Project Manual
Including Specifications for
The Construction of

CITY OF ALBUQUERQUE
MODIFICATIONS TO CENTRAL STORM WATER PUMP STATION NO. 27
AND
STORM WATER FORCEMAIN - PHASE 2

Albuquerque, New Mexico
December 2016

OWNER:

CITY OF ALBUQUERQUE
Department of Municipal Development
Engineering Division
P.O. Box 1293
Albuquerque, New Mexico 87103

ENGINEER:

MOLZEN CORBIN
2701 Miles Road, SE
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(505) 242-5700

MOLZENCORBIN
ENGINEERS | ARCHITECTS | PLANNERS

ENGINEER OF RECORD

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The technical material and data contained in the specifications were prepared under the supervision and direction of the undersigned, whose seal as a Professional Engineer, licensed to practice in the State of New Mexico, is affixed below.

(SEAL)

Kenneth R. Muller, P.E.

N.M.P.E. No. 12548

All questions about the meaning or intent of these documents shall be submitted only to the Engineer of Record, stated above, in writing.

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INTRODUCTION TO SUPPLEMENTAL TECHNICAL SPECIFICATIONS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Supplemental Technical Specifications contained herein shall govern Project except if a Technical Specification for a required item is omitted, whereupon respective City of Albuquerque Standard Specifications for Public Works Construction, 1986 Edition, Technical Specifications including updates, and the Conditions of the Contract, shall prevail.

1.02 FORMAT

A. The Division 1 through 48 Specifications are written in imperative and abbreviated form. This imperative language is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall", "the Contractor shall", and "shall be" or similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words "shall be" are to be placed by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, the Contractor shall fulfill (perform) all indicated requirements whether stated imperatively or otherwise.

B. All equipment and facilities shall be furnished, installed, and constructed by the Contractor to provide the Owner with complete, ready to use components, systems, and facilities. All necessary materials and Work required to accomplish this are the responsibility of the Contractor alone, whether or not specifically indicated on the Drawings or stated in the Specifications.

C. The various Sections of the Division 1 through 48 Specifications may contain references to standards, other specification sections, or items that do not apply to the Work covered in this project. These inappropriate references are to be considered irrelevant and ignored by the Contractor. If conflicts arise from erroneous references or lack of references to standards or other specification sections, Engineer will determine the relevancy of the apparent conflicts.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work under this contract consists of constructing a new forcemain for the Central Avenue Storm Water Pump Station in accordance with the Drawings and these Specifications.

1.02 DESCRIPTION OF WORK

A. Modifications to Existing Storm Water Pump Station No. 27 – Central:
   1. Remove and dispose of existing temporary cover over pump station structure.
   2. Complete removal and demolition work.
   3. Pump station design capacity: 5.2 cfs
   4. Install three 15 horsepower submersible pumps in existing pump station structure; including discharge piping, access covers, all associated accessories, and electrical work.
   5. Construct valve vault structure, including concrete structure, access cover, and piping system.
   6. Install temporary electrical pump controls for interim operation of the pump station.
   7. Install permanent electrical pump controls.

B. Forcemain:
   1. Construct east segment of 12-inch diameter forcemain, approximately 144 feet, as shown on the Drawings.
   2. Connect new forcemain to existing 12-inch diameter forcemain (west end) and connect new forcemain to new valve vault pipe (east end).

1.03 CONTRACT

A. All Work shall be performed under the requirements of the existing Contract between the City of Albuquerque and the Contractor.

1.04 SUMMARY OF REFERENCES

A. Work of the Contract can be summarized by references to the Contract, General Conditions, Supplementary Conditions, Specifications Sections, Drawings, addenda, and modifications to the Contract Documents issued subsequent to the initial print of the Project Manual and including, but not necessarily limited to printed material referenced by any of these. It is recognized that work of the Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon, including weather conditions and other forces outside the Contract Documents.

1.05 CONTRACTOR USE OF PREMISES

A. The immediate premises of the work will be at the disposal of the Contractor during the construction period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXECUTION

A. General: Immediately after award of the Contract, thoroughly and clearly advise all necessary personnel as to the nature and extent of the project.

END OF SECTION

SECTION 01 12 16

WORK SEQUENCE

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Work consists of constructing a new forcemain and constructing renovations to an existing storm water pump station structure with new electrical work.

1.02 WORK SEQUENCE

A. The work associated with the forcemain and pump station structure can be performed at the same time.

B. All work associated with the forcemain and pump station structure must be complete, tested, and fully functional to have the new facilities ready for service.

1.03 SUBSTANTIAL COMPLETION

A. Substantial Completion of the project will be acknowledged when certified by the Engineer, with the Owner assuming operation and maintenance of the entire facilities and equipment shall occur when:
   1. Shakedown of related facilities is completed, and
   2. Utilities, alarms, electrical, area lighting, monitoring, control, drains, piping, access, and related components and facilities completed, connected and fully functional and usable, and
   3. Owner's personnel can have unimpeded access to facilities, and
   4. Facilities can be put to intended use, and
   5. Owner can use for intended use at no additional cost to Owner.

B. Two separate Substantial Completion certificates may be issued:
   1. For Substantial Completion of the forcemain and pump station with temporary controls.
   2. For Substantial Completion of installation of the permanent electrical controls.

1.04 ADJUSTMENTS TO SEQUENCING REQUIREMENTS

A. The Owner may require the Contractor to make adjustments to the requirements of this Section to accommodate unforeseen conditions and situations. Reasonable adjustments shall be made by the Contractor at no additional cost to the Owner or additional Contract Time.

END OF SECTION

SECTION 01 14 02

UTILITY OBSTRUCTIONS

PART 1 GENERAL

1.01 WORK INCLUDED

A. General provisions for handling utility obstructions and relocations.

1.02 UTILITIES SHOWN ON DRAWINGS

A. The Engineer has made reasonable effort to show the general location of existing underground and overhead utility lines on the Drawings.

B. The Contractor shall recognize that when working in an existing plant facility, utilities may not be in the locations shown on the Drawings. Likewise, there may be utilities in locations other than that shown on the Drawings. The Contractor is required to:
   1. Perform potholing of existing utilities to verify existing utility locations, whether identified on the Drawings or not, prior to construction.
   2. Contractor to comply with utility location guidelines from the New Mexico Excavation Law (NMEL). Per NMEL guidelines, the excavator is required to expose the underground utility by non-mechanical means.
   3. Potholing Method: Vacuum/Dry type.
   4. Repair any damage to existing utilities caused by Contractor.

C. This work will be considered incidental Work to the Contract Documents' bid items.

1.03 RELOCATION OF OVERHEAD UTILITIES

A. Determine in advance of construction operations if overhead utility lines, support structures, poles, guys, etc., whether shown on the Drawings or not, will obstruct construction operations. If any obstruction to construction operations is evident, coordinate with the appropriate utility company to remove or relocate the utility obstructions. Any charges by any utility company for removal or relocation of overhead utilities are the sole responsibility of the Contractor at no additional cost to the Owner.

1.04 RELOCATION OF UNDERGROUND UTILITIES

A. Determine in advance of construction operations locations of all underground utilities (gas, telephone, fiber optic cable, electrical, cable TV, water, sewer), whether shown on the Drawings or not, that may interfere with Contractor's construction operations.

B. All Underground Utilities Except Water and Sewer Lines: Coordinate with the appropriate utility company to remove or relocate the existing utilities which interfere

with construction. Utility company charges for relocating these existing utilities will be paid from the utility line relocation allowance listed on the Bid Proposal.

C. Water and Sewer Lines:
   1. Adjust alignment on any waterline which Contractor is constructing to avoid existing underground utility lines and/or to maintain a minimum three feet of cover; Take other measures necessary (encasement of water or sewer line, change of pipe material, etc.) to protect new and existing lines.
   2. Adjust alignment of all existing waterlines as appropriate or required to avoid interference with:
   3. new sewer lines, or;
   4. new structures, or;
   5. new roadway, or;
   6. to maintain at least three feet of cover over existing waterlines unless otherwise approved in writing by Engineer.
   7. Incidental work to be performed at no additional cost to Owner: All work required to adjust alignment of new waterlines around any existing waterlines or sewer lines, or other measures necessary to protect new and existing lines.

1.05 CONTRACTOR RESPONSIBILITIES

A. Contractor is responsible for complying with New Mexico State Excavation Law prior to performing any excavations. Contractor shall obtain utility location line spots through NM ONE CALL 811 prior to performing any excavations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 03

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 APPLICABLE CODES AND ORDINANCES

A. All Work shall conform to the current versions of all applicable building, mechanical, plumbing, and electrical codes.

B. Contractor is responsible for acquiring all applicable building, mechanical, plumbing, and electrical permits related to this project.

C. Comply with all local laws, ordinances, and regulations which may impact Contractor's work.

1.02 OSHA REQUIREMENTS

A. All equipment and facilities provided, including but not limited to, handrails, guardrails, grating, hoists, equipment guards, ladders, etc., shall meet OSHA requirements whether or not such requirements are specifically indicated or described in the Contract Documents.

B. Any conflicts between OSHA requirements and Contract Documents shall be brought to the attention of the Engineer on a timely basis for resolution.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 19

USE OF SITE

PART 1 GENERAL

1.01 AVAILABLE SITES

A. Sites and easement limits available for the construction of the project are shown on the Drawings. Contractor shall not utilize any land not indicated as being available without the written approval of the applicable land owner.

B. If the Contractor requires the entire width of right-of-way or easement for construction, it shall be the Contractor's responsibility to have a licensed land surveyor establish the right-of-way line where it is not apparent.

1.02 PROTECTION AND RESTORATION

A. All existing features and improvements to or on easements shall be restored by the Contractor equivalent to those existing prior to construction at no additional cost to the Owner. Compliance with special requirements or considerations indicated on the Drawings for the use of easements shall be the Contractor's responsibility at no additional cost to the Owner.

B. Trees within construction easement shall be preserved to maximum practical extent, unless specifically indicated in the Drawings.

1.03 SPECIAL CONSTRUCTION METHODS

A. Special and hand construction methods may be required to remain within the available easements. Such methods shall be used by the Contractor at no additional cost to the Owner.

B. Other Contractors could be working on related work at or near the site; therefore, the Contractor is expected to cooperate and provide adequate access to all other working parties at or near the site.

1.04 STAGING AREAS

A. Staging area is not provided by the Owner. Locating staging area(s) on private land is the responsibility of the Contractor. Contractor staging areas shall be provided by the Contractor at no additional cost to the Owner. Contractor staging areas are to be considered incidental Work to the Contract Documents' bid items.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop Drawings

B. Product Data

C. Samples

D. Contractor Responsibility

E. Engineer Responsibility

F. Schedule of Submittals

1.02 RELATED WORK/REQUIREMENTS SPECIFIED ELSEWHERE

A. Conditions of the Contract: Definitions and Additional Responsibilities of Parties

1.03 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner.
   1. Sufficient detail to show kind, size, and arrangement and function of component materials and devices.

B. Minimum sheet size: 8-1/2” x 11”

1.04 PRODUCT DATA

A. Preparation:
   1. Provide information required in individual Sections.
   2. Where sheets are reproduced from a pamphlet, catalog, or similar publication, print the manufacturer’s name and the title of the publication on each sheet, or set of sheets, if it is not already on the sheet.
   3. Clearly mark each copy to identify applicable products or models by either neatly encircling pertinent data and marking the circle with an arrow or by crossing out all extraneous data, with black, indelible ink. Do not use highlighter because it will not reproduce well.
   4. For items that may be installed at multiple locations throughout the project, such as pipe materials, valves, other pipe appurtenances, and field coatings, indicate in a cover letter where each item is intended to be installed.
   5. Show performance characteristics and capacities.

6. Show dimensions and clearances required.
7. Indicate weights of major components.
8. Indicate materials of construction.
9. Do not prepare submittal materials from facsimile (FAX) copies of product data unless specifically authorized by Engineer.
10. Material described on Drawings but not shown in the Specifications: Provide cut sheets as a minimum, or as called for on the Drawings.

B. Installation data for all materials and equipment for which operation and maintenance manuals will not be provided. Also provide installation data with shop drawing prior to delivery of equipment, if specified in the equipment Section.
1. Provide manufacturer's installation instructions and recommendations.
2. Provide referenced standards for installation.

C. Manufacturer's standard schematic drawings, diagrams, descriptions and information:
1. Modify to delete information that does not apply to Work.
2. Supplement to provide information specifically applicable to the Work.

1.05 SAMPLES

A. Samples shall be of sufficient size and quantity to clearly illustrate:
1. Functional characteristics of the project, with integrally related parts and attachment devices.
2. Full range of color, texture, and pattern.

B. Include identification on each sample, with full project information.

1.06 CONTRACTOR RESPONSIBILITIES

A. If substitutions of materials are proposed, conform to Section 01 25 00 – Substitution Procedures.

B. Submit exactly the required quantity of materials.

C. Review Shop Drawings, Product Data, Certificates, Electrical Schematics, Electrical Connection Diagrams, Test Reports, Installation Instructions, Samples, and similar required submittal materials for completeness and accuracy prior to submission. Return unsatisfactory submittal materials to the supplier or manufacturer for correction.

D. Determine and Verify:
1. Field measurements.
2. Field construction criteria.
3. Catalog numbers and similar data.
4. Conformance with Specifications.
5. Conflicts with other items of construction past, present, or future.
6. Submittal materials are legible.

E. Coordinate each submittal with requirements of the Work and of the Contract Documents.

F. Notify the Engineer in writing, at time of submission, of any deviations in submittal from Contract requirements.

G. Begin no fabrication or work that requires submittals until return of submittals with Engineer's final review.

1.07 SUBMITTAL PROCEDURES

A. Make submittals promptly and in such sequence as to cause no delay in the Work.

B. Execute and attach "Contractor Submittal Form" to each submittal. Sample form is attached to the end of this Section. Sign, date, and forward the Form and the Contractor reviewed submittal materials to the Engineer.

C. Number submittals by respective section number followed by an "S" for submittals, "P" for preliminary O&M, and "F" for final O&M.

D. Include a copy of the respective Specification Section(s). For each paragraph of the Specifications, confirm that the submittal complies and include a tab and sheet number where the information can be found for each paragraph of the Specification. If the submittal does not comply with a paragraph, identify as such and provide an explanation why it does not. If this information is not provided with each submittal and preliminary O&M, then the Engineer will return as "Not Reviewed". Final O&Ms are excluded from this requirement.

1.08 RESUBMISSION REQUIREMENTS

A. Make corrections/changes in the submittals to comply with comments made by the Engineer and resubmit until final review.
   1. Attach Engineer's comments from previous submittal annotated with action taken in the current submittal.

B. Number resubmittals as identified in paragraph entitled "Submittal Procedures", and follow with a numeric value which identifies the number of resubmittals pertaining to that specific submittal.

C. Shop Drawings and Product Data:
   1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
   2. Indicate any changes that have been made other than those requested by the Engineer.

D. Samples: Submit new samples as required for initial submittal.

E. Specifically direct attention in writing to revisions other than the corrections called for by the Engineer on previous submittals.

F. Include a copy of previous "Contractor Submittal Forms".

G. Include a copy of previous Engineer's comments, marked to show Contractor's responses. If not provided, submittal will be returned as "Rejected/Resubmit."

H. Furnish all applicable information in the resubmittal, including information on material that was favorably reviewed. Upon request, the Engineer will return all but one of the original submittals for reuse by the Contractor.

I. Partial resubmittals are allowed, but following favorable review of the partial resubmittal, provide complete resubmittals including all favorably reviewed material.

1.09 DISTRIBUTION

A. Copy and distribute submittals returned by Engineer marked "No Exception Taken" or "Make Corrections Noted":
   1. Job site file.
   2. Job site record documents file.
   3. Subcontractors and suppliers as appropriate.

B. If returned by Engineer, distribute samples marked "No Exception Taken" or "Make Corrections Noted" as directed by the Engineer.

1.10 ENGINEER RESPONSIBILITIES

A. Review submittals with reasonable promptness as specified herein in the Timeliness subsection.

B. Return submittals with completed Contractor Submittal Form with signature and attach review comments if needed.

C. Return one copy of submittal to Contractor.

D. Submittal Review Status Categories:
   1. "NO EXCEPTION TAKEN" – Reviewed for general conformity to the requirements of the Contract Documents. Quantities shown not verified. Contractor's full responsibility is in no way relieved by this action.
   2. "MAKE CORRECTIONS NOTED" – Reviewed and noted for general conformity to requirements of the Contract Documents. Quantities shown not verified. Contractor's responsibility is in no way relieved by this action. Resubmittal is not required, provided Contractor concurs with, accepts, and complies with A/E's comments.
   3. "REVISE & RESUBMIT" – Reviewed and not accepted. Provide missing information, make corrections as noted, and resubmit full submittal.

4. "REJECTED/RESUBMIT" – Reviewed or partially reviewed and not accepted. Resubmit information in conformance with the Contract Documents.
5. "RECEIPT ACKNOWLEDGED" – Submittal for Section is not required or submittal is being held by A/E for coordination of work with that of another Section.

E. Return submittals with only cursory review and marked "Revise & Resubmit" or "Rejected/Resubmit" when:
1. It becomes apparent the submittal is not acceptable,
2. The submittal has not been thoroughly reviewed by the Contractor,
3. Submittal does not cover all of a Section,
4. Submittal improperly contains information for more than one Section, or
5. Submittal is illegible.

F. Return resubmittals only containing partial information.

G. Discard submittal copies in excess of those scheduled.

1.11 LIMITS OF ENGINEER'S RESPONSIBILITY

A. Engineer's review does not constitute acceptance or responsibility for accuracy of dimensions or quantities.

B. Engineer's review does not relieve the Contractor from meeting requirements of the Contract Documents.

C. Engineer's review does not constitute approval for any deviation from the Contract Documents unless such deviations are specifically stated as such on the submittal and specifically allowed by the Engineer by specific written notification for each such variation.

D. Engineer's review does not relieve the Contractor from responsibility for errors or omissions in the Shop Drawings or from responsibility for having complied with the Contractor's Responsibilities portion of this Section.

E. Engineer's review will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 PAYMENT AND TIME FOR REVIEW OF EXCESSIVE SUBMITTALS

A. Submittals after first resubmittal:
1. Owner will charge Contractor for all of Engineer's review time and costs at Engineer's standard billing rates through a credit by Change Order.
2. Reviewed by Engineer at convenience of the Engineer.

1.13 FORMAT

A. Furnish individual submittal packages for each Section. Include a separate Contractor Submittal Form for each Section.

B. The Contractor may elect to make a single submittal for all Sections supplied by a single manufacturer/supplier. Such single submittal must conform to the following:
1. Index the submittal with tabs with one and only one Section under a single tab.
2. Include a separate Contractor Submittal Form for each Section.
3. Identify submittal packages on the front or on the first page with the Owner's name, the project name, the Contractor's name, the subcontractor's name, the date, and the contents of the binder, including the Specification Section(s), title(s), and number(s).

C. Minimum Acceptable Binding Methods:
1. Submittals of no more than six sheets per set, including cover sheets: Staple in sets.
2. Submittals of seven to 25 sheets per set: Punch sheets and assemble in a soft-cover binder with 3-hole metal fold-down clips to hold pages or in a ring binder.
3. Submittals of 26 to 75 sheets: Punch sheets and assemble in a hard-cover ring binder.
4. Submittals of more than 75 sheets: Punch sheets and assemble in a hard-cover D-ring binder.
5. Fold 11-inch by 17-inch drawings to fit into bound sets of submittals.
6. Furnish drawings larger than 11 inches by 17 inches folded and inserted in pockets in the binders. Provide a complete index in the submittal literature set.

1.14 TIMELINESS

A. As a minimum, the Contractor shall allow the following number of calendar days for submittal process:

	Engineer's Review Time
Initial Submittal	14
Resubmittal	7
Operation and Maintenance Manuals	16

1. Engineer's Review Time is the time the submittal is in the Engineer's office.
2. The Engineer will process first those items with higher priority based on a written request from the Contractor.

B. Turnaround time for complex submittals (such as process equipment systems with multiple components, mechanical systems, electrical equipment, instrumentation control systems, and electrical process and instrumentation drawings) may exceed the total indicated in 1.14A.

C. Materials, equipment, supplies, or labor to install such materials or equipment for which submittals have not been marked “No Exception Taken” or “Make Corrections Noted” are not eligible for payment and such materials and equipment shall not be allowed on the job site.

1.15 PROJECT RECORD DOCUMENTS

A. If the equipment installed deviates in any way from the submittal for the equipment, then submit copies of submittals that are corrected to show actual equipment supplied.

1.16 ATTACHMENTS TO THIS SECTION

A. Contractor Submittal Form

1.17 REQUIRED SUBMITTALS

A. Quantity, submit either printed or electronic format:
   1. Printed Format:
      a. For submittals in printed format only, submit five (5) copies. Engineer will retain four (4).
      b. Engineer will return one (1) copy to Contractor.
      c. Any additional copies received will be discarded by Engineer.
   2. Electronic Format:
      a. Submittals in electronic searchable .pdf format are allowed when submitted with two (2) printed copies of the submittals. Engineer will retain both printed copies.
      b. Engineer’s submittal review including submittal will be returned to Contractor in electronic format.
      c. Any additional copies received will be discarded by Engineer.

B. See individual Specification Sections for description of required submittals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

#	**CONTRACTOR SUBMITTAL FORM**	
Specification No. Title/Description:	Project: CONTRACTOR: Subcontractor / Supplier:	Contractor's Submittal No.: Date: Product Description: Dates of any previous submissions: Manufacturer:
	Specification No.:	Drawing Nos.:
	Are there any deviations to the Contract Documents? ☐ No ☐ Yes (Explain and Identify:) Undisclosed deviations/modifications do not relieve the Contractor from the obligation to provide the specified product and detail of installation, and may be cause for rejection of the Work. Deviations and modifications must be listed here or in a separate Request for Substitution.	

CONTRACTOR'S CERTIFICATION: This submittal has been reviewed by the Contractor in compliance with
Submittal Procedures of the CONTRACT DOCUMENTS' SPECIFICATIONS. Any deviations or substitutions to the CONTRACT DOCUMENTS have been identified above and submitted in compliance with the CONTRACT DOCUMENTS.

If this is a re-submittal, identify on a sheet(s) attached to this form all responses to comments on the previous submittal and all changes other than those specifically requested by the A/E on the previous submittal.

Signed _____ Date:

A/E'S REVIEW RESPONSE
(Refer to Submittal Specification for explanation of categories.)

Date Received:	No. Copies Received:
☐ NO EXCEPTION TAKEN	
☐ MAKE CORRECTIONS NOTED	
☐ REVISE & RESUBMIT	
☐ REJECTED/RESUBMIT	
☐ RECEIPT ACKNOWLEDGED	
By:	Date:
Date Returned:	No. Copies Returned:
A/E'S COMMENTS, IF ANY:	
A/E'S ATTACHMENTS, IF ANY:	

Note: DO NOT combine items from different specification sections into one submittal unless called for in the Section. If provisions in the "General Conditions" conflict with this form, the provisions as stated in the "General Conditions" shall prevail.

MOLZENCORBIN
ENGINEERS | ARCHITECTS | PLANNERS
2701 Miles Road SE, Albuquerque, NM 87106

Asset Equipment Report

Project Name: Central Storm Water Pump Station
Project Number:
Contractor: Date:
COA PM: Andrew Varoz Contractor Contact: 12/15/16
Consulting Engineer: Molzen-Corbin Cell Phone:

	Equipment Name:	Equipment Description:	Equipment Tag #:	Classification:	Location:	Install Date:	Manufacturer:	Website Address:	Model:	Serial #:	Capacity/ Size	Cap/ Size Units	Equipment Cost:	Expected Life (yrs)	PM Frequency	Warranty Period	Picture 1 ID	Picture 2 ID
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

SECTION 01 42 13

ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 SPECIAL

A. A/E – Architect/Engineer

B. EPA - United States Environmental Protection Agency.

C. NMED - New Mexico Environment Department.

D. OSE – Office of State Engineer

E. OSHA - Occupational Safety and Health Administration.

1.02 OTHER

A. As indicated on the Drawings, as apparent from the Drawings, or in accordance with standard practice.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Abbreviations and acronyms used in Contract Documents to identify reference standards.

1.02 QUALITY ASSURANCE

A. Application: When a standard is specified by reference, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.

B. Publication Date: The publication in effect on the date of bid, except when a specific publication date is specified.

1.03 ABBREVIATIONS, NAMES, AND ADDRESSES OF ORGANIZATIONS

A. Obtain copies of referenced standards direct from publication source, when needed for proper performance of Work, or when required for submittal by Contract Documents.

