry a UL label.
- (c) Breakers shall be provided in drawout configuration. The 800, 1600, 2000 and 3200 ampere frame power circuit breakers shall be provided in the same physical frame size, while 4000 and 5000 ampere frame power circuit breakers shall be provided in a second physical frame size. Both physical frame sizes shall have a common height and depth.
- (d) Power circuit breakers shall utilize a two-step stored-energy mechanism to charge the closing springs. The closing of the breaker contacts shall automatically charge the opening springs to ensure quick-break operation.
- (e) Breakers shall be electrically operated (EO) unless manually operated (MO) is indicated on the drawings.
- (f) Electrically operated breakers shall be complete with 120V AC motor operators. The charging time of the motor shall not exceed 6 seconds.
- (g) To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker.
- (h) The power circuit breaker shall have a closing time of not more than 3 cycles.
- (i) The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.
- (j) The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage.
- (k) The power circuit breaker shall have auxiliary contacts, 6 N.O and 6 NC for each main breaker and bus tie breaker; 3 NO and 3 NC for each feeder breaker.

2.2.7 Trip Units

- (a) Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall be Square-D Co. type Micrologic or Cutler-Hammer type Digitrip. 1150 or approved equal.
- (b) The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.
- (c) The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.
- (d) The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.
- (e) Trip unit shall have selectable thermal memory for enhanced circuit protection.
- (f) The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the present time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.
- (g) The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

- (h) Circuit breakers, where indicated on the drawings, shall have individually adjustable ground fault alarm only.
- (i) The trip unit shall be equipped to permit serial communication via a network twisted pair for remote monitoring and control from the SCADA system. The Contractor shall coordinate with the SCADA system integrator to select proper communication protocol and provide necessary interface. Ethernet will be preferred.
- (j) The trip unit shall include a power/relay module which shall supply control to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available. An internal relay shall be programmable to provide contacts for remote ground alarm indication.
- (k) The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the power relay module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.
- (l) The display for the trip units shall be a 24-character LED display.
- (m) Metering display accuracy of the complete system, including current sensors, auxiliary CTs, and the trip unit, shall be +/- 1% of full scale for current values. Metering display accuracy of the complete system shall be +/- 2% of full scale for power and energy values.
- (n) The unit shall be capable of monitoring the following data:
 - 1) Instantaneous value of phase, neutral and ground.
 - 2) Instantaneous value of line-to-line voltage.
 - 3) Minimum and maximum current.
 - 4) Watts, vars, VA, watthours, varhours, and VA hours.
- (o) The energy-monitoring parameter values (peak demand, present demand, and energy consumption) shall be indicated in the trip unit's alphanumeric display panel.
- (p) The trip unit shall display the following power quality values: crest factor, power factor, percent total harmonic distortion, and harmonic values of all phases through the 31st harmonic.
- (q) An adjustable high load alarm shall be provided, adjustable from 50 to 100% of the long delay pickup setting.

- (r) The trip unit shall contain an integral test pushbutton. A keypad shall be provided to enable the user to select the values of test currents within a range of available settings. The protection functions shall not be affected during test operations. The breaker may be tested in the TRIP or NO TRIP test mode.
- (s) Programming may be done via a keypad at the faceplate of the unit or via the communication network.
- (t) System coordination shall be provided by the following microprocessor-based programmable time-current curve shaping adjustments. The short-time pickup adjustment shall be dependent on the long delay setting.
 - 1) Programmable long-time setting.
 - 2) Programmable long-time delay with selectable I2T or I4T curve shaping.
 - 3) Programmable short-time setting.
 - 4) Programmable short-time delay with selectable flat or I2T curve shaping, and zone selective interlocking.
 - 5) Programmable instantaneous setting.
 - 6) Programmable ground fault setting trip or ground fault setting alarm.
 - 7) Programmable ground fault delay with selectable flat or I2T curve shaping and zone selective interlocking.
- (u) The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.

2.2.8 Utility Metering

- (a) Furnished a separate barriered-off utility metering compartment, complete with hinged sealable door for each utility incoming line. Bus work shall include provisions for mounting utility company current transformers and potential transformers, or potential taps as required by the utility company. Provide service entrance label and necessary applicable service entrance features per NEC, local code and local utility company requirements.

2.2.9 Automatic Transfer Controller

- (a) General

- 1) The automatic transfer controller shall be a redundant PLC with a HMI panel mounted in the switchgear programmed to control two utility incoming line breakers, one generator breaker and two bus tie breakers for switching the electric services to the pump station.
 - 2) The PLC shall function as an RTU and communicated via Modbus TCP/IP with the Pump Station master PLC.
- (b) Sequence of Operation – Open Transition Transfer
- 1) The power system shall normally operate on two normal Utility sources with the two utility incoming line breakers closed, and, the generator breaker and the two bus tie breakers open. The transfer controller shall indicate real-time values for volts and frequency on the HMI panel along with an indication of the power sources currently in use. The transfer controller shall continuously monitor either single-phase or three-phase voltages and frequencies for Utility 1, Utility 2, and Generator lines and the open-closed status of the three incoming line breakers and two bus tie breakers. The five breakers shall be interlocked in such a way that each side of the switchgear bus can be fed by one incoming line breaker at a time.
 - 2) When the Utility 1 or Utility 2 fails (voltage or frequency is detected to be below the user programmed set points or breaker tripped), the incoming line breaker for the failed line shall be tripped and the two bus tie breakers shall be closed. When the line condition restores to normal the bus tie breakers shall be open and the previous failed incoming line breaker shall be closed after a preset time delay.
 - 3) When both Utility 1 and Utility 2 fail, transfer to Generator shall be initiated - start generator and close tie breakers after a preset time delay. When the Generator line voltage and frequency are detected to be within the programmed parameters the Generator breaker shall be closed.
 - 4) While the Load is connected to the Generator line, the controller shall continue to monitor Utility 1 and Utility 2. As soon as the Utility 1 or Utility 2 voltage and frequency return to within the programmed limits of Utility 1 or Utility 2, and after a programmed time delay, the Load transfer back to Utility 1 or Utility 2 shall be initiated. The Load transfer back to Utility 1 or Utility 2 shall be Open type, that is, the Generator line breaker shall be opened first, then only the Utility 1 or Utility 2 breaker shall close.

- 5) The programming set points and various standard and optional control parameters shall be as described under Transfer Controller section.

(c) Transfer Controller Hardware and Functions

- 1) The Transfer Controller hardware shall include the following:

- a. A redundant PLC - Two FlexLogix controllers, analog and digital I/O's and a 10" Panelview color graphic display/keypad HMI panel connected on device net.
- b. A 24VDC redundant power supply for the PLC and HMI.
- c. Two sets of three push-to-test LED indicating lights (Utility 1, Utility 2 and Generator) showing the line availability and load connection status.
- d. A 3-position UTILITY 1 - AUTO - UTILITY 2 manual transfer switch.
- e. A 3-position Generator on Bus 1- AUTO - Generator on Bus 2 generator loaded exercise switch.
- f. Four-position selector switch permitting four (4) modes of transfer controller operation: TEST (simulates Utility power outage), AUTO (standard automatic operation), OFF (de-energizes control relays and opens the engine start circuit for maintenance purposes), ENGINE START (retains transfer switch in Utility position and initiates a testing of the engine start circuit). Furnish white pilot light for OFF indication
- g. Voltage and frequency sensors for the two utility lines and the generator line.

- 2) The following logic and functions shall be provided:

- a. The six LED lights shall indicate the following:

Utility 1 Available
Utility 2 Available
Generator Line Available
Utility 1 Connected
Utility 2 Connected
Generator Line Connected

- b. Three position UTILITY 1 - AUTO - UTILITY 2 manual transfer switch shall allow the operator to test the transfer between the utility lines. If the loaded utility line fails during the test the control shall automatically transfer the load to the other utility line. All the timing and control functions related to the transfer shall apply.
- c. Three position Generator on Bus 1- AUTO - Generator on Bus 2 generator loaded exercise switch shall allow the operator to exercise the generator and test the transfer function. If the generator fails during the test the control shall automatically transfer the load to the utility line. All the timing and control functions related to the transfer shall apply.
- d. The HMI Panel shall be programmed to show the one line diagram of the two Utility lines, Generator line, two utility breakers, generator breaker, two bus tie breakers and the two switchgear bus, displaying each status/ parameter as it is functioning. The graphic of the incoming line, switchgear bus and the circuit breakers shall be color coded to indicate normal/abnormal, open/closed/tripped status. Separate graphics shall be provided to show control parameter settings. The panel graphic shall display actual line-to-line voltage, line frequency and timers. When timers are functioning, the panel shall display the timer counting down. All set points can be reprogrammed from the SCADA system as specified in Section 16D.
- e. The control program shall include the following:
 - i. Programs to provide automatic line transfer control.
 - i. Adjustable time delay to initiate transfer between Utility 1 and Utility 2, to override a momentary power outage or voltage fluctuation (0 seconds to 120 seconds).
 - ii. Adjustable time delay to initiate transfer from Utility to Generator (0 seconds to 30 minutes).
 - iii. Adjustable time delay to initiate transfer from the generator to the Utility (0 seconds to 30 minutes).

- iv. Adjustable time delay for breaker closing to allow motor load decay (0 to 20 seconds).
 - v. Adjustable Timer to allow the generator to run unloaded (engine cool off) after retransfer to the Utility power supply (1 second to 30 minutes).
 - vi. Adjustable time delay to start engine.
 - vii. Additional feature as required.
- f. The following features shall be provided:
- i. Auxiliary relay contacts that are energized when the power is available on the Utility sources.
- 3) Auxiliary relay contacts that are energized when the power is available on the generator source.
- 4) Relay auxiliary contacts (2NO/2NC) to indicate all breaker positions and the availability of each source.
- a. Engine start contact which shall be independent from the PLC. Failure of the PLC shall not affect engine starting and generator operation.
- (d) Communications
- 1) The transfer controller shall be capable of communicating phase and ground current, peak demand, present demand, energy consumption, contact status and mode of trip. The transfer controller shall respond to open and close commands from a master control unit via a communications network. Communication network shall be Modbus TCP/IP.
 - 2) Provide communications capability to monitor the Utility, generator and bus tie breaker position and Utility and generator source availability. Additional communications capability shall be provided to bypass time delays during transfer or retransfer, and to initiate engine start for no-load or load testing of the transfer switch from a remote master computer.
- (e) Auxiliary Devices

- 1) Voltage and control power transformers of the quantity and ratings as required shall be supplied. Voltage and Control power transformers shall be mounted in an enclosed auxiliary compartment.
- 2) Control system shall automatically switch to the available control power source.

(f) Shop Drawings

- 1) The PLC ladder logic diagrams, description of the transfer controller operation and parameter settings shall be recorded in a CD ROM. The CD ROM and hard copy printouts shall be included in the shop drawing and O&M manual.

2.2.10 Enclosures

- (a) NEMA 1 Enclosure.

2.2.11 Nameplates

- (a) Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16-inch high, minimum.
- (b) Furnish master nameplate giving switchgear designation, voltage ampere rating, short-circuit rating, and manufacturer's name.
- (c) Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings.

2.2.12 Finish

- (a) All exterior and interior steel surfaces of the switchgear shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchgear shall be ANSI 61.

2.2.13 Accessories

- (a) Provide a traveling type circuit breaker lifter, rail-mounted on top of switchgear complete with hoist and lifting yokes matching each size of drawout circuit breakers installed.
- (b) Racking handle manually moves circuit breaker between connected and disconnected positions.

- (c) Portable test set permits testing of all functions of circuit-breaker solid-state trip devices without removal from switchgear.

2.3 Fire Alarm System

- 2.3.1 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. The system shall be supervised and shall generate two isolated SPDT contact outputs for remote connection. One of these outputs shall be wired to the SCADA system and the other to the Pump Station Control Panel.
- 2.3.2 The system shall be complete with four zones - the electrical room, the pump room, the stairwell 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 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.
- 2.3.3 The system shall have provisions for receiving a non-latching normally open non-function contact (Combustible gas monitor horn relay). The contact closure shall activate the horn/strobes only, the other fire alarm system functions shall not be affected.
- 2.3.4 Submittal information 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.
- 2.3.5 The system shall be the product of a single manufacturer having local available service. The system shall be UL listed and Factory Mutual approved.
- 2.3.6 Horns: Electric-vibrating-polarized type, operating on 24 V dc, with provision for housing operating mechanism behind grille. Horns produce sound-pressure level of 90 dB, measures at 10 ft (3 m) from source.
- 2.3.7 Visual Alarm Devices: Xenon strobe lights with clear or nominal white polycarbonate lens. Mount lenses on aluminum faceplate. Word "FIRE" is engraved in minimum 1 in. (25 mm) high letters on lens.
 - (a) Devices have candela reading as stated in NFPA 72.

2.4 AEGIS/Intrusion Alarm System

- 2.4.1 An AEGIS/Intrusion Alarm System shall be provided as generally shown on the drawings and specified herein for the purposes of detecting unauthorized entry into the pump station along with communicating various indicated alarms. An Intrusion alarm condition shall be sent to the SCADA panel and the pump station control panel. All required input alarms shall be communicated via telephone output to the designated destination.
- 2.4.2 The system shall consist of a new NEMA 12 wall mounted panel with lockable hinged door, 120V - 12V transformer, DC power supply with battery and battery charger, digital dialer, a transmit LED, a 6 volt control relay, alarm buzzer, magnetic reed switches at the entry doors, a key operated alarm override switch at the main entry door with LED and other appurtenances in the Intrusion Alarm Panel as indicated or required.
- 2.4.3 The magnetic reed switches shall consist of two elements, the magnet which mounts 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.
- 2.4.4 The override switch shall be weatherproof, shall be suitable for recessed mounting in a masonry wall and shall be secured against unauthorized removal. The switch shall have two contacts; one contact for shutting the door switches, and one contact for connection to the SCADA panel. The switch shall be operated by a special key. The key shall be removable in both positions. The key shall match the Owner's existing keying system. The override switch shall have an LED to indicate open or closed position. The override switch shall have a tamper pushbutton incorporated into the design, which shall be held open by the cover plate and spring closed if the cover plate is removed.
- 2.4.5 A submittal for the Intrusion Alarm Panel showing the layout of the intrusion alarm system devices and complete point to point wiring diagram shall be provided.
- 2.4.6 The panel shall operate on 120V, 60 Hz input.

3. EXECUTION:

3.1 Examination

- 3.1.1 Verify location and layout of 480V Switchgear, Motor Control Centers, Aegis/Intrusion alarm equipment, and Fire alarm 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 for this project including Motor Control Center, 480v Switchgear, Intrusion Alarm Panel, and Fire Alarm Panel. Include:

- i. 4 mandays for Installation Services for Motor Control Center and 480v Switchgear.
- ii. 2 manday for Instructional Services for Motor Control Center and 480v Switchgear.
- iii. 1 manday for Post Startup Services for 480v Switchgear.
- iv. 1 manday for Installation Services for Intrusion Alarm Panel and Fire Alarm Panel.
- v. 1 manday for Instructional Services 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 one week in advance:

Motor Control Center.
480V Switchgear.
Intrusion Alarm Panel.
Fire Alarm Panel.

3.5 Adjustments

3.5.1 Motor Control Centers

- (a) Set field-adjustable pick-up time-sensitivity ranges in accordance with Section 16A-3.8.

3.5.2 Switchgear

- (a) Protective-Relay Settings: Verify that settings are appropriate for final system configuration and parameters. Where discrepancies are found, recommend final relay settings for approval before making final adjustments.
 - i. Set field adjustable pick-up and time sensitivity range in accordance with Section 16A-3.8.
- (b) Fuse Characteristics: Verify that fuse size and types are appropriate for final system configuration and parameters. Where discrepancies are found, recommend fuse selection for approval before making final adjustments.
 - i. Provide fuse sizes and types in accordance with Section 16A-3.8.

END OF THIS SECTION

DIVISION 16 - ELECTRICAL

SECTION 16D - SUPERVISORY, CONTROL AND DATA ACQUISITION (SCADA) EQUIPMENT

1. GENERAL:

1.1 Description

- 1.1.1 A SCADA (Supervisory Control and Data Acquisition) system shall be provided to function as the "Master Control Station" for the Pump Station facility. The SCADA system shall consist of, but not be limited to; programmable controllers, a personal computer, data communication equipment, printer(s), LED (light emitting diode) digital displays as noted, process instrumentation and control devices, uninterruptible power systems (UPS), and other devices as required and/or as indicated on Plans.
- 1.1.2 All materials, equipment, labor, programming, configuration and installation services, 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. The system integrator shall design and coordinate the instrumentation and control system for proper operation with related equipment and materials.
- 1.1.3 Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with equipment provided under this Contract shall be included whether shown on the drawings or not.

- 1.1.4 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.
- 1.1.5 The system integrator shall install the control system and shall perform all on-site testing, start-up, and training of IDOT's staff.
- 1.1.6 All necessary coordination required for interfacing the proposed pump station facility with the proposed SCADA system shall be provided by the system integrator.

1.2 Submittals

- 1.2.1 Submit product data, shop drawings, project documentation, O & M Data and record documents in accordance with the provisions of Section 1A. and the following.

1.2.2 Product Data

- (a) Bill of Material: List all the materials and equipment to be furnished. Tag number, manufacturer's complete catalog number, service, location, and cross-reference numbers of instruction sheet, specification data sheet and wiring diagram shall be included under each item.
- (b) 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 catalog 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.
- (c) Panel Drawings: Furnish panel drawings for each instrument/control panel. List bill of materials, show panel or cabinet structure, outline dimension, general arrangement, devices, cutouts and mounting details of instruments and control devices, terminal blocks, wire ways and piping.

1.2.3 System Diagrams

- (a) Instrument Loop Diagram: Show 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.
- (b) SCADA System Block Diagram: Show system hardware configuration and identify model numbers of each system component.

- (c) Schematic diagrams, point-to-point internal wiring diagrams, point-to-point field wiring diagrams, and other necessary diagrams and installation requirements for the SCADA system and other components and systems that are interfaced to these systems.
- (d) Interconnecting Wiring and/or Piping Diagrams: Show schematically the wiring and piping 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.

1.2.4 Software Documentation

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 logics shall also be submitted in 740MB CD-R.

1.2.5 Instruction Manuals

Submit instruction manuals covering installation, operation, calibration, maintenance, diagnostic and repair for all hardware and software.

1.2.6 Record Documents

Accurately record actual calibration setting and scales of instruments.

1.3 Work for Hire

1.3.1 Any and all configuration, programming, setup or other software functions (SOFTWARE) performed on all intelligent devices provided as part of this Project is to be 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 as the work is completed.

1.3.2 IDOT intends only to obtain the SOFTWARE for its own use.

1.3.3 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.

1.4 Operational and Performance Requirements

- 1.4.1 The SCADA system includes a PC system as the main HMI device, a master PLC for pumping system control, a RTU with a small PLC programmed as an automatic pump alternator in the Control Panel, a RTU as alarm panel, a RTU as the automatic transfer Controller for electric services and generator control in the low voltage switch gear, a reactive air bubbler level sensing system (LT-100) as the primary wet well level measurement device and a multi-float/relay level monitoring system as the backup pump control system.
- 1.4.2 The master PLC shall check the validity of LT-100 level signals using float levels as reference, and select a valid signal for pump control (LT-100 as default). If level signal is invalid, then the point level inputs signals from the multi-float system shall be used for pump control.
- 1.4.3 The SCADA System shall be designed for full automatic control of the pump station, and shall also be designed to allow manual operation. In the event of loss of signal(s) from water level sensing device(s), the SCADA system shall be capable of accepting data by manual entry of observed water levels via keypad/board or touch screen (or other acceptable means) from operating personnel at the pump station.
- 1.4.4 Pumping operation of the facility shall respond to water levels sensed in accordance with the pumping operation tables shown on the Drawings. The Programmable Logic Controller (PLC) and associated personal computer with SCADA software herein specified shall be capable of automatically controlling pumping operations.
- 1.4.5 The PLC (RTU-1) in the Control Panel shall be programmed to operate as a 7-pump alternator for the main pumps and as a 2-pump alternator for the low flow pumps. Each alternator shall sequence the pumps in its group in a cyclic mode, alternation shall occur when all pumps are off in a pumping cycle. When the generator is providing power to the 480V switchgear the PLC shall sequence the starting of pumps in proper time interval to reduce the starting and running load of the generator. The PLC shall send the lead-lag sequences to the master PLC such that the master PLC can select the proper pumps to operate in accordance with the wet well level.
- 1.4.6 The 7-pump alternator for the main pumps and the 2-pump alternator for the low flow pumps shall also programmed in the master PLC. In the events of RTU-1 PLC failure in the Control Panel the pump control output circuit of the PLC shall be disabled and master PLC takes over the pump alternator functions.
- 1.4.7 In the event of power failure of both electric utility sources or the standby generator testing, and the generator is on line the master PLC and RTU-1 shall be programmed in such a way that only two of the low flow pumps and two main pumps on the generator bus can be started at a time and the next pump can only be started after the generator is stabilized.

1.5 Related Sections

- 1.5.1 Section 16A - General Electrical Provisions.
- 1.5.2 Section 16B - Basic Electrical Materials and Methods.
- 1.5.3 Section 16C - Major Electrical Equipment.
- 1.5.4 Section 16E – Packaged Engine Generator Systems.

1.6 Reference

- 1.6.1 ISA Standards and Recommended Practices for Instrumentation and Control.

1.7 Guarantee

- 1.7.1 Provide guarantee from all defects of material and workmanship for the manufacturer's standard length of guarantee or for 1 year from the date final acceptance, whichever is longer.

1.8 Deliver, Storage and Handling

- 1.8.1 Delivery, storage and handling shall be in accordance with the provisions of Section 1A.

1.9 Basis of Payment

- 1.9.1 Supervisory, Control and Data Acquisition (SCADA) equipment will be paid for under the contract lump sum price for PUMP STATION SCADA EQUIPMENT.