AA	Aluminum Association 818 Connecticut Avenue, NW Washington, D.C. 20006
AASHTO	American Association of State Highway and Transportation Officials 444 North Capital Street, NW Washington, DC 20001
ABMA	American Bearing Manufacturers Association (formerly Anti-friction Bearing Manufacturers Association) 2025 M. Street, NW, Suite 800 Washington, DC 20036-3309
ACI	American Concrete Institute Box 19150 Reford Station Detroit, MI 48219

ADAAG	Americans with Disabilities Accessibility Act Guidelines www.access-board.gov/adaag
ADC	Air Diffusion Council 230 North Michigan Avenue Chicago, IL 60601
AGMA	American Gear Manufacturers Association 1001 N. Fairfax Street, Suite 500 Alexandria, VA 22314-1587
AI	Asphalt Institute Asphalt Institute Building College Park, MD 20740
AISC	American Institute of Steel Construction 1221 Avenue of the Americas New York, NY 10020
AISI	American Iron and Steel Institute 1000 16 Street, NW Washington, DC 20036
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
APWA	American Public Works Association 1313 E. 60th Street Chicago, IL 60637
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 345 East 47 Street New York, NY 10017
ASME	American Society of Mechanical Engineers 345 East 47 Street New York, NY 10017
ASTM	American Society for Testing and Materials International 1916 Race Street Philadelphia, PA 19103

AWI	Architectural Woodwork Institute 1411 S. Rimpau Avenue, Suite 213 Corona, CA 92879-7500
AWWA	American Water Works Association 6666 W. Quincy Avenue Denver, CO 80235
AWS	American Welding Society 2501 NW 7 Street Miami, FL 33125
CBM	Certified Ballast Manufacturers 1422 Euclid Avenue Cleveland, OH 44115
CPSC	Consumer Products Safety Commission www.cpsc.gov
CRSI	Concrete Reinforcing Steel Institute 180 North LaSalle Street, Suite 2110 Chicago, IL 60601
CSA	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario, Canada M9W 1R3
DHI	Door and Hardware Institute 7711 Old Springhouse Road McLean, VA 22102
EEI	Edison Electric Institute 1111 19 Street, NW Washington, DC 20036
ETL	Electrical Testing Laboratories 2319 Dorris Place Los Angeles, CA 90031
FM	Factory Mutual www.fmglobal.com

FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197 Washington, DC 20407 www.fss.gsa.gov/pub/fed-specs.cfm
GA	Gypsum Association 1603 Orrington Avenue Evanston, IL 60201
IBC	International Building Code published by International Code Council 500 New Jersey Avenue, NW, 6th floor Washington, DC 20001
ICEA	Insulated Cable Engineers Association P.O. Box P South Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 345 East 47 Street New York, NY 10017
ISA	Instrument Society of America 67 Alexander Drive P.O. Box 12277 Research Triangle Park, NC 27709
MIL	Military Specification Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
NACE	National Association of Corrosion Engineers P.O. Box 21830 Houston, TX 77218
NEC	National Electric Code Batterymarch Park P.O. Box 9101 Quincy, MA 02269

NEMA	National Electrical Manufacturers' Association 2101 L Street, NW Washington, DC 20037
NESC	National Electric Safety Code 345 East 47 Street New York, NY 10017
NFPA	National Fire Protection Association 470 Atlantic Avenue Boston, MA 02210
NFPA	National Forest Products Association 1619 Massachusetts Avenue, NW Washington, DC 30036
NMBC	New Mexico Building Code Code Regulations Licensing Department Construction Industries Divisions 725 St. Michaels Drive Santa Fe, NM 87504
NRCA	National Roofing Contractors Association www.nrca.net
NWWDA	National Wood Window and Door Association P.O. Box 34518 Memphis, TN 38184
OSHA	Occupational Safety & Health Administration www.osha.gov
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 20076
PCI	Prestressed Concrete Institute 20 North Wacker Drive Chicago, IL 60606
SDI	Steel Door Institute 712 Lakewood Center North Cleveland, OH 44107

SIGMA	Sealed Insulating Glass Manufacturer's Association 111 East Wacker Drive Chicago, IL 60601
SJI	Steel Joist Institute 1703 Parham Road Suite 204 Richmond, VA 23229
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association, Inc. 8224 Old Court House Road Vienna, VA 22180
SSPC	The Society for Protective Coatings (formerly Steel Structure Painting Council) 40 24th Street, 6th Floor Pittsburgh, PA 15222-4656 (877) 281-7772
UBC	Uniform Building Code International Conference of Building Officials 5360 Workman Mill Road Whittier, CA 90601-2298
UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
UPC	Uniform Plumbing Code International Association of Plumbing/Mechanical Officials 20001 Walnut Drive, South Walnut, CA 91789-2825

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 16.14

DIGITAL VIDEO RECORDING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Digital video record entire area affected by construction prior to construction.

B. Perform additional digital video recording during project as directed by Engineer.

C. Have digital video files available with viewing facilities for viewing by Engineer, Owner, and Contractor when requested.

D. Digital video recording requirement part of Contractor's general overhead for which separate payment shall not be made.

1.02 EQUIPMENT REQUIREMENTS

A. Digital Video Camera Equipment:
1. Recording Media: DVD.
2. Format: Digital files compatible with standard playback equipment, and as agreed upon beforehand with Owner.
3. Color picture.
4. Audio, clear narration in English of significant features observed during recording.
5. Zoom lens.
6. Indexing of locations on discs for easy reference.
7. File downloading capability: To a personal computer (PC) that operates on Microsoft operating system of Windows XP or higher.

B. Video Viewing System:
1. Screen: 26 inches (diagonal dimension) or greater.
2. Color picture.
3. Audio.
4. Indexing of locations on discs for easy reference.
5. Slow motion.
6. Stop frame for viewing single picture.
7. Reversing.
8. Compatible with digital recording equipment.

C. Discs:
1. Catalogued, cross-referenced, indexed.

1.03 SYSTEM OPERATOR REQUIREMENTS

A. Familiar and experienced with equipment and equipment operations.

1.04 AVAILABILITY

A. Recording equipment and operator available on-site within 0.5 hours of Engineer's request during Contractor's normal working hours if scheduled.

B. Viewing system and appropriate discs available at meetings as scheduled or when requested by Engineer.

C. Deliver one (1) complete set of files to the Owner upon acceptance by the Engineer.

1.05 DIGITAL VIDEO RECORDING REQUIRED IF SCHEDULED

A. All streets, alleys, curbs, culverts, vaults, manholes, areas, locations where construction will be done:
   1. Both directions along utility line or street to be constructed or reconstructed.
   2. Maximum speed of camera movement 4 feet per second.
   3. Lateral and close-up view of any features or facilities that may be affected by construction.
   4. Not more than 14 calendar days prior to actual construction.
   5. Include data documentation on disc.
   6. Audio explanation of significant features observed during recording.
   7. Recording results acceptable to Engineer.
   8. Special documentation if requested by Engineer.

B. Drainage Documentation:
   1. Following general rainfall over area.
   2. Prior to any construction if practical.
   3. All areas where work will be performed.
   4. Recorded to document general preconstruction drainage patterns, problems, street surface conditions, and related items.
   5. On request of Engineer.

1.06 SCHEDULE OF REQUIRED DIGITAL VIDEO RECORDING

A. Provide digital video recording as outlined in Part 1.05. A.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECTION (NOT USED)

END OF SECTION

SECTION 01 56 00

BARRIERS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnish, install, and maintain suitable barriers as required to prevent public entry, and to protect the public, Work, and existing facilities; remove when no longer needed or at completion of Work.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 BARRIERS

A. Materials to Contractor's option, as appropriate to serve required purpose.

PART 3 EXECUTION

3.01 GENERAL

A. Install facilities of a neat and reasonable uniform appearance, structurally adequate for required purposes.

B. Maintain barrier during entire construction period.

C. Relocate barriers as required by progress of construction.

D. Provide barriers to protect the public from excavations and hazardous conditions and operations.

E. If a trench or excavation, where accessible to the public, is left open at night or weekends, it must be barricaded with flashing lights.

3.02 FENCES

A. Fence Location:

1. Locate fence to enclose substantially entire Project site or that portion the Contractor establishes as required to encompass entire Project construction operation.

2. Locate vehicular entrance gates in suitable relation to construction facilities; and to avoid interference with traffic on public thoroughfares.

B. Chainlink Fence:
   1. Fence not generally required for sewer lines, waterlines, and street work.
   2. Fence generally required for treatment plant, pump stations, and similar facilities.

3.03 REMOVAL

A. Completely remove barricades, including foundations, when construction has progressed to the point that they are no longer needed.

B. Clean and repair damage caused by installation, fill and grade areas of the site to required elevations and slopes, and clean the area.

END OF SECTION

SECTION 01 57 00

TEMPORARY CONTROLS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and related areas under Contractor's control; remove physical evidence of temporary facilities at completion of Work.

1.02 NOISE CONTROL

A. Limit to practical extent.

B. Limit to normal working hours when practical.

1.03 DUST CONTROL

A. Provide positive methods and apply dust control materials to minimize raising dust from construction operations, and provide positive means to prevent airborne dust from dispersing into the atmosphere.

1.04 WATER CONTROL

A. Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.
   1. Control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels and other construction areas; and to direct drainage to proper runoff.

B. Provide, operate and maintain hydraulic equipment of adequate capacity to control surface water.

C. Dispose of drainage water and dewatering water in a manner to prevent flooding, erosion or other damage to any portion of the site or to adjoining areas. Any public agency or private landowner arrangements, permits, or other approvals required for the discharge of water are the sole responsibility of the Contractor.

1.05 PEST CONTROL

A. As found necessary during construction.

1.06 RODENT CONTROL

A. Provide rodent control as necessary to prevent infestation of construction or storage area.
   1. Employ methods and use materials which will not adversely affect conditions at the site or on adjoining properties.
   2. Should the use of rodenticides be considered necessary, submit an informational copy of the proposed program to Owner with a copy to Engineer. Clearly indicate:
      a. The area or areas to be treated.
      b. The rodenticides to be used, with a copy of the manufacturer's printed instructions.
      c. The pollution preventive measures to be employed.

B. The use of any rodenticide shall be in full accordance with the manufacturer's printed instructions and recommendations and applicable laws and regulations.

1.07 DEBRIS CONTROL

A. Maintain all areas under Contractor's control free of extraneous debris.

B. Initiate and maintain a specific program to prevent accumulation of debris at construction site, storage and parking areas, or along access roads and haul routes.
   1. Provide containers for deposit of debris as specified in Section 01 74 00 – Cleaning and Waste Management.
   2. Prohibit overloading of trucks to prevent spillages on access and haul routes.
      a. Provide periodic inspection of traffic areas to enforce requirements.

C. Schedule periodic collection and disposal of debris as specified in Section 01 74 00 – Cleaning and Waste Management.
   1. Provide additional collections and disposals of debris whenever the periodic schedule is inadequate to prevent accumulation.

1.08 POLLUTION CONTROL

A. Provide methods, means and facilities required to prevent the discharge of hazardous substances from construction operations.

B. Perform emergency measures required to report, contain and transport harmful substance discharges or spills by complying with Federal and State regulations.

C. Take special measures to prevent harmful substances from entering public waters.
   1. Prevent disposal of wastes, effluents, chemicals or other such substances adjacent to streams, or in sanitary or storm sewers.

D. Provide systems for control of atmospheric pollutants.
   1. Prevent toxic concentrations of chemicals.
   2. Prevent harmful dispersal of pollutants into the atmosphere.

1.09 EROSION CONTROL

A. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
   1. Hold the areas of bare soil exposed at one time to a minimum.
   2. Provide temporary control measures such as berms, dikes, drains, straw bales, silt fences, and wattles.

B. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.

C. Periodically inspect earthwork to detect any evidence of the start of erosion, apply corrective measures as required to control erosion.

1.10 SECURITY CONTROL

A. Provide temporary padlocks during construction on gates, hatches, doors, panels, and boxes having hasps. Coordinate with Owner to install specified permanent padlocks at completion of project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 66 01

PRODUCT DELIVERY, STORAGE, AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. For the purposes of this Specification Section, the terms “material and equipment” and “Products” have the same meaning and are used interchangeably.

B. Material and equipment incorporated into the Work:
   1. New and free of defect unless otherwise shown on the Drawings.
   2. Conform to applicable specifications and standards.
   3. Comply with size, make, type and quality specified, or as specifically approved in writing by the Engineer.
   4. Manufactured and Fabricated Products:
      a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
      b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
      c. Two or more items of the same kind shall be identical, by the same manufacturer.
      d. Products shall be suitable for service conditions.
      e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
   5. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.02 REUSE OF EXISTING MATERIAL

A. Except as specifically indicated or specified, materials and equipment removed from the existing structure shall not be used in the completed Work.

B. For material and equipment specifically indicated or specified to be reused in the Work:
   1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
   2. Arrange for transportation, storage, and handling of products which require off-site storage, restoration or renovation. Perform such work at no additional cost to Owner.

1.03 MANUFACTURER’S INSTRUCTIONS

A. When Contract Documents require that installation of work shall comply with manufacturer’s printed instructions, such instructions shall be included with:

1. Shop drawing and/or product data submitted if an operation and maintenance manual is not required, or if specified in the Shop Drawing subsection of the equipment section.
2. Operation and maintenance data if required.

B. Handle, install, connect, clean, condition, and adjust products in strict accordance with such instructions and in conformity with specified requirements.
1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
2. Do not proceed with work without clear instructions.

C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.04 TRANSPORTATION AND HANDLING

A. Arrange deliveries of Products in accordance with construction schedules, coordinate to avoid conflict with work and conditions at the site.
1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.

B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

1.05 STORAGE AND PROTECTION

A. Store Products in accordance with manufacturer's instructions, with seals and labels intact and legible.
1. Store products subject to damage by the elements in weathertight enclosures.
2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

B. Exterior Storage:
1. Store fabricated Products above the ground, on blocking or skids, prevent soiling or staining. Cover Products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored Products to assure that Products are maintained under specified conditions, and free from damage or deterioration.

D. Protection After Installation:
   1. Provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove when no longer needed.

E. Repair Damage:
   1. Repair damaged materials and equipment to new condition or replace with new, to the satisfaction of the Engineer. Refer to Conditions of the Contract.

1.06 NAMEPLATE DATA

A. Provide original component manufacturer's permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Locate nameplates in an accessible location.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 23

FIELD ENGINEERING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Provide and Pay for Field Engineering Services Required for Project:
   1. Survey work required in execution of Project.
   2. Engineering work for civil, structural or other professional engineering services specified or required to execute Contractor's construction methods.

1.02 QUALIFICATIONS OF SURVEYOR OR ENGINEER

A. Survey work during construction may be completed by the Contractor. However, all locations/elevations must be verified at the completion of the contract by a qualified land surveyor registered in the state in which the construction is being done. Final survey data shall be documented on the Record Drawings.

B. Engineering work by qualified professional engineer registered in the state in which the construction is being done.

1.03 SURVEY REFERENCE POINTS

A. Original basic horizontal and vertical control points for the Project are those designated on Drawings.

B. Locate existing control points, re-establish original control points, protect control points prior to starting site work, and preserve all permanent reference points during construction.
   1. Make no changes or relocations without prior written notice to Engineer.
   2. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
   3. Require surveyor to replace Project control points which may be lost or destroyed.
   4. Establish replacements based on original survey control.

C. Reconfirm all existing and original vertical elevation control points prior to the use of such points for project surveying. Reference control point for such reconfirmation is shown on Drawings.

D. Refer any apparent discrepancies to Engineer for resolution. Surveyor to assist Engineer with field work required for resolution of such apparent discrepancies.

1.04 PROJECT SURVEY REQUIREMENTS

A. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:
   1. Site improvements:
   2. Stakes for grading, fill and topsoil placement.
   3. Utility slopes and invert elevations.
   4. Batter boards for structures.
   5. Building foundation, column locations, and floor levels.
   6. Controlling lines and levels required for mechanical and electrical trades.

B. From time to time, verify layouts by same methods as required for control of the Work and when requested by the Engineer.

C. The Contractor shall take reasonable efforts to protect all existing property corners, permanent bench marks, right-of-way markers, government established monuments, and similar reference points. If any must be disturbed, the monuments must be referenced before removal and replaced as soon as work in the area is completed. Referencing and replacing shall be done by a licensed surveyor, and in the case of U.S.G.S. monuments and NMDOT right-of-way markers, shall be a first order survey work.

1.05 RECORDS

A. Maintain a complete, accurate log of all control and survey work as it progresses.

B. On completion of improvements, prepare record drawings showing all dimensions, locations, and elevations of construction.

1.06 SUBMITTALS

A. Submit name and address of surveyor and professional engineer to Engineer.

B. Submit documents certifying current registration of surveyor and engineer.

C. On request of Engineer, submit documentation to verify accuracy of field engineering work.

D. Survey data and computations for all Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Execute cleaning, during progress of the Work, and at completion of the Work, as required by General Conditions.

1.02 RELATED REQUIREMENTS

A. Conditions of the Contract

B. Each Specification Section: Cleaning for specific products or work.

1.03 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

A. Execute periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

B. Provide on-site containers for the collection of waste materials, debris and rubbish.

C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

A. Type 1 – For Buildings:
   1. Employ skilled workmen for final cleaning.
   2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.
   3. Wash and shine glazing and mirrors.
   4. Polish glossy surfaces to a clear shine.
   5. Ventilating Systems:
      a. Clean permanent filters and replace disposable filters if units were operated during construction.
      b. Clean ducts, blowers and coils if units were operated without filters during construction.
   6. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
   7. Prior to final completion, or Owner occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces, and all work areas, to verify that the entire Work is clean.

B. Type 2 – For Grounds and Exposed Concrete Work:
   1. Broom clean exterior paved surfaces; rake clean other ground surfaces.
   2. Broom clean all concrete slabs.
   3. Remove grease, mastic, adhesives, dust, dirt, stains, labels and other foreign materials from all piping systems surfaces and equipment.
   4. Prior to final completion or Owner occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas to verify that the entire Work is clean.

3.04 SCHEDULE

A. Type 2

END OF SECTION

SECTION 01 74 20

FILL AND WASTE MATERIAL

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Provide all fill material required to complete Work.

B. Dispose of all waste material generated by construction activities, unless otherwise stated in Contract Documents. Properly dispose of all materials in accordance with regulatory requirements.

C. No additional cost to Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 75 01

FIELD SERVICE REPRESENTATIVE

PART 1 GENERAL

1.01 FIELD SERVICE REPRESENTATIVE

A. Shall be employed by the manufacturer and shall regularly engage in field checkout, calibration, testing, trouble-shooting, installation supervision, and start-up of equipment or systems.

B. Shall have qualifications and experience acceptable to the Owner and the Engineer. Submit name and qualifications of Field Service Representative with the shop drawing submittal of the applicable equipment item.

C. A manufacturer's sales representative will not be acceptable as a field service representative unless the Contractor applies for and receives in writing a waiver for such from the Owner.

D. Shall be thoroughly familiar with the specific equipment or system for this project on arrival at the jobsite. The Field Service Representative shall perform installation supervision, field check-out, calibration, testing, troubleshooting, adjustment or other services as specified in the pertinent section.

E. The Engineer reserves the right to require a substitute Field Service Representative, at no extra cost to the Owner, if the Field Service Representative supplied by the manufacturer is not able to properly perform the required tasks.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 TEST EQUIPMENT

A. Coordinate requirements for test equipment with Field Service Representative and ensure that all necessary standard and special test, calibration, and diagnostic equipment is available for start-up testing.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Format and Content of Manuals

B. Submittals

C. Schedule of Submittals

1.02 QUALITY ASSURANCE

A. Preparation of data shall be done by personnel:
1. Trained and experienced in maintenance and operation of the described products.
2. Completely familiar with requirements of this Section.
3. Skilled as a technical writer to the extent required to communicate essential data.
4. Skilled as a draftsman competent to prepare required drawings.

B. Manuals for equipment and systems shall be prepared by the equipment manufacturer or system supplier.

1.03 FORMAT

A. Prepare data in the form of an instructional manual for use by Owner's personnel.
1. Binders:
   a. Preliminary manuals: Heavy paper covers.
   b. Final manuals: Commercial quality substantial, permanent, 3-ring or 3-post binders with durable, cleanable plastic covers. Covers of adequate size to easily contain required information.

B. Cover and Spine: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
1. Title of Project.
2. Identity of separate structure as applicable.
3. Identity of general subject matter covered in manual.

C. Assemble and bind material in the same order as specified in Paragraph 1.05 with the material grouped in the same manner as the applicable portions of the CONTRACT DOCUMENTS.

D. Text: Manufacturer's printed data, or typewritten data on 20 lb. minimum, white, paper. Size: 8-1/2 x 11.

E. Drawings:
1. Provide reinforced punched binder tab, bind in with text.
2. Reduced to 8-1/2" x 11" or 11" x 17" and folded to 8-1/2" x 11".
3. Where reduction is impractical, folded and placed in 8-1/2" x 11" envelopes bound in text.
4. Suitably identified on drawings and envelopes.

F. Provide fly-leaf for each separate product, or each piece of operating equipment.
1. Provide typed description of product, and major component parts of equipment.
2. Provide indexed tabs.

1.04 CONTENT OF MANUALS

A. Table of Contents:
1. Provide title of project.
2. Contractor, name of responsible principal, address and telephone number.
3. Schedule of products and systems, indexed to the content of the volume.
4. List, with each product, the name, address and telephone number of:
   a. Subcontractor or installer.
   b. Maintenance contractor, as appropriate.
   c. Local source of supply for parts and replacement.
   d. Manufacturer.
5. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

B. Product Data:
1. Include only those sheets which are pertinent to the specific product.
2. Annotate each sheet to:
   a. Clearly identify the specific product or part installed.
   b. Clearly identify the data applicable to the installation.
   c. Delete references to inapplicable information.
3. Preventive maintenance information shall be given for each major component of every piece of equipment in the format included in this Section.

C. Drawings:
1. Supplement product data with drawings as necessary to clearly illustrate:
   a. Relations of component parts of equipment and systems.
   b. Control and flow diagrams.
2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
3. Do not use Project Record Documents as maintenance drawings.

D. Written Text:
   1. Supplement product data for the particular installation.
   2. Organize in a consistent format under separate headings for different procedures.
   3. Provide a logical sequence of instructions for each procedure.

E. Warranties and Bonds:
   1. Copy of each Warranty, Bond and Service Contract Issued.
   2. Provide information sheet for Owner's personnel.
   3. Proper procedures in the event of failure.
   4. Instances which might affect the validity of warranties or bonds.

F. Provide an installation, operation and maintenance manual for each item of equipment or system listed in the schedule of manuals in the quantity listed in the submittal schedule.

G. Additional Requirements for Operation and Maintenance Data: The respective sections of specifications.

1.05 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System. Include and identify:
   1. Description of unit or system and component parts.
   2. Function, normal operating characteristics, and limiting conditions.
   3. Performance curves, with engineering data and tests.
   4. Complete nomenclature and commercial number of all replaceable parts.

B. Installation Instructions, include:
   1. Manufacturer's complete installation instructions and recommendations.

C. Operating Procedures, include:
   1. Startup, break-in, and routine normal operating instructions and sequences.
   2. Regulation, control, stopping, shutdown and emergency instructions.
   3. Summer and winter operating instructions, as applicable.
   4. Special operating instructions.

D. Maintenance Requirements, include:
   1. Routine procedures and guide for trouble-shooting.
   2. Disassembly, repair and reassembly instructions.
   3. Alignment, adjusting, balancing and checking instructions.
   4. Preventive maintenance information for each major component of every piece of equipment as required on the "Preventive Maintenance Information & Equipment Data Sheet" attached at the end of this section.

E. Servicing and Lubrication Schedule, provide:
   1. List of lubricants required.

2. Lubrication information for each major component of every piece of equipment as required on the "Preventive Maintenance Information & Equipment Data Sheet" attached at the end of this section.

F. Provide manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

I. Provide list of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide other data as required under pertinent sections of specifications.

1.06 MANUAL FOR ELECTRIC AND ELECTRONIC ITEMS OR SYSTEMS

A. Description of system and component parts, include and identify:
1. Function, normal operating characteristics, and limiting conditions.
2. Performance curves, engineering data and tests.
3. Complete nomenclature and commercial number of replaceable parts.

B. Circuit Directories of Panelboards; provide:
1. Electrical service characteristics
2. Controls
3. Communications

C. Provide as-installed color coded wiring diagrams.

D. Operating Procedures, include:
1. Routine and normal operating instructions.
2. Sequences required.
3. Special operating instructions.

E. Maintenance Requirements, include:
1. Routine procedures and guide to trouble-shooting.
2. Adjustment, balancing and checking instructions.

F. Provide manufacturer's printed operation and maintenance instructions.

G. Provide list of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

H. Provide other data as required under pertinent sections of specifications.

1.07 SUBMITTAL OF MANUALS

A. Preliminary Submittal of Manuals.
   1. Quantity:
      a. Submit number of preliminary manuals required by Contractor plus number to be retained by Engineer.
      b. As scheduled.
   2. Submit prior to the date of shipment of equipment or system.
   3. Engineer will review for acceptance and return to Contractor with comments as appropriate.
   4. Resubmittal Process:
      a. If unacceptable, Contractor to resubmit same number of preliminary copies for Engineer's review.
      b. Manuals will not be reviewed in detail once determined by the Engineer that a manual is not acceptable.
      c. No partial payment will be made for equipment materials or related system materials delivered to the site until preliminary manuals for that equipment are submitted and are acceptable to the Engineer.

B. Final Submittal of Manuals
   1. Quantity:
      a. Submit number required by Contractor plus number to be retained by Engineer.
      b. As scheduled.
   2. Submit copies no less than 30 days prior to putting equipment or system in service.
   3. Engineer will review and compare with accepted preliminary manual.
   4. If acceptable, manuals will be distributed as follows:
      a. Contractor: For project record documents.
      b. Engineer: For files.
      c. Owner: Held for later transmittal to Owner.
   5. If not acceptable, all copies will be returned to Contractor for revision or retained by Engineer and the necessary revision data requested from Contractor, at Engineer's option.
   6. No portion of the Work is substantially complete until final equipment and system manuals relating to that portion of the Work are accepted by Engineer.
   7. Submit copies of any revisions found desirable during instruction of Owner's personnel, with instructions for insertion for revising copies of manual.

C. Funding agency funds may be withheld from Owner if Owner's acceptable operation and maintenance manual is not submitted as required by the agencies. If this occurs and such is partially attributable to a delay by the Contractor in submitting the required operation and maintenance materials:
   1. Owner may withhold payments from Contractor.
   2. Contractor shall not terminate or suspend work.

3. No additional costs or contract time shall be claimed by Contractor if Owner withholds payments.

D. If Contractor requires additional copies of the operation and maintenance manuals for the Contractor's, subcontractor's or suppliers' use, such may be submitted and will be returned upon review by the Engineer.

1.08 REIMBURSEMENT FOR ENGINEER'S REVIEW COSTS

A. For all manual reviews beyond one review of the preliminary manual and one review of final manual:
1. Owner will charge Contractor for all of Engineer's review time and costs at Engineer's standard billing rates through a credit by Change Order.
2. Engineer will perform these unscheduled reviews in the same manner as other unscheduled work.

1.09 SUBSTANTIAL COMPLETION

A. Project will not be considered substantially complete until final O&M Manuals and instruction of Owner's personnel have been accepted by Engineer.

1.10 SCHEDULE OF SUBMITTALS

A. Prepare O&M Manuals for pieces of equipment where specified in the individual specification sections.

B. Quantities to be Retained by Engineer:
1. Preliminary Manuals: 2 manuals (hard copies)
2. Final Manuals:
   a. 2 (hard copies)
   b. 3 (CD with electronic version)

C. The "Preventive Maintenance Information & Equipment Data Sheet" at end of this section shall be completed and submitted with the preliminary and final operation and maintenance manuals.

PREVENTIVE MAINTENANCE INFORMATION
AND
EQUIPMENT DATA SHEET

1. Equipment Name:_____

2. Equipment Number:_____

3. Equipment Manufacturer:_____

   Address:_____

   Phone: (_____) _____

4. Equipment Supplier:_____

   Address:_____

   Phone: (_____) _____

5. Nameplate Data:
   Drive Unit:_____hp, _____rpm, _____volts, _____~~O~~_____ FLA
   Motor class (dripproof, TEFC, etc.)_____
   Manufacturer_____
   Model No._____ Serial No._____
   Other_____

   Driven Unit: Flow with units_____
   Discharge Pressure with units_____
   Equipment Type_____
   Model No._____ Serial No._____
   Other_____

6. Method of Power Transmission (direct coupled, V-belt, etc.)_____
   _____

7. Maintenance Requirements (list on next sheet)

   Maintenance Operation: List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable.

   Frequency: List required frequency of each maintenance operation.

   Lubricant (if applicable): Refer by symbol to recommended lubricant from list in Item

8. Comments: Give other applicable comments concerning maintenance operation.

Maintenance Operation (including any special tools required) | Frequency | Lubricant | Comments

A.

B.

C.

Use additional sheets if necessary.

9. Lubricant List (provide Mobil number in addition to any other recommended manufacturers):

Reference Symbol	Mobil	Chevron	Shell	Arco	Or Equal
List symbols used in Item 7, above.		*List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.*			

10. This data sheet prepared by:_____

Firm:_____

Date:_____

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Maintain one record copy of the following record documents at the site for the Owner:
   1. Drawings
   2. Engineer's response to Requests for Information (RFIs)
   3. Engineer Field Orders or written instructions
   4. Accepted Shop Drawings, Product Data and Samples
   5. Field Test records
   6. Receipts for delivery of items to Owner
   7. Asset management data sheet

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents used for construction.
   1. Provide files and racks for storage of documents.
   2. Provide locked cabinet or secure storage space for storage of samples.

B. File documents and samples in accordance with specification format.

C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

D. Make documents and samples available at all times for inspection by Engineer and Owner.

1.03 MARKING DEVICES

A. Provide felt tip marking pens for recording information in the color code designated by Engineer.

1.04 RECORDING

A. Label each document "PROJECT RECORD" in neat, large printed letters.

B. Record information concurrently with construction progress.
   1. Do not conceal any work until required information is recorded.

C. Drawings: Legibly mark to record actual construction:
   1. Changes made by addenda.

2. Depths of various elements of foundation in relation to finish first floor datum.
3. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
4. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
5. Field changes of dimension and detail.
6. Changes made by Field Order or by Change Order.
7. Details not on original Contract Drawings.
8. For sewer lines: Invert elevations at manholes, line and manhole alignment and locations, and location of each service line referenced by distance from downstream manhole and distance from sewer centerline to end of service line.

1.05 SUBMITTAL

A. At Contract close-out, deliver Record Documents to Engineer for the Owner.

B. Accompany submittal with transmittal letter in duplicate, containing:
1. Date
2. Project title and number
3. Contractor's name and address
4. Title and number of each Record Document
5. Signature of Contractor or his authorized representative

1.06 PAYMENT

A. Project record documents are incidental Work to the Contract Documents' bid items for which no separate payment will be made.

B. No payment will be made to the Contractor for any portion of the work for which the project record documents are not complete.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Demolition and salvage of existing facilities as indicated on Drawings and/or required for completion of works under contract.

1.02 ADDITIONAL REQUIREMENTS

A. Disposal:
   1. Contractor's full responsibility unless otherwise specifically indicated.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Plug with grout all exposed pipe lines remaining in place to be abandoned, unless otherwise noted.

B. Contractor shall properly dispose of all other demolition materials.

C. All underground piping to be abandoned in place, shall be flushed clean and plugged on all ends with concrete grout.

3.02 EXISTING WET WELL MODIFICATIONS

A. Comply with OSHA and City of Albuquerque confined space entry procedures for all work inside existing wet well.

B. Pressure wash all surfaces inside wet well prior to performing any work inside wet well.

END OF SECTION

SECTION 05 50 01

ANCHOR BOLTS AND CHEMICAL ANCHORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in anchor bolts for structural connections and to secure equipment.

B. Bolts, threaded rods, and deformed rods to be placed in holes drilled into hardened concrete or masonry and secured by chemical grouts.

1.02 SUBMITTALS

A. Section 01 33 23: Shop Drawings, Product Data, and Samples

B. Product Data

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver anchor bolts and templates in time to permit setting when structural concrete is placed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bolts:
1. Carbon steel: ASTM A 307
2. Galvanized steel: Carbon steel, hot-dip galvanized, ASTM A 153; or zinc plated, ASTM A 164, type GS
3. Stainless steel: ASTM F 593

B. Nuts:
1. Same material as bolts.
2. Carbon steel: ASTM A 563, Grade B heavy hexagonal
3. Stainless steel: ASTM F 594
4. Self-locking: Prevailing torque, IFI-100, Grade A

C. Washers:
1. Same material as bolts.
2. Flat: ASTM F 436
3. Locking: Spring type ANSI B27.1

D. Sleeves:
   1. Pipe: ASTM A 53, galvanized
   2. Bearing plates: ASTM A 36, galvanized

E. Chemical Anchor Systems:
   1. Fastener or connector: Bolt, threaded rod or deformed rod as shown on Drawings, material as indicated on Drawings or specified.
   2. Screen sleeves: For attachment to hollow masonry walls, provide stainless steel screen sleeves specifically manufactured for the purpose and approved by the manufacturer of the adhesive to be used.
   3. Chemical adhesive: Two component system to be mixed at the site and placed into predrilled holes.
   4. Acceptable products: Subject to compliance with the requirements of these specifications, products which may be used in the work include, but are not limited to, the following:
      a. Epcon Epoxy Injection System as manufactured by ITW Ramset/Red Head.
      b. HIT Renovation Anchor System as manufactured by the HILTI Corporation.
      c. Molly PARAFAST Resin Mortar as manufactured by the Molly Fastening Systems Group of Emhart Corporation.

2.02 FABRICATION AND MANUFACTURE

A. Anchor Bolts:
   1. 3/4” minimum, except as indicated on the Drawings.
   2. Type:
      a. General use: L-shaped hook type.
      b. Where indicated on Drawings or specified:
         1) Straight bolt with square head.
         2) Straight bolt with square plate welded to bolt and nut welded to plate and bolt.
         3) Through-bolt with sleeve and square plate assembly.
         4) Coupled bolt with sleeve welded to square plate and bolt.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that holes for anchor bolts in forms and templates match applicable equipment shop drawings.

3.02 INSTALLATION

A. Anchor Bolts:
   1. Where installed in cast-in-place concrete, install a nut on the concrete side of the form or supporting template.
   2. Provide 3 nuts for each equipment anchor bolt for which a lock nut is indicated, 2 for others.
   3. Sleeved anchor bolts:
      a. Centered in pipe sleeve.
      b. Sleeve ID: Approximately 2-1/2 times bolt OD.
      c. Sleeve length: Approximately 8 times bolt OD.
      d. Bearing plate minimum thickness: 1/2 times bolt OD.
   4. Through bolts:
      a. Sleeved with bearing plates.
      b. Bearing plates welded to bolt and plate welded to sleeve.
      c. Dimension: As specified for sleeved anchor bolts.

B. Chemical Anchor Systems:
   1. Install in conformity with the manufacturer's instructions.

3.03 SCHEDULE

A. Anchor bolts to be stainless steel unless noted otherwise on Drawings.

B. All sleeves and plates galvanized unless noted otherwise on Drawings.

END OF SECTION

SECTION 26 00 10

GENERAL CONDITIONS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Labor, equipment, tools, materials, supplies, and operations necessary to install a complete electrical system, including that which may be reasonably implied on the Drawings or in the Specifications as being incidental to the work of Division 26.

B. Labor, equipment, tools, materials, supplies, and operations required to make a completely electrically operable system of the equipment furnished under other Divisions of this Specification.

1.02 MISCELLANEOUS MATERIALS

A. The Drawings are not intended to and do not show all equipment such as junction boxes, outlet boxes, conduit, fittings, mounting and miscellaneous hardware, and similar. Even though such items may not be specifically mentioned in the Specifications nor shown on the Drawings, nor noted on Shop Drawings, if they are necessary to make a complete installation, include them in the work required under this Division.

1.03 QUALITY ASSURANCE

A. Use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the recommendations of the manufacturer of the specified items to fabricate, install, and test the work of this Division.

B. Where the Specifications or Drawings call for equipment or methods to be of better quality or higher standards than required by referenced Codes or Standards, the Specifications and Drawings shall prevail.

1.04 SUBSTITUTIONS

A. When requesting substitution of material for products specified in this Division, comply with Section 01 25 00 – Substitution Procedures. Include as part of the request detailed descriptions and drawings showing all resultant changes to the electrical work.

B. The design of certain equipment may be related to factors not immediately obvious. Changes in design of equipment may require technical justification, or require changes be made in other equipment to match the proposed changes, or require the equipment be supplied as specified, or any combination of the above, at no additional cost to the Owner.

1.05 LOCATION OF ELECTRIC EQUIPMENT

A. The Drawings or other Specification sections define the approximate location of services, cabinets, panelboards, switches, lights, receptacles, and other equipment. Determine the most suitable location by actual measurement during construction. Maintain clearance required by NEC Article 110. Propose final location and obtain approval of the Engineer in advance of installation.

B. Coordinate location and configuration of electrical work with the work of other trades to avoid interference, to assure convenient access for operation and maintenance of equipment, for optimum luminaire placement, and for neat appearance.

1.06 SIZE AND RATING OF MATERIALS

A. The size and rating of the conductors, conduits, overcurrent protection devices, disconnect devices, motor starters, and other related equipment used to provide and control electric supply to the various power consuming equipment furnished under this contract have been determined based on the requirements of the specified equipment. If the requirements of the power consuming equipment actually furnished causes a need to change the rating of any of these materials:
   1. Consult with the Engineer to determine the changes necessary to provide and control electric supply to the equipment furnished, and
   2. Install the agreed upon materials at no increase in the Contract amount or time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 00 20

CODES, PERMITS, AND FINES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 COMPLIANCE

A. This Section applies to Division 26 and to Division 40 Section 40 90 00 – Plant Control System, and to Sections referenced therein.

B. Perform electrical work and provide material and equipment in compliance with the State of New Mexico Electrical Code (NMEC but also referred to as NEC in these specifications for convenience) and other national, state, and local codes, regulations, laws, and ordinances. The Engineer will resolve conflicts between the above and the Specifications or the Drawings.

C. Without relieving the Contractor from the obligation to comply with all provisions of the NMEC and other codes and standards, attention is directed to the following portion of the NMEC, 2011, 14 NMAC 10.4.11 B. (1) "Section 110.2 Approval." Only with written permission of the Engineer and of the Authority Having Jurisdiction (AHJ), provide certification of non-labeled equipment or material from a nationally recognized testing laboratory that has been approved by the electrical bureau.

1.02 PERMITS

A. Obtain electrical permits. This applies whether or not the AHJ requires a permit for the structural/process portion of a project.

1.03 INSPECTIONS AND CERTIFICATES

A. Arrange and pay for electrical inspections.

B. Correct deficiencies noted as a result of inspections then arrange for additional inspections.

C. Furnish properly executed certificates of final electrical inspection and approval from the AHJ at the conclusion of the work and before final acceptance of the work by the Owner.

D. It is recognized that inspection by the AHJ is intended to determine whether the work is in compliance with applicable codes, not to determine whether the work is in compliance with the Contract Documents.

1.04 PAYMENTS TO THE AHJ

A. Include in the Bid the cost of permits and initial inspections.

B. No change in the Contract Amount will be allowed for other costs associated with this Section, such as but not limited to the cost for certification of non-labeled equipment, additional inspections, and fines/penalties levied by the AHJ. Exception: If a Change Order results in charges from the AHJ for an additional permit and/or additional inspections, then itemized, documented costs will be included in the Change Order amount.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 00 30

AREA CLASSIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL (NOT USED)

PART 2 PRODUCTS

2.01 MATERIALS

A. Hazardous Areas:
1. Comply with New Mexico Electrical Code (NMEC) Article 500 and 501 requirements.
2. Enclosures for intrinsically safe equipment: NEMA 4X SS, unless specified otherwise in specific Sections.
3. Enclosures for other equipment: Minimum NEMA 7; combination such as NEMA 4X and 7 where specified specific Sections.
4. Other material as specified in other Sections.

PART 3 EXECUTION

3.01 INSTALLATION

A. Hazardous Areas:
1. Comply with NMEC Article 500 and 501, requirements for the respective location.
2. Not all gas seals and similar accessories are shown on the Drawings. Install where required by the NMEC. Certain seals shown on the Drawings may not be required by the NMEC. Install the latter in addition to those required by the NMEC.

3.02 SCHEDULE

A. Hazardous Areas:
1. Class 1, Division I Areas: Area inside wet well.
2. Class 1, Division II Areas: 10’ envelope ground openings of the wet well.

B. Non-Process Indoor Areas: None.

C. Process Areas: All other areas.

END OF SECTION

SECTION 26 00 40

PROJECT RECORD DOCUMENTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 GENERAL

A. Except as may be stated below, this Section applies to Division 26 and to Section 40 80 00 – Instrumentation and Controls, and to Sections referenced therein. It contains minimum requirements; also comply with Section 01 78 39 – Project Record Documents.

1.02 LEGIBILITY

A. Materials that are not sufficiently legible to the Engineer may be returned without being reviewed.

B. Materials of marginal legibility may be accepted for preliminary review but rejected for use as final Record Documents.

C. Minimum text height on project-specific submittal drawings such as schematics, connection diagrams, loop diagrams, and similar: 1/8 inch.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTRACT DRAWINGS

A. Maintain a complete set of Contract Drawings in "Record" condition. Mark, initial, and date changes, modifications, or corrections as they occur.

B. Show by dimensions and by correct scale the location and burial depth of underground conduits, duct banks, conduit stubouts, and direct buried cables. Show location and depth at each end and at every bend.

C. Show all differences between electrical and instrumentation design and the actual construction of electrical and instrumentation systems.

D. Have the Drawings available for inspection by the Engineer during standard work hours at the project site.

E. Furnish the "Record" Contract Drawings to the Engineer after completing the work and tests.

3.02 SHOP DRAWINGS/SUBMITTALS

A. Maintain a complete set of Shop Drawings in "Record" condition. Mark, initial and date changes, modifications, or corrections as they occur.

B. Where required in the equipment sections, return field marked Shop Drawings to the respective manufacturer who shall transfer "Record" markings to the original tracings, stamp the originals "Record" and place the date adjacent to the stamp. Contractor submit.

C. Where a connection diagram is required as part of the submittals for a Section of these Specifications, whether in Division 26 or Division 40 or not, the Record documents for that section shall include copies of the connection diagrams that show all field interconnection information. Where a wire goes to a field device, such as a STOP pushbutton, the interconnection information may simply say "STOP pushbutton, field." Where a wire goes to an equipment where it is terminated on a terminal board, show the wire destination by equipment name or abbreviation, then terminal board number, then terminal point number, AFD1-B 6 for example.

D. Furnish other "Record" Shop Drawings to the Engineer.

E. Furnish "Record" submittals to the Engineer where specified in individual sections.

END OF SECTION

SECTION 26 00 60

EXTRA MATERIALS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extra materials, such as spare parts, maintenance materials, and special tools for Division 26, Section 40 90 00 – Plant Control System, for Sections referenced therein, and for other Sections as required below.

B. Marking, packaging, and delivery of extra materials as required in Division 1.

1.02 SUBMITTALS

A. Include detailed descriptions of extra materials in the submittal materials for specific Sections and show in the Master List as required in Section 01 78 44 – Spare Parts and Maintenance Materials.

PART 2 PRODUCTS

2.01 EXTRA MATERIALS REQUIRED

A. If the equipment submitted differs from that specified and the manufacturer recommends extra materials which differ from those specified, provide extra materials of equal function to those specified. Also provide additional materials if so recommended in the manufacturer's Operation and Maintenance Manual.

B. Regardless of the Division/Section in which the equipment is specified, provide spares of every type and rating of fuse used in the project. Provide minimum quantity as shown below but provide more if so specified elsewhere.
1. Fuses of 250 V or less: One standard package or ten, whichever is greater.
2. 600 V fuses: Six.

C. Regardless of the Division/Section in which the equipment is specified, provide spares of every type and rating of pilot lamp used in the project. Provide minimum quantity as shown below but provide more if so specified elsewhere.
1. Incandescent lamps: Two standard packages or twenty, whichever is greater.
2. LED lamps for heavy-duty industrial pilot devices: Two of each color.

D. As required in specific Sections.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 19

LOW VOLTAGE WIRE AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low voltage wire and cable.

1.02 SYSTEM DESCRIPTION

A. Furnish wire and cable for all systems except:
   1. Where supplied as part of an equipment or system.
   2. Where specifically stated otherwise in other parts of the Specifications or on the Drawings.

B. Install, connect, mark, and test all wire and cable.

1.03 SUBMITTALS

A. Paragraph 2.01: Not required.

B. Paragraphs 2.02 through 2.07: Manufacturer's standard literature.

PART 2 PRODUCTS

2.01 600V POWER AND GENERAL PURPOSE WIRE

A. Meet NEC 310, UL 83, and the ANSI C8 Series.

B. Conductor: Copper.

C. NEC Type: THWN/THHN

D. Minimum wire size unless specifically noted otherwise on the Drawings:
   1. 480V: #10 AWG.
   2. 120/208/240V: #12 AWG.
   3. Control: #14 AWG, stranded.
   4. Grounding/bonding conductors: #12, except #14 for control runs.

2.02 600 POWER AND GENERAL PURPOSE WIRE (ALUMINUM)

A. Meet UL Standard 1581 for stranded AA-800 series aluminum allow conductors.

B. Conductor: Aluminum.

C. NEC Type: XHHW-2.

D. Wire Size: #6 to 1000 kcmil.

2.03 SHIELDED CABLE (TWSH)

A. 90 degree C. operation.

B. Single Pair: Stranded bare or tinned copper, #16 AWG with 600V insulation, meet NEC 336.

C. Insulation: Extruded PE, PVC, or PVC/Nylon.

D. Conductor Identification: Colored pairs.

E. Pair Construction: Twisted pair, lay 1-1/2 inches to 2-1/2 inches.

F. Core Tape: Polyester with 25 percent overlap.

G. Shield: Polyester supported aluminum tape with tinned #18 AWG copper drain wire.

H. Jacket: Ultraviolet stabilized, flame retardant extruded black PVC with non-hygroscopic rip cord.

2.04 TRAY CABLE (TC)

A. Meet NEC 336, 50l, 725, 727, and 760. UL listed as Type TC. UL listed as suitable for direct burial in sizes #l4 AWG and larger.

B. Flame, moisture, and sunlight resistant. Meet UL 1581 Vertical Tray Flame Test at 70,000 BTU.

C. Ratings:
1. 600V.
2. 90 degrees C. dry locations; 75 degrees C. wet locations.

D. Construction:
1. Conductor: Stranded soft annealed copper.
2. Insulation: Polyvinyl chloride with 5 mil nylon jacket.
3. Jacket: Polyvinyl chloride.

E. Conductor Identification:
1. #8 AWG and larger: ICEA Method 4.
2. #l0 AWG and smaller: ICEA Table K 2, Methods l and 4.
3. As shown on Drawings or Schedules.

2.05 DEVICENET™ CABLE

A. DeviceNet Thick Cable:
1. UL Labeled 600V rated power limited tray cable (PLTC).
2. Power pair, signal pair, drain wire, braided shield, jacket.

3. Specifically designed for DeviceNet data communications networks.
4. Meet the standards of ODVA™ (www.odva.org) for trunk cable.

B. DeviceNet Thin Cable:
1. UL Labeled 300V rated CL2/AWM cable.
2. Power pair, signal pair, drain wire, braided shield, jacket.
3. Specifically designed for DeviceNet data communications networks.
4. Meet the standards of ODVA (www.odva.org) for drop cable.

C. Northwire, Inc. (www.northwire.com/devicenet) DataCELL® FIELD DeviceNet Cable or Engineer reviewed equivalent.

2.06 ETHERNET CABLE

A. Labeled as c(UL)US compliant.

B. Verified to Category 6 ANSI/TIA/EIA-568-B.2.

C. Four pair 24 gage with blue jacket.

D. Use ANSI/TIA/EIA compliant connectors and installation.

2.07 PROFIBUS CABLE

A. NEC PLTC. UL listed.

B. For Profibus DP signals.

C. 300V 75 degree C.

D. Construction:
1. 2 – 22 AWG (7x30 AWG) stranded copper with FRFPE insulation, twisted.
2. 100% coverage foil insulation.
3. 65% coverage tinned copper braided shield.
4. Purple PVC jacket.

E. Belden Profibus DP Hi-Flex, 3079E, or equivalent.

2.08 OTHER WIRE AND CABLES

A. As supplied under other Sections or as required on the Drawings or Schedules.

PART 3 EXECUTION

3.01 COLOR CODING

A. 600V Power and General Purpose Wire:
   1. Neutral and ground as required by NEC. Where two neutrals are run in a conduit, make one white and one grey. For three: one white, one grey, and one white that is field marked with a band of grey tape at each end.
   2. 480V Phases: Brown, orange, yellow (A,B,C, respectively).
   3. 120/240V: Black and blue.
   4. 120/208V: Black, blue, violet (A,B,C, respectively).
   5. Motor Control Leads:
      a. THWN/THHN: Red to field devices with white (grey) neutral.
      b. Tray Cable: Inherent to cable.
   6. THWN/THHN: #14 to #10 AWG: Colored insulation.
   7. THWN/THHN: Larger than #0: Tape may be used.

B. TWSH and TC: Inherent to cable construction.

C. Color shall be the same from end to end of a run. Do not change conductor color at splices or terminal boards.

3.02 MARKING

A. Mark all field conductors unless directed otherwise on the Drawings or Schedules.

B. Text:
   1. Power and Control Circuits associated with MCC:
      a. Mark power feeders to motors with the motor control center number, cubicle number and terminal strip number, such as, 28 2A-T1 for MCC 28, cubicle 2A, phase A.
      b. Mark control conductors with motor tag number followed by MCC cubicle terminal point number; such as, M394l-X2. Use pump or equipment number in the absence of a tag number.
   2. All lighting circuits and power circuits not associated with a motor control center (MCC): Panel designation and circuit number, such as, LP1-12, or PPA-23,25,27.
   3. Lighting and power circuits from a panelboard furnished as an integral part of a MCC: Panel designation and circuit number, such as, LP1-12, or PPA-23,25,27.
   4. Control Circuits not associated with MCC: Terminal board number or wire number shown on schematics and/or submittals.
   5. Instrumentation (all ends of complete run of all milliamp signal cables): Tag number, i.e., LS01, on pair, then "+" on positive conductor. Use black for positive polarity and white for negative.
   6. Mark otherwise as specifically shown on the Drawings or Schedules.

C. Method:
1. Hot marked (embossed, not just surface printed) heat shrink tubing of the proper diameter; Raychem, or
2. Typed or computer printed, wrap-on, cloth adhesive labels held in place with a length of clear heat shrinkable tubing, or
3. Typed or computer printed, wrap-on labels held in place with a wrapped and heat bonded cover, 3M ScotchCode, or
4. Engineer reviewed equivalent.
5. Direct hot marking of wire or labeling methods, which depend solely on adhesive for attachment, are not acceptable.

D. Location: Install wire markers at every connection point to terminal boards, control stations, indicators, starters, instruments, and similar equipment, and at all splices.