1.10 SCADA System I/O List

1.10.1 Master PLC Hardwired I/O Points

DESCRIPTION	DI	DO	AI	AO	NOTE
Pump Station Wet Well Level, LT-100			1		
Pump Station Wet Well Level, LT-101			1		
Main Pump 1 Thru 7 Running	7				
Main Pump 1 Thru 7 HOA in AUTO	7				
Main Pump 1 Thru 7 HOA in OFF	7				
Main Pump 1 Thru 7 Breaker Tripped	7				
Main Pump 1 Thru 7 Fail	7				
Main Pump 1 Thru 7 Motor Hi Temp	7				
Main Pump 1 Thru 7 Motor Hi Moisture	7				
Main Pump 1 Thru 7 Bearing Hi Temp	7				
Main Pump 1 Thru 7 Bearing Hi Moisture	7				
Main Pump 1 Thru 7 Run		7			

Low Flow Pump 1 & 2 Running	2				
Low Flow Pump 1 & 2 HOA in AUTO	2				
Low Flow Pump 1 & 2 HOA in OFF	2				
Low Flow Pump 1 & 2 Breaker Tripped	2				
Low Flow Pump 1 & 2 Fail	2				
Low Flow Pump 1 & 2 Motor Hi Temp	2				
Low Flow Pump 1 & 2 Motor Hi Moisture	2				
Low Flow Pump 1 & 2 Bearing Hi Temp	2				
Low Flow Pump 1 & 2 Run		2			
Lead Pump Call		1			
Lag 1 Pump Call		1			
Lag 2 Pump Call		1			
Lag 3 Pump Call		1			
Lag 4 Pump Call		1			
Lag 5 Pump Call		1			
Lag 6 Pump Call		1			
Lead Low Flow Pump Call		1			
Lag Low Flow Pump Call		1			
Wet Well Floats Below Activation Level	15				
Utility Line 1 Power Failure	1				
Utility Line 2 Power Failure	1				
480V SWGR Utility Line 1 Breaker Closed	1				
480V SWGR Utility Line 2 Breaker Closed	1				
480V SWGR Bus Tie Breaker 1 Closed	1				
480V SWGR Bus Tie Breaker 2 Closed	1				
480V SWGR Generator Breaker Closed	1				
480V SWGR Utility Line 1 TVSS Alarm	1				
480V SWGR Utility Line 2 TVSS Alarm	1				
Generator Running	1				
Generator Alarm	1				
Generator DC Power Failure	1				
Generator Room CO Alarm	1	1			
Generator Room CO Detector Failure	1	1			
MCC 1 & 2 Power Failure	2				
MCC 1 & 2 TVSS Alarm	2				

Pump Control Circuit AC Power Failure	1				
Combustible Gas Warning	1				
Combustible Gas Alarm	1				
Combustible Gas Detector Trouble	1				
Fire Alarm	1				
Pump Station Intrusion Alarm	1	1			
Pump Station Entry Key Switch Bypass	1				
Control Bldg Intrusion Alarm	1	1			
Control Bldg Entry Key Switch Bypass	1				
UPS Power Feeder Failure	1				
UPS alarm	1				
24VDC Power Supply Alarm	1				
Control Building High Temperature	1				
Alarm Acknowledge		1			To Annunciator (?)
Enable RTU-1 Output		1			
Control Power Panel TVSS Alarm	1				
Spare	23	6	6		
TOTAL	140	31	8		

1.10.2 Master PLC I/O Points via Ethernet

(a) From 480V Switchgear:

- 1) From Utility Line 1, Utility Line 2 & Generator Breaker Trip Unit: Breaker status (Closed), 3 phase line voltage, 3 phase current, KW and power factor, and trip settings.
- 2) From Tie Breaker 1 & 2 Trip Unit: Breaker status (Closed) & trip settings.
- 3) From each Feeder Breaker Trip Unit: Breaker status (Closed), 3 phase current, KW and power factor, and trip settings.

(b) From Engine Generator Controller:

Metering: Elapsed Run Time, Engine RPM, DC Voltage, 3 phase current, voltage, KW and KVA; P.F., KWHr, Alarms: Hi/Lo coolant temp., Low oil pressure, Low DC volts, System not in automatic, Hi/Lo fuel level, Over crank, Over speed, Battery charger malfunction, Generator on load, Circuit breaker tripped.

1.10.3 Master PLC I/O Points via ControlNet

- (a) From RTU-1: Main Pump Lead Lag Sequence, low flow pump Lead Lag sequence, Watchdog Timer.

1.10.4 RTU-1 Hardwired I/O Points

DESCRIPTION	DI	DO	AI	AO	NOTE
Float Run Lead Low Flow Pump	1				
Float Run Lag Low Flow Pump	1				
Low Flow Pump 1 Run		1			
Low Flow Pump 2 Run		1			
Float Run Lead Main Pump	1				
Float Run Lag 1 Main Pump	1				
Float Run Lag 2 Main Pump	1				
Float Run Lag 3 Main Pump	1				
Float Run Lag 4 Main Pump	1				
Float Run Lag 5 Main Pump	1				
Float Run Lag 6 Main Pump	1				
Main Pump 1 Run		1			
Main Pump 2 Run		1			
Main Pump 3 Run		1			
Main Pump 4 Run		1			
Main Pump 5 Run		1			
Main Pump 6 Run		1			
Main Pump 7 Run		1			
480V SWGR Bus Tie Breaker 1 Closed	1				
480V SWGR Bus Tie Breaker 2 Closed	1				
480V SWGR Generator Breaker Closed	1				
Spare	5	8			
TOTAL	17	17			

1.10.6 RTU-1 PLC I/O Points via ControlNet

The following information shall be sent to MASTER PLC via ControlNet:

- (a) Low Flow Pump Operating Sequence and Main Pump Operating Sequence.
- (b) PLC Normal.
- (c) Generator on line feeding MCC 1, MCC 2 or both.

DESCRIPTION	DI	DO	AI	AO	NOTE
Main Pump 1 thru 7 Running		7			
Main Pump 1 thru 7 Standby		7			
Main Pump 1 thru 7 Fail		7			
Low Flow Pump 1 & 2 Running		2			
Low Flow Pump 1 & 2 Standby		2			
Low Flow Pump 1 & 2 Fail		2			
Utility Line 1 Power Fail		1			
Utility Line 2 Power Fail		1			
Generator Running		1			
Generator Fail		1			
MCC 1 Power Fail		1			
MCC 2 Power Fail		1			
Pump Control Power Fail		1			
Low Water Level		1			
High Water Level		1			
Pump Alternator RTU-1 Fail		1			
Level Transmitter LT-100 Fail		1			
UPS Input Power Fail		1			
Combustible Gas Warning	1				
Combustible Gas Alarm	1				
Combustible Gas Detector Trouble	1				
Generator Running		1			
Generator Fail		1			
Generator DC Power Fail		1			
Fire alarm		1			
Communication Fail		1			
Alarm Silenced		1			
Wet Well Level (LT-100)				1	
Wet Well Level (LT-101)				1	
Horn		1			
Alarm Acknowledged	1				
Lamp Test	1				
Spare	14	15		2	
TOTAL	16	64		5	

1.11 System Description

1.11.1 The following 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 diagnostics.

1.11.2 The system is based on the SCADA system block diagram shown on Plans. The system shall include:

- (a) Redundant programmable logic controllers (PLCs) with local input/output (I/O), graphical interface panels, network communications and other capabilities as specified herein and shown on the SCADA system block diagram.
- (b) Computer work station with associated peripherals.
- (c) Computer operating system, Human Machine Interface(HMI) control/graphic software, PLC programming software, and other application software as specified herein.
- (d) The computer shall be linked to the PLC over an Ethernet (IEEE 802.3) based local area network (LAN).

1.11.3 All process control functions including PID, calculations, sequencing, set points, timing, etc., shall be done in the PLCs. The real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc., shall be done by the computers.

1.11.4 The system shall allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, etc. (i.e., on-off, open-close, set point value, etc.) when viewing the appropriate graphic screen on HMI.

1.11.5 Intellution FIX Dynamic to iFIX latest version as the SCADA HMI software.

2. PRODUCTS:

Field Devices:

Equipment listed in the table below shall conform to the instrumentation standards described in the paragraphs following the table:

- a. Control Stations (Type x).
- b. Analysis Instrumentation (A Series).
- c. Level Instrumentation (L Series).
- d. Miscellaneous Instrumentation (M Series).
- e. Pressure Instrumentation (P Series).
- f. Programmable Controllers and Computer Equipment (Y Series).

Tag	Device Type	Location/Description	Additional Information
CS-MP-1A	Type C	Main Pump No.1 Upper Control Station	
CS-MP-1B	Type C	Main Pump No.1 Lower Control Station	
CS-MP-2A	Type C	Main Pump No.2 Upper Control Station	
CS-MP-2B	Type C	Main Pump No.2 Lower Control Station	
CS-MP-3A	Type C	Main Pump No.3 Upper Control Station	
CS-MP-3B	Type C	Main Pump No.3 Lower Control Station	
CS-MP-4A	Type C	Main Pump No.4 Upper Control Station	
CS-MP-4B	Type C	Main Pump No.4 Lower Control Station	
CS-MP-5A	Type C	Main Pump No.5 Upper Control Station	
CS-MP-5B	Type C	Main Pump No.5 Lower Control Station	
CS-SMP-1A	Type C	Standby Main Pump No.1 Upper Control Station	
CS-SMP-1B	Type C	Standby Main Pump No.1 Lower Control Station	
CS-SMP-2A	Type C	Standby Main Pump No.2 Upper Control Station	
CS-SMP-2B	Type C	Standby Main Pump No.2 Lower Control Station	
CS-LFP-1A	Type C	Low Flow Pump No.1 Upper Control Station	
CS-LFP-1B	Type C	Low Flow Pump No.1 Lower Control Station	
CS-LFP-2A	Type C	Low Flow Pump No.2 Upper Control Station	
CS-LFP-2B	Type C	Low Flow Pump No.2 Lower Control Station	
CS-TR-1A	Type C	Trash Rack No.1 Upper Control Station	
CS-TR-1B	Type D	Trash Rack No.1 Intermediate EStop Station	
CS-TR-1C	Type C	Trash Rack No.1 Lower Control Station	
LT-100	L10	Primary Wet Well Level Element	Bubbler System
LT-101	L10	Secondary Wet Well Level Element	Bubbler System
LT-102	L10	Screen Chamber Level Element	Bubbler System
LT-103	L10	Inlet Channel Level Element	Bubbler System
LT-104	L10	Discharge Chamber Level Element	Bubbler System
FS-HWA	L8	High Water Alarm	
FS-MP-1A	L8	Start Lead Pump Float	
FS-MP-2A	L8	Start Lag 1 Pump Float	
FS-MP-3A	L8	Start Lag 2 Pump Float	
FS-MP-4A	L8	Start Lag 3 Pump Float	
FS-MP-5A	L8	Start Lag 4 Pump Float	

FS-SMP-1A	L8	Start Lead Standby Main Pump Float	
FS-SMP-2A	L8	Start Lag Standby Main Pump Float	
FS-LFP-1A	L8	Start Lead Low Flow Pump Float	
FS-LFP-2A	L8	Start Lag Low Flow Pump Float	
FS-MP-1B	L8	Stop Lead Pump Float	
FS-MP-2B	L8	Stop Lag 1 Pump Float	
FS-MP-3B	L8	Stop Lag 2 Pump Float	
FS-MP-4B	L8	Stop Lag 3 Pump Float	
FS-MP-5B	L8	Stop Lag 4 Pump Float	
FS-SMP-1B	L8	Stop Lead Standby Main Pump Float	
FS-SMP-2B	L8	Stop Lag Standby Main Pump Float	
FS-LFP-1B	L8	Stop Lead Low Flow Pump Float	
FS-LFP-2B	L8	Stop Lag Low Flow Pump Float	
FS-LWA	L8	Low Water Alarm	
AE-1	A25	Combustible Gas Sensor Intermediate Level	
AE-2	A25	Combustible Gas Sensor Discharge Floor	
AE-3	A25	Combustible Gas Sensor Entrance	
AE-4	A25	Combustible Gas Sensor Trash Rack Room	
AE-5	A25	Combustible Gas Sensor Pump Room	
AE-6	A25	Combustible Gas Sensor Roof Access	
AH-1	M30	Alarm Horn Lower Level	
AH-2	M30	Alarm Horn Intermediate Level	
AH-3	M30	Alarm Horn Upper Level	
AH-4	M30	Alarm Horn Pump Room	
AH-5	M30	Alarm Horn Trash Rack Room	
AH-6	M30	Alarm Horn Entrance	
DS-1	M50	Door Switch Trash Rack Room	
DS-2	M50	Door Switch SW Entrance	
DS-3	M50	Door Switch Pump Room South	
DS-4	M50	Door Switch Pump Room East	
DS-5	M50	Door Switch Electrical Room South	
DS-6	M50	Door Switch Electrical Room East	
TSH-1	T5	Electrical Room High Temp	
TSH-2	T5	Pump Room High Temp	
ASH-1	M51	Electrical Room Smoke Detector	

2.1 024-PLC-1 SCADA Panel at Electrical Control Room

2.1.1 A SCADA panel shall house a programmable logic controller (PLC) which shall be programmed for automatic control and monitoring of the operations of all control and monitoring functions at the Pump Station. The PLC shall control the starting and stopping of two low flow pumps and seven main pumps to prevent highway flooding. The PLC shall be configured to become SCADA master communicating with RTU-1 (Pump alternator PLC) in the Control Panel.

2.1.2 The SCADA panel shall be NEMA 12 floor mounted, front accessible only, metal enclosed type, arranged for cable and/or conduit entry from the top, bottom or sides, as required. Panel design shall allow easy access to all internal wiring and appurtenances. Ventilation fan, air filter, thermostatically controlled space heater, light kit and 120V receptacle shall be provided.

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.

- 2.1.3 The enclosure shall be finished inside and out. Exterior color shall match that for the motor control center, and the interior color shall be white or as otherwise approved by the Engineer.

2.2 (Y50) Programmable Logic Controllers

- 2.2.1 An Allan-Bradley programmable logic controller (PLC) system shall be furnished and shall be programmed to operate all functions herein specified. All analog and discrete inputs and outputs shall be provided as necessary. The logic program shall be of a universal type architecture and shall not be of a proprietary language. In addition, the programmable controller shall be capable of being operated from the District 8 Dispatcher's Alarm Panel via leased telephone lines or radio. 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.
- 2.2.2 The system integrator shall furnish the 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.
- 2.2.3 024-PLC-1 MASTER PLC: The PLC shall be a redundant system consisting of two(2) redundant ControlLogix processors with 1.5 Mbytes of memory, two(2) ControlLogix System Redundancy Modules, two(2) Control Net communication interfaces, two(2) Ethernet modules, two(2) redundant hot-swappable power supplies, Remote I/O system with redundant power supplies, Communication gateways, two(2) Graphic Interface Panels(GIP), necessary cable assembly, and necessary specialty modules to form a complete system. The PLC shall be Allen-Bradley ControlLogix Redundant System with sufficient memory and I/O capacity to handle monitor and control functions of present system plus 20% spare memory and 10% spare I/O. The PLC shall be mounted in the control building SCADA Panel and shall be programmed for monitoring and control functions. The two GIP's shall be Allen-Bradley PanelView Plus 1250 12.1" TFT active matrix color display with keypad for operator interface, one with NEMA 1 panel mounted enclosure on the SCADA panel door, the other with NEC Class I, Division 1, Group D wall mounted enclosure in the pumping Station. The main processor module shall be capable of accepting additional I/O plug-in modules for expansion. Analog and digital terminal interface modules (Allen-Bradley 1492-IFM and 1492-AIFM), pre-wired cables with removable terminals and connectors.

- 2.2.4 024-RTU-1A: The PLC shall be a FlexLogix controller with ControlNet interface programmed as a two pump alternator for low flow pumps and as a 7-pump alternator for the main pumps. The PLC shall be furnished and installed in the Control Panel 024-RTU-1.
- 2.2.5 2.2.6 The PLC system design is based on a specific manufacturer's, other manufacturer's system will be acceptable only if they are proven to be the same as the specified in functionality and reliability.

2.3 Computer Work Station

- 2.3.1 Provide fully configured desktop computer systems including computer hardware, peripherals, operating software, application software, and configuration as specified herein for data logging, alarm annunciation and report generation.
- 2.3.2 Manufacturers: Computers and peripherals shall be manufactured by Dell, Hewlett-Packard (HP), or IBM.
- 2.3.3 The computer shall be a Intel Xeon processor based PC in a tower case with the following features as a minimum requirement:

Dual Intel Xeon 2.4 GHZ CPU's with 512 KB Cache
512 MB 333 MHz DDR SDRAM
Two 16553 Serial ports minimum
2 ECC/EPP Parallel ports
4 Universal Serial Ports
7 expansion slots minimum
Two 80 GB hot swappable Raid 1 SCSI hard drives
CD
52x24x52x CD-RW
40GB DDS4 SCSI tape drive
Graphic controller with 16 MB VRAM
10/100 Base-T Ethernet card
2 hot-pluggable redundant power supplies, 400W minimum each
Keyboard and optical mouse
Microsoft Office software
Windows XP Professional operating system
MultiTech Model MT5600BL V.90/56 Kbps Dialup/2-4wire lease line
Modem
19" color LCD monitor
Laser jet printer, Hewlett-Packard Model 1200N
Dot matrix printer, 24 pin, narrow carriage, Epson LQ-870 or OKI ML-590.

2.3.4 Software

Provide all software on original diskettes, software publishers license, and manual(s), including Intellution iFIX with iHistorian upgrade from existing Fix dynamic; Logix5000, PanelBuilder and other software as required.

- 2.3.5 The desktop computer, running the SCADA system software which will direct the PLC and remote terminal units (RTU) shall be capable of off line usage for purposes other than system control and supervision, without loss of statistical data. The computer shall be capable of off line services for periods of up to one year without loss of statistical data.
- 2.3.6 The computer shall be capable of multi-mode menu driven statistical analysis with hard copy capability. Communications between the system and the supervisory computer shall automatically re-establish in the event that communications are momentarily lost.
- 2.3.7 The computer shall be arranged for system monitoring and management. The primary function of the computer shall be to provide the control logic, monitoring and, operational records for the pump station facility. In addition, the computer shall be capable of generating reports and maintenance records.
- 2.3.8 Provide one (1) computer desk for the desktop computer and printer. Desk shall be 48" x 30" in dimension. Desk shall be steel industrial or heavy-duty commercial grade in construction. Locate desk in Electrical Room.

2.4 System Software

2.4.1 General Requirement

- (a) The System Integrator shall furnish and install all 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) Software shall be modular, comprised of an integrated group of proven, standard software modules.
- (c) 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.
- (d) 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.

- (e) 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 on the logging printer and a historical disk file with date, new value, and previous value.
- (f) The System Integrator shall develop and implement all specified LCD 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.

2.4.2 Operating System

- (a) The operating system software shall provide system resource allocation and management in a pseudo real-time environment. Both program development and on-line monitoring and control programs shall execute concurrently under predetermined priority assignments. The Operating System shall control storage allocation and program movement; program scheduling; monitoring of system security timers; and interrupt processing for internal and external events such as Input/Output transfer completion, real-time program initiation, and detection of abnormal system conditions.
- (b) The operating system shall provide automatic start-up of the system, including processor and network communication, and all application software functions, upon initial power up or restoration of power after a power failure without operator intervention.
- (c) Provide operating system to monitor and control the execution of all programs; handle job initiation and termination requests; monitor program requests for system service; accept job control, operator commands, and translate them into actions; respond to and report error conditions relating to program processing.
- (d) Process Input/Output Handler: Process Input/Output routines shall be main memory resident, and shall provide interface to programs, process measurements and control system, and perform "reads" and "writes" and monitor device status.
- (e) Security: Provide operating system with provisions for password protection and security access to files and programs. On log-off, access to all computer functions shall be inhibited including boot-access via floppy diskettes. Configure the system and develop file structure for three user types initially.
 - a. System Administrator: Full access to system.
 - b. Engineer/Supervisor: Full access to all HMI and control system variables, databases, and programs. Restricted access to system/network parameters.

- c. Operator: Read access to all HMI and control system variables, databases, and programs. Full access to WTP operating functions including reports, control setpoints, manual overrides, alarm acknowledgment, etc.
- (f) Provide 32 bit operating system, Microsoft Windows XP Workstation, Version 4.0 or later as recommended by the HMI software manufacturer. Provide Microsoft Remote Access Service for remote access of the HMI.

2.4.3 Support Software

- (a) The Support Software shall include a collection of programs, which simplify new program development and implementation, permit testing and verifying the functional operation of the equipment associated with the system, and provide tools to perform the tasks associated with the creation and maintenance of an efficient system environment. All support software shall be Microsoft Windows XP Version 4.0 or later compliant.
- (b) The support software shall provide an on-line facility through the operator's Flat Panel Display/keyboard which will allow an operator or programmer to access, print, and change contents of allowable memory locations, as well as enable the activation of new process inputs and control outputs.
- (c) The support software shall contain Utility Routines which shall allow operator or programmer to:
 - 1) Load and verify CD's.
 - 2) System status routines which output to the system terminal, printers, and disk files. Routines shall include memory allocations, dumps, interrupt definitions, disk status, processor performance, etc.
- (d) The support software shall contain diagnostic routines which shall be provided to test the performance of the computer-based control and data acquisition system in at least the following areas:
 - 1) Main memory.
 - 2) Execution of all instructions.
 - 3) Input/Output system.
 - 4) Hard disk.
 - 5) Failure to pass any of the above tests shall be reported with indication of the location and type of system error.
- (e) The DATA tape software provided with the system shall perform the following functions:

- 1) Automatic scheduler for automatic (unattended) backup.
 - 2) File by file and image backup (selectable).
 - 3) File restoration.
 - 4) Menu driven configuration guide.
- (f) Modem Communication Software: Provide communication software for use of dial-up modems provided with the HMI computer and laptop computer.
- (g) Spreadsheet software: Provide spreadsheet software. Spreadsheet software shall be compatible with HMI application software and allow import of data using Dynamic Data Exchange (DDE) protocols. Provide Microsoft Excel, latest version.