3.03 TAGGING

A. Tag conductors and cables unless directed otherwise on the Drawings or Schedules.

B. Text:
1. Power and Control Circuits associated with MCC: MCC number and cubicle designation, such as MCC28-2BL.
2. All lighting circuits and power circuits not associated with a motor control center (MCC): Panel designation and circuit number, such as, LP1-12, or PPA-23,25,27.
3. Lighting and power circuits from a panelboard furnished as an integral part of a MCC: Panel designation and circuit number, such as, LP1-12, or PPA-23, 25, 27.
4. Control Circuits not associated with MCC: Name of equipment being controlled.
5. Instrumentation: Tag number.
6. Mark otherwise as specifically shown on the Drawings or Schedules.

C. Method:
1. Loosely group conductors of same service. Use tie wraps to keep grouped.
2. Install marking tag as specified in Section 26 05 53.

D. Location: In pull boxes, handholes, manholes, and other enclosures where accessible but neither terminated nor spliced. It is not necessary to tag conductors in 4 by 4 or smaller boxes, or in conduit bodies.

E. Mark the cover of 4x4 or smaller boxes with a permanent black felt tip marker to indicate wiring content as required in paragraph 3.03.B above.

3.04 INSTALLATION

A. Install all wiring in conduit, except where specifically allowed otherwise on the Drawings.

B. Bending Radii: Not less than permitted by ICEA or as recommended by cable manufacturer, whichever is greater.

C. Cable in cable trays, open wireway, and trenches:
1. Except for individual THWN grounding conductors, use TC or PLTC only.
2. Maintain separation between AC and DC cables.

D. Splicing:
1. Power Circuits:
   a. Splicing of THWN/THHN and XHHW-2 conductors is permissible in boxes, enclosures, handholes, manholes or similar accessible and protected locations.
   b. Splicing in conduit bodies is not permitted.
2. Control circuits and instrument wiring:
   a. No splicing allowed.
   b. If intermediate connections are required, provide enclosure and terminal block(s) where allowed by Engineer. Mark conductors as required above in this Section. Mark terminal boards as required in Section 26 27 27.
3. Direct buried splices allowed only as shown on the Drawings or Schedules.

E. Shields of TWSH:
1. Ground instrumentation cable shields at the PLC Cabinet.
2. Cut shield at field end 1/2" shorter than cable pair(s). Install heat shrink tubing over shield to prevent contact with ground.

3.05 UNUSED CONDUCTORS OF TC, PLTC

A. When a cable has conductors which are not shown to be terminated then fold them back and tape in place. Do not cut short.

3.06 GROUNDING CONDUCTORS

A. Grounding Electrodes/Grounding Electrode Conductors: Bare copper.

B. Equipment Grounding Conductors: Insulated as required in 2.01, or as part of a cable. Bare copper where shown thus on the Drawings.

3.07 SCHEDULE

B. Wire and cable required under this Section for this project:
1. PARA 2.01 600V Power and General Purpose Wire
2. PARA 2.03 Shielded Cable (TWSH)
3. PARA 2.04 Tray Cable (TC)
4. PARA 2.06 Ethernet Cable

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Furnish, install, connect, and test a complete grounding system for all non-current carrying conductive components and grounded circuit conductors of the wiring system, building structural steel, metallic piping, motor controls and panels, transformer neutrals and cases, motor frames, and other electrical systems and components.

B. Where grounding systems are not shown on the Drawings, as a minimum, ground in accordance with the NEC.

C. Where grounding systems are shown on the Drawings and are more stringent than required by the NEC, the Drawings take precedence.

1.02 SUBMITTALS

A. Literature for electrolytic ground rods.

PART 2 PRODUCTS

2.01 GROUND RODS

A. High carbon steel rod with minimum 0.01 inch thick electroplated copper coating.

B. Minimum 5/8” diameter and minimum 10’ long; provide larger if so scheduled or shown on the Drawings.

C. Nehring Electrical Works Company NCC series (NCCS series for sectional rods) or Engineer approved equivalent.

2.02 ELECTROLYTIC GROUND RODS

A. Manufacturer:
1. Minimum 10 years experience manufacturing electrolytic ground rods.
2. ISO 9002 certified.

B. Ground Rod:
1. UL listed.
2. 100% self activating/sealed and maintenance free without addition of chemical or water solutions.

3. Operate by hygroscopically extracting moisture from the air to activate the electrolytic process improving performance.
4. 100% copper 2" nominal diameter hollow copper tube with a minimum wall thickness of 0.083 inches.
5. Permanently capped on the top and bottom with air breather holes in the top of the tube and holes in the bottom of the tube for electrolyte drainage into the surrounding soil.
6. Factory filled with non-hazardous Calsolyte to enhance grounding performance.
7. Ten feet long unless shown otherwise by schedule or Drawings.
8. Provide a stranded 4/0 AWG Cu ground wire that is bonded to the side of rod by means of heavy-duty exothermic welding process.
9. 25 year manufacturer's warranty.
10. Lyncole XIT or Engineer approved substitution.

C. Backfill Material:
1. Provide manufacturer recommended quantity but minimum 50 pounds per rod.
2. Natural volcanic, non-corrosive form of clay grout backfill material free of polymer sealants, which absorbs approximately 14 gallons of water per 50 pound bag for optimal 30% solids density and which has a pH value of 8-10 with maximum resistivity of 3 ohm-m at 30% solids density.
3. Lynconite II or Engineer approved substitution.

2.03 GROUND ACCESS BOX

A. Composite Box:
1. For non-traffic applications only.
2. Provide snap-lock flush cover with "breather" holes.
3. Nominal twelve inch diameter by ten inches high.
4. Lyncole model XB-12F or Engineer approved substitution.
5. Use only where specifically called for on Drawings.

B. Precast Concrete Access Box, Medium Traffic:
1. Slots for conduit entrances.
2. Minimum size ten inch diameter by twelve inches high.
3. Round cast iron grate flush cover with "breather" slots.
4. Lyncole Model XB-12C or Engineer approved substitution.
5. Unless shown otherwise on the Drawings, use in dirt areas, in sidewalks, and in asphalt dust aprons.

C. Precast Concrete Access Box, Heavy Traffic:
1. Minimum twelve inch diameter by ten inches high.
2. Cast iron frame with lifting sockets.
3. Triangular cast iron cover with breather holes.
4. Lyncole model XB-22 or Engineer approved equal.
5. Unless shown otherwise on the Drawings, use in driveways, parking lots, access aprons, alleys (paved or otherwise), private streets, and public streets.

2.04 GROUND CONDUCTORS AND TAPS

A. Stranded soft-drawn bare copper.

B. Conductor Size: NEC Article 250, unless shown larger on Drawings.

2.05 CONNECTIONS

A. Use heavy duty exothermic welding process (HDEWP) or NEC/UL approved/listed compression connectors for all copper to copper grounding connections and for copper to ground rod connections.

B. Use NEC/UL approved/listed compression connectors from copper conductor to structural reinforcing rod. Burndy Hyground Hygrid YGL-C or Figure 6 Hytap YGHP-C, or equal.

C. Connection to power equipment (switchboard, MCC, panelboard, AFD, and similar): Install compression lugs on wire and bolt lugs to equipment ground bus.

PART 3 EXECUTION

3.01 CONDUIT AND RACEWAY SYSTEMS

A. Conduit Systems at Panels and Boxes: Double locknuts with sealing-type locknut on outside. Use bonding jumpers for conduits installed in concentric or eccentric knockouts and between conduits installed at non-metallic boxes.

B. Conduit Systems: Install a green insulated grounding conductor in all conduits for the length of the conduit. Size conductor in accordance with the NEC, as a minimum, unless otherwise specified on the Drawings. Use grounding bushing and connectors.

C. Install a #4/0 (minimum) bare copper grounding conductor under all underground primary power duct banks. No grounding conductor is required in primary conduits.

D. Install bare copper grounding conductors within or under other duct banks as shown on the Drawings.

3.02 SOLID GROUND RODS

A. Install in firm soil outside of excavated areas.

B. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.

C. Unless either excluded or shown otherwise on the Drawings, install access box at each rod. If box will have concrete cast adjacent to it, install one-half inch expansion material around box before pouring concrete. Set box flush with concrete surface.

D. Depth:
   1. Where access box is installed, drive rod so top is 4 inches below finished grade.
   2. Where access box is not installed, drive rod so top is 24 inches below finished grade.

3.03 ELECTROLYTIC GROUND RODS

A. Install according to manufacturer's instructions.

B. Use for lightning protection grounds, whether specifically differentiated on the Drawings or not.

C. Use for other grounds where shown on the Drawings.

D. Install precast concrete access box at each rod. If box will have concrete cast adjacent to it, install ½ inch expansion material around box before pouring concrete. Set box flush with concrete surface.

3.04 STRUCTURE GROUNDING ELECTRODE SYSTEM

A. Where shown on the Drawings, install bare copper grounding conductor in the concrete of the footing. Braze copper conductor to the tail of a reinforcing rod at minimum 4 places. Bond copper conductor to equipment where shown. Bond copper conductor to building structural steel columns, metallic piping, and similar, whether shown or not.

3.05 MARKING OF GROUND ACCESS BOXES

A. If called for on the Drawings, mark each ground access box.

B. Where an access box is surrounded by concrete, stamp the legend "GND" into the concrete adjacent to the box, minimum one inch high letters.

C. Where an access box is surrounded by asphalt, pour a twenty inch by six inch by twelve inch deep concrete marker in a nearby non-traffic area with the legend "GND BOX ?? FT" and an arrow pointing to the box, minimum one-inch high characters.

D. Where an access box is surrounded by dirt, pour a six inch by six inch by twelve inch deep concrete marker adjacent to it. Stamp the legend "GND" into the concrete, minimum one inch high letters.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Strut Systems.

B. Supports.

C. Anchors.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 CORROSION RESISTANT METAL STRUT SYSTEM

A. Channel:
1. Designed with edges turned in, forming lips which allow special spring loaded nuts to be inserted anywhere along the channel.
2. Material: 6063-T6 aluminum, or 304 stainless steel.

B. Spring Loaded Nut and Spring:
1. Nut made of 304 stainless steel and designed to provide positive locking in place when tightened.
2. Spring made of zinc chromate plated steel or stainless steel.

C. Braces, Brackets, and Structural Shapes Used in the Assembly of Metal Strut: 6063-T6 aluminum, 5052-H32 aluminum, or 304 stainless steel.

D. Threaded Rod, Bolts, and Nuts: 304 stainless steel.

E. All materials by the same manufacturer and designed as a system.

F. Dimensions and Style:
1. Single strut: 1-5/8” by 1-5/8” – 12 gage, solid.
2. Back-to-back strut: 1-5/8” x 3-1/4” – 12 gage, solid.
3. As specifically noted otherwise on Drawings.

G. Unistrut, B-Line, Superstrut, or Engineer reviewed equivalent.

2.02 FIBERGLASS STRUT SYSTEM

A. Strut and Hanger Rod Construction: Linear glass strands, continuous mat laminates, and corrosion-resistant polyester resins simultaneously pultruded to form a uniform rigid thermoset shape.

B. Fiberglass: Self-extinguishing with UL 94 V-O classification.

C. Hanger Rod Washers: Stamped from pultruded flat stock.

D. Hanger Rod Square Nuts: Made from pultruded flat stock.

E. Hanger Rod Nex Nuts and Strut Nuts: Injection molded.

F. Hanger Rod Beam Clamps and Pipe Straps: Steel, with 15 mil PVC coating and SS bolts.

G. Deflection Versus Loading and Recommended Loading: Equal to or better than that of Rob Roy Industries Rob-Glass Fiberglass Strut Support System.

H. Single Strut: 1.715 by 1.76 by 0.15 wall by length.

I. Back-to-Back Strut: 1.715 by 3.52 by 0.15 wall by length.

2.03 METAL STRUT SYSTEM

A. Same as 2.01 except galvanized or painted steel.

B. Hardware: Zinc or cadmium plated.

2.04 ANCHORS

A. Comply with the requirements of Division 5, specifically with Section 05 50 01 – Anchor Bolts and Chemical Anchors. Lead shields with lag bolts: not acceptable. Concrete tapping screws: not acceptable.

B. Anchors placed in poured concrete: Stainless steel expansion bolts, such as Hilti, Wejit, or equal, or chemical anchors.

C. Anchors Placed in Concrete Masonry Units:
   1. Chemical anchors.
   2. Toggle bolts may be used in hollow portions of concrete masonry units in Non-Process Indoor Areas.

PART 3 EXECUTION

3.01 ANCHORS

A. Comply with the installation requirements of Section 05 50 01 – Anchor Bolts and Chemical Anchors.

3.02 SUPPORT OF ALUMINUM CONDUIT AND BOXES

A. Support with stainless steel bolts, washers, and nuts and aluminum clamps, plates, angles, and/or strut.

3.03 SUPPORT OF OTHER CONDUIT AND BOXES

A. Support with stainless steel bolts, threaded rod, washers, and nuts and stainless steel clamps, plates, angles and/or stainless steel strut.

B. As allowed in Paragraph 3.05.

3.04 FLEXIBLE STRAP

A. Flexible steel and/or copper perforated straps (such as plumber's tape) are not acceptable for support of any electrical item.

3.05 USAGE OF STRUT

A. Do not install fiberglass strut where exposed to sunlight.

B. Do not cast fiberglass or aluminum strut in concrete.

C. Follow manufacturer's recommendation as to maximum loading.

D. Do not exceed deflection stated in manufacturer's literature.

E. Unless specifically allowed otherwise on Drawings, use painted Metal Strut Systems (paragraph 2.03), only in Non-Process Indoor Areas.

F. Unless specifically allowed otherwise on Drawings, use galvanized Metal Strut Systems (paragraph 2.03), only in Non-Process Indoor Areas, and in indoor spaces in which liquid sewage or sludge is not handled, such as a blower room.

END OF SECTION

SECTION 26 05 33.10

ELECTRICAL CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit and accessories.

1.02 SUBMITTALS

A. Manufacturer's standard literature for conduits and fittings.

B. Additional Submittals Required for PVC RMC:
1. Copy of ETL or UL Report to show compliance with the requirements of Paragraph 2.02 A.2.
2. Furnish documentation certifying that each installer, who will install PVC RMC on this project, has been trained by the manufacturer in the proper methods and tools for installing PVC RMC.
3. Furnish a certification from the conduit manufacturer that a representative of the manufacturer has inspected the completed installation, found the installation to conform to the Manufacturer's recommendations, and certifies the Manufacturer's Warranty is in effect. Include the ending date of the warranty on the face of the warranty.

C. Additional Submittals Required for RTRC:
1. Furnish documentation certifying that each installer, who will install RTRC on this project, has been trained by the manufacturer in the proper methods and tools for installing RTRC.
2. Where installed in Class 1 Division 2 locations, if in the Schedule, or were required on the Drawings, furnish a certification from the conduit manufacturer that a representative of the manufacturer has inspected the completed installation, found the installation to conform to the Manufacturer's recommendations, and certifies the Manufacturer's Warranty is in effect. Include the ending date of the warranty on the face of the warranty.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

A. Steel RMC:
1. Meet NEC 344 and ANSI C80.1.
2. Listed and labeled under UL6 or CSA recognized.
3. Electro-galvanized on outside, inside, and on threads.

B. Aluminum RMC:
   1. Meet NEC 346, UL 6, and ANSI C80.5.
   2. Listed and labeled under UL6 or CSA recognized.

2.02 POLYVINYL CHLORIDE COATED RIGID METAL CONDUIT (PVC RMC)

A. Standards:
   1. Comply with NEC 344, UL 6, and ANSI C80.1.
   2. ETL Verified to meet Intertek ETL SEMKO High Temperature Water PVC Coating Adhesion Test Procedure, or successfully tested by UL for PVC adhesion after 240 hours at 100 degrees C in an air-circulating oven and 600 hours of salt spray (fog) exposure in accordance with ASTM B 117-94.
   3. Each length of conduit shall bear the ETL Verification Mark "ETL Verified to PVC-001" and a UL6 label.

B. Steel Conduit: Threaded, then hot-dip galvanized inside, outside, and on the threads, then coated inside, outside, and on the threads.

C. External PVC Coating:
   1. 0.035 to 0.045 inch thick polyvinyl chloride on the full length of the exterior of the conduit except on the threads.
   2. Comply with NEMA RN 1 - Type A.
   3. Minimum strength of bond between galvanized steel and PVC coating: 3500 PSI.

D. External Urethane Coating:
   1. Minimum 2 mil thickness of clear two-part urethane.
   2. Apply on threads, overlapping the PVC coating and the inner coating.

E. Internal Urethane Coating:
   1. Minimum 2 mil thickness of colored two-part urethane.
   2. Finished coating: Sufficiently flexible so it does not peel or crack when bends are made in the conduit.
   3. Apply on the full length of the interior of the conduit.

F. Boxes and Fittings:
   1. Listed and labeled under UL514B.
   2. Same materials as the conduit.
   3. Coated on the exterior, interior, and threads the same as the conduit.

G. Boxes, Fitting, and Sealing Fittings for Hazardous Locations:
   1. Listed under UL886.
   2. Same materials as the conduit.
   3. Coated on the exterior, interior, and threads the same as the conduit.
   4. Provide gas seals which are designed and manufactured so the total allowable fill in the gas seal is not less than the total allowable fill in the conduit.

H. PVC and Urethane Coating Repair Materials: By the conduit manufacturer.

I. Provide manufacturer's warranty that the conduit and fittings are free from defects in material and workmanship. Length of warranty: Five years from the date of shipment from the manufacturer's plant or three years from the date the installation is certified, whichever occurs last.

J. Perma-Cote, Robroy, Ocal, or Engineer reviewed equivalent.

2.03 RIGID NONMETALLIC CONDUIT (RNC)

A. Might be referred to as RNMC on the Drawings.

B. Meet NEC 352 and NEMA TC2.

C. Listed/labeled under UL 651 for use with conductors operating at 90 degrees C.

D. Ultraviolet resistant.

E. Schedule 40 Polyvinyl Chloride Except Schedule 80:
1. Where called for in the schedule.
2. Where installed exposed, or
3. Where called for on Drawings.

F. Glue all Joints Except:
1. Provide bell and spigot expansion joint with O rings where required for expansion/contraction, and
2. Provide glue to thread fittings for transition to threaded conduit systems.

G. Fittings and Cement: By conduit manufacturer.

H. Carlon Plus 40 (Plus 80), or Engineer reviewed equivalent.

2.04 FIBERGLASS – REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Meet NEC 355 and NEMA TC14.

B. Listed/labeled under UL 2420 (below grade) and UL 2515 (above grade).

C. Manufacturing Process:
1. Manufactured using a single circuit filament winding process.
2. Winding mandrels shall be straight and true as to produce non-tapered conduits.
3. Epoxy based resin system with no fillers, using an anhydride curing agent.
4. Fiberglass shall consist of continuous E-glass Grade "A" roving.
5. Curing using two step oven heated process.
6. Interior conduit body walls shall be smooth and all fibers embedded in the epoxy.

D. Mechanical Characteristics:
1. Tensile strength: 11,000 psi (ASTM D2105)

2. Compression strength: 12,000 psi (ASTM D695)
3. Impact resistance: ASTM D2444

Minimum Impact Resistance @ 0°C		
Size (inches)	**Standard Wall Ft-lbs**	**Heavy Wall Ft-lbs**
0.75	20	150
1	25	400
1.5	35	500
2	40	550
2.5	55	600
3	70	700
3.5	80	850
4	120	1,000
5	160	1,200
6	200	1.300

E. Minimum Wall Thickness:

Size (inches)	Standard Wall – Wall Thickness (inch)	Heavy Wall – Wall Thickness (inch)
0.75	.070	.25
1	.070	.25
1.5	.070	.25
2	.070	.25
2.5	.070	.25
3	.070	.25
3.5	.070	.25
4	.096	.25
5	.096	.25
6	.096	.25

F. Couple by means of bell and spigot with triple seal gasket or with glued couplers. Glued couplers required when there is no interference joint (e.g. after a field cut).

G. Elbows: Factory formed.

H. Factory assemble couplers onto conduit where adapting to different conduit types.

I. Two-Part Epoxy: Provided by manufacturer of conduit.

J. Champion Fiberglass or Engineer reviewed equivalent.

2.05 ELECTRICAL METALLIC TUBING (EMT)

A. Meet NEC 358. Listed/labeled under UL 797.

B. Connectors and Couplings:
   1. Steel, not die-cast.
   2. Rain-tight compression type, T&B TC11xA or equivalent.
   3. Neither set screw nor indenter type will be acceptable.

2.06 FLEXIBLE METAL CONDUIT (FMC)

A. Meet NEC 348. Listed/labeled under UL 1.

B. Steel.

C. Use a single piece for each run. Do not use couplings.

D. Connectors: Steel squeeze type, Appleton Catalog Numbers 7480 through 7490, or Engineer reviewed equivalent.

2.07 LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT (LFMC)

A. Meet NEC 350.

B. Listed/labeled under UL 360 for use in ambient temperatures from –30 degrees C to +80 degrees C, wet.

C. Galvanized steel with UV resistant PVC jacket.

D. Use a single piece for each run. Do not use couplings.

E. Connectors: Appleton ASTM series or Engineer reviewed equivalent.

2.08 LIQUID-TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Conform to NEC 356.

B. Listed/labeled under UL 1660 for use in ambient temperatures up to +80 degrees C, dry; +60 degrees C, wet.

C. Sunlight resistant.

D. Use a single piece for each run. Do not use couplers.

E. Connectors: Appleton ASTM series or Engineer reviewed equivalent.

2.09 OTHER CONDUITS

A. Meet requirements of appropriate NEC article and applicable UL standard.

B. Use only after specific written approval of the Engineer.

2.10 FLEXIBLE EXPLOSION-PROOF COUPLING (XPFC)

A. Listed/labeled under UL 886.

B. Braided steel or copper alloy with inner insulating sleeve.

C. Fittings: Threaded.

D. Crouse-Hinds Series EC, or Engineer reviewed equivalent.

2.11 CABLE CONNECTOR

A. Aluminum liquid tight, strain relief type, T & B 29XXSST series.

B. Where installed through enclosure wall, also use sealing ring with SS retainer, T & B 5262 series.

2.12 CONDUIT GAS SEALS

A. Approved for use in Class I and Class II areas as defined in NEC Article 500.

B. Listed/labeled under UL 886.

C. Malleable iron construction with NPT threads.

D. Where used with PVC RMC or RTRC conduit, provide seals with the same coating systems as the conduit and other fittings.

E. Designed so the cross-sectional area is larger than or equal to the cross-sectional area of the conduit.

PART 3 EXECUTION

3.01 CONDUITS REQUIRED

A. Many conduits and associated conductors are not shown or are only partially shown on plan views in the Drawings. Install as if fully shown.

B. In addition to conduits that are shown on plan views in the Drawings:
1. Install conduits which are shown in the conduit schedules. Schedules are appended to this Section or are included in the Drawings.
2. An entry in a conduit schedule requires conduits and conductors end-to-end, complete. For example, there is only one entry for a given motor feeder, even though there is actually one conduit and set of conductors from the starter to the local disconnect switch and another from the disconnect switch to the motor.
3. Install as implied for circuiting, such as where a panelboard circuit number is shown adjacent to a wiring device, and from switches to associated luminaires.
4. Install as called for in panelboard schedules.
5. Install as called for in tables shown as part of schematic diagrams.

6. Install as required for control of process equipment. Pay special attention where recommendations of the manufacturer of the process equipment supplied differ from that shown in the design.
7. Install as required for a complete system.
8. Install as called for on the One-Line Diagram.

3.02 INSTALLATION

A. Conduit Bends:
1. Factory made or made with a conduit bending machine recommended by the conduit manufacturer.
2. If EMT is specifically allowed in the matrix of conduit usage then bends in EMT may be made with a hand bender which fully supports the side walls.

B. Wrench tighten all threaded joints, couplings, fittings, and connectors.

C. Run conduits concealed in finished areas and where indicated on the Drawings. In many places, such as at motors and surface-mounted wiring devices in pump rooms and electrical rooms, the end of a run may be an exposed vertical riser even though the symbol used for the conduit denotes concealed.

D. Run exposed conduit either parallel with or perpendicular to structural members of the building or structure except where allowed otherwise by the Engineer.

E. The only conduit that may be above a roof is conduit that serves equipment on that roof. Locate roof penetrations so no horizontal runs of conduit are required on the roof.

F. Conduit installed above lay-in ceilings will be considered to be concealed, and need not comply with parallel/perpendicular requirements for exposed conduit. Route to avoid interference with piping, duct work, and luminaries. Locate conduit well above the lay-in ceiling. Support independently of ceiling suspension wires.

G. Do not install conduit on slabs, decks, sidewalks or floors where it may create a trip hazard. The Engineer or Owner judges what conditions are “trip hazards”. Conduits may be installed on slabs only with written permission from the Engineer or Owner.

H. Drainage: Avoid pockets in conduit runs. Provide suitable drainage fittings in low spots in exposed conduit. Weep holes not permitted.

I. Field Cuts and Threads:
1. Cut ends of conduit square. Ream to remove burrs and sharp edges.
2. Non-factory threads: Same effective length, thread dimensions, and taper as factory cut threads.
3. Carefully remove burrs from threads.
4. For steel RMC, paint conduit threads with vinyl repair compound, same as used for PVC RMC.

J. Supports:
   1. Comply with NEC and Section 26 05 29 – Hangers and Supports.
   2. In horizontal conduits runs install one-hole conduit straps with the anchor below the conduit.

K. Conduit Ends:
   1. Where conduits terminate in hand holes, manholes, trenches, floor cavities, or similar, or through concrete into open-bottom enclosures plug spaces between conductors/cables and conduit with duct seal.
   2. Protect conduit ends during construction to prevent entrance of foreign material.
   3. Install insulated throat grounding bushing on conduit ends and install bonds as specified in Section 26 05 26 – Grounding and Bonding, and as required by the NEC.
   4. Where conduits enter an enclosure from underground, whether through concrete or from earth (such as in a transformer), set end of conduit at two to three inches above the surrounding or nearby concrete.

L. Clean and swab inside by mechanical means to remove foreign materials and moisture before wires or cables are installed, also for spare conduits.

M. Spare Conduits:
   1. Blow a pull string through the conduit.
   2. If end is buried or exposed to weather, glue pull string to inside of cap with silicone seal, let set, leave adequate slack, then install cap.
   3. Where not exposed to weather, seal conduit end with duct seal.

N. Use anti-seize compound on threads of aluminum RMC.

O. Conduit and Boxes Installed on Guard Rails:
   1. Allowed only where shown on the Drawings or where specifically proposed in writing by the Contractor and approved by the Engineer.
   2. If allowed for conduits, mount on the outside of the rail (opposite from the walking surface).
   3. If allowed for enclosures, install strut on the outside of the rail then extend upward to support enclosures.
   4. Where guard rail is removable, provided with a gap and chains, or has a gate, run conduit on the side of the bridge, below the level of the walking surface.

P. Where shown on Drawings, provide sleeves for conduit penetrations. Where the penetration is through the wall of a process structure which contains water, provide mechanical “link-seals” between the inside of the sleeve and the outside of the conduit. Seal other penetrations with 40-year rated silicone seal.

Q. Requirements where conduits enter/exit a structure/building below grade:
   1. Do not run conduits in/through footings.
   2. Bury conduits larger than 2 inch trade size minimum 12 inches below the bottom of the footing.

3. Fewer than 5 conduits of 2 inch trade size or less in a loose grouping may penetrate the stem wall.
4. More than 5 conduits of any size in a grouping:
    a. Bury minimum 12 inches below the bottom of the footing or
    b. Submit structural details of blockouts and reinforcing through the stem wall for review by the Engineer. After conduits are installed through a blockout, fill the remaining space with non-exothermic, non-shrink grout.

R. Expansion Joints: Where conduit spans building expansion joints or in long duct runs, use expansion fittings and bonding jumpers.

3.03 INSTALLATION OF PVC RMC

A. Comply with installation requirements of paragraph 3.02. In addition, comply with the requirements of paragraph 3.03.

B. Obtain training and certification of installers of PVC RMC from the manufacturer and use only installers who are trained and certified and whose records are on file with the Engineer, all specifically for this project.

C. Use special bending tools, vise jaws, pliers, wrenches, drivers, and other tools designed for working with PVC RMC to eliminate damage to the PVC coating.

D. Repair external coating where damaged. Apply coating repair liquid in multiple coats so the thickness of the coating at the entire damaged area is minimum 80 mils.

E. Paint all metal surfaces exposed by field cutting and/or threading with colored two-part urethane and allow to dry before installing conduit.

F. Paint male threads with coating repair liquid immediately prior to installation of a fitting or coupling.

G. During installation, seal PVC to PVC at the joints with coating repair liquid.

H. The requirements of the above five paragraphs are minimum requirements, even if more stringent than the recommendations of the manufacturer. If portions of the recommendations of the manufacturer are more stringent than the above, follow those as well. Bring objections of the conduit manufacturer (if any) to the Engineer for resolution.

I. Furnish the services of an authorized representative of the conduit manufacturer to inspect the finished installation.
1. If the representative cites installation problems then rectify the problems.
2. When the representative finds the installation to be at least in accordance with the manufacturer's recommendation, then obtain from the representative and furnish to the Owner a certification from the conduit manufacturer that the installation conforms to the manufacturer's recommendations and that the Manufacturer's Warranty is in effect.

3. If during the warranty period any material or the installation of any material is defective, replace or repair such material as mutually agreed between the Owner and the Contractor. Replacement or repair operations shall not adversely affect the warranty.

3.04 INSTALLATION OF RTRC

A. Comply with installation requirements of paragraph 3.02. In addition, comply with the requirements of paragraph 3.04.

B. Obtain training and certification of installers of RTRC from the manufacturer and use only installers who are trained and certified and whose records are on file with the Engineer, all specifically for this project.

C. Use special tools designed for working with RTRC.

D. Where installed in a Class I Division 2 location, for below grade elbow elbows, and where penetrating a concrete slab, only Heavy Wall RTRC shall be used. All other locations Standard Wall is acceptable, except if noted otherwise in the Schedule or on the Drawings.

E. Where installed in Class 1 Division 2 locations, if in the Schedule, or were required on the Drawings, furnish the services of an authorized representative of the conduit manufacturer to inspect the finished installation.
1. If the representative cites installation problems then rectify the problems.
2. When the representative finds the installation to be at least in accordance with the manufacturer's recommendation, then obtain from the representative and furnish to the Owner a certification from the conduit manufacturer that the installation conforms to the manufacturer's recommendations.
3. If during the warranty period any material or the installation of any material is defective, replace or repair such material as mutually agreed between the Owner and the Contractor. Replacement or repair operations shall not adversely affect the warranty.

3.05 DUCT BANKS

A. Encase conduits in 4000 PSI concrete. Comply with the requirements of Division 2 for earthwork and of Division 3 for concrete.

B. Drawings show known interferences but others may exist. Where close to known interferences or where evidence of other interferences is found in the field, hand excavate trench.

C. Install conduits using plastic spacers. Provide spacers maximum of 8 feet on center, but closer where so shown in the conduit manufacturer's instructions or where required for adequate support at elbows, offsets, or sweeps.

D. Remove mud and other foreign substances from conduits before pouring of concrete.

E. Provide minimum 3" of concrete all around the outside of conduits. Provide minimum 3" of concrete between walls of adjacent conduits.

F. To prevent floating, tie down duct banks with reinforcing bars and steel wire before pouring concrete.

G. Dye all concrete red. Use seven to eight pounds of Bayferrox CC16 Red dye, or Engineer reviewed equivalent, per cubic yard of concrete mix.

H. Prevent loose dirt from falling into trench during concrete pouring operations.

I. Pour each section, i.e. riser to riser, riser to pull box, pull box to pull box, etc., of duct in one operation. If such construction is not feasible, construction joints will be permitted, subject to review of Engineer, provided 40 mil PVC RMC is used a minimum of 5 feet on both sides of joint, and minimum 4 #4 by ten foot reinforcing bars are run through the joint.

J. Make sure that concrete flows all around all conduits by suitable means, except do not use mechanical concrete vibrators and do not significantly displace conduits.

K. Duct bank concrete may be poured without forming, provided trench walls are firm and do not cave; otherwise, use forms as specified in Division 3.

L. After construction of duct banks is complete, pull a mandrel through each duct. Use a mandrel 1/4 inch smaller in diameter than duct unless the manufacturer recommends otherwise. If any obstructions are encountered or if there is evidence of water pocket in duct, locate, remove and replace that section at no cost to Owner.

M. Where shown on the Drawings, install bare copper ground wire under or in concrete of duct bank. Connect to ground conductors/ground bars at each end.

3.06 APPLICATION

A. RMC:
   1. Steel RMC is not permitted direct buried.
   2. Aluminum RMC is not permitted:
      a. In contact with earth.
      b. Embedded in concrete.
      c. In contact with concrete below grade, outdoors, or in wet indoor locations.

B. PVC RMC:
   1. Permitted in areas subject to corrosive environment.
   2. Permitted underground, direct buried.
   3. Use where required by other paragraphs of this Section or other Sections.
   4. Permitted for elbows in larger size underground installations of RNC.
   5. Use for all penetrations of slabs except:
      a. Where a run of RNC comes into the bottom of an enclosure having an open bottom, such as an MCC.

b. Where the upward continuation of a run is anchored to a block or poured concrete wall directly and close above the penetration.
c. Where the upward continuation of a run will be hidden within a wall.
d. Where Heavy Wall RTRC is used to penetrate a slab.

C. RNC:
1. Do not use where exposed to direct sunlight.
2. Permitted underground or direct buried.
3. Do not use RNC elbows for underground installations with conduit sizes 2 inches or greater. Elbows may be RTRC or PVC RMC.

D. RTRC:
1. Permitted in areas subject to corrosive environment.
2. Permitted underground, direct buried.
3. Permitted for elbows in larger size underground installations of RNC.
4. Use where required by other paragraphs of this Section or other Sections.

E. EMT:
1. Use only where shown in the matrix of conduit usage.

F. Flexible Conduits:
1. Use for final connection to luminaires, motors, dry type transformers, HVAC equipment, water heaters, unit heaters, and similar applications.
2. Do not install within a wall or slab. Do not install as/in a penetration of a wall or slab.
3. Do not install in lengths of more than 18 inches except:
   a. For connection of lay-in luminaries.
   b. For connection of equipment where O&M manual recommends moving it for maintenance, such as certain models of uninterruptible power supply systems.
   c. For connection of adjustable frequency drives.
   d. Where proposed in writing case-by-case by the Contractor and specifically allowed by the Engineer. No other exceptions to length restrictions.
4. LFMC and LFNC: Allowed as a factory component of luminaires and/or process equipment.
5. FMC: Allowed as a factory component of luminaries.
6. Use FMC for connections to adjustable equipment and devices in air ducts or plenums.

G. Use XPFC for final connection to motors or other equipment subject to vibration in Class I Division 1 areas; also in Class I Division 2 areas if so required by NEC. XPFC is not shown in the matrix of conduit usage but use as required by above, by NEC, and where specifically called for on the Drawings.

H. All Conduits:
1. Use type specifically called for on the matrix of conduit usage. If not shown in the matrix of conduit usage, comply with requirements shown on the Drawings.

If not shown in either the matrix of conduit usage or on the Drawings, refer to the matrix of conduit usage for all other work.

2. No plastic conduit allowed above lay-in ceilings where the cavity functions as an air-handling plenum, regardless of matrix of conduit usage.
3. Do not install exposed conduits in finished areas, such as laboratories, offices, training rooms, and similar. Clarify any questionable area with the Engineer in the field before installing.

I. Matrix of Conduit Usage:

1. The matrix of conduit usage is shown on the Drawings.
2. If multiple columns are marked, any marked type is allowed subject to NEC restrictions and restrictions above, such as but not limited to those concerning buried conduits, elbows, penetrations, exposed installation, and use in cavities.
3. Different parts of a run may be of different type conduit, such as where a flexible connection is required.
4. If a column is marked "C" then use only where concealed in a wall or above a gypsum board or lay-in ceiling.
5. If a column is marked "CA" then use only above a gypsum board or lay-in ceiling.
6. If a column is marked "E" then use only for connections between electrical supply and control equipment, not for connection of utilization equipment and not for connection of field devices such as flow transmitters and hand switches. A marking of "E" is typically intended to be limited to electrical rooms.
7. If a column is marked "H" then use only above 6 feet or directly above equipment where not subject to damage.
8. See matrix of conduit usage for other column marking notes.
9. Where the matrix of conduit usage shows RNC for outdoor use, it is allowed only where protected from direct sun exposure, such as under a bridge or under a digester cover.

3.07 SIZE

A. The Drawings and/or conduit schedules may show a minimum size for certain conduit runs. Where size is not shown, then comply with paragraph C. below.

B. If a conduit size has to be increased because a motor or other equipment furnished by the Contractor requires more power (and therefore larger wire and conduit than shown) than the specified motor or equipment, then include the cost of the larger conduit in the Bid.

C. Minimum Size Requirements:

1. As required by NEC, but larger if so shown on the Drawings or required below.
2. Lighting circuits except circuits to HID pole lights: 1/2 inch.
3. HID pole lighting circuits: 1 inch.
4. 120/208/240V receptacle circuits:
5. Last receptacle in run: 1/2 inch.
6. Other runs: 3/4 inch.

7. 120/208/240V branch circuits to a single load: 1/2 inch.
8. 208/240V feeders: 3/4 inch.
9. 480V circuits: 3/4 inch.
10. 120VAC control circuits: 1/2 inch minimum: 3/4 inch for 10 to 20 #14; 1 inch minimum for more than 20 #14, then by NEC.
11. Shielded or coaxial cable: 3/4 inch.
12. Circuits of special systems: As shown on Drawings or as required in the specification section for the respective system.
13. Other circuits: 3/4 inch.

END OF SECTION

SECTION 26 05 34

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Boxes.

1.02 SUBMITTALS

A. None required.

PART 2 PRODUCTS

2.01 BOXES LOCATED OUTDOORS AND IN PROCESS AREAS

A. NEMA 4X stainless steel.

B. Heavy-Duty Device Boxes for use with Rigid Metal Conduit:
1. Copper-free cast aluminum.
2. Conduit hubs cast integral with box.
3. Hubs exterior to box.
4. Conduit hubs with tapered threads (NPT).
5. Integral green ground screw.
6. Unless explicitly shown otherwise on Drawings, covers by same manufacturer as box.
7. Crouse-Hinds FS/FD series or equivalent.

C. Heavy Duty Device Boxes for use with PVC RMC: Same as paragraph B. but from the manufacturer of PVC RMC and coated the same as the conduit.

D. Standard Duty Device Boxes for use with Rigid Metal Conduit:
1. Die-cast aluminum.
2. Conduit hubs cast integral with box.
3. Hubs interior to box.
4. Conduit hubs with tapered threads (NPT).
5. Red Dot, or Engineer reviewed equivalent.

E. As called out in specific Sections or on the Drawings.

2.02 BOXES LOCATED IN NON-PROCESS INDOOR AREAS

A. NEMA 12 for starter enclosures, control panels, and similar unless a different type is called for on the Drawings or in specific Sections or as scheduled.

B. Device Boxes for use with EMT:
   1. Single piece steel with conduit knock outs.
   2. Four inch square by 2-1/8 inch deep, with appropriate device cover.
   3. Steel City Catalog No. 2G4D series, or Engineer reviewed equivalent.

C. Device boxes for use with rigid conduit: PARA 2.01 C.

D. As called out in specific Sections or on the Drawings.

2.03 BOXES LOCATED IN HAZARDOUS AREAS

A. Copper-free cast aluminum.

B. UL listed for NEC Class and Division where installed.

2.04 CONDUIT CONNECTORS

A. NEMA 4X Boxes: Watertight hubs; PVC coated watertight hubs for use with PVC RMC.

B. Cast Boxes: Threaded portion of box.

C. NEMA 12 Boxes: "O-ring" type lock nut connectors.

D. NEMA 3R Boxes: Lock nut connectors for conduit connections to the bottom of the box but watertight hubs for all other conduit connections.

E. Steel boxes used with EMT:
   1. Steel, not die-cast.
   2. Concrete-tight and rain-tight.
   3. Compression type, not set screw nor indenter type.
   4. Steel City TC-11x series, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Boxes: Securely support independent of conduits so that they are level and in vertical and horizontal alignment.

B. Flush Boxes: Properly plumb, flush, and aligned with the surface surrounding it.

C. Boxes Outside:
   1. Fully accessible and visible.
   2. Do not use "Exception" to Article 314.29 of the NEC.

D. Device Boxes.

1. Unless shown differently on Drawings or required by field conditions, inside in non-process areas mount receptacle boxes 18 inches centerline above finished floor.
2. Unless shown differently on Drawings or required by field conditions, outside and in process areas mount receptacle boxes 30 inches centerline above finished grade or floor.
3. Unless shown differently on Drawings or required by field conditions, mount toggle switch boxes 48 inches centerline above finished floor
4. Install heavy duty device boxes unless the use of standard duty device boxes are explicitly called for on Drawings.

END OF SECTION

SECTION 26 05 43

UNDERGROUND PULL BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. 600 V underground pull boxes.

1.02 SUBMITTALS

A. Manufacturer's literature.

PART 2 PRODUCTS

2.01 VEHICULAR TRAFFIC PULL BOXES

A. Meet AASHTO H-20 standards of 32,000 pounds single axle load over a 10-inch by 10-inch area.

B. Precast, steel reinforced, Portland™ cement concrete, completely enclosed, whether 4-sided with top and bottom, or cylindrical with top and bottom. Provide 2-inch diameter drain hole in center of bottom.

C. Cast iron ring.

D. Cover:
1. Cast iron.
2. Watertight seal to ring.
3. No hole through cover.
4. Provide pockets for insertion of pick for removal.

2.02 NON-DELIBERATE VEHICULAR TRAFFIC PULL BOXES

A. Subjected to and shown to pass all of the performance and testing for Tier 15 of ANSI/SCTE77-2002 Specification for Underground Enclosure Integrity. UL labeled to that standard.

B. Polymer concrete. Vertical rather than sloped walls. Solid bottom. Stackable as required. Gasket to match cover.

C. Heavy duty cover with gasket. Molded-in lifting points. Pentahead SS bolts with boots to exclude water. Provide two pentahead sockets for the project.

D. Strongwell Quazite, such as gasketed PG style box with gasketed HG cover or similar.

PART 3 EXECUTION

3.01 TYPE REQUIRED

A. In paved areas, use AASHTO H-20 boxes as specified in paragraph 2.01 unless specifically shown otherwise on the Drawings.

B. In other areas, use ANSI Tier 15 boxes as specified in paragraph 2.02 unless specifically shown otherwise on the Drawings.

3.02 INSTALLATION OF AASHTO H-20 BOXES

A. Excavate down to 24 inches below proper depth for bottom of box. Install engineered fill, same as used for pavement sub-grade. Compact to 95% modified proctor or to match paving requirements, whichever is greater. Drill 10" hole in dirt at center of box. Fill with 1 inch sieve gravel. Re-compact as needed. Place 1-foot square portion of ½-inch by ½-inch SS wire mesh in center. Set box plumb and to grade required below. Partially backfill and compact to match paving requirements.

B. Drill sides of box for conduits. Install conduits. Fill annulus with non-shrink, non-exothermic grout.

C. Backfill and compact to match paving requirements.

D. Set box so the cover will be ½-inch above the high point of the surrounding surface. Contour and slope paving to meet box over a 3-foot area, so as to prevent runoff from standing on the cover.

3.03 INSTALLATION OF ANSI TIER 15 BOXES

A. Drill a 2-inch diameter hole in the center of the bottom of the box.

B. Excavate down to approximately 18 inches below proper depth for bottom of box. Place 1-inch sieve gravel with the same or larger footprint as the footprint of the box and nominal 18" inch depth. Place 1-foot square portion of ½-inch by ½-inch SS wire mesh in center. Set box plumb on wire mesh and to grade required below. Partially backfill and compact to 90% modified proctor.

C. Drill sides of box for conduits. Install conduits. Fill annulus with non-shrink, non-exothermic grout.

D. If boxes are stacked, seal thoroughly between sections with silicone seal.

E. Backfill and compact to match civil design requirements of surrounding area.

F. Boxes in sidewalks: Set 1/4" above surrounding concrete. If in a sloped portion of sidewalk, set upper lip of box above upper slope. Contour concrete as needed to avoid runoff from standing on the box and to avoid a trip hazard.

G. Boxes in dirt areas: Do not place in a swale, taking the location of the box on the Drawings as approximate to allow adjustment to avoid swales. Set three inches above surrounding finished grade.

3.04 OTHER REQUIREMENTS

A. Provide boxes which are approximately 20% larger than NEC minimum in length and width dimension. Provide depth to accommodate burial depths of conduits.

B. Leave minimum one full turn of each cable/conductor in the box. Tag as specified in Section 26 05 53 – Electrical Identification.

C. Splices are not allowed in underground pull boxes unless specifically called for on the Drawings, case-by-case.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates and marking tags.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 NAMEPLATES (NP)

A. Minimum Character Height:
1. One-half (1/2) inch for the title of equipment which meets any of the following criteria.
   a. Oil-filled transformers
   b. Engine generator sets
   c. Motor Control Centers (MCC)
   d. Floor mounted PLC enclosures
   e. Automatic and manual transfer switches
   f. Service disconnecting means
   g. Equipment 400Amps or greater
   h. Equipment greater than 600Volts
   i. Equipment with interrupt rating greater than 22kAIC
2. Three-eighths (3/8) inch for the title of equipment which do not meet the criteria above and meets any of the following criteria.
   a. Dry transformers
   b. Individual starters
   c. Individual MCC sections
   d. Panelboards rated less than 400Amps
   e. Motor/equipment disconnecting means
   f. Motor and/or control terminal boxes
   g. Wall mounted control panels
3. One-eighth (1/8) inch minimum for other text but larger as specified below or if called for on the Drawings.

B. Engraved Nameplates:
1. Black engraving stock with white core, unless shown otherwise, below or on the Drawings.
2. Gravoply, or Engineer reviewed equivalent.

C. Printed Nameplates:
   1. Vinyl, self adhesive tape. Provide white, tan (sand) or gray for least contrast with color of surrounding surface.
   2. Color of lettering: Black.
   3. Brady™ Handimark® printer With Brady B-580 tape or Engineer reviewed equivalent.

2.02 CAUTION AND WARNING NAMEPLATES

A. Comply with NEC and OSHA requirements.

B. Engraved Nameplate: Red with white text.

C. Instead of an engraved or custom-printed label, a standard, off-the-shelf label, such as from Seton, is acceptable.

D. Character Size: One-quarter inch minimum height.

2.03 MARKING TAGS

A. Engraved plate as in paragraph 2.01 with minimum 1/8" character height.

B. Drill hole for attaching.

C. Attach with tie wrap.

PART 3 EXECUTION

3.01 NAMEPLATES REQUIRED

A. Motor Nameplates:
   1. Install a red nameplate on each motor or other electrically controlled equipment that has maintained (two-wire), remote, or automatic control.
   2. Character size: Caution: one-half inch characters; balance: 1/4 inch.
   3. Text equivalent to "CAUTION. THIS EQUIPMENT MAY START AUTOMATICALLY OR REMOTELY."
   4. Instead of an engraved or custom-printed label, a standard, off-the-shelf label, such as from Seton, is acceptable. Comply with NEC and OSHA requirements.

B. Voltage Warnings: As required by NEC and OSHA.

C. Where called for in other Sections.

D. As scheduled.

E. As required on the Drawings. Generally, a note on a Drawing will call for a nameplate or NP. The type (engraved or printed) is mentioned on the Drawings only if an engraved NP is required in a location in which a printed nameplate might otherwise be allowed in the paragraphs below.

3.02 MOUNTING OF NAMEPLATES

A. Engraved Nameplates:
1. Use indoors or outdoors.
2. On panel fronts, attach with screws or drive rivets. Elsewhere, attach with 30 year rated silicone seal.
3. Attach with edge parallel to edge of enclosure or device plate.

B. Printed Nameplates:
1. Use only inside a fully enclosed and roofed building or structure.
2. Do not use where exposed to sunlight, precipitation, freezing temperatures.
3. Do not use where Drawings call for engraved nameplates.
4. Self-adhesive.
5. Attach with edge parallel to edge of enclosure or device plate.

3.03 SCHEDULE

A. Minimum nameplate requirements. Refer to Drawings and other sections for additional requirements. Where italicized enter equipment specific information and where bold text is fixed.
1. Panelboards, switchgear, MCCs and similar:
Line 1: Equipment Name
Line 2: Fed From: Source equipment
2. Transformers:
Line 1: Equipment Name
Line 2: Fed From: Source Equipment
Line 3: Feeding: Destination Equipment
3. Automatic and Manual Transfer Switches:
a. Nameplate 1:
Line 1: Equipment Name
Line 2: Feeding: Destination Equipment
b. Nameplate 2 (install next to respective position/indication):
Line 1: Source 1: Source Equipment
c. Nameplate 3 (install next to respective position/indication):
Line 1: Source 2: Source Equipment
4. Equipment disconnecting means located near the respective equipment, starter/equipment controllers not located in a MCC and similar:
Line 1: Equipment Name
Line 2: Equipment Tag Number
Line 3: Fed From: Source equipment
5. MCC cubicles (starters):
Line 1: Equipment Name
Line 2: Equipment Tag Number
Line 3: Starter Type and size (e.g. VFD, FVNR Size 2, RVSS)
Line 4: load HP rating

6. MCC cubicles (circuit breaker):
    Line 1: Circuit breaker rating
    Line 2: Feeding Equipment Name
7. MCC cubicles (feeders):
    Line 1: Feeder Circuit Breaker or Feeder Lugs
    Line 2: Fed From: Source equipment
8. MCC cubicles (miscellaneous):
    Line 1: Description of cubical (e.g. Spare FVNR Size 1, E-Net I/O)
    Line 2: Tag number if applicable

END OF SECTION

SECTION 26 08 00

ELECTRICAL TESTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical testing.

1.02 SUBMITTALS

A. Four copies of megger test reports.

B. Four copies of performance test reports.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide equipment to perform testing.

B. Test equipment shall bear a current calibration sticker which shows performance, when it was calibrated, and when it is next due for calibration.

C. Have calibration performed by a testing laboratory which uses reference instruments whose accuracy is documented and traceable to National Institute for Standards and Technology reference standards.

PART 3 EXECUTION

3.01 MEGGER TESTING

A. Test feeder and branch circuits which will operate at greater than 250V to ground with a 1000V megohm meter.

B. Record test results between phases, phase to neutral, phase to ground, and neutral to ground.

C. Prepare and submit test reports.

D. Tests deemed unsatisfactory by the Engineer:
   1. Replace defective conductor and all other conductors which are in the same conduit.
   2. Re-test and re-submit.