2.4.4 Application Programs

- (a) General Requirements: The software package shall be supplied for data base generation; process monitoring and control; collection, analysis, storage, preparation and printing or display of operating information for historical reports; and for plant start-up, normal operating cycles, and shutdown. The application programs shall perform the following general tasks:
- 1) Scanning of PLC data table for transferring analog and discrete data to and from the PLC. Scan rates shall be selectable over a range of approximately 1 sec to 8 hr and individually assignable to any point. In general, scan periods will be initially set at 1 second but shall be field adjusted by the System Integrator to achieve the fastest possible time PC/PLC scan without negative impact on system performance.
 - 2) Digital filtering via either an assignable filter constant or by difference equation method.
 - 3) Perform alarm monitoring of discrete and analog inputs/outputs. The analog inputs shall also be checked for out of range (via high and low limit checks). Alarms shall be capable of being assigned to a minimum of three severity categories (critical, non-critical, advisory) with each category producing a distinct sound via the CPU speaker. Alarm acknowledgment shall be from the keyboard or mouse. Audible alarm enable/disable shall be selectable by the operator.
 - 4) Permit the addition or deletion of system inputs or outputs and modification of the system database using pop-up graphics and fill-in-the-blanks configuration tables.
 - 5) Supervise and control all routines necessary to respond to operator requests for control changes, displays, allowable operator modifications, printouts, and any other required operator requests.

Operator actions shall be serviced on an interrupt basis, and shall be interweaved with normal operations.

- 6) Permit manual data entry through the keyboard. This data shall consist of laboratory inputs, and entering or changing such things as alarm limits, set points, or constants. Confirmation shall be required via the respective display and keyboard prior to actual entry into the process database. Security coding shall prevent unauthorized data entry. The system shall be structured so that personnel will not experience an excessive delay time when entering or modifying data.
- 7) Support all required graphic displays for LCD. The software will both format and display LCD images of fixed and dynamic data. The System Integrator shall develop the screens using object oriented, pixel graphics. Displays shall be consistent with a Microsoft Windows NT environment and a common user interface look and feel shall be provided for all graphic screens.
- 8) Support all required logging and reporting. All logs, reports, and print-outs will be free form, that is the headings and format will be programmed and printed at the time of generation. Pre-printed sheets are unacceptable. The basic logs, reports, printouts, are described herein, to give the system supplier a general description of the quantity, complexity and types.
- 9) The final format and variables to be printed shall be developed by the System Integrator after consulting with IDOT after award of Contract. Any calculations required shall be made at the time of printing and indicate the latest status of the variable. Each page of report shall have the name of the plant, type of report, time and date the report was prepared and the page number. All logs and summary reports, with the exception of the alarm and equipment status logs, shall be allowed to be manually initiated and canceled.
- 10) Provide the capability to manually OPEN/CLOSE, START/STOP or initiating auto sequences of selected plant equipment via the operator's LCD and keyboard.
- 11) Provide for output of current or historical trending values to either the LCD or report printer.
- 12) Provide an optional automatic reset sequence for all alarms.
- 13) Provide export and import of the system configuration database to/from an ASCII (comma delimited) or Excel format file for modification or printing.
- 14) Provide a library of standard graphics symbols in conformance with ISA standard S5.1.

- 15) Perform configuration and operator interface to implement the control strategies included in this Section.
- 16) Application program shall be Microsoft Windows XP compliant and allow launching of other Windows XP compliant programs, transfer of Dynamic Data Exchange (DDE) data points to other programs, and execution of Windows XP applications while the application program is on-line.

(b) Real Variables Processing:

- 1) Real Variables shall represent process data for which there are analog signal inputs to the system. The system shall sample each of these input signals at the selected scan frequency, and perform the proper conversions and scaling to obtain the instantaneous engineering values. These values then shall be used to update real-time data on LCD displays, check for alarm conditions, and store for use in the historical files.
- 2) The instantaneous values of all variable data shall be displayed and added to the historical database whenever the present value exceeds a preprogrammed compression deadband. The compression deadband will be field adjusted by the System Integrator to provide for maximum storage utilization.
- 3) Provide for storage of historical data on an adjustable file period of daily, weekly, monthly, quarterly, or yearly period for the purpose of trends or data analysis.
- 4) Variables, such as rate of flow, weight, and kilowatt usage, shall have their instantaneous values integrated with respect to time and their quantities totaled. the storage of each of these totals shall be done on an hourly basis into the historical file.
- 5) Alarm conditions shall be stored in the historical file. In addition, the last 100 alarms shall be displayed on the alarm graphic screen. The alarm storage format shall be an alarm description, time of occurrence, and tag number.

(c) Calculated Variables Processing:

- 1) Calculated variables shall represent process parameters for which there are no direct analog inputs to the system. These variables shall utilize real variables, and manually entered constants or laboratory data to compute their value.
- 2) Calculated variables which utilize one or more real variables and/or manually entered constants. These variables shall be treated in the same manner as real variables and shall have the same attributes as real variables (including alarming and control), with the exception that the calculation shall be performed automatically over an adjustable cycle period.

- 3) Calculated variables which are used only for the Daily, Monthly, and Annual Operation Summary reports, and which utilize laboratory input data shall be computed once a day for inclusion in the Daily report and stored for use in the Monthly and Annual reports. The capability to display these variables shall be provided.
 - 4) The system shall provide for a minimum of 200 calculated variables.
- (d) Manual Input Data Handling:
- 1) Provide the capability to enter data manually from the keyboard. Data shall consist of additional values for the current data file (e.g., laboratory analyses), inserting alarm limits, set point changes, adjustments to process constants, control system set point changes and system tuning parameter adjustments.
 - 2) All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the data entry device prior to incorporation to the database.
- (e) LCD Displays:
- 1) All 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:
 - Index displays
 - Graphic displays
 - Trend displays
 - Manual lab summary displays
 - Alarm summary displays
 - System status displays
 - Single point configuration/status displays
 - Pop-up displays
 - Help displays
 - Setpoint displays
 - 2) 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. The use of color for status shall be unique and consistent for all graphic screens.
 - 3) 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.

- 4) The system shall allow the operator to manually control the status of pumps, valves, etc., via either keyboard entry on the currently displayed graphic screen. The status change shall require a secondary acknowledgement (action confirmation) by the operator before the status is processed.
- 5) 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.
- 6) Graphic displays: The display shall depict basic process schematic diagrams with representative symbols for pumps, tanks, 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.
- 7) 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.

- 8) Alarm summary display: The display shall consist of all points 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.
- 9) 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.
- 10) Single Point Configuration/Status displays: The configuration/status displays shall be of the software vendors standard format.
- 11) 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.
- 12) 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.
- 13) Setpoint displays: Provide standard display for all PID loops presenting all analog process variables, associated PID setpoints and loop tuning parameters stored in the PLC. Provide additional level of password protection prior to allowing any changes to loop tuning parameters.
- 14) 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.

(f) Alarm/Equipment Status Reporting:

- 1) The alarm log shall print 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.
- 2) 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.

- 3) The current alarm summary printout shall print all points currently in alarm with point identification number, point name, time of occurrence, and type of alarm.

(g) Daily Operation Summary Report:

- 1) The daily operation summary report shall summarize plant operation for the previous day. The report information shall be based on calculations using stored hourly averages of on-line monitored process variables as well as manually input laboratory data. In general, the report shall contain an item for each monitored process related parameter of the facility (i.e., flow, etc.).
- 2) The report format shall consist of: the correct date, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units. The daily minimum, average, maximum, and total where applicable shall also be calculated and printed for each point.
- 3) Values for which there are no data available shall be left blank or identified with a special character. Thus, only values which are actually zero shall be printed as such.
- 4) The daily operation summary report shall be available for printing or writing to a database file on demand or by schedule. The system shall be initially configured to automatically write the report data to a computer file (a separate file shall be created for each new report) at 1:00 a.m. of the following day. Immediately after the file is created, the system should automatically send the report to the report printer.
- 5) The laboratory report portion of the daily operation summary report shall be available for printing by itself, on demand without requiring printing of the entire report.

(h) Monthly Operation Summary Report:

- 1) The monthly operation report shall summarize plant operation for the previous calendar month. The information printed shall be based on calculations using stored daily values of on-line monitored process variables as well as manually entered laboratory data.
- 2) The report format shall be identical to the daily operation summary report, with the exception of the day being replaced by the month, and the hour column being replaced by the day column.
- 3) The monthly operation summary report shall be available for printing or writing to a file, on demand or by schedule during the entire following calendar month.

The system shall initially be configured to automatically write the report data to a computer file (a separate file shall be created for each new report) at 1:00 a.m. on the first day of the new month. Immediately after the file is created, the system should automatically send the report to the report printer.

- 4) The monthly report shall conform in all other respects to the requirements for the daily report.

(a) Process Reports:

- 1) Provide fifteen additional process reports incorporating real-time, historical, or manually entered data. Specifics of these reports shall be coordinated with IDOT during the submittal phase of this project.

2.5 PLC Program Development Software System

- 2.5.1 The System Integrator shall provide as part of the System a software package to allow off-line or on-line ladder logic program development, annotation and monitoring on an IBM or compatible personal computer operating under the computer operating system specified herein.
- 2.5.2 The software shall be utilized for development of the ladder logic programs and transfer to the PLC. Provide all PLC configuration required to implement the control strategies specified in this Section and shown on E19 SCADA System Diagrams.
- 2.5.3 The software package shall be completely menu driven and shall be distributed on standard CD's.
- 2.5.4 All required hardware (including cables, cable adapters, etc.) to allow the PLC's connection to a Standard RS-232-C or USB personal computer port shall be furnished.
- 2.5.5 The software package shall include a software license agreement allowing IDOT the rights to utilize the software as required for any current or future modification, documentation, or development of the PLC's furnished for this project.
- 2.5.6 The software shall provide as a minimum the following functions:
 - (a) Annotation of all ladder elements with at least 3 lines of 6 characters each.
 - (b) Annotation of all ladder rungs with at least 240 characters.
 - (c) Provide visual "power flow" monitoring of circuit elements (when connected to the PLC).

- (d) Provide annotated ladder diagram printout on a standard IBM compatible dot matrix printer for documentation purposes.
 - (e) On-line help facility.
 - (f) Download or upload ladder program from the PLC to the PC.
 - (g) Provide a ladder element and I/O cross reference table.
 - (h) Provide all monitoring, forcing, programming error detection, searching, configuration, etc., functions as required to allow an operator/programmer to completely program a PLC.
- 2.5.7 Programming software shall be Allen-Bradley RSLogix 5000 for Windows NT. Software shall be suitable for simultaneous operation with the computer based control system software specified herein. Provide means for development software operation without affecting on-line operation of the computer control system.

2.6 Graphical Interface Panels (GIP)

- 2.6.1 Provide graphical interface panels incorporated into each PLC as shown on the drawings. Graphical interface panels shall be configured to allow operator access to status and control of local processes being monitored by the PLC. Provide all software, hardware, cables, and appurtenances for a fully configured system.
- 2.6.2 Provide industrial grade NEMA 4 sealed panel with keypad. Keypad shall include a minimum of 15 user definable panel buttons and 5 user definable control buttons. Provide 12.1-inch, 800 x 600 pixel or 6.5 inch as specified, 640 x 480 pixel, VGA, color TFT display.
- 2.6.3 Provide PLC communications interface drivers to allow direct access of the graphical interface panel to the PLC and network. During configuration, the System Integrator shall assign specific addressing and input/output access to allow monitoring of the specific local process. Provide a minimum of two configurable serial communication ports.
- 2.6.4 Provide Windows based configuration software with the graphical interface panels. Configuration software shall utilize fill-in-the-blank style structure and support a minimum of 30 control display pages per panel. Control pages shall be stored in non-volatile EEPROM memory. Configuration shall be performed using the POWS device specified herein.
- 2.6.5 Provide screen templates for screen configuration including discrete indicator, analog numeric readout, message text display, graphical analog bar, register table, alarm windows, and control button. Panel software shall allow mixing of custom graphics and templates on any page configuration. Provide variable sizing of templates with no limitation on the number of elements on any alarm page.

- 2.6.6 Provide custom graphic capability for a schematic, graphical representation of the process. Resolution of graphics shall be to the screen pixel level. Custom graphics shall have the ability to be animated including proportional and status color based strategies. Provide a library of pre-developed symbols based on ISA graphical standards.
 - 2.6.7 Provide alarm monitoring capabilities with audio output. Alarm buffer shall store a minimum of 100 alarms for scrolling, review, and acknowledgment by the operator using an alarm summary page. Provide alarm acknowledge and audio output silence logic. Alarm audio output shall be adjustable up to 2 watts maximum.
 - 2.6.8 Provide capacity for a minimum of 500 text messages.
 - 2.6.9 Provide all configuration, transfer, and graphics software as required.
 - 2.6.10 Unit shall operate from 24V DC power source. Operating temperature range shall be 0-50°C with 20-80% humidity range, non-condensing. Provide a single Form C alarm fault contact rated a minimum of 1A at 120 VAC. Contact shall be wired into a discrete input of the PLC serving the GIP.
 - 2.6.11 Graphical interface panel shall be Allen-Bradley Panel View Plus, Cutler-Hammer PanelMate Power Pro, or approved equal.
- 2.7 GIP Software Configuration
- 2.7.1 General: The GIP graphical presentation shall present graphic logic for the PanelView monitor. Specific details of the graphical presentation at the GIP are not necessarily shown on the Drawings or described in the Control Descriptions. When GIP requirements are not specifically shown, provide GIP panel graphics that match that of the HMI logic for the points as detailed on the Drawings or in the Control Descriptions.
 - 2.7.1 The GIP shall provide the following general purpose screens:
 - (a) Two system status screens that summarize the present operational status of the pump station and sluice gate structure.
 - (b) Main menu and navigation screens for the GIP screens presented in a general to specific hierarchy.
 - (c) System alarm screen that presents a list of critical system wide alarms. Alarms shall be for operator information only. Operator acknowledgment of all system alarms shall not be possible at the GIP level, only at the HMI level.
 - (d) Local alarm screen that presents a list of local process alarms. Alarms shall be for operator information only. Operator acknowledgment of all system alarms shall not be possible at the GIP level, only at the HMI level.

(e) GIP Help screen(s) that summarize operator interface formats, use of function keys, navigational standards, etc.

2.7.2 GIP Interface shall match to the greatest extent possible the formats used at the HMI level including status colors, alarm presentation, text fonts, screen formats, etc. The operator interface at the GIP shall match that used for the HMI whenever possible.

2.8 Modular Data Switches

A. Manufacturers:

1. Phoenix Contact FL Switch MM HS.
2. Or equal.

B. Features:

1. Modular Ethernet switch, expandable to 24 ports (fiber or twisted pair). Provide "head station" and one "expansion module". Locate equipment in enclosure to allow addition of one additional "expansion module" in the future, including sufficient length of DIN rail.
2. Store and forward switch in compliance with IEEE 802.3, 2 priority classes in accordance with IEEE 802.1D, TCP/IP protocol.
3. Fiber modules (100 BASE FX):
 - a. 2-ports per module, provide total of 4 fiber ports.
 - b. 100-Mbps.
 - c. Multimode SC.
4. Twisted-Pair modules 10/100 BASE T):
 - a. 2-ports per module, provide total of 8 twisted pair ports.
 - b. Provide one module with switch configuration memory to allow replacement of switch hardware without the need to reconfigure switch settings.
 - c. Autosensing 10-/100-Mbps.
 - d. RJ45 connection.
5. Self-learning address tables.
6. Integrated web server function.
7. Integrated Management Agent, SNMP protocol.
8. 24 VDC power supply, internal.
9. Shock test in accordance with IEC 60068-2-27.
10. Operation: 25 g, 11 ms duration, semi-sinusoidal shock impulse.
11. Ambient temperature (operation) – 0 °C to 55 °C.
12. Humidity: 10% to 95% non-condensing.

2.9 Data Outlet - Industrial

- A. Data Outlets shall support Universal applications in a multivendor environment, accepting modular RJ-45 plugs, and shall be provided with the following features:

1. Bulkhead connector suitable for through-front of control panel installation.
2. Gasketed, screw-on closure cap with chain.
3. Data Jacks – 8 position/ 8 conductor, RJ-45, modular, insulation displacement type for 24 AWG copper cable.
4. Duplex jack outlet in process building electrical rooms. One process Control Network (PCN) jack, one telephone jack.
5. NEMA 4 rated.
6. Quantity of jacks as specified.

2.10 Uninterruptible Power Supply (UPS) System

- 2.10.1 Uninterruptible Power Supplies (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 isolation between the control system and the plant power system.
- 2.10.2 The UPS shall be a single phase, true on-line, solid DEPARTMENT unit with microprocessor controlled static inverter, hot pluggable batteries, battery charger, LED display and keypad, and manual isolated make before break maintenance bypass switch.
- 2.10.3 Under normal operating conditions, the critical load shall be continuously supplied by the UPS inverter. The battery charger shall maintain a float-charge on the battery. When AC line power fails, or goes out of tolerance, the inverter shall obtain power from the batteries and supply AC power to the loads without interruption.
- (a) The UPS system shall be sized to sustain 1.5 times the connected full load for a minimum period of 30 minutes in an operating environment of 32°F to 104°F. Final UPS sizing is the responsibility of System Integrator.
 - (b) The UPS system shall be lightning and surge tested per ANSI/IEEE C62.41 and shall be capable of reducing an input spike to less than 3 volts on the output for a 2000 to 1 spike attenuation. The UPS system shall have 120 dB common mode and 60 dB Transverse mode noise attenuation.
 - (c) The UPS system shall provide a true separately derived power source as defined in the NEC article 250.30 with output neutral bonded to ground. There shall be no direct connection between input and output and less than 2 pf of effective input to output capacitance.
 - (d) The UPS system output shall be regulated to 120/208 VAC \pm 3%, single phase three wire, 60 HZ \pm 0.5 HZ over the full dynamic range from no load to full load and low line VAC to high line VAC and low battery voltage to high battery voltage.
 - (e) The UPS system shall provide computer grade sine wave power with 5 percent or less total harmonic distortion.

- (f) The UPS system capacity shall be rated in volt amperes (VA) while loaded with typical computer grade switch mode power supplies having a power factor of 0.6 to 0.7 and crest factor of 2.7 to 3.5.
- (g) The UPS system shall have an efficiency of at least 92% when operated from AC line.
- (h) The UPS system shall have built-in self-diagnostic monitoring capable of monitoring as a minimum AC volts in/out, AC current in/out, battery voltage, VA load, watts, power factor percent of full load, time of day, system hours, inverter hours and projected run time available. Unit shall have relay contacts that close on UPS alarm condition and normal (utility) power failure.
- (i) The UPS system shall have a dual track redundant configuration that utilizes either line or inverter output for power and shall be designed to meet or exceed a MTBF of 100,000 hours.
- (j) The system input voltage shall be 120/208 VAC, 60 Hz, single phase, 3 wire. Provide external break before make disconnect switch to allow transition to like power for testing or removal of the UPS.
- (k) Topaz P8 or equal 3KVA power conditioner shall be provided.
- (l) The system batteries shall be supplied with a battery cabinet of the same design and finish as the UPS. The batteries shall be sealed, no maintenance type rated to provide minimum continuous operation of connected equipment as specified herein.
- (m) The System Integrator shall provide sizing data on the UPS listing all loads and calculations required for sizing the UPS system. As a minimum a 3 KVA unit shall be provided. The UPS system shall be as manufactured by Liebert or MGE with maintenance bypass switch and extra battery module or approved equal.

2.11 (A25) Combustible Gas Detector

- A. Manufacturers:
 - 1. MSA Ultima Series.
 - 2. General Monitors "Smart Sensor" Series.
 - 3. Or Equal.
- B. Catalytic Bead sensor/transmitter for Combustible Gas detection.
- C. Provide single sensor wall mounted enclosures for sensor/transmitter. Sensor/transmitter enclosures shall be rated for Class I, Division 1, Group D environment.
- D. Provide permanently installed remote test gas applicator and tubing for all combustible gas detectors.

- E. Provide wall-mounted enclosures for associated monitoring unit. Monitoring unit enclosure shall be rated NEMA 4x.
- F. Sensor Power: Loop Powered, 24 Vdc.
- G. 4-20 mAdc into 600 ohms for each sensor input channel.
- H. Provide 1 portable calibration unit for each type of sensor.
- I. Monitoring Unit Power: 120 Vac.
- J. Isolated, High/Low Fault alarm relay contacts for each sensor type with individual High/Low Fault alarm setpoints.
- K. Provide relay contacts for local alarm light/horn and for transmission to remote monitoring device.
- L. Fault alarm relay contacts shall be latched until manually reset. Provide reset pushbutton integral to Monitoring Unit.
- M. Local reset pushbutton. Provide reset pushbutton integral to Monitoring Unit.
- N. Response Time:
 - 1. 90% LEL, 10 sec.

2.12 (L8) Direct Acting Float Switches

- 2.12.1 Direct acting float switches equal to Healy-Ruff Co., Type P Roto-Float for level sensing complete with mounting pipe and stainless steel brackets shall be provided. The floats shall sense water levels as shown on the Drawings. The float shall contain a metal enclosed mercury switch which closes or opens its contacts when floating in a horizontal position. The non-inductive mercury switch rating shall be 10 amps at 120-V, 60Hz. The cable shall be Neoprene Type SO. Each float shall be provided with sufficient length of cable to allow a direct connection to the junction box without field splicing.
- 2.12.2 Float switches LS-100(A) through LS-100(O) shall provide back-up level sensing.

2.13 (L10) Level Sensing System - Bubbler

- 2.13.1 Provide compressed air bubbler systems for monitoring of pump station levels. Bubbler systems shall be provided for each compression bell location as shown on drawings.
- 2.13.2 Each bubbler system shall be provided with, at a minimum, an air compressor, pressure transmitter, pressure control valve, indicating flow regulator and purge valve.

2.14 Pilot Devices and Control Station Components

A. Manufacturers:

1. Allen Bradley 800T.
2. Square D Class 9001, Type K.
3. Cutler-Hammer 10250T.

B. Construction:

1. Heavy duty.
2. Watertight.
3. Oil-tight.
4. Flush panel mounting.
5. Size to mount in 30.5-mm diameter.
6. Match NEMA rating of associated Control Station (see below).

C. Pushbuttons:

1. Flush head unless specified elsewhere.
2. Contact Blocks:
 - a. Double break silver contacts.
 - b. Ac Ratings: 7,200 va make, 720 va break.
 - c. Single pole, double throw or double pole, single throw.
 - d. Up to six tandem blocks.
3. Momentary contact unless specified elsewhere.
4. Non-illuminated.
5. Legend plates, as required, for type of operation or as specified elsewhere.

D. Pushbuttons – Emergency Stop (ESTOP):

1. Jumbo red mushroom head.
2. Contact Blocks:
 - a. Double break silver contacts.
 - b. Ac Ratings: 7,200 va make, 720 va break.
 - c. Single pole, single throw.
 - d. Up to six tandem blocks as specified.
3. Push/pull.
4. Maintained contact.
5. Non-illuminated.
6. Legend plates:
 - a. Extra large.
 - b. Red.
 - c. "ESTOP".

E. Pullcord Lever Switches – Emergency Stop (ESTOP):

1. Manufacturer: Conveyor Components Company, Model RS.
2. Cast Aluminum housing.
3. Lever arm actuation.
4. Contact Blocks:
 - a. Double break silver contacts.
 - b. Ac Ratings: 7,200 va make, 720 va break.
 - c. Single pole, single throw.
 - d. Two tandem blocks: one form 'A' and one form 'B', or two form 'C'.
5. Maintained contact.
6. Non-Illuminated.
7. Legend plate:
 - a. Oversize.
 - b. "ESTOP".
7. Provide vinyl coated safety cable, eyebolts and cable end fittings sufficient to span length of equipment.

F. Selector Switches:

1. Maintained position unless specified elsewhere.
2. Contact Blocks:
 - a. Double break silver contacts.
 - b. Ac Ratings: 7,200 va make, 720 va break.
 - c. Contact configuration as specified.
 - d. Up to six tandem blocks.
3. Operators:
 - a. Number of positions as specified elsewhere.
 - b. Standard knob type unless specified elsewhere.
4. Legend plates as required for type of operation or specified elsewhere.

G. Pilot Lights:

1. Transformer type.
2. Bayonet, 6 to 8 v bulb.
3. Colored lens as specified elsewhere.
4. Interchangeable lenses.
5. Transformer rated for 120 v, 60 Hz.
6. Push to test.
7. Legend plates as specified elsewhere.

H. Potentiometers:

1. Three-terminal potentiometer.
2. Resistance: 10 kOhm.
3. Power Rating: 2 watt, 50V ac/dc.
4. Resolution: 1 percent.
5. Linearity: +/- 5 percent.

I. Control Stations:

1. Describes enclosures used to house field pilot devices.
2. NEMA ratings:
 - a. NEMA 7 in Class 1, Division 1 or 2 Hazardous (Classified) Locations.
 - b. NEMA 4X 316 stainless steel in indoor wet/corrosive locations or outdoors.
 - c. NEMA 12 in other areas.
3. 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.

2.15 Control Stations – Definitions, Types A – D

- A. LOCAL/REMOTE, START/STOP: One 2-position selector switch with 3 contact blocks (XO/OX) for local/remote. One NO momentary contact pushbutton for start. One NC maintained contact pushbutton for stop.
- B. START/STOP, RUNNING: One NO momentary contact pushbutton for start. One NC momentary contact pushbutton for stop. One green 120 VAC pilot light for running.
- C. PRIMARY/STANDBY/DEWATERING PUMP: One 2-position selector switch with 3 contact blocks (XO/OX) for local/remote. One NO momentary contact pushbutton for start. One NC momentary contact pushbutton for stop. One NO momentary contact pushbutton for jog. One green 120 VAC pilot light for running. One NC maintained contact mushroom head pushbutton with 2 contact blocks (XO/XO) for emergency stop.
- D. ESTOP: One NC maintained contact mushroom head pushbutton with 2 contact blocks (XO/XO) for emergency stop.

2.16 (M30) Exterior Mounted Alarm Horns

A. Manufacturers:

Federal Signal Vibratone, Model 350.

B. 120 vac.

- C. NEMA 4: Suitable for use in wet location or outdoors, gasketed, where specified.
- D. NEMA 7: Suitable for Class I, Division 1, Group D Hazardous (Classified) Area, where specified.
- E. Wall or surface mounted, provide mounting lugs.
- F. Body to include outlet box.
- G. 3/4 in. conduit hubs.
- H. Annunciator unit to project 100 dB tone at 10 ft.
- I. Provide horn with projector cone.
- J. Gray enamel finish.

2.17 (M31) Exterior Mounted Alarm Lights

A. Manufacturers:

- 1. Appleton Electric Company.
- 2. Crouse Hinds.

B. 120 vac.

C. NEMA 4: Suitable for use in wet location or outdoors, gasketed, where specified.

D. NEMA 7: Suitable for Class I, Division 1, Group D Hazardous (Classified) Area, where specified.

E. Surface-mounted, provide mounting lugs. Body to include mounting lugs.

F. Aluminum mounting hood.

G. Red glass globe with guard.

H. 3/4 in. conduit hubs.

2.18 (M37) Process Indicators, Electronic

A. Manufacturers:

- 1. Precision Digital.
- 2. Red Lion, IMP.
- 3. Moore Industries.

B. 4-20mA dc Input.

C. 4 ½ digit LED indicator.

D. Loop powered.

E. Enclosures:

NEMA 4X: Impact-resistant polycarbonate body, clear gasketed polycarbonate cover. ½" conduit hole in bottom of case.

NEMA 7 XP: FM approved cast aluminum body, screw-type cast aluminum cover with view port. Two ¾" conduit holes.

F. Provide 2" pipe mounting kit as detailed.

G. Model: PD675-N, NEMA 4X; PD677-N, NEMA 7 XP.

2.19 (M50) Proximity Switches in Intrusion

A. Manufacturers:

1. ADT.
2. Sentrol.

B. Proximity switch for monitoring of building or control panel door position.

C. Solid State Hall Effect sensor with magnetic actuating bar.

D. Switch shall be commercial grade. Inductive, tubular or barrel type switches shall not be acceptable.

E. Provide dry contacts suitable for connection to PLC input. Use switch manufacturer's recommended switching relay/amplifier as necessary to affect proper interface. Relay/amplifier shall be installed in PLC panel.

2.20 (T5) Temperature Switches – Building Status

A. Manufacturers:

1. Honeywell.

B. Integral temperature indicator.

C. Suitable for wall or ceiling mount.

D. Adjustable high and low temperature setpoints.

E. Dry contacts suitable for connection to PLC Reed Relay input.

2.21 (M51) Smoke Detectors – Building Status

A. Manufacturers:

1. Simplex.
- B. Photo-electric type smoke detector.
- C. Dry contacts suitable for connection to PLC input.
- D. 24Vdc power.

2.22 CONTROL RELAYS

A. Manufacturers:

1. Potter and Brumfield.
 2. Struthers Dunn.
- B. Operating Data:
1. Pickup Time: 13 ms maximum.
 2. Dropout Time: 10 ms maximum.
 3. Operating Temperature: -45°F to 150°F.

C. ac Coil:

1. 120 or 240 vac.
2. Continuous rated.
3. 3.5 va inrush maximum.
4. 1.2 va sealed, maximum.
5. 50 to 60 Hz.
6. Light to indicate energization.
7. Minimum Dropout Voltage: 10% of coil rated voltage.

D. dc Coil:

1. 24 or 120 Vdc.
2. Continuous rated.
3. Light to indicate energization.
4. Minimum Coil Resistance:
 - a. 24 Vdc: 450 Ω .
 - b. 120 Vdc: 9,000 Ω .

E. Contacts:

1. Gold flashed fine silver, gold diffused for 1 amp or less resistive load.
2. Silver cadmium oxide.
3. 4 form C.
4. 120 vac.
5. 10 amp make, 1.5 amp break, (inductive).

- F. Rated at 10 million operations.
- G. 11 pin, square socket.
- H. DIN rail mountable.
- I. Enclosed and protected by polycarbonate cover.
- J. Provide relay-retaining clips.

2.23 Timers

A. 24-hour Clock Timer (Repeat Cycle):

- 1. Manufacturers:
 - a. Tork Time Controls.
 - b. Intermatic.
 - c. Or equal.
- 2. Mounting: Surface.
- 3. Display: 24-hour LCD.
- 4. Contacts: 1 SPDT rated 20 A.
- 5. Set Points: 288 per 24-hour.
- 6. Skip Feature: 1 to 7 day adjustable.
- 7. Minimum On-Off Time: 5 min.
- 8. Time cycle programmable by keypad.
- 9. Power: 120 vac, 60 Hz.

B. Elapsed Time Meters:

- 1. Manufacturers:
 - a. Engler.
 - b. Eagle Signal.
 - c. Or equal.
- 2. Mounting: Surface.
- 3. Digits: 5, non-reset.
- 4. Power: 120 vac, 60 Hz.

C. Interval/Duration Timer (Rear of Panel):

- 1. Manufacturers:
 - a. Potter and Brumfield, CN series.
 - b. Eagle Signal DM 100 series.
 - c. Or equal.
- 2. Mounting: Plug-in with dust tight cover.

3. Type: Integrated circuit.
4. Range: 0.5 sec to 99 min. Field selectable.
5. Contacts: 2 DPDT contacts rated 10 amp, 120 vac.
6. Power: 120 vac, 60 Hz.

D. Interval/Duration Timer (Front of Panel):

Manufacturers:

- a. Eagle Signal, CX300 series.
- b. Or equal.

Type: Microprocessor.

Timing Range: Five ranges from 200 sec to 200-hr field selectable.

Contacts: 10 amp, 120 vac.

Controls: Membrane switches for operator input.

2.24 Terminal Blocks

A. Manufacturers:

Phoenix Contact.
Weidmuller.
Or equal.

B. 300 v rating for 120 v circuits and below, 600 v rating for 480 v circuits.

C. Clamping screw type.

D. Isolating end caps for each terminal.

E. Identification on both terminals.

F. Clip-mounted on DIN rail.

G. Accept AWG 12 to 22.

H. Feed-Through Terminals:

1. 20 Amp rating.

I. Switched Terminals:

1. Knife disconnect with test sockets.

- 2. 10 Amp rating.
- J. Fused Terminals:
 - Hinged fuse removal/disconnect.
 - 10 Amp rating.
 - Include blown fuse indication.

2.25 Electronic Current Isolator

- A. Manufacturers:
 - 1. Phoenix Contact Model MCR Series.
- B. 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.
- C. Mounting: DIN Rail.
- D. Temperature compensated, calibration-free.
- E. Signals: Input: 4-20 mAdc into 50 ohms. Output: 4-20 mAdc into output load up to 500 ohms.
- F. Isolation: Common mode up to 700 vac between input and output.
- G. Accuracy: 0.5% of span.
- H. Provide power supply specific to isolator.

2.26 (P9) Pressure Indicating Transmitter, Electronic

- A. Manufacturers:
 - 1. Emerson/Rosemount.
- B. Sense positive or negative pressures as specified.
- C. Transmitter: Electronic , two-wire, force transfer type.
- D. Wetted parts: 316 stainless steel unless noted otherwise.
- E. Process temperature range: -20 degrees F to +120 degrees F minimum.
- F. Dampening: Fluid or electronically dampened with dampening adjustment.

- G. Output: 4 to 20 mA dc signal into a load impedance of 0 to 750 ohms with 24V dc supply.
- H. Range: Adjustable as noted with no suppressed or elevated zero unless noted otherwise.
- I. Accuracy: +/- 0.5 percent of calibrated span.
- J. Hysteresis and repeatability: 0.5 percent of calibrated span maximum.
- K. Enclosure: NEMA 7 construction, unless otherwise noted.
- L. Units shall be provided with brackets for pipe stand or wall mounting, as shown.
- M. Units shall be provided with isolation valves for rigid calibration.

2.3 Control Panel Fabrication

2.3.1 General

- (a) The panels shall match the general construction of the motor control center and shall be of the same height.
- (b) The panels shall conform to all applicable standards of NEMA and ANSI and shall consist of formed steel panels containing equipment and devices as indicated.
- (c) The control panel shall be complete with float type water level control systems integrated as indicated on the drawings and as specified.
- (d) The panels shall be equipped with space heater(s) as specified for motor control centers.
- (e) A SCADA panel shall be furnished by under separate contract for pumping system monitoring and control. SCADA panel shall be installed under this contract.

2.3.2 Enclosure

- (a) The enclosure shall be NEMA 12, of a height and depth to match the motor control center and of a width sufficient for the equipment to be housed.
- (b) The panel shall have a full piano hinge door and a 3-point latch with a locking handle. The handle shall have a cylinder type lock keyed to match the Owner's system. The door for the Control Panel shall have a hinged gasketed door with clear polycarbonate window to cover the flush mounted combustible gas monitor.

- (c) The enclosure shall be finished inside and out. The finish shall be as specified for the motor control center. Exterior color shall match that for the motor control center, and the interior color shall be white or as otherwise approved by the Engineer.

2.3.3 Devices and appurtenances

- (a) Unless otherwise indicated, pushbuttons, selector switches, indicating lights, relays, and other devices shall be provided as part of the control panel and shall be as specified for motor control centers. Devices similar to those in the motor control center panel shall be of the same manufacturer.
- (b) Where indicated, certain devices shall be furnished under other Sections of the Specifications for installation under this Section. The control panel manufacturer shall coordinate the arrangement and wiring of these devices for a complete finished assembly. Such devices shall be factory installed by the panel manufacturer.
- (c) The alarm panel shall be as specified under "Alarm Annunciators".
- (d) The float control system circuit shall be as specified under "Float Control System". The float relays shall be intrinsically safe.
- (e) The Combustible Gas Detectors shall be as specified under "Combustible Gas Detection System".
- (f) Nameplates shall be as specified in Section 16A. Relays and other devices located inside the panel shall be identified with nameplates.

2.3.4 Wiring

- (a) Wiring shall be brought to terminal strips near the bottom of enclosures and 10 percent spare terminals shall be provided in each. The identification of terminals shall conform to the schematic diagrams and shall consist of adhesive labels as manufactured by Brady, Thomas, or equal.

2.4 Float Control System

- 2.4.1 The float control system shall include floats, interconnecting integral cable of a length required, and control logic for the functions indicated.
- 2.4.2 Floats shall consist of sealed switches sealed in stainless steel spherical floats, with integral neoprene jacketed cable.
- 2.4.3 The system shall be intrinsically safe for installation in the wet well.
- 2.4.4 The system shall be complete with control logic to provide the contacts for controls and alarm functions indicated.

- 2.4.5 The system shall be complete with all required mounting hardware and accessories.
- 2.4.6 The float system shall be complete with mounting arrangement with a stilling well of adequate size, or by other means approved by the Engineer, to forestall the attachment of large sections of ice to the floats during cold weather which could then disturb the system mounting. The mounting arrangement shall permit easy removal of the floats and easy realignment when replaced. Submit details for approval by the Engineer prior to installation.

2.5 Alarm Annunciators

- 2.5.1 Unless otherwise indicated, alarm annunciators shall be of the plug-in relay type and shall be configured of single-alarm modules in an arrangement as indicated on the Drawings or as otherwise directed by the Engineer.
- 2.5.2 Each module shall be engraved as indicated on the Drawings or as otherwise directed by the Engineer.
- 2.5.3 The relay annunciator modules shall be individually removable from the front of the unit. Input and output terminals shall be accessible from the rear of the unit.
- 2.5.4 Relays shall be hermetically sealed and shall be securely held in place by retaining clips or other means approved by the Engineer. Relays shall have silver/silver alloy contacts rated not less than 2 amperes at 120 volts. Each alarm module shall produce at least one isolated double throw auxiliary contact for remote connection.
- 2.5.5 The annunciator shall operate in a "Sequence A" flashing mode as follows:

(a) The control logic selectable to incorporate lock-in or non-lock-in alarm activation. Lock-in selection shall maintain alarm status until the alarm has been acknowledged by depressing the acknowledge pushbutton at the annunciator. Non-lock-in selection shall permit alarm status to return to the normal off condition as soon as the alarm input is cleared.

(b)	<u>Condition</u>	<u>Nameplate Status</u>
	Normal	Off
	Alarm	Flashing
	Acknowledge	Steady On
	Normal (clear)	Off
	Lamp Test	Steady On

- 2.5.6 Each alarm window shall be illuminated with not less than two long-life lamps which shall be easily accessible for replacement.

- 2.5.7 Each annunciator shall be complete with an integral flasher unit. Alarm logic, such as for the flasher, shall be solid state. The flasher shall not occupy a designated alarm module, i.e., if twelve alarm positions are shown, all shall be useable for alarms.
 - 2.5.8 Unless otherwise indicated, annunciators shall have provisions for an audible alarm and silence upon alarm "acknowledge" condition for possible future addition of an audible alarm.
 - 2.5.9 Each unit shall be complete with "ACKNOWLEDGE" and "LAMP TEST" pushbutton functions, with heavy duty oil-tight pushbuttons mounted adjacent to the alarm windows.
 - 2.5.10 Each annunciator shall be equipped with a power monitor relay to monitor the power supply to the unit, complete with a DPDT contact rated not less than 2 amperes at 120 volts for remote connection.
 - 2.5.11 Unless otherwise indicated, annunciators shall operate from a 120 volt, 60 Hz supply.
 - 2.5.12 Unless otherwise indicated, annunciators shall be flush panel mounted.
 - 2.5.13 Blank alarm module units shall be fully equipped for alarms, complete with relays and logic.
 - 2.5.14 After power failure all alarm output contacts shall remain in the original positions just before the power failure.
 - 2.5.15 For uniformity among stations, alarm annunciators shall be Ronan Model X3-1010, Panalarm Series 10, De-Lins Model 11, or approved equal.
- 2.6 Combustible Gas Detection System (Gasoline)
- 2.6.1 The combustible gas detection system shall be a central gas monitoring system capable of continuously monitoring ambient air for gasoline at locations as shown on the drawings, using remote gas sensor/transmitters designed to measure the concentrations of gasoline.
 - 2.6.2 The combustible gas detection system shall operate on the catalytic oxidation principle, and shall be Model 5300 as manufactured by Mine Safety Appliances Company, or approved equal.
 - 2.6.3 The gas detection system shall measure and display gas concentration. The system shall provide identifiable audible and visual alarms when preset limits are exceeded. Relays for different alarm setpoint levels shall be provided for alarms and ventilation controls.
 - 2.6.4 The system shall consist of three (3) 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 six(6) 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.

- 2.6.5 The combustible gas monitor/readout unit shall be of the panel mounted type suitable for flush mounting in the door of Control Panel CP21 as shown. 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.
- 2.6.6 Alarms and relays at the monitoring/readout unit shall be set for the following levels of gas concentration:
- (a) Gasoline "WARNING" alarm - 20% LEL
 - (b) Gasoline "ALARM" - 50% LEL
- 2.6.7 The combustible gas sensor/transmitter shall be of the catalytic bead type sensing element with 3-wire LDL signal transmitting electronic circuit designed to monitor the presence of petroleum in the ambient air. The transmitter circuit shall produce a 4 to 9 kHz frequency output signal proportional to 0 to 100% LDL and shall be mounted in an explosion proof conduit 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. The sensing element shall have 1-year minimum operating life and shall be replaceable without opening the enclosure. A non-intrusive hand held wireless remote infrared controller unit shall be provided for sensor calibration, clocking setting, Min/Max gas value and date of last calibration display. Installation, set-up, calibration and start-up of the sensor unit shall not require opening of the sensor/transmitter enclosure.
- 2.6.8 In response to a WARNING or ALARM signal from the gas detection system, due to a high concentration of gasoline in the monitored space, an explosion-proof horn in the Pump Room shall be energized. The ventilation system for the monitored space shall be activated. The horn shall be provided.
- 2.6.9 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.
- 2.6.10 Spare parts shall be provided for the air monitoring equipment as follows:
- One set of fuses, one sensor head assembly and one sensor.

- 2.6.11 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.
- 2.6.12 The combustible gas detection system shall include a locally mounted gas monitor unit, controller, calibration tube box, calibration kit and a remote gas sensor capable of continuously monitoring ambient air for gasoline concentration inside the wet well as shown on the drawings and remote calibration.
- 2.6.13 The combustible gas sensor shall be of the diffusion type, catalytic bead sensing element mounted in a Class I, Division 1, Group B, C & D explosion proof stainless steel enclosure for monitoring the presence of petroleum in the ambient air. Sensor unit shall receive power from and send signals corresponding to gas values to the monitor unit. The sensor shall be remotely mounted from the monitor. A calibration sample tube shall be connected to the sensor. 50 feet of sensor cable and sample tubing shall be connected to the sensor. The sensing element shall have 1-year minimum operating life
- 2.6.14 The calibration tube box shall be a 6"x4"x4" stainless steel continuous hinge type 4X enclosure with a stainless steel or brass female quick connector for ¼" tubing and a protector plug or cap mounted on one side of the box.
- 2.6.15 15A non-intrusive hand held wireless remote infrared controller unit shall be provided for sensor calibration, clocking setting, Min/Max gas value and date of last calibration display. Installation, set-up, calibration and start-up of the sensor unit shall not require opening of the sensor/transmitter enclosure.