3.02 PERFORMANCE TEST

A. Demonstrate to the Engineer the satisfactory performance of all electrical equipment moved, modified, or provided under this Contract including, but not limited to, demonstrating that all equipment works properly in HAND and that hardware type automatic control components and systems work properly.

B. Calibrate plant equipment and instrumentation as required for proper operation.

C. If testing and/or calibration requirements are shown in Division 40:
   3. Perform megger testing as required in this Section.
   4. Where more stringent performance testing or more stringent calibration procedures are required in Division 40, follow those more stringent requirements and submit reports as required in Division 40.

3.03 OTHER TESTS

A. As required in other Sections.

3.04 WITNESS

A. Notify Engineer minimum three working days before megger testing.

B. Notify Engineer minimum seven working days before performance testing.

C. Engineer will either witness the testing or waive the requirement.

END OF SECTION

SECTION 26 08 01

SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.

B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E - Standard for Electrical Safety in the Workplace. The Arc Flash Hazard Analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.

C. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this Contract.

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):
1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

C. The National Fire Protection Association (NFPA):
   1. NFPA 70 – National Electrical Code, latest edition
   2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.03 QUALIFICATIONS

A. The short-circuit, protective device coordination and Arc Flash Hazard Analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

1.04 SAFETY

A. Safety shall be the sole responsibility of the Contractor.

PART 2 PRODUCTS

2.01 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm.

B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.02 DATA COLLECTION

A. The Owner shall provide as-built one-line diagrams as a basis for bidding purposes. It shall be the Contractor's responsibility to verify the accuracy of the as-builts and obtain any additional information necessary to perform the study.

B. Include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

C. Contractor shall perform all field data collection in accordance with their Safety Plan. Contractor shall be responsible for coordination with the Owner's staff when access is required to a facility or if equipment needs to be de-energized for data collection purposes.

D. Contractor shall coordinate with Owner to identify the necessary Lockout-Tagout (LOTO) procedures.

E. Contractor shall acquire all equipment (including cable information) data necessary for the study. The Owner will assist in providing equipment data if available, but if they do not have it in their library, then the Contractor shall acquire it as needed.

2.03 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Provide a short-circuit study, protective device evaluation, and coordination study based on on-line diagrams and field data.

B. Use actual conductor impedances, if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

C. Transformer design impedances shall be used when test impedances are not available.

D. Provide the following:
1. Calculation methods and assumptions.
2. Selected base per unit quantities.
3. One-line diagram of the system being evaluated (analysis software-generated).
4. Source impedance data, including electric utility system and motor fault contribution characteristics.
5. Tabulations of calculated quantities.
6. Results, conclusions, and recommendations.

E. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Unit substation primary and secondary terminals.
4. Low voltage switchgear.
5. Motor control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.
8. Other significant locations throughout the system.

F. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

G. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings.
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Notify Owner, in writing, of existing circuit protective devices improperly rated for the calculated available fault current.

2.04 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:
1. Electric utility's overcurrent protective device.
2. Medium voltage equipment overcurrent relays.
3. Medium and low voltage fuses, including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
6. Conductor damage curves.
7. Ground fault protective devices, as applicable.
8. Pertinent motor starting characteristics and motor damage points, where applicable.
9. Pertinent generator short-circuit decrement curve and generator damage point.
10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.05 ARC FLASH HAZARD ANALYSIS

A. The Arc Flash Hazard Analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. The Arc Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. When appropriate, the short-circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared, and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all

normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
   1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
   2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

G. For each piece of equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

H. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

I. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location, and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

J. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at two (2) seconds, based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than two seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.06 REPORT SECTIONS

A. Input data shall include, but not be limited to the following:
   1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
   2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps, and phase shift.

3. Reactor data, including voltage rating, and impedance.
4. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X"d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
5. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-Circuit Output Data shall include, but not be limited to the following reports:
1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage
   b. Calculated fault current magnitude and angle
   c. Fault point X/R ratio
   d. Equivalent impedance
2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage
   b. Calculated fault current magnitude and angle
   c. Fault point X/R ratio
   d. No AC Decrement (NACD) Ratio
   e. Equivalent impedance
   f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.

C. Recommended Protective Device Settings:
1. Phase and Ground Relays:
   a. Current transformer ratio
   b. Current setting
   c. Time setting
   d. Instantaneous setting
   e. Recommendations on improved relaying systems, if applicable.
2. Circuit Breakers:
   a. Adjustable pickups and time delays (long time, short time, ground)
   b. Adjustable time-current characteristic
   c. Adjustable instantaneous pickup
   d. Recommendations on improved trip systems, if applicable.

D. Incident Energy and Flash Protection Boundary Calculations:
1. Arcing fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy

7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

PART 3 EXECUTION

3.01 FIELD ADJUSTMENTS

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing Contract portion.

B. Notify Owner in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

A. The Contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high-adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:
1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Personal Protective Equipment (PPE) requirements
6. Incident energy
7. Working distance
8. Engineering report number, revision number and issue date

D. Labels shall be machine-printed, with no field markings.

E. Arc flash labels shall be provided in the following manner, and all labels shall be based on recommended overcurrent device settings:
1. For each 600, 480, and applicable 208 volt panelboard, one (1) arc flash label shall be provided.
2. For each motor control center, one (1) arc flash label shall be provided.
3. For each low voltage switchboard, one (1) arc flash label shall be provided.
4. For each switchgear, one (1) arc flash label shall be provided.
5. For medium voltage switches, one (1) arc flash label shall be provided.

F. Labels shall be field-installed by the Contractor performing the study.

3.03 ARC FLASH TRAINING

A. The Contractor of the Arc Flash Hazard Analysis shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 6 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

END OF SECTION

SECTION 26 22 13.10

LOW-VOLTAGE DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Low voltage transformers dry type transformers for general lighting and power service.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts with ratings.

PART 2 PRODUCTS

2.01 DRY TYPE TRANSFORMERS

A. UL Listed/Labeled two-winding dry type transformers with voltage, phases, and kVA ratings as shown on Drawings or Schedule.

B. Copper windings.

C. Connection: Furnish three phase transformers with delta connection on higher voltage windings and wye connection on lower voltage windings.

D. Maximum design temperature rise over 40°C ambient:
   1. Single phase:
      a. 2 kVA and less - 80°C.
      b. 3 kVA through 25 kVA - 115°C.
      c. Greater than 25 kVA - 150°C.
   2. Three phase:
      a. 45 kVA and less - 115°C.
      b. Greater than 45 kVA - 150°C.

E. Furnish transformers rated 30 kVA and less with core and coil resin encapsulated suitable for indoor or outdoor use.

F. Furnish transformers rated greater than 30 kVA with ventilated enclosure rated NEMA 1 where installed indoors or NEMA 3R where outdoors.

G. Minimum taps required:
   1. Transformers rated 3 kVA or less: No taps.
   2. Transformers rated greater than 3 kVA through 30 kVA: Two 2 1/2 % full capacity above normal (FCAN) and two 2 1/2% full capacity below normal (FCBN) taps.

3. Transformers rated greater than 30 kVA: Two 2 □□□% full capacity above normal (FCAN) and four 2 1/2% full capacity below normal (FCBN) taps.

H. Furnish transformers with different or other features as shown on Drawings or Schedule, such as but not limited to aluminum windings, different winding connections, additional taps.

I. Transformers which fall within the scope of the Guide for Determining Energy Efficiency for Distribution Transformers, published by the National Electrical Manufacturers Association® (NEMA® TP-1-2002): Meet Class I Efficiency Levels for distribution transformers specified in Table 4-2 of the Guide.

J. Cutler-Hammer type EP and DS-3 single phase or type EPT and DT-3 three phase, General Electric type QB, QMS, and QL single phase and type QMS3 and QL three phase, Square D Class 7400, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install transformer plumb and level.

B. Provide clearance around transformer for access and ventilation as recommended by manufacturer.

C. Use flexible conduit for connections to transformer case. Make conduit connections to transformer enclosure only at locations designated by the manufacturer's installation instructions.

D. After normal operating load have been energized, measure secondary voltages and adjust tap settings as necessary. Record tap settings on record drawings.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panelboards.

1.02 SUBMITTALS

A. Summary Sheet showing:
1. Voltage, phases, and main bus ampacity.
2. MLO panels: Type of main lugs.
3. MCB panels: Main breaker rating.
4. Neutral and ground bar ratings.
5. Bus material and plating.
6. Short circuit rating.
7. Flush or surface mount, enclosure NEMA type, and trim details.
8. Rating and arrangement of branch circuit breakers.
9. Description of specified factory assembled modification including, but not limited to, sub-feed breakers, sub-feed lugs, feed-through lugs, and metering transformers.

B. Panelboard layout showing all circuit breakers, strapping and mounting hardware for future circuit breakers, and space for future strapping and mounting hardware.

C. If the submitted circuit breaker layout differs from the Drawings then demonstrate that the phase current balance will be substantially the same.

1.03 OPERATIONS AND MAINTENANCE DATA

A. As-built layout drawing showing location, ampacity, and poles of each breaker.

B. Copies of all directories.

C. Settings used for electronic trip units and ground fault relays.

1.04 QUALITY ASSURANCE

A. Conform to the following:
1. UL 50 Enclosures for Electrical Equipment.
2. UL 67 Panelboards.
3. NFPA 70 National Electrical Code.
4. NEMA PB1 Panelboards.
5. UL 489, “Molded Case Circuit Breakers and Circuit Breaker Enclosures”.

6. NEMA AB1, “Molded Case Circuit Breakers”.

PART 2 PRODUCTS

2.01 PANELBOARDS – COMMON REQUIREMENTS

A. Voltage, phases, and current ratings as shown on Drawings.

B. Minimum branch circuit breaker space as shown on Drawings.

C. Minimum Box Width:
1. 14 inches for:
   a. 100 amp, single phase, flush mounted.
   b. 100 amp, 208Y/120 volt, three phase, flush mounted.
2. 20 inches for all others.

D. Main circuit breaker (MCB) or main lugs only (MLO) as shown on Drawings.

E. Bus: Tin plated aluminum unless shown otherwise on the Drawings or Schedule.

F. Ground Bar: Furnish all panelboards with a ground bar having a screw for each pole.

G. Neutral Bar:
1. 208Y/120 volt and 120/240 volt single phase panelboards: Provide 100 percent neutral bar with a screw for each pole unless shown otherwise on the Drawings or Schedules.
2. 480Y/277 volt panelboards which are used as service equipment: Provide 100 percent neutral bar.
3. 480Y/277 volt panelboards which power 277 volt loads, such as site lighting and UV systems, and elsewhere required on the Drawings: Provide 100 percent neutral bar with a screw for each pole.
4. 480 volt panelboards which power no 277 volt loads: No neutral bar required.

H. Furnish sub-feed breakers, sub-feed lugs, feed-through lugs or other factory options as shown on Drawings.

I. Flush or surface mount as shown on Drawings.

J. Listed and labeled for service entrance use if used for service entrance equipment or so indicated on Drawings.

K. Circuit Breakers:
1. Furnish circuit breakers recommended by the manufacturer of the panelboard for use in the panelboard furnished.
2. Provide as shown on Drawings or Schedules.

L. Furnish all required strapping and mounting hardware required for the future installation of a circuit breaker of the frame size shown where “FUTURE” is shown

on the Drawings or Schedules.

M. Furnish a panelboard with the required space for the future installation of strapping, mounting hardware, and circuit breakers where "SPACE" is shown on the Drawings or Schedules."

N. Circuit Breaker Mounting and Connection:
1. Connection between line side of circuit breaker and bus by direct bolted connection, or
2. Connection between line side of circuit breaker and bus by spring tension jaws designed to produce increased contact pressure under fault conditions and entire circuit breaker secured in place with bolt, and
3. No restriction on ability to mount circuit breakers of different frame size or number of poles opposite each other.

O. Manufacturers and Types:
1. Cutler-Hammer: Pow-R-Line 1 and Pow-R-Line 2.
2. General Electric: AQ, AE, and AD.
3. Square D: NQOD and NF.
4. Engineer reviewed equivalent.

2.02 ENCLOSURE AND TRIM

A. Enclosure rated NEMA 1, NEMA 3R, NEMA 4, NEMA4X SS or NEMA 12 as shown on Drawings or Schedules.

B. Enclosure constructed of zinc-coated sheet steel for all but NEMA4X SS.

C. For NEMA 3R, 4, and 12, provide enclosure with exterior surfaces prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.

D. Flush mounted 208Y/120 volt and 120/240 volt single phase panelboards rated 100A: Furnish with decorative trim fastened to the box on four sides with screws or screwdriver operable captive latches and a hinged and latched door to cover access to circuit breaker operating handles but without access to any energized parts.

E. Flush mounted 208Y/120 volt and 120/240 volt single phase panelboards rated greater than 100A and all flush mounted 480 volt panelboards: Furnish "door-in-door" trim.
1. Inner door with hinges and latch to cover access to circuit breaker operating handles but without access to any energized parts.
2. Outer door hinged on one side and secured on remaining sides with captive screws or screw driver operated latches. Provide door that provides full access to wiring gutter on all four sides when open.
3. Provide decorative trim around box to cover the gap between the enclosure and the wall surface.
4. Provide trim prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.

F. Furnish Surface Mounted Panelboards with "Hinged Trim" Cover:
   1. Inner door with hinges and latch to cover access to circuit breaker operating handles but without access to any energized parts.
   2. Trim hinged at one edge of box and secured on remaining sides with captive screws or screw driver operated latches. Provide door that provides full access to wiring gutter on all four sides when open.
   3. Provide trim prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.

G. Furnish latched and lockable door with metal frame cardholder with clear plastic window on inside of door for panel directory.

H. Provide other features as shown on the Drawings or Schedules.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. General: Provide circuit breakers as integral components of panelboard with indicated features, ratings, characteristics, and settings.

B. Future Devices: Equip compartments with mounting brackets, supports, bus connections and necessary appurtenances for future circuit breakers as show on the Drawings or Schedules.

C. Molded-Case Circuit Breakers:
   1. General: UL489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
   2. Suitable for use with conductors operating at 75° C.
   3. Characteristics: Frame size, trip rating, number of poles, and short-circuit interrupting capacity rating as shown on the Drawings or Schedules.
   4. Interrupting capacity not less than shown on the Drawings or Schedules. Furnish all circuit breakers with full interrupting capacity. Do not use series ratings.
   5. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous over-current trip protection for each pole.
   6. Adjustable instantaneous trip devices: Front adjustable; factory adjusted to low trip setting.
   7. Solid state trip devices: When called for on the Drawings, provide molded case circuit breakers that use solid-state trip devices.
   8. Furnish circuit breakers for lighting circuits that are switching duty rated.
   9. Furnish heating, air conditioning, refrigeration (HACR) rated circuit breakers when called for on the Drawings or Schedules.
   10. Furnish single pole circuit breakers with ground fault interrupting capability when called for on the Drawings or Schedules. When required furnish Class A (6ma.) or Class B (30ma.) as shown on the Drawings or Schedules.

D. Electronic Circuit Breaker Trip Devices: True RMS sensing, microprocessor based, solid-state overcurrent trip device system that includes one or more integrally

mounted current transformer or sensor per phase, a release mechanism, and the following features:

1. Temperature compensation to assure accuracy and calibration stability from minus 20 degree C. to plus 55 degree C.
2. Time-current tripping functions, field adjustable with the breaker closed and energized, as scheduled or shown on the Drawings, often abbreviated as L, S, I, and G.
    a. Adjustable long-time pick-up current.
    b. Adjustable long-time-delay.
    c. Adjustable short-time pick-up current.
    d. Adjustable short-time-delay.
    e. Adjustable instantaneous trip current.
    f. Adjustable ground-fault pick-up current.
    g. Adjustable ground-fault-delay.
    h. Selectable I2t function on short-time-delay.
    i. Selectable I2t function on ground-fault-delay.
3. Clear, sealable cover over adjustments.
4. Other factory options as shown on the Drawings or Schedules.
5. Trip Indication: Labeled lights or mechanical indicators indicating long-time overload, short-time overload, instantaneous, or ground fault as cause of trip. If lights are used, furnish with integral power source capable of maintaining indication for not less than 48 hours.
6. Arrangement to permit testing of all functions without removal from panelboard and to permit viewing and adjustment of all functions without removal of any metal panels.
7. Furnish 80 percent rated circuit breakers unless otherwise shown on the Drawings or Schedules.

E. Ground Fault Protection Systems: If and as indicated on the Drawings or Schedules, provide zone selectively interlocked ground fault protection system using a single window type rectangular split core current transformer for each circuit and separate relays as specified in Section 26 28 20 – Zone Interlocked Ground Fault Relay Systems.

F. Other devices as shown on the Drawing or Schedules.

PART 3 EXECUTION

3.01 PANELBOARD INSTALLATION

A. Install panelboards following manufacturer's instructions.

B. Mount panelboards plumb and rigid.

C. Mount flush panelboards so that the trim fits flat against finished wall.

D. For MLO panelboards, install compression lugs on conductors with press and die recommended by lug manufacturer. Bolt lug to bus.

3.02 IDENTIFICATION

A. Properly and accurately label panel directories by hand during construction.

B. Install neatly typed, accurate directories in holders prior to Substantial Completion.

C. Identify panelboard and its source with a nameplate.

3.03 KEYS

A. Keep panelboard keys properly marked and identified with panel number and location.

B. Furnish the Owner at least 2 copies of all panelboard keys, with tag showing identifying number and location of panel.

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Motor Control Centers (MCC)

1.02 SUBMITTALS

A. Manufacturer's elevation and layout view with MCC ratings, cubicle arrangement and ratings, nameplate engravings, special features, and dimensions. Identify cubicles in elevations and tables using the same identification scheme as used in the Contract Drawings, including the name and tag number of the load.

B. Catalog cuts of starters, overload relays, pushbuttons, selector switches, pilot light assemblies, control power transformers, fuses.

C. If relays, time delay relays, or similar are required to be mounted in the MCC by the schematics on the Drawings, then submit catalog cuts.

D. MCC manufacturer's typical diagrams may be used for mains, feeders, dry transformers, and panelboards.

E. Motor starter schematic and connection diagrams.
   1. Submit as required in Section 40 94 23 – Plant Control System. Engineer will not review diagrams submitted under this Section.
   2. If Section 40 94 23 – Plant Control System is not included, then submit as follows: Provide an individual diagram for each different type of starter and contactor. Diagrams shall be electrically and functionally equivalent to the schematic sheets in the Drawings. Format and style of diagrams may be manufacturer's standard. Numbering of terminal points may be manufacturer's standard. Include identification on diagram to relate each sheet either to an equipment name and MCC cubicle number.

F. It is recognized that some of the above submittal requirements may be more stringent than NEMA standard requirements. The specifications govern in case of conflict and the NEMA standards shall be considered to be minimum requirements.

1.03 AMPACITY

A. Where Contractor supplies process, HVAC, or other equipment requiring different ampacity than that shown on the MCC schedules or one-line diagrams, the Contractor shall ensure that the MCC and auxiliary equipment supplied is suitable for that equipment.

B. If the MCC contains a starter for a well pump motor, do not purchase the MCC until after the actual HP of the motor is established by change order.

1.04 OPERATION AND MAINTENANCE DATA

A. Correct elevation and layout view with MCC ratings, cubicle arrangement and ratings, nameplate engraving, special features, and dimensions, corrected to match installed conditions.

B. Catalog cuts of all electrical components used in the MCC, including but not limited to, circuit breakers, fusible switches, fuse blocks, fuse holders, fuses, control power transformers, motor circuit protectors, contactors, starters, overload relays, pushbuttons, selector switches, contact blocks, pilot light assemblies, pilot lights, relays, time delay relays, potential transformers, current transformers, meters, other metering components, and terminal boards.

C. Schematic and connection diagrams: Either under Section 40 94 23 – Plant Control System, or this Section, provide copies of submittal materials, corrected to show installed conditions.

D. Tabulation of normal running current of each motor and rating of heater furnished for each conventional overload relay or setting of each solid state overload relay.

E. Manufacturer's O&M Manual, including renewal parts information.

PART 2 PRODUCTS

2.01 RATINGS & STANDARDS

A. Voltage: 480V unless shown otherwise on the Drawings or Schedules.

B. Horizontal bus ampacity: As shown on the Drawings or Schedules, but not less than 600 amperes.

C. Vertical bus ampacity: As required by line and/or load current in the section, but not less than 300 amperes.

D. Neutral bus ampacity for 4 wire construction: Not less than 50 percent of main.

E. Bus short circuit withstand: 42,000A RMS symmetrical unless shown otherwise on the Drawings or Schedules.

F. Interrupt capacity of main and feeder circuit breakers: 42,000A RMS symmetrical unless shown otherwise on the Drawings or Schedules.

G. Interrupting capacity of 480V fuses: 200,000 amperes RMS symmetrical, minimum.

H. Enclosure: As shown on the Drawings or Schedules. If not shown, Furnish NEMA 1A where indoors; NEMA 3R non-walk-in where outdoors.

I. Each section UL listed/labeled. Each cubicle UL listed/labeled.

J. Constructed in accordance with NEMA Industrial Control Standard (ICS2) and NEC.

2.02 BUS SYSTEM

A. Tin-plated copper, round edge. Square cut bar stock is unacceptable. Rated ampacity based on current density of not more than 1,000 A/in2.

B. Horizontal main bus: Totally enclosed in a combination of steel and a fiberglass reinforced polyester (FRP) insulating system to prevent accidental contact by maintenance personnel and to prevent entry of rodents.

C. Vertical bus: Totally enclosed in a FRP insulating system which isolates phase from phase as well as phase from ground and prevents entry of rodents. Provide stab openings. Install covers over unused openings and provide extra covers to temporarily cover openings exposed by the removal of a cubicle for maintenance. Automatic shutters are acceptable in lieu of covers.

D. Ground bus: 600 ampere rated, same material as phase bus.

E. Other features as shown on the Drawings or Schedules.

2.03 GENERAL REQUIREMENTS

A. Construction: Such that installation, wiring, and maintenance may be done from the front, permitting back-to-back or back-to-wall installation.

B. Section Depth: 15 inches nominal except where equipment such as reduced voltage starters require 20 inches depth. All sections in a given MCC must be the same depth.

C. Each section shall have a four inch nominal wireway door for access to the vertical wireway.

D. Provide a horizontal wireway, completely isolated from the phase bus bars. Contractor shall designate top or bottom location of the wireway for maximum convenience of installing wire.

E. The MCC shall contain the motor control components, feeders, and other items shown in the Drawing or Schedules.

F. Other features as shown on the Drawings or Schedules.

2.04 CUBICLE CONSTRUCTION

A. Starters NEMA size 3 and smaller and feeder circuit breakers 225 amperes and smaller mounted in removable plug-in type cubicles.

1. Guide system in the main structure to support and hold the unit in alignment during removal or alignment.
2. Floating plug-in stabs for automatic alignment during insertion.
3. Design of rail and alignment system to prevent twisting of cubicle in the horizontal plane to allow a short or cross connect of stabs during insertion or removal.
4. Design of rail and alignment system to prevent jamming of partially inserted or removed cubicle.
5. Equipped with a mechanical latch to hold the cubicle in a semi-installed test position, absolutely disconnected from the vertical bus. Cubicle padlockable in the semi-installed test position.

B. Like type removable cubicles physically interchangeable.

C. Cubicle door:
1. Removable with cubicle, or
2. Separable at hinge by removing hinge pin without tools.

2.05 AIR BREAK MAGNETIC MOTOR CONTROLLER

A. General:
1. Traditional, heavy-duty NEMA rated controller.
   a. IEC rated controller: Not acceptable.
   b. Controller originally designed to IEC standards but also labeled as if NEMA: Not acceptable.
2. Line lugs at top, load lugs at bottom.
3. Meet all applicable NEMA and UL standards.

B. NEMA size:
1. As shown on Drawings or Schedules.
2. If size not shown on Drawings or Schedules, size as stated in NEMA standard to match the motor being controlled but minimum NEMA size 1.

C. Main contacts:
1. Three pole.
2. 600 volt.
3. Double break silver alloy.
4. Replaceable without removing power wiring.

D. Auxiliary contacts:
1. NEMA B600
2. As required by the Drawings.

E. Coil:
1. Encapsulated.
2. Replaceable from the front.
3. Connection for operating voltage by exposed wiring to permit insertion of a stop switch directly in the conductor carrying coil current.

4. 120 volt, 60 Hz. unless shown otherwise on the Drawings or Schedules.
5. Minimum Pickup: 85% rated voltage.

F. Manufacturers:
1. Allen-Bradley: Bulletin 509 series.
2. General Electric: CR306 series.
3. Square D: Class 8536.
4. Cutler-Hammer: A200.
5. Engineer reviewed substitution.

2.06 OVERLOAD RELAY

A. Unless otherwise noted on the Drawings or Schedules, furnish electronic solid-state overload relay.

B. Electronic solid state type overload relay:
1. Three pole.
2. Trip setting adjustable from front of relay.
3. Trip setting adjustable while relay is energized.
4. Adjustable for class 10, class 20, or class 30 operation.
5. Test trip function.
6. Trip indication.
7. Reset button through door of the enclosure.
8. If the Drawings call for an extra auxiliary contact of OL relay, furnish an isolated type, not connected to power, neutral, or ground.
9. One piece construction, replaceable without replacing the contactor. Not a single piece with the contactor but furnish contactor and overload relay designed to be operated as a unit.