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 The modification, demolition and installation of the SCADA equipment shall be scheduled to minimize interruption of automatic operation and monitoring of the pumping system. The contractor shall submit a detailed schedule for IDOT's approval.

3.3 System Testing

- 3.3.1 System Testing and Start-up including the following, shall be provided as specified under provisions of Section 1A.
- 3.3.2 System Shop Tests

- (a) The Contractor shall be able to simulate the present SCADA system within his shop. Shop testing shall include, but not necessarily be limited to, the following:
 - (b) Manually fill-in required additions to data base.
 - (c) Manual forcing of outputs.
 - (d) Operation of the control programs.
 - (e) Recall of simulated data points on the LCD displays and printers.
 - (f) Recall of all reports with partial fill-in data and manual fill-in data at time of testing.
 - (g) Routing testing of logger, alarm printer and LCD displays based upon manual input data.
 - (h) Change of alarm and limit setpoints, etc., and observation of results.
 - (i) Any additional testing which may be found to be necessary at the time the above is observed.
 - (j) 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.
 - (k) Prior to such acceptance tests, the Contractor 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 Contractor will be expected to do all necessary pretrial testing and debugging to ascertain that the system is in running order. After the Contractor has confirmed that the proper responses can be achieved, the date for final shop test may be established.
 - (l) During shop testing, the Contractor shall generate hard copy prints 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 shall be submitted. IDOT reserves the right to be present when shop tests are run.

3.3.3 System Field Tests

- (a) The pre-acceptance test procedures, as outlined in the preceding paragraphs, shall apply. Acceptance testing shall include the following:

- (b) Acknowledge receipt of all analog and contact inputs, their reliability value and range.
- (c) Transmission of contact and analog signals to perform their intended tasks.
- (d) Any additional testing which may be found necessary at the time the above is observed.

3.3.4 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.
- (b) Final acceptance test will be run for 40 days within which cumulative major component down time, consisting of the computer systems and the PLC's, does not exceed 8 hours. Repeat test if 8 hour limit is exceeded.
- (c) Written acceptance by IDOT shall be the starting date of the guarantee period.

4. TRAINING:

4.1 Operator Training

- 4.1.1 Operator training shall be provided at IDOT's facility 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.
- 4.1.2 Training shall include operation of the SCADA system, set up the changes of control logic and set points, initiation of diagnostic routine, set up and revisions of graphic and report format, system shutdown and restart, etc. It shall also include care, maintenance and tuning of the monitor and screens.
- 4.1.3 Upon completion of this program, 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 (2) 3 day (8 hours per day) classes for 2 persons in each class. Training manuals shall be provided.

4.2 Programmer Training

- 4.2.1 The Contractor shall make arrangement for two persons from IDOT District 1 to attend software manufacturers' regular programming classes held by the manufacturers or their representatives. The class shall not be less than 1 week for SCADA HMI software (iFIX) and 1 week for PLC programming (Allen-Bradley PLC). The training course fee shall be paid for by the Contractor. The manufacturer shall have regular training facilities within 40 miles of Main Pumping Station.

4.3 Maintenance Training

- 4.3.1 The Contractor shall provide two 1-day on-site maintenance training classes for 2 persons in each class. The maintenance training may be combined with the OPERATOR TRAINING.

5. GUARANTEE AND ADDITIONAL SERVICES:

- 5.1 All hardware and software furnished under this contract including but not limited to the Microprocessors, accessory peripherals, discrete devices, analog instruments and control devices shall be unconditionally guaranteed for one year from the date of 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 request.

END OF THIS SECTION

DIVISION 16 - ELECTRICAL

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 owner, 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 16B - Basic Electrical Materials and Methods.
- 1.2.4 Section 16D - Supervisory Control and Data Acquisition (SCADA) Equipment.

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 provisions and access and working space requirements.
- (b) Wiring Diagrams for Systems: Show power and control connections and distinguish between factory-installed and field-installed wiring.

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.

1.4.3 Test Results:

- (a) Certified Summary of Prototype Unit Test Report: Submit certified copies of actual prototype unit test report if requested by ENGINEER.
- (b) Certified Test Reports of Components and Accessories: Submit for devices that are equivalent, but not identical, to those tested on prototype unit if requested by ENGINEER.
- (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) Field Test Report.

1.4.3 Operation and Maintenance Data:

- (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.

1.5 Guarantee

- 1.5.1 All electrical equipment shall be guaranteed from all defects of material and workmanship for the manufacturer's standard length of guarantee or for 1 year from the date of final acceptance, 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

PUMP STATION ELECTRICAL WORK

which shall be payment in full for the work described herein.

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 24 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: -15°C to +40°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 105°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 (Contact: Tim O'Connell 708.482.2882).
- (b) Kohler Co (Contact: Guy Gammons 847.956.2165).
- (c) Caterpillar (Contact: Tony Yang: 630.516.4471)

2.1.2 Engine Generator System:

- (a) System is coordinated assembly of compatible components.
- (b) Ratings: 3-ph, 4-wire 277/480v, 60 Hz, 1,500 kW, 1,875 KVA.
- (c) Motor starting KVA of 6716 minimum required to start and operate following load steps without exceeding 20% maximum voltage dip and with return to steady state in less than 2 sec.
 - 1) Step No.1 325 HP Main Pump on reduced voltage starter.
 - 2) Step No.1 100 HP Low Flow Pump on reduced voltage starter.
 - 3) Step No.1 30 KVA lighting transformer.
 - 4) Step No.1 2 HP Trash Rack.
 - 5) Step No.1 3/4 HP Exhaust Fan.
 - 6) Step No.1 2 HP Slide Gate.
 - 7) Step No.1 20 KW Unit Heater.
 - 8) Step No.1 1.5 HP Air Compressor.

 - 9) Step No.2 325 HP Main Pump on reduced voltage starter.
 - 10) Step No.2 100 HP Low Flow Pump on reduced voltage starter.
 - 11) Step No.2 1.5 HP Exhaust Fan.
 - 12) Step No.2 2 HP Slide Gate.
 - 13) Step No.2 7.5 KW Unit Heater.
 - 14) Step No.2 20 KW Unit Heater.

 - 15) Step No.3 7.5 HP Supply Fan.
 - 16) Step No.3 2 HP Slide Gate.
 - 17) Step No.3 12.5 KW Unit Heater.
 - 18) Step No.3 20 KW Unit Heater.

 - 19) Step No.4 7.5 HP Exhaust Fan.
 - 20) Step No.4 20 KW Unit Heater.
- (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: 208.
 - 2) Watts: 6,500.
 - 3) Quantity: 2.
- (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 24 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 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 16B-2.8. 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) Ac Voltmeter.
 - 2) Ac Ammeter.
 - 3) Ac Frequency Meter.
 - 4) Dc Voltmeter (Alternator Battery Charging).
 - 5) Engine Coolant Temperature Gage.
 - 6) Engine-Lubricating Oil Pressure Gage.
 - 7) Running Time Meter.
 - 8) Ammeter/Voltmeter Phase Selector Switch or Switches.
 - 9) Generator Voltage-Adjusting Rheostat.
 - 10) 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 Audible Alarms: Conform to NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Locate audible device and silencing means where indicated.
 - 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) 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 communication capability. Data system connections to terminals are covered in another Section.
 - 1) Separate terminal block factory-wired to Form C dry contacts for each alarm.

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: Drip-proof.
- (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. Enclosure shall be sized to allow access to transformer and auxiliary power panel, "skin-tight" enclosure is not acceptable.
- (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) Incandescent light fixtures with wire guards shall be provided inside enclosure. Fixtures shall be factory wired to a light switch and auxiliary power panel. Coordinate light switch position with access panels and locate near generator control panel.
- (g) Two duplex receptacles shall be provided inside enclosure and factory wired to auxiliary power panel. One receptacle shall be located next to light switch with the second located on the opposite side of the enclosure near an access panel.
- (h) A step down transformer and an auxiliary power panel shall be provided to supply power to the engine generator set's auxiliary devices such as battery charger, jacket water heaters, lighting, maintenance receptacles, etc. The auxiliary power panel shall be 120/208 3-phase, with main breakers and sufficient branch breakers plus 2 spares. A 480V 3-phase power feeder will be provided for the transformer, feeder size shall be coordinated with feeder breaker in power panel in pump station. Devices within enclosure and provided with generator set shall be factory wired to auxiliary power panel.

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.
 - 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 OWNER and ENGINEER.
- 7) Report test results within 10 days of completion of tests.

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.

3.4 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.

END OF THIS SECTION

ALKALI-SILICA REACTION FOR CAST-IN-PLACE CONCRETE (BDE)

Effective: August 1, 2007

Revised: January 1, 2009

Description. This special provision is intended to reduce the risk of a deleterious alkali-silica reaction in concrete exposed to humid or wet conditions. The special provision is not intended or adequate for concrete exposed to potassium acetate, potassium formate, sodium acetate or sodium formate. The special provision shall not apply to the dry environment (humidity less than 60 percent) found inside buildings for residential or commercial occupancy. The special provision shall also not apply to precast products or precast prestressed products.

Aggregate Expansion Values. Each coarse and fine aggregate will be tested by the Department for alkali reaction according to ASTM C 1260. The test will be performed with Type I or II cement having a total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of 0.90 percent or greater. The Engineer will determine the assigned expansion value for each aggregate, and these values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.05 percent will be assigned to limestone or dolomite coarse aggregates and 0.03 percent to limestone or dolomite fine aggregates (manufactured stone sand); however the Department reserves the right to perform the ASTM C 1260 test.

Aggregate Groups. Each combination of aggregates used in a mixture will be assigned to an aggregate group. The point at which the coarse aggregate and fine aggregate expansion values intersect in the following table will determine the group.

AGGREGATE GROUPS			
Coarse Aggregate or Coarse Aggregate Blend ASTM C 1260 Expansion	Fine Aggregate or Fine Aggregate Blend ASTM C 1260 Expansion		
	≤ 0.16%	> 0.16% - 0.27%	> 0.27%
≤ 0.16%	Group I	Group II	Group III
> 0.16% - 0.27%	Group II	Group II	Group III
> 0.27%	Group III	Group III	Group IV

Mixture Options. Based upon the aggregate group, the following mixture options shall be used; however, the Department may prohibit a mixture option if field performance shows a deleterious alkali-silica reaction or Department testing indicates the mixture may experience a deleterious alkali-silica reaction.

- Group I - Mixture options are not applicable. Use any cement or finely divided mineral.
- Group II - Mixture options 1, 2, 3, 4, or 5 shall be used.
- Group III - Mixture options 1, 2 and 3 combined, 4, or 5 shall be used.
- Group IV - Mixture options 1, 2 and 4 combined, or 5 shall be used.

For Class PP-3 concrete the mixture options are not applicable, and any cement may be used with the specified finely divided minerals.

- a) Mixture Option 1. The coarse or fine aggregates shall be blended to place the material in a group that will allow the selected cement or finely divided mineral to be used.

When a coarse or fine aggregate is blended, the weighted expansion value shall be calculated separately for the coarse and fine aggregate as follows:

$$\text{Weighted Expansion Value} = (a/100 \times A) + (b/100 \times B) + (c/100 \times C) + \dots$$

Where: a, b, c... = percentage of aggregate in the blend;
A, B, C...= expansion value for that aggregate.

- b) Mixture Option 2. A finely divided mineral shall be used as described in 1), 2), 3), or 4) that follow. The replacement ratio is defined as "finely divided mineral:portland cement".

1) Class F Fly Ash. For Class PV, BS, MS, DS, SC, and SI concrete and cement aggregate mixture II (CAM II), Class F fly ash shall replace 15 percent of the portland cement at a minimum replacement ratio of 1.5:1.

2) Class C Fly Ash. For Class PV, MS, SC, and SI Concrete, Class C fly ash with 18 percent to less than 26.5 percent calcium oxide content, and less than 2.0 percent loss on ignition, shall replace 20 percent of the portland cement at a minimum replacement ratio of 1:1; or at a minimum replacement ratio of 1.25:1 if the loss on ignition is 2.0 percent or greater. Class C fly ash with less than 18 percent calcium oxide content shall replace 20 percent of the portland cement at a minimum replacement ratio of 1.25:1.

For Class PP-1, RR, BS, and DS concrete and CAM II, Class C fly ash with less than 26.5 percent calcium oxide content shall replace 15 percent of the portland cement at a minimum replacement ratio of 1.5:1.

3) Ground Granulated Blast-Furnace Slag. For Class PV, BS, MS, SI, DS, and SC concrete, ground granulated blast-furnace slag shall replace 25 percent of the portland cement at a minimum replacement ratio of 1:1.

For Class PP-1 and RR concrete, ground granulated blast-furnace slag shall replace 15 percent of the portland cement at a minimum replacement ratio of 1.5:1.

For Class PP-2, ground granulated blast-furnace slag shall replace 25 to 30 percent of the portland cement at a minimum replacement ratio of 1:1.

4) Microsilica or High Reactivity Metakaolin. Microsilica solids or high reactivity metakaolin shall be added to the mixture at a minimum 25 lb/cu yd (15 kg/cu m) or 27 lb/cu yd (16 kg/cu m) respectively.

- c) Mixture Option 3. The cement used shall have a maximum total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of 0.60 percent. When aggregate in Group II is involved, any finely divided mineral may be used with a portland cement.

- d) Mixture Option 4. The cement used shall have a maximum total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of 0.45 percent. When aggregate in Group II or III is involved, any finely divided mineral may be used with a portland cement.
- e) Mixture Option 5. The proposed cement or finely divided mineral may be used if the ASTM C 1567 expansion value is ≤ 0.16 percent when performed on the aggregate in the concrete mixture with the highest ASTM C 1260 test result. The ASTM C 1567 test will be valid for two years, unless the Engineer determines the materials have changed significantly. For latex concrete, the ASTM C 1567 test shall be performed without the latex. The 0.20 percent autoclave expansion limit in ASTM C 1567 shall not apply.

If during the two year time period the Contractor needs to replace the cement, and the replacement cement has an equal or lower total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$), a new ASTM C 1567 test will not be required.

Testing. If an individual aggregate has an ASTM C 1260 expansion value > 0.16 percent, an ASTM C 1293 test may be performed by the Contractor to evaluate the Department's ASTM C 1260 test result. The ASTM C 1293 test shall be performed with Type I or II cement having a total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of 0.80 percent or greater. The interior vertical wall of the ASTM C 1293 recommended container (pail) shall be half covered with a wick of absorbent material consisting of blotting paper. If the testing laboratory desires to use an alternate container or wick of absorbent material, ASTM C 1293 test results with an alkali-reactive aggregate of known expansion characteristics shall be provided to the Engineer for review and approval. If the expansion is less than 0.040 percent after one year, the aggregate will be assigned an ASTM C 1260 expansion value of 0.08 percent that will be valid for two years, unless the Engineer determines the aggregate has changed significantly.

The Engineer reserves the right to verify a Contractor's ASTM C 1293 or 1567 test result. The Engineer will not accept the result if the precision and bias for the test methods are not met.

The laboratory performing the ASTM C 1567 test shall either be accredited by the AASHTO Materials Reference Laboratory (AMRL) for ASTM C 227 under Portland Cement Concrete or Aggregate; or shall be inspected for Hydraulic Cement - Physical Tests by the Cement and Concrete Reference Laboratory (CCRL) and shall be approved by the Department. The laboratory performing the ASTM C 1293 test shall be inspected for Portland Cement Concrete by CCRL and shall be approved by the Department.

APPROVAL OF PROPOSED BORROW AREAS, USE AREAS, AND/OR WASTE AREAS (BDE)

Effective: November 1, 2008

Revised: November 1, 2010

Replace the first paragraph of Article 107.22 of the Standard Specifications with the following:

"All proposed borrow areas, including commercial borrow areas; use areas, including, but not limited to temporary access roads, detours, runarounds, plant sites, and staging and storage areas; and/or waste areas are to be designated by the Contractor to the Engineer and approved prior to their use. Such areas outside the State of Illinois shall be evaluated, at no additional cost to the Department, according to the requirements of the state in which the area lies; and approval by the authority within that state having jurisdiction for such areas shall be forwarded to the Engineer. Such areas within Illinois shall be evaluated as described herein.

A location map delineating the proposed borrow area, use area, and/or waste area shall be submitted to the Engineer for approval along with an agreement from the property owner granting the Department permission to enter the property and conduct cultural and biological resource reconnaissance surveys of the site for archaeological resources, threatened or endangered species or their designated essential habitat, wetlands, prairies, and savannahs. The type of location map submitted shall be a topographic map, a plat map, or a 7.5 minute quadrangle map. Submittals shall include the intended use of the site and provide sufficient detail for the Engineer to determine the extent of impacts to the site. The Engineer will initiate cultural and biological resource reconnaissance surveys of the site, as necessary, at no cost to the Contractor. The Engineer will advise the Contractor of the expected time required to complete all surveys. If the proposed area is within 150 ft (45 m) of the highway right-of-way, a topographic map of the proposed site will be required as specified in Article 204.02.”

CEMENT (BDE)

Effective: January 1, 2007

Revised: April 1, 2009

Revise Section 1001 of the Standard Specifications to read:

“SECTION 1001. CEMENT

1001.01 Cement Types. Cement shall be according to the following.

- (a) Portland Cement. Acceptance of portland cement shall be according to the current Bureau of Materials and Physical Research’s Policy Memorandum, “Portland or Blended Cement Acceptance Procedure for Qualified and Non-Qualified Plants”.

Portland cement shall be according to ASTM C 150, and shall meet the standard physical and chemical requirements. Type I or Type II may be used for cast-in-place, precast, and precast prestressed concrete. Type III may be used according to Article 1020.04, or when approved by the Engineer. All other cements referenced in ASTM C 150 may be used when approved by the Engineer.

The total of all organic processing additions shall be a maximum of 1.0 percent by weight (mass) of the cement. The total of all inorganic processing additions shall be a maximum of 4.0 percent by weight (mass) of the cement. However, a cement kiln dust inorganic processing addition shall be limited to a maximum of 1.0 percent. Organic processing additions shall be limited to grinding aids that improve the flowability of cement, reduce pack set, and improve grinding efficiency. Inorganic processing additions shall be limited to granulated blast-furnace slag according to the chemical requirements of AASHTO M 302, Class C fly ash according to the chemical requirements of AASHTO M 295, and cement kiln dust.

- (b) Portland-Pozzolan Cement. Acceptance of portland-pozzolan cement shall be according to the current Bureau of Materials and Physical Research’s Policy Memorandum, “Portland or Blended Cement Acceptance Procedure for Qualified and Non-Qualified Plants”.

Portland-pozzolan cement shall be according to ASTM C 595 and shall meet the standard physical and chemical requirements.

Type IP may be used for cast-in-place, precast, and precast prestressed concrete, except when Class PP concrete is used. The pozzolan constituent for Type IP shall be a maximum of 21 percent of the weight (mass) of the portland-pozzolan cement.

For cast-in-place construction, portland-pozzolan cement shall not be used in concrete mixtures when the air temperature is below 40 °F (4 °C) without permission of the Engineer. If permission is given, the mix design strength requirement may require the Contractor to increase the cement or eliminate the cement factor reduction for a water-reducing or high range water-reducing admixture which is permitted according to Article 1020.05(b).

The total of all organic processing additions shall be a maximum of 1.0 percent by weight (mass) of the cement. Organic processing additions shall be limited to grinding aids as defined in (a) above. Inorganic processing additions shall be limited to cement kiln dust at a maximum of 1.0 percent.

- (c) Portland Blast-Furnace Slag Cement. Acceptance of portland blast-furnace slag cement shall be according to the current Bureau of Materials and Physical Research's Policy Memorandum, "Portland or Blended Cement Acceptance Procedure for Qualified and Non-Qualified Plants".

Portland blast-furnace slag cement shall be according to ASTM C 595 and shall meet the standard physical and chemical requirements. Type IS portland blast-furnace slag cement may be used for cast-in-place, precast, and precast prestressed concrete, except when Class PP concrete is used. The blast-furnace slag constituent for Type IS shall be a maximum of 25 percent of the weight (mass) of the portland blast-furnace slag cement.

For cast-in-place construction, portland blast-furnace slag cement shall not be used in concrete mixtures when the air temperature is below 40 °F (4 °C) without permission of the Engineer. If permission is given, the mix design strength requirement may require the Contractor to increase the cement or eliminate the cement factor reduction for a water-reducing or high range water-reducing admixture which is permitted according to Article 1020.05(b).

The total of all organic processing additions shall be a maximum of 1.0 percent by weight (mass) of the cement. Organic processing additions shall be limited to grinding aids as defined in (a) above. Inorganic processing additions shall be limited to cement kiln dust at a maximum of 1.0 percent.

- (d) Rapid Hardening Cement. Rapid hardening cement shall be used according to Article 1020.04 or when approved by the Engineer. The cement shall be on the Department's current "Approved List of Packaged, Dry, Rapid Hardening Cementitious Materials for Concrete Repairs", and shall be according to the following.

- (1) The cement shall have a maximum final set of 25 minutes, according to Illinois Modified ASTM C 191.
- (2) The cement shall have a minimum compressive strength of 2000 psi (13,800 kPa) at 3.0 hours, 3200 psi (22,100 kPa) at 6.0 hours, and 4000 psi (27,600 kPa) at 24.0 hours, according to Illinois Modified ASTM C 109.

- (3) The cement shall have a maximum drying shrinkage of 0.050 percent at seven days, according to Illinois Modified ASTM C 596.
- (4) The cement shall have a maximum expansion of 0.020 percent at 14 days, according to Illinois Modified ASTM C 1038.
- (5) The cement shall have a minimum 80 percent relative dynamic modulus of elasticity; and shall not have a weight (mass) gain in excess of 0.15 percent or a weight (mass) loss in excess of 1.0 percent, after 100 cycles, according to AASHTO T 161, Procedure B.