C. Overload reset operator: On the door of cubicle.

2.07 MOTOR CIRCUIT PROTECTOR

A. General:
1. Instantaneous only magnetic trip protective device.
2. UL recognized.
3. 600 volt rated.

B. Fault duty rating when used in combination with a properly sized overload relay.
1. 240 volt: 100,000 amperes.
2. 480 volt: 65,000 amperes.

C. Continuous current rating:
1. As shown on the Drawings or Schedules.
2. If not shown on the Drawings or Schedules, as recommended by the manufacturer for the motor being controlled.

D. Magnetic trip range: Appropriate for motor being served.

E. Operating handle mechanism:
   1. Interlocked with door so disconnecting means must be in the "OFF" position to open the door, and door must be closed to close disconnecting means unless interlocking is intentionally bypassed.
   2. Padlockable in the "OFF" position with the door closed. When so padlocked, the door must be held closed positively, and the bypass means shall not allow the door to be opened.

F. Manufacturers:
   1. Cutler-Hammer/Westinghouse: HMCP
   2. General Electric: Mag Break
   3. Square D: Mag-Gard

2.08 CONTROL POWER

A. Unless shown otherwise on the Drawing or Schedules, furnish a control power transformer for each starter operating a 460 volt motor. Connect transformer primary to line side of starter.
   1. Comply with Section 26 28 13 – Low Voltage Fuses.
   2. Two fuses on primary and one fuse on secondary.

B. Size transformer to meet requirements of starter coil, indicator lights and other devices shown on Drawings. Provide additional capacity where called for on the Drawings.

C. Unless shown otherwise on the Drawings or Schedules, furnish a fuse to protect 120V control power circuit for each starter operating a 200/230 volt motor. Connect fuse to line side of starter.

2.09 COMPONENTS

A. Pilot Lights: LED type, unless scheduled otherwise.

B. Pilot Devices:
   1. Dielectric Strength: 2,200 volts for one minute
   2. Push button electrical and mechanical design life: 1,000,000 at maximum rated load.
   3. 30.5mm mounting hole.
   4. Watertight/oiltight
   5. Maximum continuous contact current: 5 amperes.
   6. Hermetically sealed reed switch contacts.
   7. Allen-Bradley bulletin 800R or engineer reviewed equivalent.

2.10 WIRING

A. Wiring: NEMA Class I Type B nless shown otherwise on the Drawing or Schedules.

B. Conductors which carry foreign voltage over 24V: Yellow.

C. 24VDC Conductors: #16 AWG twisted, shielded pair with grey jacket. Run separate from AC wiring.

2.11 MARKING AND LABELING

A. Nameplate showing model, voltage, current rating, MCC factory shop order number, date.

B. Nameplate showing designation of MCC as shown on the Drawings or Schedules.

C. Nameplate on each cubical identifying equipment served. Show name of equipment and tag number. Nameplate "SPARE" for cubicles equipped with starter/feeder but not currently used.

D. Nameplate on each cubicle containing foreign 120V control power: "CAUTION FOREIGN 120VAC ON YELLOW WIRE."

E. Other nameplates as required on the Drawings or Schedules.

2.12 SOURCE

A. Allen-Bradley, General Electric, Square D, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install MCC in location shown on the Drawings.

B. Install in accordance with manufacturer's written instructions.

C. Only after the MCC is in the final location, remove temporary lifting eyes, channels, and brackets and temporary blocking for moving parts.

D. If a main disconnecting device is not provided, make wire connections to busses only with bolted lugs compressed on the wire using dies and presses as recommended by the lug manufacturer.

3.02 ADJUSTING

A. Adjust all operating mechanisms for free mechanical movement.

B. Check all bolted connections and circuit breaker or motor starter lugs for proper torque. Place distinctive marking on each bolt after it is torque.

C. Adjust all control device and time delay relay settings to values provided by the Engineer.

D. Adjust trip setting on MCPs to lowest setting that will permit consistent motor starts.

E. Unless shown otherwise on the Drawings or Schedules or unless otherwise instructed by the Engineer, adjust trip settings on overload relays based on motor nameplate FLA. Record settings.

F. Touch up scratched or marred surfaces to match original finish.

3.03 MOTOR CURRENT MEASUREMENTS

A. Measure and record running current of each motor under normal operating conditions.

END OF SECTION

SECTION 26 27 10

ELECTRICAL SERVICE

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Section 01 21 00 – Allowances

1.02 SYSTEM DESCRIPTION

A. Arrange with the Public Service Company of New Mexico (PNM) for extension of 480V underground service to the property. PNM to provide: underground splices in existing power manhole, low voltage cable from existing manhole to solid blade disconnect, meter and meter wiring. Contractor to provide: trench and backfill for 24 inch wide by 51 inch deep ditch for service conduit, service conduit, strut stand for solid blade disconnect, meter enclosure and socket, all in compliance with PNM requirements, whether shown on the Drawings or not.

B. Arrange with PNM and the Owner for an outage of no more than 4 hours for connection of a new feeder to the existing transformer.

C. Pay PNM the amount required in order for PNM to begin construction.

D. Submit to the Engineer detailed documentation related to all PNM charges.

E. Upon favorable review of PNM charges by the Engineer, make complete payment to PNM then recover the amount of payments made to PNM under the Allowance.

1.03 CONSTRUCTION POWER

A. Include in the Bid costs associated with arrangement with PNM to furnish construction power.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 27 16

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cabinets.

B. Enclosures.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 CABINETS AND ENCLOSURES

A. NEMA 4X stainless steel outdoors, NEMA 12 indoors. Other type are allowed as noted on the Drawings.

B. Hinged doors are required for all cabinets and enclosure larger than 6 inch by 6 inch.

C. Padlockable.

D. Hoffman or equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Securely support independently of conduits.

B. Level in the vertical and horizontal.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wiring Devices: Switches, receptacles, covers.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts.

PART 2 PRODUCTS

2.01 TOGGLE SWITCHES

A. Heavy-duty, "silent" AC type, 20 A, 120 VAC – 277 VAC.

B. Back and side wiring feature. Positive clamping with screw-activated pressure plate.

C. Poles and Contact Action: As shown on the Drawings.

D. Motor Switching Rated:
1. 1-1/2 horsepower at 120 VAC.
2. 2 horsepower at 240 VAC.

E. Manufacturers:
1. Hubbell HBL1221, HBL1222, HBL1223, HBL1224 series.
2. Pass & Seymour 20AC1, 20AC2, 20AC3, 20AC4 series.
3. Engineer reviewed equivalent.

F. Other features or switches as shown on the Drawings or Schedules.

2.02 DUPLEX RECEPTACLES

A. Commercial Grade Duplex Receptacle:
1. NEMA 5-15R.
2. Back and side wiring feature. Positive clamping with screw activated pressure plate.

B. Specification Grade Duplex Receptacle:
1. NEMA 5-15R.
2. Back and side wiring feature. Positive clamping with screw activated pressure plate.
3. Positive grounding without bonding jumpers.

C. GFCI Receptacle:
1. NEMA 5-15R.
2. Side wired.
3. Flush polycarbonate face.
4. Trip level: 4 to 6 mA.
5. Trip time: .025 sec. nominal.
6. Operating temperature: -35 degree C. to +66 degree C.
7. Hubbell GF5252A series, Leviton 6599 series, Pass & Seymour 1591 series, or Engineer reviewed equivalent.

D. Hospital Grade Duplex Receptacle:
1. NEMA 5-15R.
2. Back and side wiring feature. Positive clamping with screw activated pressure plate.
3. Positive grounding without bonding jumpers.
4. Marked with green dot on face.
5. Hubbell 8200/8300 series, Leviton 8200/8300 series, Pass & Seymour 8200/8300 series, or Engineer reviewed equivalent.

E. All toggle switches and duplex receptacles: By same manufacturer. Other switches and receptacles by the same manufacturer, except where shown by a different manufacturer in the Schedule or on the Drawings.

2.03 OTHER RECEPTACLES

A. Other devices as scheduled or as shown on the Drawings.

2.04 DEVICE PLATES

A. Proper for the device(s) installed.

B. Use a single plate for multiple devices.

C. Oversize Polycarbonate or Nylon:
1. Premium grade.
2. Match device color.
3. Use on flush boxes in appropriate areas.
4. Use standard size plate if oversized plate is not manufactured.
5. Hubbell PJ series or Engineer reviewed equivalent.

D. Standard Size Polycarbonate or Nylon:
1. Premium grade.
2. Match device color.
3. Use on surface-mounted boxes in appropriate areas.
4. Use on flush boxes in appropriate areas if oversized plate is not manufactured.
5. Same manufacturer, material, and appearance as oversize Polycarbonate or Nylon.

E. 302/304 Stainless Steel: Hubbell S1, or Engineer reviewed equivalent.

F. NEMA 7 in hazardous areas.

G. Telephone Plates: Match material and general appearance of other device plates in the area.

H. Special Plates: As scheduled or as shown on the Drawings.

I. Outdoor Toggle Switch Covers: Wet location lift cover, self-closing.

J. Damp Location Duplex Receptacle Cover and Box:
1. Single horizontal self-closing lid.
2. Die cast aluminum or polycarbonate.
3. UL listed as raintight in the closed position.
4. Meet NEC 406.8 (A).
5. Box: Designed for the specific cover and device combination and recommended by the manufacturer of the cover for use with the particular weatherproof cover.

K. Wet Location Duplex Receptacle Cover and Box:
1. Single horizontal self-closing.
2. Polycarbonate.
3. Paintable.
4. Other features as shown on the Drawings or Schedules.
5. UL listed as NEMA 3R with a cord connected.
6. Meet NEC 406.8 (B) (1).
7. Unless shown differently on the Drawings or Schedules, furnish Carlon E9UHG, TayMac 60310, or Engineer approved equivalent.
8. Box: Designed for the specific cover and device combination and recommended by the manufacturer of the cover for use with the particular weatherproof cover.

PART 3 EXECUTION

3.01 DEVICE COLOR

A. Special Colors:
1. Where scheduled.
2. Where called for on the Drawings.
3. Where manufacturer's or industry standard for device, such as orange for isolated ground receptacles and red for emergency power receptacles.

B. All others: White.

3.02 USAGE OF RECEPTACLES

A. Furnish GFCI Type Receptacles at Each Location:
1. Where required by NEC or

2. Where scheduled or
3. Where called for on the Drawings.

B. Unless shown otherwise on the Drawings or Schedules, use commercial grade receptacles as specified herein.

3.03 COVER TYPE

A. Wet Location, In-use: Outdoors and in process areas not excepted immediately below.

B. Damp Location: Indoor, above-grade process areas except spaces, such as blower rooms, that have no piping that carries sewage or sludge.

C. Stainless Steel: In laboratories, offices, meeting rooms, lobbies and other similar office/commercial type areas.

D. Standard Size Polycarbonate/Nylon or Galvanized Steel: Indoor surface-mounted device boxes.

E. Oversize Polycarbonate/Nylon: Indoor flush-mounted device boxes.

F. As scheduled or as called for on the Drawings.

3.04 INSTALLATION POSITION

A. Mount toggle switches at 42 inches centerline above finished floor unless shown otherwise on the Drawings.

B. Indoors: Mount duplex receptacles at 18 inches centerline above finished floor, unless shown otherwise on the Drawings.

C. Outdoors and In Areas Considered Wet Location: Mount duplex receptacles at 30 inches centerline above finished grade or finished floor unless shown otherwise on the Drawings.

3.05 IDENTIFICATION

A. Mount nameplate above cover plate of each receptacle and switch.

B. Text:
1. Receptacles: Panelboard designation and circuit number(s). For example: “PP3-2, 4, 6” or “LP2IG-17.”
2. Switches: Circuit designation as above and description of lights controlled.
3. Otherwise as shown on the Drawings or Schedules.

END OF SECTION

SECTION 26 27 27

WIRE CONNECTORS AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire connectors and accessories.

1.02 SUBMITTALS

A. If products from manufacturer and of the model shown in Part 2 are to be furnished, submittals are not required and will not be reviewed.

B. If products from a different manufacturer or of a different model than shown in Part 2 are to be furnished:
   1. Submit complete manufacturer's cuts.
   2. Furnish other material demonstrating product equivalence as directed by the Engineer.

C. If a manufacturer and model are not shown in Part 2, furnish complete manufacturer's cuts.

PART 2 PRODUCTS

2.01 600V WIRE NUTS

A. UL listed and CSA certified for 600V maximum building wire, 1000V maximum fixture wire, 105 degrees C. maximum temperature rating.

B. Color coded outer shell to identify manufacturer approved wire combinations.

C. Nylon insulated.

D. Reusable.

E. Scotch 3M Ranger 312 or Ranger 512, or Engineer reviewed equivalent.

2.02 BUTT CONNECTORS

A. Non-insulated, brazed seam or seamless, compression type.

B. Insulation: Tubular pre-stretched EPDM rubber cold shrink insulators. 3M 8420 series or Engineer reviewed equivalent.

2.03 LOCKING FORK WIRE TERMINALS

A. UL listed and CSI certified.

B. One-piece burr-free electro-tin plated copper, locking fork style.

C. Ranges Required:
1. 22-18 AWG for 4, 6, 8, 10 studs.
2. 16-14 AWG for 4, 6, 8, 10, 1/4 studs.
3. 12-10 AWG for 6, 8, 10, 1/4 studs.

D. Barrel:
1. Silver-brazed seam.
2. Beveled opening to facilitate wire insertion.
3. Multiple V-grooves inside barrel for better wire retention.
4. Non-insulated.

E. Scotch 3M M18-4FL through M10-14FL or Engineer reviewed equivalent.

F. Installation Tool:
1. Hardened steel jaws and handles.
2. Color-coded, indent shape dies.
3. Compound lever action with a ratchet mechanism to insure positive closure for full crimping cycle.
4. Capable of being field adjusted to proper calibration.
5. Complete with operation, maintenance, and calibration instructions.
6. Scotch 3M TR-490 or Engineer reviewed equivalent.

2.04 SMALL RING TONGUE WIRE TERMINALS

A. Same as 2.04 except ring terminal.

B. Scotch 3M M18-4R/S through M10-12R or Engineer reviewed equivalent.

C. Installation Tool: Scotch 3M TR-490 or Engineer reviewed equivalent.

2.05 LARGE RING TONGUE WIRE TERMINALS

A. Same as 2.04 except ring terminal in sizes from #8 to #4/0 AWG for 3/8, 1/2 studs.

B. Thomas and Betts StaKon D through L or Engineer reviewed equivalent.

C. Installation Tool: T&B TBM6 or TBM6S or Engineer reviewed equivalent.

2.06 AREA LIGHTING CONNECTION KIT

A. Complete kit with Allen set screw multiple connector blocks; separable, crimp-on wire terminals; UV stabilized waterproof multiple entry boot; fuse holder and fuse for branch circuit.

B. Buchanan 82S series or Engineer reviewed equivalent.

2.07 MEDIUM DUTY TERMINAL BLOCKS

A. UL component recognized.

B. Voltage Rating: 600V UL.

C. Material: Nylon with elevated marking strip.

D. Spacing: 0.375 inch center to center.

E. Contacts:
1. Electrical grade copper alloy.
2. Tubular clamp type.
3. 40A.

F. Wire Range: #22 to #10 AWG.

G. Maximum Service Temperature: 105 degrees C.

H. Buchanan #0715, #0730, #64, #68, #99, and #52, or Engineer reviewed equivalent.

2.08 HEAVY DUTY TERMINAL BLOCKS

A. UL component recognized.

B. Voltage Rating: 600V UL.

C. Material: Nylon with elevated marking strip.

D. Spacing: 0.5 inch center to center.

E. Contacts:
1. Electrical grade copper alloy.
2. Tubular clamp type.
3. 70A

F. Wire Range: #18 to #6 AWG.

G. Maximum Service Temperature: 125 degrees C.

H. Buchanan #0243; #0250; #64; #68; #99; and #52, or Engineer reviewed equivalent.

2.09 POWER DISTRIBUTION BLOCKS

A. UL component recognized.

B. Tin plated high conductivity aluminum.

C. Main and branch conductor size and number as shown on the Drawings or Schedules.

D. Number of poles as shown on the Drawings or Schedules.

E. Manufacturers:
1. Square D: Class 9080 – Type LB.
2. Cooper/Bussman: 16 Series.
3. Engineer reviewed equivalent.

2.10 DIN RAIL-MOUNTED CONTROL TERMINAL BLOCKS

A. General:
1. Comply with UL standards 486 and 1059.
2. Termination:
   a. Box type clamp in which a screw applies continuous pressure to a plate which compresses the wire against the current bar, or
   b. An automatic wire clamping system design to increase the clamping force as force is applied to pull the wire out of the clamp. Furnish clamping system with minimum retention forces (lbs) not less than shown in the following table:

Wire Size	Type of Wire	
AWG	Solid	Stranded
14	20.5	13.5
12	31.5	20.5
10	38.5	23.0
8	69.0	41.0

3. Accept solid or stranded wire, or stranded wires with ferrules.
4. Mount on standard TS 35 DIN-rail.

B. Terminal Blocks, 600V Rating:
1. Digital and analog signals: 6mm spacing (.238”), for 22-10 AWG wire.
   a. DC positive or supply: Grey body.
   b. DC negative or return: Blue body.
2. DC shield and drain wire: 6mm spacing.
   a. Terminals insulated from ground: Yellow body.
   b. Terminals grounded to rail: Yellow body with green stripe.
3. AC signal or power: 8mm spacing (.315”), for 22-8 AWG wire.
4. AC foreign voltage, where circuits remain live after opening of control voltage disconnect switch: 8mm spacing, orange body.
5. AC equipment ground, terminals grounded to rail: 8mm spacing, yellow body with green stripe.

C. Switch Terminal Blocks:
1. DC: 6mm spacing, short hinged blade, grey body, orange blade.
2. AC: 8mm spacing, long hinged blade, grey body, orange blade.

D. Fuse-Holder Terminal Blocks:
   1. DC or AC: Fused switch style, for 6.35x32mm (1/4" x 1-1/4") fuses, greater than 13mm (.512") spacing, with blown fuse indicator.
   2. Self-contained without the need for an end cover.

E. Other terminal blocks as shown on the Drawing or Schedules.

F. Accessories:
   1. Mounting rails: Bichromated zinced steel or anodized copper.
   2. End sections for blocks: Required on the open extremity of each size and style of terminal block.
   3. Circuit Separator: Required between blocks of different voltages, power and control, AC and DC.
   4. End stops for rails: Required at the extremities of each series of terminal blocks.
   5. Jumpers: Required for jumpering between blocks. Either a. or b. as below, or as specified on the Drawings.
      a. Comb type.
      b. Bar type.

G. Markers: Required for every terminal block and board.
   1. Terminal block: Side mount, pre-printed vertical or horizontal to match board alignment. Coordinate abbreviations of text with Engineer if descriptor exceeds available space.
   2. Terminal Board: End stop marker holder.

H. Test Devices and Plugs: Provide during testing, and leave with the project spares the following items:
   1. Screw head test receptacle for 6mm blocks (if used): Four each.
   2. Screw head test receptacle for 8mm blocks (if used): Four each.
   3. Test plugs for the above receptacles: Eight each.

I. Manufacturers:
   1. Phoenix Contact
   2. Wago
   3. Engineer reviewed equivalent.

2.11 CABLE GRIPS

A. Material: 302 or 304 stainless steel.

B. Heavy duty unless shown otherwise on the Drawings.

C. Single offset eye unless shown otherwise on the Drawings or otherwise submitted and reviewed.

D. Basket weave, rod closure, reusable.

E. Hubbell Kellems or Engineer reviewed equivalent.

2.12 CONNECTORS FOR DEVICENET™

A. Comply with ODVA™ standards.

B. Provide connectors which are designed so disconnection of a device does not disrupt the network and as shown on the Drawings.

C. Provide drop line connectors/connections to match end devices.

PART 3 EXECUTION

3.01 WIRE NUTS

A. Not allowed unless reviewed by the Engineer on a case by case basis.

B. Consult manufacturer's instructions for approved wire nut based on combination of wires being spliced.

C. Do not use for splices that may become submerged, such as in manholes, handholes, underground pull boxes, and wet wells.

D. Do not use for control or instrumentation conductors.

3.02 COMPRESSION TYPE CONNECTORS

A. Use only the tool and die specified by the manufacturer for installation.

3.03 BUTT CONNECTORS

A. For splices on 120, 240, 480V circuit conductors #6 AWG and larger (except at motors). Use only where specifically required on Drawings.

3.04 MOTOR LEAD CONNECTORS

A. Solid wire: 600V wire nuts.

B. Stranded Wire:
1. Install non-insulated, brazed seam or seamless, ring terminal compression lugs on each conductor, then bolt together.

C. Insulate with Scotch 5300 - 5204 Series pigtail kits, or Engineer reviewed equivalent.

3.05 MARKING OF TERMINAL BOARDS AND TERMINALS

A. DIN-Rail Mounted Terminal Systems: See Part 2.

B. Other Terminal Boards:
   1. Engraved Micarta nameplate with 1/8” letters.
   2. Adjacent to each row or column of terminals.
   3. Text: As shown on Drawings or submittals.

C. Terminal Points:
   1. Mark each terminal that will be wired.
   2. Mark other terminals if so shown on Drawings.
   3. Text: As shown on Drawings or submittals; if not shown, then match wire number.

3.06 INSTALLATION, ORIENTATION, AND CONNECTION OF DIN RAIL TERMINALS

A. Mount switch and fuse-holder terminal blocks so the blades will fall open, with the hinge at the bottom if blocks are mounted vertically (horizontal rail).

B. Connect switch and fuse-holder terminal blocks so the blade is de-energized; i.e., with voltage on the non-hinged side and load on the hinged side.

C. Install DIN rails with empty space for one future block for each ten installed, except that no rail shall have fewer than four empty spaces for the largest block used.

D. Attach DIN rails each 15 cm (6”).

E. Other devices such as relays, surge protectors, power terminals, and interface modules may occupy the same rail as terminal blocks.

END OF SECTION

SECTION 26 28 13

LOW VOLTAGE FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Fuse blocks and holders.

1.02 SUBMITTALS

A. Catalog cuts.

B. Time-current characteristic curves.

C. Current limitation curves.

D. Operating temperature characteristics.

E. Submit only for the types of fuses, blocks, and holders required by the Drawings.

1.03 EXTRA MATERIALS

A. Section 26 00 60 – Extra Materials for Electrical Systems

PART 2 PRODUCTS

2.01 CURRENT LIMITING, DUAL-ELEMENT, TIME DELAY FUSES

A. Time Delay: 10 seconds minimum at 5 times rated current.

B. Note Well: Overload portion of dual element shall open at a temperature not greater than 300 degrees F.

C. Interrupting Rating at rated voltage: 300,000A RMS symmetrical.

D. UL Class RK-5.

E. 250VAC: Bussmann Fusetron FRN-RK_SP or Engineer reviewed equivalent.
600VAC: Bussmann Fusetron FRS-RK_SP or Engineer reviewed equivalent.

2.02 FAST CURRENT LIMITING, DUAL-ELEMENT, TIME DELAY FUSES

A. Time Delay: 10 seconds minimum at 5 times rated current.

B. Note Well: Overload portion of dual element shall open at a temperature not greater than 300 degrees F.

C. Interrupting Rating: 300,000A RMS symmetrical.

D. UL Class RK-1.

E. 250VAC: Bussmann Low Peak LPN-RK or Engineer reviewed equivalent.
600VAC: Bussmann Low Peak LPS-RK or Engineer reviewed equivalent.

2.03 HIGH AMPACITY, FAST CURRENT LIMITING, TIME DELAY FUSES

A. Open at 150 percent of rated current within 4 hours.

B. Time Delay: 4 seconds minimum of 5 times rated current.

C. Interrupting Rating: 300,000A RMS symmetrical.

D. U.L. Class L.

E. 600 VAC: Bussmann Low-Peak KRP-C or Engineer reviewed equivalent.

2.04 CONTROL TRANSFORMER PRIMARY AND INSTRUMENT FUSES

A. Open at 135 percent of rated current within 1 hour.

B. Time Delay: 4 seconds minimum at 3 times rated current.

C. Interrupting Rating: 200,000A RMS symmetrical.

D. UL Class CC, with rejection feature.

E. 600 VAC: Bussmann CC-Tron FNQ-R or Engineer reviewed equivalent.

2.05 SMALL DIMENSION CONTROL CIRCUIT FUSES

A. Bussmann AGC, ABC, MDL, MDQ, MDX, or Engineer reviewed equivalent, to match current and voltage of circuit. Use dual-element fuses unless recommended otherwise by equipment manufacturer or shown as fast acting on the Drawings.

2.06 REJECTION FUSE BLOCKS FOR 2.01 AND 2.02 FUSES

A. Base: Phenolic.

B. Box terminals.

C. Bussmann Class R Phenolic or Engineer reviewed equivalent.

2.07 REJECTION FUSE BLOCKS FOR 2.04

A. Base: Phenolic.

B. Copper alloy box terminals.

C. Bussmann BC603-1B, BC603-2B, BC603-3B, or Engineer reviewed equivalent.

2.08 REJECTION FUSE HOLDERS FOR 2.04

A. Body: Phenolic, with mounting holes for bolting to panel, and screw knob.

B. Combination 1/4 inch quick connect/solder terminals.

C. Bussmann HPF-RR or Engineer reviewed equivalent.

2.09 FUSEHOLDERS FOR 2.05

A. Body: Phenolic with bayonet knob.

B. Voltage Rating: 250V

C. Maximum fuse size: 20A

D. Terminals: 1/4” right angle quick connect

E. Bussmann HTB-48I or Engineer reviewed equivalent.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 28 16.10

SWITCH RATED PLUGS AND RECEPTACLES

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Switch rated plugs.