(e) Calcium Aluminate Cement. Calcium aluminate cement shall be used only where specified by the Engineer. The cement shall meet the standard physical requirements for Type I cement according to ASTM C 150, except the time of setting shall not apply. The chemical requirements shall be determined according to ASTM C 114 and shall be as follows: minimum 38 percent aluminum oxide (Al_2O_3), maximum 42 percent calcium oxide (CaO), maximum 1 percent magnesium oxide (MgO), maximum 0.4 percent sulfur trioxide (SO_3), maximum 1 percent loss on ignition, and maximum 3.5 percent insoluble residue.

1001.02 Uniformity of Color. Cement contained in single loads or in shipments of several loads to the same project shall not have visible differences in color.

1001.03 Mixing Brands and Types. Different brands or different types of cement from the same manufacturing plant, or the same brand or type from different plants shall not be mixed or used alternately in the same item of construction unless approved by the Engineer.

1001.04 Storage. Cement shall be stored and protected against damage, such as dampness which may cause partial set or hardened lumps. Different brands or different types of cement from the same manufacturing plant, or the same brand or type from different plants shall be kept separate.”

CONCRETE ADMIXTURES (BDE)

Effective: January 1, 2003

Revised: April 1, 2009

Replace the first paragraph of Article 1020.05(b) of the Standard Specifications to read:

“(b) Admixtures. The use of admixtures to increase the workability or to accelerate the hardening of the concrete will be permitted when approved by the Engineer. Admixture dosages shall result in the mixture meeting the specified plastic and hardened properties. The Department will maintain an Approved List of Corrosion Inhibitors. Corrosion inhibitor dosage rates shall be according to Article 1020.05(b)(12). The Department will also maintain an Approved List of Concrete Admixtures, and an admixture technical representative shall be consulted when determining an admixture dosage from this list. The dosage shall be within the range indicated on the approved list unless the influence by other admixtures, jobsite conditions (such as a very short haul time), or other circumstances warrant a dosage outside the range. The Engineer shall be notified when a dosage is proposed outside the range. To determine an admixture dosage, air temperature, concrete temperature, cement source and quantity, finely divided mineral sources(s) and quantity, influence of other admixtures, haul time, placement conditions, and other factors as appropriate shall be considered.

The Engineer may request the Contractor to have a batch of concrete mixed in the lab or field to verify the admixture dosage is correct. An admixture dosage or combination of admixture dosages shall not delay the initial set of concrete by more than one hour. When a retarding admixture is required or appropriate for a bridge deck or bridge deck overlay pour, the initial set time shall be delayed until the deflections due to the concrete dead load are no longer a concern for inducing cracks in the completed work. However, a retarding admixture shall not be used to further extend the pour time and justify the alteration of a bridge deck pour sequence.

When determining water in admixtures for water/cement ratio, the Contractor shall calculate 70 percent of the admixture dosage as water, except a value of 50 percent shall be used for a latex admixture used in bridge deck latex concrete overlays.”

Revise Section 1021 of the Standard Specifications to read:

“SECTION 1021. CONCRETE ADMIXTURES

1021.01 General. Admixtures shall be furnished in liquid form ready for use. The admixtures shall be delivered in the manufacturer's original containers, bulk tank trucks or such containers or tanks as are acceptable to the Engineer. Delivery shall be accompanied by a ticket which clearly identifies the manufacturer and trade name of the material. Containers shall be readily identifiable as to manufacturer and trade name of the material they contain.

Corrosion inhibitors will be maintained on the Department's Approved List of Corrosion Inhibitors. All other concrete admixture products will be maintained on the Department's Approved List of Concrete Admixtures. For the admixture submittal, a report prepared by an independent laboratory accredited by the AASHTO Materials Reference Laboratory (AMRL) for Portland Cement Concrete shall be provided. The report shall show the results of physical tests conducted no more than five years prior to the time of submittal, according to applicable specifications. However, for corrosion inhibitors the ASTM G 109 test information specified in ASTM C 1582 is not required to be from an independent lab. All other information in ASTM C 1582 shall be from an independent lab.

Tests shall be conducted using materials and methods specified on a "test" concrete and a "reference" concrete, together with a certification that no changes have been made in the formulation of the material since the performance of the tests. Per the manufacturer's option, the cement content for all required tests shall either be according to applicable specifications or 5.65 cwt/cu yd (335 kg/cu m). Compressive strength test results for six months and one year will not be required.

Prior to the approval of an admixture, the Engineer reserves the right to request a sample for testing. The test and reference concrete mixtures tested by the Engineer will contain a cement content of 5.65 cwt/cu yd (335 kg/cu m). For freeze-thaw testing, the Department will perform the test according to AASHTO T 161, Procedure B. The flexural strength test will be performed according to AASHTO T 177. If the Engineer decides to test the admixture, the manufacturer shall submit AASHTO T 197 water content and set time test results on the standard cement used by the Department. The test and reference concrete mixture shall contain a cement content of 5.65 cwt/cu yd (335 kg/cu m). The manufacturer may select their lab or an independent lab to perform this testing. The laboratory is not required to be accredited by AASHTO.

The manufacturer shall include in the submittal the following admixture information: the manufacturing range for specific gravity, the midpoint and manufacturing range for residue by oven drying, and the manufacturing range for pH. The submittal shall also include an infrared spectrophotometer trace no more than five years old.

For air-entraining admixtures according to Article 1021.02, the specific gravity allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM C 494. For residue by oven drying and pH, the allowable manufacturing range and test methods shall be according to ASTM C 260.

For admixtures according to Articles 1021.03, 1021.04, 1021.05, 1021.06, and 1021.07, the pH allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM E 70. For specific gravity and residue by oven drying, the allowable manufacturing range and test methods shall be according to ASTM C 494.

When test results are more than seven years old, the manufacturer shall re-submit the infrared spectrophotometer trace and the report prepared by an independent laboratory accredited by AASHTO.

All admixtures, except chloride-based accelerators, shall contain a maximum of 0.3 percent chloride by weight (mass).

Random field samples may be taken by the Department to verify an admixture meets specification. A split sample will be provided to the manufacturer if requested. Admixtures that do not meet specification requirements or an allowable manufacturing range established by the manufacturer shall be replaced with new material.

1021.02 Air-Entraining Admixtures. Air-entraining admixtures shall be according to AASHTO M 154.

1021.03 Retarding and Water-Reducing Admixtures. The admixture shall be according to the following.

- (a) The retarding admixture shall be according to AASHTO M 194, Type B (retarding) or Type D (water-reducing and retarding).
- (b) The water-reducing admixture shall be according to AASHTO M 194, Type A.
- (c) The high range water-reducing admixture shall be according to AASHTO M 194, Type F (high range water-reducing) or Type G (high range water-reducing and retarding).

1021.04 Accelerating Admixtures. The admixture shall be according to AASHTO M 194, Type C (accelerating) or Type E (water reducing and accelerating).

1021.05 Self-Consolidating Admixtures. The self-consolidating admixture system shall consist of either a high range water-reducing admixture only or a high range water-reducing admixture combined with a separate viscosity modifying admixture. The one or two component admixture system shall be capable of producing a concrete mixture that can flow around reinforcement and consolidate under its own weight without additional effort and without segregation.

The high range water-reducing admixture shall be according to AASHTO M 194, Type F.

The viscosity modifying admixture shall be according to ASTM C 494, Type S (specific performance).

1021.06 Rheology-Controlling Admixture. The rheology-controlling admixture shall be capable of producing a concrete mixture with a lower yield stress that will consolidate easier for slipform applications used by the Contractor. The rheology-controlling admixture shall be according to ASTM C 494, Type S (specific performance).

1021.07 Corrosion Inhibitor. The corrosion inhibitor shall be according to one of the following.

- (a) Calcium Nitrite. The corrosion inhibitor shall contain a minimum 30 percent calcium nitrite by weight (mass) of solution, and shall comply with the requirements of AASHTO M 194, Type C (accelerating).
- (b) Other Materials. The corrosion inhibitor shall be according to ASTM C 1582.”

CONSTRUCTION AIR QUALITY – DIESEL RETROFIT (BDE)

Effective: June 1, 2010

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/otaq/retrofit/verif-list.htm>), or verified by the California Air Resources Board (CARB) (<http://www.arb.ca.gov/diesel/verde/verdev.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.

CONSTRUCTION AIR QUALITY - DIESEL VEHICLE EMISSIONS CONTROL (BDE)

Effective: April 1, 2009

Revised: July 1, 2009

Diesel Vehicle Emissions Control. The reduction of construction air emissions shall be accomplished by using cleaner burning diesel fuel. The term "equipment" refers to any and all diesel fuel powered devices rated at 50 hp and above, to be used on the project site in excess of seven calendar days over the course of the construction period on the project site (including any "rental" equipment).

All equipment on the jobsite, with engine ratings of 50 hp and above, shall be required to: use Ultra Low Sulfur Diesel fuel (ULSD) exclusively (15 ppm sulfur content or less).

Diesel powered equipment in non-compliance will not be allowed to be used on the project site, and is also subject to a notice of non-compliance as outlined below.

The Contractor shall submit copies of monthly summary reports and include certified copies of the ULSD diesel fuel delivery slips for diesel fuel delivered to the jobsite for the reporting time period, noting the quantity of diesel fuel used.

If any diesel powered equipment is found to be in non-compliance with any portion of this specification, the Engineer will issue the Contractor a notice of non-compliance and identify an appropriate period of time, as outlined below under environmental deficiency deduction, in which to bring the equipment into compliance or remove it from the project site.

Any costs associated with bringing any diesel powered equipment into compliance with these diesel vehicle emissions controls 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 also not be grounds for a claim.

Environmental Deficiency Deduction. When the Engineer is notified, or determines that an environmental control deficiency exists, he/she will notify the Contractor in writing, and direct the Contractor to correct the deficiency within a specified time period. The specified time-period, which begins upon Contractor notification, will be from 1/2 hour to 24 hours long, based on the urgency of the situation and the nature of the deficiency. The Engineer shall be the sole judge regarding the time period.

The deficiency will be based on lack of repair, maintenance and diesel vehicle emissions control.

If the Contractor fails to correct the deficiency within the specified time frame, 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.

If a Contractor or subcontractor accumulates three environmental deficiency deductions 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 contract time, waiver of penalties, or be grounds for any claim.

CONSTRUCTION AIR QUALITY - IDLING RESTRICTIONS (BDE)

Effective: April 1, 2009

Idling Restrictions. The Contractor shall establish truck-staging areas for all diesel powered vehicles that are waiting to load or unload material at the jobsite. Staging areas shall be located where the diesel emissions from the equipment will have a minimum impact on adjacent sensitive receptors. The Department will review the selection of staging areas, whether within or outside the existing highway right-of-way, to avoid locations near sensitive areas or populations to the extent possible. Sensitive receptors include, but are not limited to, hospitals, schools, residences, motels, hotels, daycare facilities, elderly housing and convalescent facilities. Diesel powered engines shall also be located as far away as possible from fresh air intakes, air conditioners, and windows. The Engineer will approve staging areas before implementation.

Diesel powered vehicle operators may not cause or allow the motor vehicle, when it is not in motion, to idle for more than a total of 10 minutes within any 60 minute period, except under any of the following circumstances:

- 1) The motor vehicle has a gross vehicle weight rating of less than 8000 lb (3630 kg).
- 2) The motor vehicle idles while forced to remain motionless because of on-highway traffic, an official traffic control device or signal, or at the direction of a law enforcement official.
- 3) The motor vehicle idles when operating defrosters, heaters, air conditioners, or other equipment solely to prevent a safety or health emergency.
- 4) A police, fire, ambulance, public safety, other emergency or law enforcement motor vehicle, or any motor vehicle used in an emergency capacity, idles while in an emergency or training mode and not for the convenience of the vehicle operator.
- 5) The primary propulsion engine idles for maintenance, servicing, repairing, or diagnostic purposes if idling is necessary for such activity.
- 6) A motor vehicle idles as part of a government inspection to verify that all equipment is in good working order, provided idling is required as part of the inspection.
- 7) When idling of the motor vehicle is required to operate auxiliary equipment to accomplish the intended use of the vehicle (such as loading, unloading, mixing, or processing cargo; controlling cargo temperature; construction operations, lumbering operations; oil or gas well servicing; or farming operations), provided that this exemption does not apply when the vehicle is idling solely for cabin comfort or to operate non-essential equipment such as air conditioning, heating, microwave ovens, or televisions.
- 8) When the motor vehicle idles due to mechanical difficulties over which the operator has no control.
- 9) The outdoor temperature is less than 32 °F (0 °C) or greater than 80 °F (26 °C).

When the outdoor temperature is greater than or equal to 32 °F (0 °C) or less than or equal to 80 °F (26 °C), a person who operates a motor vehicle operating on diesel fuel shall not cause or allow the motor vehicle to idle for a period greater than 30 minutes in any 60 minute period while waiting to weigh, load, or unload cargo or freight, unless the vehicle is in a line of vehicles that regularly and periodically moves forward.

The above requirements do not prohibit the operation of an auxiliary power unit or generator set as an alternative to idling the main engine of a motor vehicle operating on diesel fuel.

Environmental Deficiency Deduction. When the Engineer is notified, or determines that an environmental control deficiency exists based on non-compliance with the idling restrictions, he/she will notify the Contractor, and direct the Contractor to correct the deficiency.

If the Contractor fails to correct the deficiency a monetary deduction will be imposed. The monetary deduction will be \$1,000.00 for each deficiency identified.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION (BDE)

Effective: September 1, 2000

Revised: January 1, 2010

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.

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. This 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 4.00% 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 forth 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 may 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 web site at www.dot.il.gov.

BIDDING PROCEDURES. Compliance with this Special Provision is a material bidding requirement. The failure of the bidder to comply will render the bid not responsive.

- (a) The bidder shall submit a Disadvantaged Business Utilization Plan on Department forms SBE 2025 and 2026 with the bid.
- (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 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 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 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.

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 the good faith efforts of the bidder 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 commits sufficient commercially useful DBE work performance 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 commit 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.

(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 and 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 why good faith efforts have not been found.

(c) The bidder may request administrative reconsideration of a determination adverse to the bidder within the five working days after 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 and/or argument concerning the issue of whether an adequate good faith effort was made to meet the contract goal. 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 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 it 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 or 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 regular dealer or 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.

- (a) 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) The Contractor must notify and obtain written approval from the Department's Bureau of Small Business Enterprises prior to replacing a DBE or making any change in the participation of a DBE. Approval for replacement will be granted only if it is demonstrated that the DBE is unable or unwilling to perform. The Contractor must make every good faith effort to find another certified DBE subcontractor to substitute for the original DBE. The good faith efforts shall be directed at finding another DBE to perform at least the same amount of work under the contract as the original DBE, to the extent needed to meet the contract goal.
- (c) Any deviation from the DBE condition-of-award or contract specifications must be approved, in writing, by the Department. 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.

(d) 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 reasonably 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) 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, must be signed and submitted.

(f) If the commitment of work is in the form of additional tasks assigned to an existing subcontract, then 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.

(g) All work indicated for performance by an approved DBE shall be performed, managed, and supervised by the DBE executing the Participation Statement. The Contractor shall not terminate for convenience a DBE listed in the Utilization Plan and then perform the work of the terminated DBE with its own forces, those of an affiliate or those of another subcontractor, whether DBE or not, without first obtaining the written consent of the Bureau of Small Business Enterprises to amend the Utilization Plan. The Contractor shall notify the Bureau of Small Business Enterprises of any termination for reasons other than convenience, and shall obtain approval for inclusion of the substitute DBE in the Utilization Plan. If good faith efforts following a termination of a DBE for cause are not successful, the Contractor shall contact the Bureau of Small Business Enterprises and provide a full accounting of the efforts undertaken to obtain substitute DBE participation. The Bureau of Small Business Enterprises will evaluate the good faith efforts in light of all circumstances surrounding the performance status of the contract, and determine whether the contract goal should be amended.

(h) The Contractor shall maintain a record of payments for work performed to the DBE participants. The records shall be made available to the Department for inspection upon request. 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 Regional 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 (j) of this part.

(i) 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.

(j) Notwithstanding any other provision of the contract, including but not limited to Article 109.09 of the Standard Specifications, the Contractor may 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.

ENGINEER'S FIELD OFFICE TYPE A (BDE)

Effective: April 1, 2007

Revised: January 1, 2011

Revise Article 670.02 of the Standard Specifications to read:

"670.02 Engineer's Field Office Type A. Type A field offices shall have a minimum ceiling height of 7 ft (2 m) and a minimum floor space 450 sq ft (42 sq m). The office shall be provided with sufficient heat, natural and artificial light, and air conditioning.

The office shall have an electronic security system that will respond to any breach of exterior doors and windows. Doors and windows shall be equipped with locks. Doors shall also be equipped with dead bolt locks or other secondary locking device.

Windows shall be equipped with exterior screens to allow adequate ventilation. All windows shall be equipped with interior shades, curtains, or blinds. Adequate all-weather parking space shall be available to accommodate a minimum of ten vehicles.

Suitable on-site sanitary facilities meeting Federal, State, and local health department requirements shall be provided, maintained clean and in good working condition, and shall be stocked with lavatory and sanitary supplies at all times.

Sanitary facilities shall include hot and cold potable running water, lavatory and toilet as an integral part of the office where available. Solid waste disposal consisting of two waste baskets and an outside trash container of sufficient size to accommodate a weekly provided pick-up service.

In addition, the following furniture and equipment shall be furnished.

- (a) Four desks with minimum working surface 42 x 30 in. (1.1 m x 750 mm) each and five non-folding chairs with upholstered seats and backs.
- (b) One desk with minimum working surface 48 x 72 in. (1.2 x 1.8 m) with height adjustment of 23 to 30 in. (585 to 750 mm).
- (c) One four-post drafting table with minimum top size of 37 1/2 x 48 in. (950 mm x 1.2 m). The top shall be basswood or equivalent and capable of being tilted through an angle of 50 degrees. An adjustable height drafting stool with upholstered seat and back shall also be provided.
- (d) Two free standing four drawer legal size file cabinet with lock and an underwriters' laboratories insulated file device 350 degrees one hour rating.
- (e) One 6 ft (1.8 m) folding table with six folding chairs.
- (f) One equipment cabinet of minimum inside dimension of 44 in. (1100 mm) high x 24 in. (600 mm) wide x 30 in. (750 mm) deep with lock. The walls shall be of steel with a 3/32 in. (2 mm) minimum thickness with concealed hinges and enclosed lock constructed in such a manner as to prevent entry by force. The cabinet assembly shall be permanently attached to a structural element of the field office in a manner to prevent theft of the entire cabinet.
- (g) One refrigerator with a minimum size of 16 cu ft (0.45 cu m) with a freezer unit.
- (h) One electric desk type tape printing calculator.
- (i) A minimum of two communication paths. The configuration shall include:
 - (1) Internet Connection. An internet service connection using telephone DSL, cable broadband, or CDMA wireless technology. Additionally, an 802.11g/N wireless router shall be provided, which will allow connection by the Engineer and up to four Department staff.
 - (2) Telephone Lines. Three separate telephone lines.
- (j) One plain paper copy machine capable of reproducing prints up to 11 x 17 in. (280 x 432 mm) with an automatic feed tray capable of storing 30 sheets of paper. Letter size and 11 x 17 in. (280 x 432 mm) paper shall be provided.
- (k) One plain paper fax machine with paper.
- (l) Two telephones, with touch tone, where available, and a digital telephone answering machine, for exclusive use by the Engineer.
- (m) One electric water cooler dispenser.
- (n) One first-aid cabinet fully equipped.
- (o) One microwave oven, 1 cu ft (0.03 cu m) minimum capacity.

(p) One fire-proof safe, 0.5 cu ft (0.01 cu m) minimum capacity.

(q) One electric paper shredder.

(r) One post mounted rain gauge, located on the project site for each 5 miles (8 km) of project length.”

Revise the first sentence of the first paragraph of Article 670.07 of the Standard Specifications to read:

“The building or buildings fully equipped as specified will be paid for on a monthly basis until the building or buildings are released by the Engineer.”

Revise the last sentence of the first paragraph of Article 670.07 of the Standard Specifications to read:

“This price shall include all utility costs and shall reflect the salvage value of the building or buildings, equipment, and furniture which become the property of the Contractor after release by the Engineer, except that the Department will pay that portion of the monthly long distance and monthly local telephone bills that, when combined, exceed \$150.”

EQUIPMENT RENTAL RATES (BDE)

Effective: August 2, 2007

Revised: January 2, 2008

Replace the second and third paragraphs of Article 105.07(b)(4)a. of the Standard Specifications with the following:

“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).”

Replace Article 109.04(b)(4) of the Standard Specifications with the following:

“(4) Equipment. Equipment used for extra work shall be authorized by the Engineer. The equipment shall be specifically described, be of suitable size and capacity for the work to be performed, and be in good operating condition. For such equipment, the Contractor will be paid as follows.

- a. Contractor Owned Equipment. Contractor owned equipment will be paid for by the hour using the applicable FHWA hourly rate from the “Equipment Watch Rental Rate Blue Book” (Blue Book) in effect when the force account work begins. The FHWA hourly rate is calculated as follows.

$$\text{FHWA hourly rate} = (\text{monthly rate}/176) \times (\text{model year adj.}) \times (\text{Illinois adj.}) + \text{EOC}$$

Where: EOC = Estimated Operating Costs per hour (from the Blue Book)

The time allowed will be the actual time the equipment is operating on the extra work. For the time required to move the equipment to and from the site of the extra work and any authorized idle (standby) time, payment will be made at the following hourly rate: $0.5 \times (\text{FHWA hourly rate} - \text{EOC})$.

All time allowed shall fall within the working hours authorized for the extra work.

The rates above include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs, overhaul and maintenance of any kind, depreciation, storage, overhead, profits, insurance, and all incidentals. The rates do not include labor.

The Contractor shall submit to the Engineer sufficient information for each piece of equipment and its attachments to enable the Engineer to determine the proper equipment category. If a rate is not established in the Blue Book for a particular piece of equipment, the Engineer will establish a rate for that piece of equipment that is consistent with its cost and use in the industry.

- b. Rented Equipment. Whenever it is necessary for the Contractor to rent equipment to perform extra work, the rental and transportation costs of the equipment plus five percent for overhead will be paid. In no case shall the rental rates exceed those of established distributors or equipment rental agencies.

All prices shall be agreed to in writing before the equipment is used.”

FRICTION AGGREGATE (BDE)

Effective: January 1, 2011

Revise Article 1004.01(a)(4) of the Standard Specifications to read:

- “(4) Crushed Stone. Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
- a. Carbonate Crushed Stone. Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0 percent or more magnesium oxide (MgO). Limestone shall contain less than 11.0 percent magnesium oxide (MgO).
 - b. Crystalline Crushed Stone. Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.”

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	<u>Allowed Alone or in Combination:</u> Gravel Crushed Gravel Carbonate Crushed Stone Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag Crushed Concrete		
HMA All Other	Stabilized Subbase or Shoulders	<u>Allowed Alone or in Combination:</u> 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-25.0, IL-19.0, or IL-19.0L SMA Binder	<u>Allowed Alone or in Combination:</u> 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-12.5,IL-9.5, or IL-9.5L SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination:</u> Crushed Gravel Carbonate Crushed Stone ^{2/} Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) Crushed Steel Slag ^{4/} Crushed Concrete ^{3/}		
HMA High ESAL	D Surface and Leveling Binder IL-12.5 or IL-9.5 SMA Ndesign 50 Surface	<u>Allowed Alone or in Combination:</u> Crushed Gravel Carbonate Crushed Stone (other than Limestone) ^{2/} Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) ^{5/} Crushed Steel Slag ^{4/ 5/} Crushed Concrete ^{3/}		
		<u>Other Combinations Allowed:</u>		
		<table border="1"> <tr> <td><i>Up to...</i></td> <td><i>With...</i></td> </tr> <tr> <td>25% Limestone</td> <td>Dolomite</td> </tr> </table>	<i>Up to...</i>	<i>With...</i>
<i>Up to...</i>	<i>With...</i>			
25% Limestone	Dolomite			

		50% Limestone	Any Mixture D aggregate other than Dolomite
		75% Limestone	Crushed Slag (ACBF) ^{5/} or Crushed Sandstone
HMA High ESAL	E Surface IL-12.5 or IL-9.5 SMA Ndesign 80 Surface	<u>Allowed Alone or in Combination:</u> Crushed Gravel Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) ^{5/} Crushed Steel Slag ^{5/} Crushed Concrete ^{3/} No Limestone.	
		<u>Other Combinations Allowed:</u>	
		<i>Up to...</i>	<i>With...</i>
		50% Dolomite ^{2/}	Any Mixture E aggregate
		75% Dolomite ^{2/}	Crushed Sandstone, Crushed Slag (ACBF) ^{5/} , Crushed Steel Slag ^{5/} , or Crystalline Crushed Stone
		75% Crushed Gravel or Crushed Concrete ^{3/}	Crushed Sandstone, Crystalline Crushed Stone, Crushed Slag (ACBF) ^{5/} , or Crushed Steel Slag ^{5/}
HMA High ESAL	F Surface IL-12.5 or IL-9.5 SMA Ndesign 80 Surface	<u>Allowed Alone or in Combination:</u> Crystalline Crushed Stone Crushed Sandstone Crushed Slag (ACBF) ^{5/} Crushed Steel Slag ^{5/} No Limestone.	
		<u>Other Combinations Allowed:</u>	
		<i>Up to...</i>	<i>With...</i>
		50% Crushed Gravel, Crushed Concrete ^{3/} , or Dolomite ^{2/}	Crushed Sandstone, Crushed Slag (ACBF) ^{5/} , Crushed Steel Slag ^{5/} , or Crystalline Crushed Stone

- 1/ Crushed steel slag allowed in shoulder surface only.
- 2/ Carbonate crushed stone 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 either slag is used, the blend percentages listed shall be by volume.”

HOT-MIX ASPHALT – ANTI-STRIPPING ADDITIVE (BDE)

Effective: November 1, 2009

Revise the first and second paragraphs of Article 1030.04(c) of the Standard Specifications to read:

“(c) Determination of Need for Anti-Stripping Additive. The mixture designer shall determine if an additive is needed in the mix to prevent stripping. The determination will be made on the basis of tests performed according to Illinois Modified AASHTO T 283. To be considered acceptable by the Department as a mixture not susceptible to stripping, the conditioned to unconditioned split tensile strength ratio (TSR) shall be equal to or greater than 0.85 for 6 in. (150 mm) specimens. Mixtures, either with or without an additive, with TSRs less than 0.85 for 6 in. (150 mm) specimens will be considered unacceptable. Also, the conditioned tensile strength for mixtures containing an anti-strip additive shall not be lower than the original conditioned tensile strength determined for the same mixture without the anti-strip additive.

If it is determined that an additive is required, the additive may be hydrated lime, slaked quicklime, or a liquid additive, at the Contractor's option.”

HOT-MIX ASPHALT - DENSITY TESTING OF LONGITUDINAL JOINTS (BDE)

Effective: January 1, 2010

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 2 in. (50 mm), from each pavement edge. (i.e. for a 4 in. (100 mm) lift the near edge of the density gauge or core barrel shall be within 4 in. (100 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 ten feet 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-9.5, IL-12.5	Ndesign ≥ 90	92.0 – 96.0%	90.0%
IL-9.5,IL-9.5L, IL-12.5	Ndesign < 90	92.5 – 97.4%	90.0%
IL-19.0, IL-25.0	Ndesign ≥ 90	93.0 – 96.0%	90.0%
IL-19.0, IL-19.0L, IL-25.0	Ndesign < 90	93.0 – 97.4%	90.0%
SMA	Ndesign = 50 & 80	93.5 – 97.4%	91.0%
All Other	Ndesign = 30	93.0 - 97.4%	90.0%"

HOT-MIX ASPHALT – DROP-OFFS (BDE)

Effective: January 1, 2010

Revise the third paragraph of Article 701.07 of the Standard Specifications to read:

“At locations where construction operations result in a differential in elevation exceeding 3 in. (75 mm) between the edge of pavement or edge of shoulder within 3 ft (900 mm) of the edge of the pavement and the earth or aggregate shoulders, Type I or II barricades or vertical panels shall be placed at 100 ft (30 m) centers on roadways where the posted speed limit is 45 mph or greater and at 50 ft (15 m) centers on roadways where the posted speed limit is less than 45 mph.”

LIQUIDATED DAMAGES (BDE)

Effective: April 1, 2009

Revise the table in Article 108.09 of the Standard Specifications to read:

"Schedule of Deductions for Each Day of Overrun in Contract Time			
Original Contract Amount		Daily Charges	
From More Than	To and Including	Calendar Day	Work Day
\$ 0	\$ 100,000	\$ 375	\$ 500
100,000	500,000	625	875
500,000	1,000,000	1,025	1,425
1,000,000	3,000,000	1,125	1,550
3,000,000	5,000,000	1,425	1,950
5,000,000	10,000,000	1,700	2,350
10,000,000	And over	3,325	4,650"

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM / EROSION AND SEDIMENT CONTROL DEFICIENCY DEDUCTION (BDE)

Effective: April 1, 2007

Revised: November 1, 2009

Revise Article 105.03(a) of the Standard Specifications to read:

“(a) National Pollutant Discharge Elimination System (NPDES) / Erosion and Sediment Control Deficiency Deduction When the Engineer is notified or determines an erosion and/or sediment control deficiency(s) exists, or the Contractor’s activities represents a violation of the Department’s NPDES permits, the Engineer will notify and direct the Contractor to correct the deficiency within a specified time. The specified time, which begins upon notification to the Contractor, will be from 1/2 hour to 1 week based on the urgency of the situation and the nature of the work effort required. The Engineer will be the sole judge.

A deficiency may be any lack of repair, maintenance, or implementation of erosion and/or sediment control devices included in the contract, or any failure to comply with the conditions of the Department’s NPDES permits. A deficiency may also be applied to situations where corrective action is not an option such as the failure to participate in a jobsite inspection of the project, failure to install required measures prior to initiating earth moving operations, disregard of concrete washout requirements, or other disregard of the NPDES permit.

If the Contractor fails to correct a deficiency within the specified time, a daily monetary deduction will be imposed for each calendar day or portion of a calendar day until the deficiency is corrected to the satisfaction of the Engineer. The calendar day(s) will begin with notification to the Contractor and end with the Engineer’s acceptance of the correction. The base value of the daily monetary deduction is \$1000.00 and will be applied to each location for which a deficiency exists. The value of the deficiency deduction assessed for each infraction will be determined by multiplying the base value by a Gravity Adjustment Factor provided in Table A. Except for failure to participate in a required jobsite inspection of the project prior to initiating earthmoving operations which will be based on the total acreage of planned disturbance at the following multipliers: <5 Acres: 1; 5-10 Acres: 2; >10-25 Acres: 3; >25 Acres: 5. For those deficiencies where corrective action was not an option, the monetary deduction will be immediate and will be valued at one calendar day multiplied by a Gravity Adjustment Factor.

Table A Deficiency Deduction Gravity Adjustment Factors				
Types of Violations	Soil Disturbed and Not Permanently Stabilized At Time of Violation			
	< 5 Acres	5 - 10 Acres	>10 - 25 Acres	> 25 Acres
Failure to Install or Properly Maintain BMP	0.1 - 0.5	0.2 - 1.0	0.5 - 2.5	1.0 - 5
Careless Destruction of BMP	0.2 - 1	0.5 - 2.5	1.0 - 5.	1.0 - 5
Intrusion into Protected Resource	1.0 - 5	1.0 - 5	2.0 - 10	2.0 - 10
Failure to properly manage Chemicals, Concrete Washouts or Residuals, Litter or other Wastes	0.2 - 1	0.2 - 1	0.5 - 2.5	1.0 - 5
Improper Vehicle and Equipment Maintenance, Fueling or Cleaning	0.1 - 0.5	0.2 - 1	0.2 - 1	0.5 - 2.5
Failure to Provide or Update Written or Graphic Plans Required by SWPPP	0.2 - 1	0.5 - 2.5	1.0 - 5	1.0 - 5
Failure to comply with Other Provisions of the NPDES Permit	0.1 - 0.5	0.2 - 1	0.2 - 1	0.5 - 2.5”

PAYMENTS TO SUBCONTRACTORS (BDE)

Effective: June 1, 2000

Revised: January 1, 2006

Federal regulations found at 49 CFR §26.29 mandate the Department to establish a contract clause to require Contractors to pay subcontractors for satisfactory performance of their subcontracts and to set the time for such payments.

State law also addresses the timing of payments to be made to subcontractors and material suppliers. Section 7 of the Prompt Payment Act, 30 ILCS 540/7, requires that when a Contractor receives any payment from the Department, the Contractor shall make corresponding, proportional payments to each subcontractor and material supplier performing work or supplying material within 15 calendar days after receipt of the Department payment. Section 7 of the Act further provides that interest in the amount of two percent per month, in addition to the payment due, shall be paid to any subcontractor or material supplier by the Contractor if the payment required by the Act is withheld or delayed without reasonable cause. The Act also provides that the time for payment required and the calculation of any interest due applies to transactions between subcontractors and lower-tier subcontractors and material suppliers throughout the contracting chain.

This Special Provision establishes the required federal contract clause, and adopts the 15 calendar day requirement of the State Prompt Payment Act for purposes of compliance with the federal regulation regarding payments to subcontractors. This contract is subject to the following payment obligations.

When progress payments are made to the Contractor according to Article 109.07 of the Standard Specifications, the Contractor shall make a corresponding payment to each subcontractor and material supplier in proportion to the work satisfactorily completed by each subcontractor and for the material supplied to perform any work of the contract. The proportionate amount of partial payment due to each subcontractor and material supplier throughout the contracting chain shall be determined by the quantities measured or otherwise determined as eligible for payment by the Department and included in the progress payment to the Contractor. Subcontractors and material suppliers shall be paid by the Contractor within 15 calendar days after the receipt of payment from the Department. The Contractor shall not hold retainage from the subcontractors. These obligations shall also apply to any payments made by subcontractors and material suppliers to their subcontractors and material suppliers; and to all payments made to lower tier subcontractors and material suppliers throughout the contracting chain. Any payment or portion of a payment subject to this provision may only be withheld from the subcontractor or material supplier to whom it is due for reasonable cause.

This Special Provision does not create any rights in favor of any subcontractor or material supplier against the State or authorize any cause of action against the State on account of any payment, nonpayment, delayed payment, or interest claimed by application of the State Prompt Payment Act. The Department will not approve any delay or postponement of the 15 day requirement except for reasonable cause shown after notice and hearing pursuant to Section 7(b) of the State Prompt Payment Act. State law creates other and additional remedies available to any subcontractor or material supplier, regardless of tier, who has not been paid for work properly performed or material furnished. These remedies are a lien against public funds set forth in Section 23(c) of the Mechanics Lien Act, 770 ILCS 60/23(c), and a recovery on the Contractor's payment bond according to the Public Construction Bond Act, 30 ILCS 550.

POST MOUNTING OF SIGNS (BDE)

Effective: January 1, 2011

Revise the second paragraph of Article 701.14 of the Standard Specifications to read:

“Post mounted signs shall be a breakaway design. The sign shall be within five degrees of vertical. Two posts shall be used for signs greater than 16 sq ft (1.5 sq m) in area or where the height between the sign and the ground exceeds 7 ft (2.1 m).”

SELECTION OF LABOR (BDE)

Effective: July 2, 2010

Revise Section I of Check Sheet #5 of the Recurring Special Provisions to read:

“I. SELECTION OF LABOR

The Contractor shall comply with all Illinois statutes pertaining to the selection of labor.

EMPLOYMENT OF ILLINOIS WORKERS DURING PERIODS OF EXCESSIVE
UNEMPLOYMENT

Whenever there is a period of excessive unemployment in Illinois, which is defined herein as any month immediately following two consecutive calendar months during which the level of unemployment in the State of Illinois has exceeded five percent as measured by the United States Bureau of Labor Statistics in its monthly publication of employment and unemployment figures, the Contractor shall employ at least 90 percent Illinois laborers. "Illinois laborer" means any person who has resided in Illinois for at least 30 days and intends to become or remain an Illinois resident.

Other laborers may be used when Illinois laborers as defined herein are not available, or are incapable of performing the particular type of work involved, if so certified by the Contractor and approved by the Engineer. The Contractor may place no more than three of his/her regularly employed non-resident executive and technical experts, who do not qualify as Illinois laborers, to do work encompassed by this contract during period of excessive unemployment.

This provision applies to all labor, whether skilled, semi-skilled, or unskilled, whether manual or non-manual.”

SUBCONTRACTOR MOBILIZATION PAYMENTS (BDE)

Effective: April 2, 2005

To account for the preparatory work and operations necessary for the movement of subcontractor personnel, equipment, supplies, and incidentals to the project site and for all other work or operations that must be performed or costs incurred when beginning work approved for subcontracting in accordance with Article 108.01 of the Standard Specifications, the Contractor shall make a mobilization payment to each subcontractor.

This mobilization payment shall be made at least 14 days prior to the subcontractor starting work. The amount paid shall be equal to 3 percent of the amount of the subcontract reported on form BC 260A submitted for the approval of the subcontractor's work.

This provision shall be incorporated directly or by reference into each subcontract approved by the Department.

STEEL COST ADJUSTMENT (BDE) (RETURN FORM WITH BID)

Effective: April 2, 2004

Revised: April 1, 2009

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 on the attached form whether or not this special provision will be part of the contract and submit the completed form with his/her bid. Failure to submit the form or failure to indicate contract number, company name, and sign and date the form shall make this contract exempt of steel cost adjustments for all items of steel. 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 has a contract value of \$10,000 or greater.

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:

$$SCA = Q \times D$$

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. 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:

$$\text{Percent Difference} = \{(MPI_L - MPI_M) \div MPI_L\} \times 100$$

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)

RETURN WITH BID

ILLINOIS DEPARTMENT OF TRANSPORTATION

OPTION FOR STEEL COST ADJUSTMENT

The bidder shall submit this completed form with his/her bid. Failure to submit the form or properly complete contract number, company name, and sign and date the form shall make this contract exempt of steel cost adjustments for all items of steel. Failure to indicate "Yes" for any item of work will make that item of steel exempt from steel cost adjustment. After award, this form, when submitted shall become part of the contract.

Contract No.: _____

Company Name: _____

Contractor's Option:

Is your company opting to include this special provision as part of the contract plans for the following items of work?

Metal Piling	Yes	<input type="checkbox"/>
Structural Steel	Yes	<input type="checkbox"/>
Reinforcing Steel	Yes	<input type="checkbox"/>
Dowel Bars, Tie Bars and Mesh Reinforcement	Yes	<input type="checkbox"/>
Guardrail	Yes	<input type="checkbox"/>
Steel Traffic Signal and Light Poles, Towers and Mast Arms	Yes	<input type="checkbox"/>
Metal Railings (excluding wire fence)	Yes	<input type="checkbox"/>
Frames and Grates	Yes	<input type="checkbox"/>

Signature: _____ **Date:** _____

ILLINOIS DEPARTMENT OF LABOR

PREVAILING WAGES FOR COOK COUNTY EFFECTIVE DECEMBER 2010

The Prevailing rates of wages are included in the Contract proposals which are subject to Check Sheet #5 of the Supplemental Specifications and Recurring Special Provisions. The rates have been ascertained and certified by the Illinois Department of Labor for the locality in which the work is to be performed and for each craft or type of work or mechanic needed to execute the work of the Contract. As required by Prevailing Wage Act (820 ILCS 130/0.01, et seq.) and Check Sheet #5 of the Contract, not less than the rates of wages ascertained by the Illinois Department of Labor and as revised during the performance of a Contract shall be paid to all laborers, workers and mechanics performing work under the Contract. Post the scale of wages in a prominent and easily accessible place at the site of work.

If the Illinois Department of Labor revises the prevailing rates of wages to be paid as listed in the specification of rates, the contractor shall post the revised rates of wages and shall pay not less than the revised rates of wages. Current wage rate information shall be obtained by visiting the Illinois Department of Labor web site at <http://www.state.il.us/agency/idol/> or by calling 312-793-2814. It is the responsibility of the contractor to review the rates applicable to the work of the contract at regular intervals in order to insure the timely payment of current rates. Provision of this information to the contractor by means of the Illinois Department of Labor web site satisfies the notification of revisions by the Department to the contractor pursuant to the Act, and the contractor agrees that no additional notice is required. The contractor shall notify each of its subcontractors of the revised rates of wages.

Cook County Prevailing Wage for December 2010

Trade Name	RG	TYP	C	Base	FRMAN	*M-F>8	OSA	OSH	H/W	Pensn	Vac	Trng
=====	==	===	=	=====	=====	=====	===	===	=====	=====	=====	=====
ASBESTOS ABT-GEN		ALL		35.200	35.700	1.5	1.5	2.0	9.130	8.370	0.000	0.400
ASBESTOS ABT-MEC		BLD		31.540	0.000	1.5	1.5	2.0	9.670	9.610	0.000	0.620
BOILERMAKER		BLD		43.020	46.890	2.0	2.0	2.0	6.720	9.890	0.000	0.350
BRICK MASON		BLD		39.030	42.930	1.5	1.5	2.0	8.800	10.67	0.000	0.740
CARPENTER		ALL		40.770	42.770	1.5	1.5	2.0	9.840	9.790	0.000	0.490
CEMENT MASON		ALL		41.850	43.850	1.5	1.5	2.0	8.600	9.810	0.000	0.220
CERAMIC TILE FNSHER		BLD		33.600	0.000	2.0	1.5	2.0	6.950	8.020	0.000	0.540
COMM. ELECT.		BLD		36.440	38.940	1.5	1.5	2.0	8.420	8.910	0.000	0.700
ELECTRIC PWR EQMT OP		ALL		40.850	46.430	1.5	1.5	2.0	10.27	12.98	0.000	0.310
ELECTRIC PWR GRNDMAN		ALL		31.860	46.430	1.5	1.5	2.0	8.010	10.13	0.000	0.240
ELECTRIC PWR LINEMAN		ALL		40.850	46.430	1.5	1.5	2.0	10.27	12.98	0.000	0.310
ELECTRICIAN		ALL		40.400	43.000	1.5	1.5	2.0	13.83	7.420	0.000	0.750
ELEVATOR CONSTRUCTOR		BLD		46.160	51.930	2.0	2.0	2.0	10.03	9.460	2.770	0.000
FENCE ERECTOR		ALL		32.660	34.660	1.5	1.5	2.0	10.67	10.00	0.000	0.500
GLAZIER		BLD		38.000	39.500	1.5	2.0	2.0	10.19	13.64	0.000	0.790
HT/FROST INSULATOR		BLD		42.050	44.550	1.5	1.5	2.0	9.670	10.81	0.000	0.620
IRON WORKER		ALL		40.750	42.750	2.0	2.0	2.0	12.45	17.09	0.000	0.300
LABORER		ALL		35.200	35.950	1.5	1.5	2.0	9.130	8.370	0.000	0.400
LATHER		ALL		40.770	42.770	1.5	1.5	2.0	9.840	9.790	0.000	0.490
MACHINIST		BLD		43.160	45.160	1.5	1.5	2.0	7.640	8.700	0.000	0.000
MARBLE FINISHERS		ALL		29.100	0.000	1.5	1.5	2.0	8.800	10.67	0.000	0.740
MARBLE MASON		BLD		39.030	42.930	1.5	1.5	2.0	8.800	10.67	0.000	0.740
MATERIAL TESTER I		ALL		25.200	0.000	1.5	1.5	2.0	9.130	8.370	0.000	0.400
MATERIALS TESTER II		ALL		30.200	0.000	1.5	1.5	2.0	9.130	8.370	0.000	0.400
MILLWRIGHT		ALL		40.770	42.770	1.5	1.5	2.0	9.840	9.790	0.000	0.490
OPERATING ENGINEER		BLD 1		45.100	49.100	2.0	2.0	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		BLD 2		43.800	49.100	2.0	2.0	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		BLD 3		41.250	49.100	2.0	2.0	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		BLD 4		39.500	49.100	2.0	2.0	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		BLD 5		48.850	49.100	2.0	2.0	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		BLD 6		46.100	49.100	2.0	2.0	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		BLD 7		48.100	49.100	2.0	2.0	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		FLT 1		51.300	51.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		FLT 2		49.800	51.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		FLT 3		44.350	51.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		FLT 4		36.850	51.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		HWY 1		43.300	47.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		HWY 2		42.750	47.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		HWY 3		40.700	47.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		HWY 4		39.300	47.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		HWY 5		38.100	47.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		HWY 6		46.300	47.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
OPERATING ENGINEER		HWY 7		44.300	47.300	1.5	1.5	2.0	11.70	8.050	1.900	1.150
ORNAMNTL IRON WORKER		ALL		40.200	42.450	2.0	2.0	2.0	10.67	14.81	0.000	0.500
PAINTER		ALL		38.000	42.750	1.5	1.5	1.5	9.750	11.10	0.000	0.770
PAINTER SIGNS		BLD		31.740	35.640	1.5	1.5	1.5	2.600	2.540	0.000	0.000
PILEDRIIVER		ALL		40.770	42.770	1.5	1.5	2.0	9.840	9.790	0.000	0.490
PIPEFITTER		BLD		43.150	46.150	1.5	1.5	2.0	8.460	9.850	0.000	1.770
PLASTERER		BLD		39.250	41.610	1.5	1.5	2.0	10.60	10.69	0.000	0.550
PLUMBER		BLD		44.000	46.000	1.5	1.5	2.0	9.860	7.090	0.000	1.030
ROOFER		BLD		37.650	40.650	1.5	1.5	2.0	7.750	6.570	0.000	0.430
SHEETMETAL WORKER		BLD		40.460	43.700	1.5	1.5	2.0	9.830	16.25	0.000	0.630
SIGN HANGER		BLD		28.960	29.810	1.5	1.5	2.0	4.700	2.880	0.000	0.000
SPRINKLER FITTER		BLD		49.200	51.200	1.5	1.5	2.0	8.500	8.050	0.000	0.450
STEEL ERECTOR		ALL		40.750	42.750	2.0	2.0	2.0	10.95	15.99	0.000	0.300
STONE MASON		BLD		39.030	42.930	1.5	1.5	2.0	8.800	10.67	0.000	0.740
TERRAZZO FINISHER		BLD		35.150	0.000	1.5	1.5	2.0	6.950	10.57	0.000	0.430
TERRAZZO MASON		BLD		39.010	42.010	1.5	1.5	2.0	6.950	11.91	0.000	0.510

TILE MASON		BLD		40.490	44.490	2.0	1.5	2.0	6.950	9.730	0.000	0.610
TRAFFIC SAFETY WRKR		HWY		24.300	25.900	1.5	1.5	2.0	3.780	1.875	0.000	0.000
TRUCK DRIVER	E	ALL	1	30.700	31.350	1.5	1.5	2.0	6.750	5.450	0.000	0.150
TRUCK DRIVER	E	ALL	2	30.950	31.350	1.5	1.5	2.0	6.750	5.450	0.000	0.150
TRUCK DRIVER	E	ALL	3	31.150	31.350	1.5	1.5	2.0	6.750	5.450	0.000	0.150
TRUCK DRIVER	E	ALL	4	31.350	31.350	1.5	1.5	2.0	6.750	5.450	0.000	0.150
TRUCK DRIVER	W	ALL	1	32.550	33.100	1.5	1.5	2.0	6.500	4.350	0.000	0.000
TRUCK DRIVER	W	ALL	2	32.700	33.100	1.5	1.5	2.0	6.500	4.350	0.000	0.000
TRUCK DRIVER	W	ALL	3	32.900	33.100	1.5	1.5	2.0	6.500	4.350	0.000	0.000
TRUCK DRIVER	W	ALL	4	33.100	33.100	1.5	1.5	2.0	6.500	4.350	0.000	0.000
TUCKPOINTER		BLD		39.200	40.200	1.5	1.5	2.0	7.830	10.25	0.000	0.770

Legend:

M-F>8 (Overtime is required for any hour greater than 8 worked each day, Monday through Friday.)

OSA (Overtime is required for every hour worked on Saturday)

OSH (Overtime is required for every hour worked on Sunday and Holidays)

H/W (Health & Welfare Insurance)

Pensn (Pension)

Vac (Vacation)

Trng (Training)

Explanations

COOK COUNTY

The following list is considered as those days for which holiday rates of wages for work performed apply: New Years Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day and Veterans Day in some classifications/counties. Generally, any of these holidays which fall on a Sunday is celebrated on the following Monday. This then makes work performed on that Monday payable at the appropriate overtime rate for holiday pay. Common practice in a given local may alter certain days of celebration. If in doubt, please check with IDOL.

TRUCK DRIVERS (WEST) - That part of the county West of Barrington Road.

EXPLANATION OF CLASSES

ASBESTOS - GENERAL - removal of asbestos material/mold and hazardous materials from any place in a building, including mechanical systems where those mechanical systems are to be removed. This includes the removal of asbestos materials/mold and hazardous materials from ductwork or pipes in a building when the building is to be demolished at the time or at some close future date.

ASBESTOS - MECHANICAL - removal of asbestos material from mechanical systems, such as pipes, ducts, and boilers, where the mechanical systems are to remain.

CERAMIC TILE FINISHER

The grouting, cleaning, and polishing of all classes of tile, whether for interior or exterior purposes, all burned, glazed or unglazed products; all composition materials, granite tiles, warning detectable tiles, cement tiles, epoxy composite materials, pavers, glass, mosaics, fiberglass, and all substitute materials, for tile made in tile-like units; all mixtures in tile like form of cement, metals, and other materials that are for and intended for use as a finished floor surface, stair treads, promenade roofs, walks, walls, ceilings, swimming pools, and all other places where tile is to form a finished interior or exterior. The mixing of all setting mortars including but not limited to thin-set mortars, epoxies, wall mud, and any other sand and cement mixtures or adhesives when used in the preparation, installation, repair, or maintenance of tile and/or similar materials. The handling and unloading of all sand, cement, lime, tile, fixtures, equipment, adhesives, or any other materials to be used in the preparation, installation, repair, or maintenance of tile and/or similar materials. Ceramic Tile Finishers shall fill all joints and voids regardless of method on all tile work, particularly and especially after installation of said tile work. Application of any and all protective coverings to all types of tile installations including, but not be limited to, all soap compounds, paper products, tapes, and all polyethylene coverings, plywood, masonite, cardboard, and any new type of products that may be used to protect tile installations, Blastrac equipment, and all floor scarifying equipment used in preparing floors to receive tile. The clean up and removal of all waste and materials. All demolition of existing tile floors and walls to be re-tiled.

COMMUNICATIONS ELECTRICIAN

Installation, operation, inspection, maintenance, repair and service of radio, television, recording, voice sound vision production and reproduction, telephone and telephone interconnect, facsimile, data apparatus, coaxial, fibre optic and wireless equipment, appliances and systems used for the transmission and reception of signals of any nature, business, domestic, commercial, education, entertainment, and residential purposes, including but not limited to, communication and telephone, electronic and sound equipment, fibre optic and data communication systems, and the performance of any task directly related to such installation or service whether at new or existing sites, such tasks to include the placing of wire and cable and electrical power conduit or other raceway work within the equipment room and pulling wire and/or cable through conduit and the installation of any incidental conduit, such that the employees covered hereby can complete any job in full.

MARBLE FINISHER

Loading and unloading trucks, distribution of all materials (all stone, sand, etc.), stocking of floors with material, performing all rigging for heavy work, the handling of all material that may be needed for the installation of such materials, building of scaffolding, polishing if needed, patching, waxing of material if damaged, pointing up, caulking, grouting and cleaning of marble, holding water on diamond or Carborundum blade or saw for setters cutting, use of tub saw or any other saw needed for preparation of material, drilling of holes for wires that anchor material set by setters, mixing up of molding plaster for installation of material, mixing up thin set for the installation of material, mixing up of sand to cement for the installation of material and such other work as may be required in helping a Marble Setter in the handling of all material in the erection or installation of interior marble, slate, travertine, art marble, serpentine, alberene stone, blue stone,

granite and other stones (meaning as to stone any foreign or domestic materials as are specified and used in building interiors and exteriors and customarily known as stone in the trade), carrara, sanionyx, vitrolite and similar opaque glass and the laying of all marble tile, terrazzo tile, slate tile and precast tile, steps, risers treads, base, or any other materials that may be used as substitutes for any of the aforementioned materials and which are used on interior and exterior which are installed in a similar manner.

MATERIAL TESTER I: Hand coring and drilling for testing of materials; field inspection of uncured concrete and asphalt.

MATERIAL TESTER II: Field inspection of welds, structural steel, fireproofing, masonry, soil, facade, reinforcing steel, formwork, cured concrete, and concrete and asphalt batch plants; adjusting proportions of bituminous mixtures.

OPERATING ENGINEER - BUILDING

Class 1. Asphalt Plant; Asphalt Spreader; Autograde; Backhoes with Caisson Attachment; Batch Plant; Benoto (requires Two Engineers); Boiler and Throttle Valve; Caisson Rigs; Central Redi-Mix Plant; Combination Back Hoe Front End-loader Machine; Compressor and Throttle Valve; Concrete Breaker (Truck Mounted); Concrete Conveyor; Concrete Conveyor (Truck Mounted); Concrete Paver Over 27E cu. ft; Concrete Paver 27E cu. ft. and Under; Concrete Placer; Concrete Placing Boom; Concrete Pump (Truck Mounted); Concrete Tower; Cranes, All; Cranes, Hammerhead; Cranes, (GCI and similar Type); Creter Crane; Crusher, Stone, etc.; Derricks, All; Derricks, Traveling; Formless Curb and Gutter Machine; Grader, Elevating; Grouting Machines; Highlift Shovels or Front Endloader 2-1/4 yd. and over; Hoists, Elevators, outside type rack and pinion and similar machines; Hoists, One, Two and Three Drum; Hoists, Two Tugger One Floor; Hydraulic Backhoes; Hydraulic Boom Trucks; Hydro Vac (and similar equipment); Locomotives, All; Motor Patrol; Lubrication Technician; Manipulators; Pile Drivers and Skid Rig; Post Hole Digger; Pre-Stress Machine; Pump Cretes Dual Ram; Pump Cretes: Squeeze Cretes-Screw Type Pumps; Gypsum Bulker and Pump; Raised and Blind Hole Drill; Roto Mill Grinder; Scoops - Tractor Drawn; Slip-Form Paver; Straddle Buggies; Tournapull; Tractor with Boom and Side Boom; Trenching Machines.

Class 2. Boilers; Broom, All Power Propelled; Bulldozers; Concrete Mixer (Two Bag and Over); Conveyor, Portable; Forklift Trucks; Highlift Shovels or Front Endloaders under 2-1/4 yd.; Hoists, Automatic; Hoists, Inside Elevators; Hoists, Sewer Dragging Machine; Hoists, Tugger Single Drum; Rock Drill (Self-Propelled); Rock Drill (Truck Mounted); Rollers, All; Steam Generators; Tractors, All; Tractor Drawn Vibratory Roller; Winch Trucks with "A" Frame.

Class 3. Air Compressor; Combination Small Equipment Operator; Generators; Heaters, Mechanical; Hoists, Inside Elevators; Hydraulic Power Units (Pile Driving, Extracting, and Drilling); Pumps, over 3" (1 to 3 not to exceed a total of 300 ft.); Low Boys; Pumps, Well Points; Welding Machines (2 through 5); Winches, 4 Small Electric Drill Winches; Bobcats (up to and including ¾ cu yd.) .

Class 4. Bobcats and/or other Skid Steer Loaders (other than bobcats up to and including ¾ cu yd.); Oilers; and Brick Forklift.

Class 5. Assistant Craft Foreman.

Class 6. Gradall .

Class 7. Mechanics.

OPERATING ENGINEERS - HIGHWAY CONSTRUCTION

Class 1. Asphalt Plant; Asphalt Heater and Planer Combination; Asphalt Heater Scarfire; Asphalt Spreader; Autograder/GOMACO or other similar type machines: ABG Paver; Backhoes with Caisson Attachment; Ballast Regulator; Belt Loader; Caisson Rigs; Car Dumper; Central Redi-Mix Plant; Combination Backhoe Front Endloader Machine, (1 cu. yd. Backhoe Bucket or over or with attachments); Concrete Breaker (Truck Mounted); Concrete Conveyor; Concrete Paver over 27E cu. ft.; Concrete Placer; Concrete Tube Float; Cranes, all attachments; Cranes, Tower Cranes of all types: Creter Crane: Crusher, Stone, etc.; Derricks, All; Derrick Boats; Derricks, Traveling; Dowell Machine with Air Compressor; Dredges; Formless Curb and Gutter Machine; Grader, Elevating; Grader, Motor Grader, Motor Patrol, Auto Patrol, Form Grader, Pull Grader, Subgrader; Guard Rail Post Driver Truck Mounted; Hoists, One, Two and Three Drum; Hydraulic Backhoes; Backhoes with shear attachments; Lubrication Technician; Manipulators; Mucking Machine; Pile Drivers and Skid Rig; Pre-Stress Machine; Pump Cretes Dual Ram; Rock Drill - Crawler or Skid Rig; Rock Drill - Truck Mounted; Rock/Track Tamper; Roto Mill Grinder; Slip-Form Paver; Soil Test Drill Rig (Truck Mounted); Straddle Buggies; Hydraulic Telescoping Form (Tunnel); Tractor Drawn Belt Loader (with attached pusher - two engineers); Tractor with Boom; Tractaire with Attachments; Trenching Machine; Truck Mounted Concrete Pump with Boom; Raised or Blind Hole Drills (Tunnel Shaft); Underground Boring and/or Mining Machines 5 ft. in diameter and over tunnel, etc; Underground Boring and/or Mining Machines under 5 ft. in diameter; Wheel Excavator; Widener (APSCO).

Class 2. Batch Plant; Bituminous Mixer; Boiler and Throttle Valve; Bulldozers; Car Loader Trailing Conveyors; Combination Backhoe Front Endloader Machine (Less than 1 cu. yd. Backhoe Bucket or over or with attachments); Compressor and Throttle Valve; Compressor, Common Receiver (3); Concrete Breaker or Hydro Hammer; Concrete Grinding Machine; Concrete Mixer or Paver 7S Series to and including 27 cu. ft.; Concrete Spreader; Concrete Curing Machine, Burlap Machine, Belting Machine and Sealing Machine; Concrete Wheel Saw; Conveyor Muck Cars (Haglund or Similar Type); Drills, All; Finishing Machine - Concrete; Highlift Shovels or Front Endloader; Hoist - Sewer Dragging Machine; Hydraulic Boom Trucks (All Attachments); Hydro-Blaster; All Locomotives, Dinky; Off-Road Hauling Units (including articulating)/2 ton capacity or more; Non Self-Loading Ejection Dump; Pump Cretes: Squeeze Cretes - Screw Type Pumps, Gypsum Bulker and Pump; Roller, Asphalt; Rotary Snow Plows; Rototiller, Seaman, etc., self-propelled; Scoops - Tractor Drawn; Self-Propelled Compactor; Spreader - Chip - Stone, etc.; Scraper; Scraper - Prime Mover in Tandem (Regardless of Size); Tank Car Heater; Tractors, Push, Pulling Sheeps Foot, Disc, Compactor, etc.; Tug Boats.

Class 3. Boilers; Brooms, All Power Propelled; Cement Supply Tender; Compressor, Common Receiver (2); Concrete Mixer (Two Bag and Over); Conveyor, Portable; Farm-Type Tractors Used for Mowing, Seeding, etc.; Fireman on Boilers; Forklift Trucks; Grouting Machine; Hoists, Automatic; Hoists, All Elevators; Hoists, Tugger Single Drum; Jeep Diggers; Low Boys; Pipe Jacking Machines; Post-Hole Digger; Power Saw, Concrete Power Driven; Pug Mills; Rollers, other than Asphalt; Seed and Straw Blower; Steam Generators; Stump Machine; Winch Trucks with "A" Frame; Work Boats; Tamper-Form-Motor Driven.

Class 4. Air Compressor; Combination - Small Equipment Operator; Directional Boring Machine; Generators; Heaters, Mechanical; Hydraulic Power Unit (Pile Driving, Extracting, or Drilling); Hydro- Blaster; Light Plants, All (1 through 5); Pumps, over 3" (1 to 3 not to exceed a total of 300 ft.); Pumps, Well Points; Tractaire; Welding Machines (2 through 5); Winches, 4 Small Electric Drill Winches.

Class 5. Bobcats (all); Brick Forklifts; Oilers.

Class 6. Field Mechanics and Field Welders

Class 7. Gradall and machines of like nature.

OPERATING ENGINEER - FLOATING

Class 1. Craft Foreman; Diver/Wet Tender; and Engineer (hydraulic dredge).

Class 2. Crane/Backhoe Operator; 70 Ton or over Tug Operator; Mechanic/Welder; Assistant Engineer (Hydraulic Dredge); Leverman (Hydraulic Dredge); Diver Tender; Friction and Lattice Boom Cranes.

Class 3. Deck Equipment Operator, Machineryman; Maintenance of Crane (over 50 ton capacity); Tug/Launch Operator; Loader/Dozer and like equipment on Barge; and Deck Machinery, etc.

Class 4. Deck Equipment Operator, Machineryman/Fireman (4 Equipment Units or More); Off Road Trucks (2 ton capacity or more); Deck Hand, Tug Engineer, Crane Maintenance 50 Ton Capacity and Under or Backhoe Weighing 115,000 pounds or less; and Assistant Tug Operator.

TERRAZZO FINISHER

The handling of sand, cement, marble chips, and all other materials that may be used by the Mosaic Terrazzo Mechanic, and the mixing, grinding, grouting, cleaning and sealing of all Marble, Mosaic, and Terrazzo work, floors, base, stairs, and wainscoting by hand or machine, and in addition, assisting and aiding Marble, Masonic, and Terrazzo Mechanics.

TRAFFIC SAFETY

Work associated with barricades, horses and drums used to reduce lane usage on highway work, the installation and removal of temporary lane markings, and the installation and removal of temporary road signs.

TRUCK DRIVER - BUILDING, HEAVY AND HIGHWAY CONSTRUCTION - EAST & WEST

Class 1. Two or three Axle Trucks. A-frame Truck when used for transportation purposes; Air Compressors and Welding Machines, including those pulled by cars, pick-up trucks and tractors; Ambulances; Batch Gate Lockers; Batch Hopperman; Car and Truck Washers; Carry-alls; Fork Lifts and Hoisters; Helpers; Mechanics Helpers and Greasers; Oil Distributors 2-man operation; Pavement Breakers; Pole Trailer, up to 40 feet; Power Mower Tractors; Self-propelled Chip Spreader; Skipman; Slurry Trucks, 2-man operation; Slurry Truck Conveyor Operation, 2 or 3 man; TEamsters Unskilled dumpman; and Truck Drivers hauling warning lights, barricades, and portable toilets on the job site.

Class 2. Four axle trucks; Dump Crets and Adgetors under 7 yards; Dumpsters, Track Trucks, Euclids, Hug Bottom Dump Turnapulls or Turnatrailers when pulling other than self-loading equipment or

similar equipment under 16 cubic yards; Mixer Trucks under 7 yards; Ready-mix Plant Hopper Operator, and Winch Trucks, 2 Axles.

Class 3. Five axle trucks; Dump Crets and Adgetors 7 yards and over; Dumpsters, Track Trucks, Euclids, Hug Bottom Dump Turnatrailers or turnapulls when pulling other than self-loading equipment or similar equipment over 16 cubic yards; Explosives and/or Fission Material Trucks; Mixer Trucks 7 yards or over; Mobile Cranes while in transit; Oil Distributors, 1-man operation; Pole Trailer, over 40 feet; Pole and Expandable Trailers hauling material over 50 feet long; Slurry trucks, 1-man operation; Winch trucks, 3 axles or more; Mechanic--Truck Welder and Truck Painter.

Class 4. Six axle trucks; Dual-purpose vehicles, such as mounted crane trucks with hoist and accessories; Foreman; Master Mechanic; Self-loading equipment like P.B. and trucks with scoops on the front.

Other Classifications of Work:

For definitions of classifications not otherwise set out, the Department generally has on file such definitions which are available. If a task to be performed is not subject to one of the classifications of pay set out, the Department will upon being contacted state which neighboring county has such a classification and provide such rate, such rate being deemed to exist by reference in this document. If no neighboring county rate applies to the task, the Department shall undertake a special determination, such special determination being then deemed to have existed under this determination. If a project requires these, or any classification not listed, please contact IDOL at 217-782-1710 for wage rates or clarifications.

LANDSCAPING

Landscaping work falls under the existing classifications for laborer, operating engineer and truck driver. The work performed by landscape plantsman and landscape laborer is covered by the existing classification of laborer. The work performed by landscape operators (regardless of equipment used or its size) is covered by the classifications of operating engineer. The work performed by landscape truck drivers (regardless of size of truck driven) is covered by the classifications of truck driver.