B. Receptacles.

1.02 SUBMITTALS

A. Complete manufacturer’s catalog cuts.

PART 2 PRODUCTS

2.01 DISCONNECTING MEANS NON-CLASSIFIEDNot for use in classified areas as defined in NEC Article 500.

B. Where stainless steel is required on the drawings, provide disconnect in accordance with Para 2.03.

C. For use on motors rated ≤ 75Hp (@ 480V,3P) and non-motor loads ≤ 150A, where shown on Drawings.

D. UL 2682 Listed.

E. Ratings:
1. Voltage as shown on the Drawings.
2. For non-motor loads, provide current rating as shown on the Drawings.
3. For motor loads, provide Hp rating as shown on the Drawings.

F. Auxiliary Contacts: Provide as shown on the Drawings. If not shown on the Drawings, provide 2 auxiliary contacts.

G. Plug and receptacle must have constant pressure butt-contacts with solid silver-nickel nipples.

H. Minimum 65kA short circuit rating.

I. Plug and receptacle must incorporate an integral switching mechanism to ensure the load is broken before the plug is removed from the receptacle.

J. Housing: NEMA 4X IP66 + IP67, Poly casing.

K. Provide a poly handle with figure draw plates (2).

L. Receptacle:
1. Dead front construction.
2. Padlock lockable.
3. Cover cap.
4. Provide 70° metal angle junction box adaptor, unless shown otherwise on Drawings.

M. Temperature range: -40°F to 140°F

N. ISO 9001 certified.

O. Meltric DSN or Engineer reviewed equivalent.

2.02 DISCONNECTING MEANS CLASS I DIVISION 2

A. Suitable for Class I Division 2 Group A, B, C, D and Class 2 Division 2 Group E, F, and G as defined in NEC Article 500.

B. For use on motors rated ≤ 40Hp (@ 480V,3P) and non-motor loads ≤ 60A, where shown on Drawings.
1. Where stainless steel is required on the Drawings, provide disconnect in accordance with Para 2.03.
2. Where ampacity rating exceeds that as described above, provide disconnect in accordance with Para 2.03.

C. When installed on a motor, provide a nameplate above the disconnect which states: "NOT A LOAD BREAKING DISCONNECTING MEANS."

D. UL Listed or CSI rated for Class I Division 2 Group A, B, C, D and Class II Division 2 Group E, F, G environments.

E. Ratings:
1. Voltage as shown on the Drawings.
2. For non-motor loads, provide current rating as shown on the Drawings.
3. For motor loads, provide nameplate current rating x 1.25 at a minimum.

F. Auxiliary Contacts: 2.

G. Plug and receptacle must have constant pressure butt-contacts with solid silver-nickel nipples.

H. Plug and receptacle must incorporate an integral switching mechanism to ensure the load is broken before the plug is removed from the receptacle.

I. Housing: NEMA 4X IP66 + IP67, Poly casing.

J. Provide a poly handle with figure draw plates (2).

K. Receptacle:
1. Dead front construction.
2. Padlock lockable.
3. Cover cap.
4. Provide 70° angle junction box adaptor, unless shown otherwise on Drawings.

L. Temperature range: -40°F to 140°F

M. ISO 9001 certified.

N. Meltric DXN or Engineer reviewed equivalent.

2.03 DISCONNECTING MEANS CLASS I DIVISION 1Suitable for Class I Division 1 and 2, Group C and D as defined in NEC Article 500.

B. For use on motors rated ≤ 160Hp (@ 480V,3P) and non-motor loads ≤ 200A, where shown on Drawings.

C. When installed on a motor, provide a nameplate above the disconnect which states: "NOT A LOAD BREAKING DISCONNECTING MEANS."

D. UL Listed for Class I Group C and D environments (UL 1010).

E. Ratings:
1. Voltage as shown on the Drawings.
2. For non-motor loads, provide current rating as shown on the Drawings.
3. For motor loads, provide nameplate current rating x 1.25 at a minimum.

F. Auxiliary Contacts: Where auxiliary contacts are required on the Drawings provide the 60A, 100A, or 200A version respectively. Consult with manufacturer of contact limitations.

G. Plug and receptacle must have constant pressure butt-contacts with solid silver-nickel nipples.

H. Plug and receptacle must incorporate an integral switching mechanism to ensure the load is broken before the plug is removed from the receptacle.

I. Housing: Stainless Steel Type 316.

J. Fully submersible, when fully mated, to withstand 200psi (external pressure) and 100psi (internal pressure).

K. Plug:
1. Mechanical cord clamp strain relief on cable attached to connector when connected to a cable.
2. Conduit treaded when connected to conduit.
3. Cover cap.

L. Receptacle:
   1. Dead front construction.
   2. Padlock lockable.
   3. Cover cap.
   4. Provide factory junction, unless shown otherwise on Drawings.

M. ISO 9001 certified.

N. Vantage Technology SD Millennium Series or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 MARKING

A. Furnish engraved nameplate on each receptacle.

B. Refer to Section 26 05 53, Electrical Identification.

3.02 TYPE OF ENCLOSURE

A. Comply with requirements shown on Drawings.

B. If not shown on Drawings then:
   1. Para 2.01 in non-process and non-hazardous, unclassified process areas.
   2. Para 2.02 in Class I Division 2 areas.
   3. Para 2.03 in Class I Division 1 areas, and chemical storage rooms.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Enclosed switches.

B. May also be referred to as disconnect switches, safety switches, and/or service disconnects switches.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 ENCLOSED SWITCHES

A. Type of Enclosure: See paragraph 3.02.

B. Service Disconnect Switches: 3 pole plus neutral and ground. Other switches: 3 pole plus ground unless neutral is required by the Drawings.

C. 600 Volt unless shown otherwise on the Drawings.

D. Ampere Rating: As shown on the Drawings.

E. Heavy duty, padlockable to the off position.

F. Switch Mechanism: Positive action quick-make, quick-break, with visible blades.

G. Non-fusible: Where shown on Drawings.

H. Fusible:
1. Where shown on Drawings.
2. Fuse clips reject all except Class R current limiting fuses.

I. Provide electrical interlock kits, as shown in the Drawings, on those switches through which the control circuit wiring is routed. The kit shall have 1 NO and 1 NC contact rated 10 A resistive and 6 A inductive or 2 NO where noted. The contacts, when actuated, shall break the control circuit before the safety switch opens.

J. Switches with non-metallic NEMA 4X enclosures: Square D Class 3110 Krydon® or Engineer reviewed equivalent.

K. Switches with NEMA 1, 3R, 12, 4X SS enclosure: General Electric Type TH, Cutler-Hammer DH, Square D Class 3110, or Engineer reviewed equivalent.

L. Switches with NEMA 7, 8, or 9 enclosure: Crouse Hinds FLS, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 MARKING

A. Furnish engraved nameplate on each switch.

B. Text as shown on the Drawings, but if not shown, then:
1. Source of power to the switch, example "Fed From MCC1."
2. Name and Tag Number of equipment served, example "Influent Lift Pump 1, PMP1011."

3.02 TYPE OF ENCLOSURE

A. Comply with the matrix which is appended to this Section.

B. If not shown in matrix, comply with requirements shown on Drawings.

C. If not shown in either place, then:
1. NEMA 1 in indoor non-process areas, such as: blower rooms, electrical rooms, administration building offices and mechanical rooms.
2. NEMA 4X non-metallic in indoor process areas where there is liquid piping but no open liquid, such as a room with sludge pumps.
3. NEMA 4X SS in indoor process area where there is open liquid, such as a membrane basin.
4. NEMA 3R outdoors in areas more than 100 feet from a primary/secondary process structure. This includes structures containing raw or partially treated sewage but not a UV disinfection structure.
5. Stainless steel NEMA 4X in all other indoor and outdoor areas, including but not limited to areas less than 100 feet from a primary/secondary process structure.
6. Regardless of any/all other requirements above: NEMA 7 in classified (hazardous) areas, whether indoors or outdoors.

END OF SECTION

SECTION 31 10 00

REMOVALS

PART 1 GENERAL

1.01 WORK INCLUDED

A. This work includes the removal and disposal of all obstructions, materials, and resultant debris required for the completion of construction.

1.02 REFERENCES

A. Manual on Uniform Traffic Control Devices (MUTCD).

1.03 QUALITY ASSURANCE

A. Conduct removal operations to prevent damage to adjacent property, buildings, and other facilities.

B. Any damage to adjacent property or facilities shall be promptly repaired at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 EXPLOSIVES

A. The use of explosives for removals is prohibited.

PART 3 EXECUTION

3.01 REMOVAL

A. Remove all items shown on Drawings to be removed.

B. Contractor shall not remove any other items without approval from Engineer.

C. Excavation created during removal operations shall be barricaded in accordance with MUTCD.

D. Contractor shall perform miscellaneous excavating, backfilling, and reshaping of slopes as required.

3.02 DISPOSAL

A. Contractor shall haul and dispose of all debris, rubbish, broken concrete, broken asphaltic concrete, rocks, and other material removed.

B. Disposal: In accordance with applicable State and Federal Regulations.

C. Burning of debris and rubbish will not be permitted on the project site.

END OF SECTION

SECTION 31 23 00

EXCAVATION, BACKFILL, AND COMPACTION FOR STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes furnishing labor, equipment, and incidentals necessary for excavation, backfill, and compaction for structures.

1.02 REFERENCES

A. ASTM C131 - Resistance to Degradation of Small Size Coarse Aggregates.

B. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.

C. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

D. ASTM D1557 - Standard Test Method for Moisture Density Relations of Soil and Soil-Aggregate Mixtures Using 10-16 rammer and 18-inch drop.

E. ASTM D4253 - Standard Test Method for Maximum Index Density of Soils Using a Vibratory Table.

1.03 EXISTING CONDITIONS

A. These specifications are prepared using the information contained in the geotechnical report prepared for this project by Geo-Test dated December 31, 2014.

1.04 JOB CONDITIONS

A. Use all means necessary, such as moistening of surfaces to prevent the spread of dust and creating a nuisance for adjacent areas.

1.05 SUBMITTALS

A. Laboratory Test Results for Select Fill, Ordinary Fill, and Pea Gravel:
   1. Moisture-density relationships (ASTM D698)
   2. Gradation (ASTM C136, ASTM 422)
   3. Liquid limit, plastic limit, plastic index (ASTM D4318)

1.06 QUALITY ASSURANCE

A. Unless otherwise noted, all compaction will be to a density of not less than 95 percent of ASTM D698 maximum dry density. The moisture content of the soil at the time of compaction shall be within two percent of the optimum moisture content.

PART 2 PRODUCTS

2.01 BACKFILL

A. All structural fill shall meet the requirements for structural fill as outlined in section 2.02 of these specifications. All structural fill shall be non expansive and shall meet the specifications for structural fill outlined in the geotechnical report.

2.02 STRUCTURAL FILL

A. Structural fill shall meet the following requirements as determined in accordance with ASTM D-422:

Sieve Size (Square Openings)	Percent Passing by Weight
4 inch	100
No. 4	35 - 100
No. 200	20-70

1. The structural fill material shall be free from roots, grass, other vegetable matter, clay lumps, rocks larger than 3 inches in any dimension, or other deleterious. Structural fill shall not have a plasticity index greater than 20.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to beginning work, carefully inspect the entire site. The drawings do not purport to show all objects existing on the site. Verify with the Owner all objects to be removed and all objects to be preserved.

B. Locate all active utility lines transversing the site, designate them and determine the requirements for their protection.

C. Compaction: All fill shall be spread in layers not exceeding 8 inches, watered as necessary and compacted. Moisture content at the time of compaction shall be within two percent of the optimum moisture content. Compaction of the fill shall be accomplished by mechanical means only to obtain a density of not less than 95 percent of maximum dry density for the building pad, slabs and other structural areas. Optimum moisture content and maximum dry density for each soil type used shall be determined in accordance with ASTM D-698. Where vibratory compaction

equipment is used, it shall be the contractor's responsibility to insure that the vibrations do not damage nearby buildings or other adjacent property.

D. Weather Limitations: Controlled fill shall not be constructed when the atmospheric temperature is below 35 degrees F. When the temperature falls below 35 degrees, it shall be the responsibility of the contractor to protect all areas of completed surface against any detrimental effects of ground freezing by methods approved by the Engineer. Any areas that are damaged by freezing shall be reconditioned, reshaped and compacted by the contractor in conformance with the requirements of this specification without additional cost to the owner.

E. Testing and field density tests shall be performed by an independent testing laboratory. The cost for testing and re-testing shall be borne by the contractor.

3.02 FOUNDATIONS

A. Footings and on grade concrete slabs shall be placed on properly densified native soils or compacted structural fill as required above. The fill shall extend laterally from edge of footing a distance equal to the depth of the structural fill beneath the footings.

B. Non-expansive and select fill shall be placed in eight inch lifts and compacted to not less than 95 percent of maximum dry density (ASTM D-698).

C. Prior to placement of fill, exposed subgrade shall be scarified to a minimum depth of eight inches, moistened or aerated to be at or above optimum, and compacted to not less than 95 percent of maximum dry density (ASTM D-698).

3.03 FINISH GRADING

A. Grading shall be generally smooth to slopes indicated by the drawings and well compacted.

3.04 FIELD QUALITY CONTROL

A. Provide access to site for Owner's testing laboratory personnel.

END OF SECTION

SECTION 31 23 23.33

FLOWABLE FILL BACKFILL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Trench Backfilling

B. Bedding of Buried Pipes

1.02 SUBMITTALS

A. Flowable fill mix design.

B. Testing laboratory results on mix design to demonstrate compliance with specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bedding Materials: Refer to Section 31 23 33

B. Backfill Material - Flowable Fill:
1. Backfill materials are those materials placed in the trench between the bedding material and the top of the trench.

C. Materials Not Allowed: Refer to Section 31 23 33

2.02 CONCRETE MIX - BACKFILL MATERIAL (Lean Backfill, Digable Material For Filling Excavations)

A. Comply with ASTM C94, and ASTM C150, Portland Type I-II, low alkali.

B. Portland Cement Content: Quantity sufficient to meet specified compressive strength range.

C. Compressive Strength:
1. Compressive strength requirement shall be fully achieved in time indicated.
2. Compressive Strength at 28 days: 35 psi minimum, 60 psi maximum when sampled and tested as specified in Part 3.
3. Concrete shall not exceed maximum compressive strength because it shall be capable of being excavated with a backhoe tractor without any problems.
4. Concrete that does not meet the specified strength in the specified time is not acceptable regardless of what strength it may later demonstrate, and at the

Engineer's sole discretion:

a. Shall be removed and replaced at the Contractor's sole expense, or
b. May be allowed to remain as part of the project, but the Contractor will not be paid for the total in-place cost of the concrete.

D. Admixtures:

1. Batching method and time of introduction shall be in accordance with the manufacturer's recommendations for compliance with this specification.
2. Use of a water reducing admixture is optional.
3. Calcium chloride shall not be used.
4. Air Entraining Admixture: ASTM C260, 2 to 5 percent air.

E. Combined Aggregate Gradation:

SCREEN SIZE	% PASSING
1 in.	100
¾ in.	95-100
3/8 in.	82-100
no. 4	70-100
no. 8	55-85
no. 16	38-60
no. 50	6-30
no. 100	2-10

F. Slump: 5 inches to 8 inches

G. Fly Ash: Class "C" or "F" fly ash as specified in ASTM C618 may be proportioned in the cementitious material as required to improve pumpability.

2.03 CONCRETE MIX – BACKFILL MATERIAL (Cement Slurry Mix For Filling Voids)

A. Comply with ASTM C94, and ASTM C150, Portland Type I-II, low alkali.

B. Cementitious Material Content: 141 to 235 lbs./cu. yd.

C. Compressive Strength:

1. Compressive strength requirement shall be fully achieved in time indicated.
2. Compressive Strength at 28 Days: 50 psi minimum, 150 psi maximum when sampled and tested as specified in Part 3.
3. Concrete that does not meet the specified strength in the specified time is not acceptable regardless of what strength it may later demonstrate, and at the Engineer's sole discretion:
   a. Shall be removed and replaced at the Contractor's sole expense, or
   b. May be allowed to remain as part of the project, but the Contractor will not be paid for the total in-place cost of the concrete.

D. Admixtures:
   1. Batching method and time of introduction shall be in accordance with the manufacturer's recommendations for compliance with this specification.
   2. Use of a water reducing admixture is optional.
   3. Calcium chloride shall not be used.
   4. Air Entraining Admixture: ASTM C260, 8 to 30 percent air.

E. Combined Aggregate Gradation:

SCREEN SIZE	% PASSING
3/8 in.	100
no. 4	90-99
no. 8	60-95
no. 16	45-80
no. 50	10-40
no. 100	5-45

F. Fly Ash: Class "C" or "F" fly ash as specified in ASTM C618 may be proportioned in the cementitious material up to 150 lbs./cu.yd. to improve pumpability.

PART 3 EXECUTION

3.01 INSPECTION

A. Refer to Section 31 23 33 – Trenching and Backfilling

3.02 BATCHING, MIXING AND DELIVERY

A. Ready-Mixed Concrete: ASTM C 94.

B. Field Batched Concrete: ASTM C 685.

C. Delivery Ticket: Deliver to Owner's Field Representative prior to unloading at site.
   1. Name of flowable fill supplier.
   2. Delivery ticket number.
   3. Date of delivery.
   4. Name of Contractor.
   5. Name or location of project.
   6. Design mix number.
   7. Volume of flowable fill in load.
   8. Time loaded.
   9. Batched weight of cement, fly ash, fine aggregate, coarse aggregate.
   10. Batched weight or volume of admixtures and water.
   11. Reading of mixer drum revolution counter at start of mixing.
   12. Certification that materials delivered are same brand, type and source as those defined in the design mix authorized by the Engineer.

13. Target proportions of the design mix.
14. Weight or volume of water added at the job site.
15. Signature and name of person who authorized addition of water after leaving the batch plant, and affiliation to the project.

3.03 PLACING

A. Secure utility pipe from movement and flotation.

B. Place flowable fill uniformly without voids or segregation.

C. Place flowable fill in lifts not exceeding 4 feet in height. Do not place over previous lift until previous lift has been placed for at least 2 hours.

D. Do not place flowable fill on frozen material, in standing water, or during rain. Protect flowable fill from flooding or disturbance for at least 24 hours after placement.

E. Place flowable fill only when ambient temperature is at least 35oF and rising. When ambient temperature at the time of placement is less than 40oF, the temperature of the flowable fill placed shall not be less than 50oF.

3.04 APPLICATION OF LOAD

A. Do not place any load on flowable fill until it exceeds a penetration resistance of 12 psi.
1. Penetration resistance will be considered acceptable if a person weighing at least 150 pounds, by using his body weight as an axial load on a 3.5” x 3.5” wooden block, cannot penetrate the material more than 1 inch.

3.05 FIELD QUALITY CONTROL

A. Field quality control is required to insure compliance with the project requirements. All portions of the field quality control sampling and testing shall be performed by the testing laboratory selected by the Contractor and accepted by the Engineer.

B. Field quality control testing shall include but not be limited to the following:
1. Sampling: ASTM C 172.
2. Test Sample:
    a. Frequency: One for each 150 CY or each day’s placement, whichever is greater.
    b. Field Tests:
        1) Slump: ASTM C 143.
        2) Air Content: ASTM C 231.
        3) Unit Weight: ASTM C 138.
        4) Temperature
    c. Compression Tests:

1) Sample: Do not use material from the field tests.
2) Molds: 4-inch diameter x 4.5-inch high, free-draining at base, ASTM D 558.
3) Initial Field Curing: 24 +/- 4 hours in mold, ASTM C 31.
4) Laboratory Curing: After initial curing, extrude from mold and cure in laboratory per ASTM C 192, do not cure in curing tank.
5) Number of Specimens: Four (4); test 1 at one (1) day, 1 at seven (7) days, and 2 at twenty eight (28) days.
6) Compression Testing: ASTM D 1633.

3. Reporting:
   a. Written report to Engineer within four (4) days of completion of a test.
   b. Non-complying Test Results: Notify Engineer within one (1) working day after completion of a test.

3.06 SCHEDULE

A. Backfill with lean backfill and cement slurry mix where indicated on Drawings.

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Trenching, Backfilling, and Compacting for Buried Pipes and Manholes

B. Bedding of Buried Pipes

1.02 REFERENCES

A. AASHTO T-180, Test for Moisture-Density Relationships of Soils Using a 4.54-kg (10-lb.) Rammer and a 457-mm (18-in.) Drop (Modified Proctor).

B. ASTM C12, Installing Vitrified Clay Pipe Lines

C. ASTM D2774, Underground Installation of Thermoplastic Pressure Piping

D. ASTM D2321, Underground Installation of Flexible Thermoplastic Sewer Pipe

E. ANSI/AWWA C150/A21.50, Thickness Design of Ductile-Iron Pipe

F. ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

G. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances

H. ANSI/AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fitting for Water

I. OSHA Regulations, 29 CFR 1926 Subpart P – Excavations

1.03 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples:
   1. Testing laboratory results on bedding materials to demonstrate compliance with specifications.
   2. Product data for identification tape, marker posts, and tracer wire.

1.04 JOB CONDITIONS

A. All trenching is unclassified.

B. Protect adjacent structures and surrounding areas.

C. Work to remain within available easements.

D. Weather:
1. No backfill placement during freezing weather.
2. No frozen materials, ice, or snow in backfill or fill.
3. No backfill or fill on frozen surfaces.

1.05 REGULATORY REQUIREMENTS

A. Comply with OSHA Standard 29 CFR Part 1926, Subpart P – Excavations, during all excavation, trenching, and shoring operations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bedding Materials:
1. Bedding materials are those materials located a maximum of 8 inches below bottom of pipe to bottom or spring line of pipe, depending on bedding class or condition required.
2. Material shall be granular and free flowing:
   a. Maximum particle or clump size:
      1) Plastic Pipe 8" Diameter and Smaller: 0.25 inches
      2) All other Pipe: 0.75 inches
   b. Portion Passing No. 200 Sieve: 50% maximum
   c. Free from refuse, organic material and frozen soils.
3. Materials require prior written approval.
4. Concrete: Division 03

B. Initial Backfill Materials:
1. Initial backfill material is that material placed above the bedding material, around and over the pipe to 12 inches over the top of the pipe.
2. Material to be defined and required by applicable ASTM standard for installation for bedding class or type required or scheduled.
3. In no case shall initial backfill material contain particles or clumps with any dimension greater than:
   a. Plastic Pipe 8" Diameter and Smaller: 0.25 inches
   b. All Other Pipe: 0.75 inches
4. If not otherwise defined, same as bedding material.

C. Backfill Materials:
1. Backfill materials are those materials placed in the trench between the initial backfill material and the top of the trench.
2. Material to be as defined and required by applicable ASTM standard for installation for bedding class or type required or scheduled.

3. Backfill shall have no particles or clumps having a dimension larger than 6 inches within 3 feet of the top of the pipe.

D. Materials Not Allowed:
1. All pipe bedding, initial backfill, and backfill material shall be clean and free of roots, vegetable or organic material, frozen material, mine tailings, or any contaminants that could endanger public health.

E. Identification Tape:
1. Identification tape shall consist of high visibility, color coded inert polyethylene tape that is impervious to all known alkalis, acids, chemical reagents and solvents found in the soil.
2. The tape shall have the following properties:
   a. Minimum overall thickness: ASTM D 1593: Plain, 4.0 mils; detectable, 4.5 mils.
   b. Minimum tensile strength (longitudinal): ASTM D 638: Plain, 1500 psi; detectable, 4,544 psi.
   c. Maximum imprint length: 36 inches
   d. Detectable Tape Metallic Foil Stripes: Permanently laminated to the polyethylene tape so that tape may be more readily located using a metal detector. Refer to Part 3 for application of use. Width: 3 inches.
3. Tape to meet the APWA Uniform Color Code for utilities.
4. Imprinted message, "Caution Buried Utility Line Below", printed with black letters on APWA approved colors.
5. Acceptable Manufacturers:
   a. Seton Identification Products, Branford, CT or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSPECTION

A. Field verify location of underground utilities and obstructions.

3.02 CLEARING AND GRUBBING

A. General: Clear and grub all areas within the construction limits that will be disturbed by trenching or stockpiling.

B. Clearing: Remove and dispose of trees and other vegetation, downed timber, snags, brush, and rubbish within areas to be cleared.

C. Grubbing: Remove stumps, matted roots, and roots larger than 2 inches in diameter from areas to be excavated and from within 6 inches of surface of areas to receive stockpiled material. Do not allow grubbed material to mix with trench backfill.

D. Disposal: Properly dispose of all waste material in accordance with Section 01 74 20 – Fill and Waste Material.

3.03 DEWATERING

A. Provide and maintain adequate dewatering equipment to remove and dispose of surface and groundwater entering excavations, trenches, and other parts of the Work.

B. Keep excavation dry during subgrade preparation and continuously thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

C. Dewater excavations which extend to or below groundwater by lowering and keeping the groundwater level beneath such excavation at least 12” below the bottom of the excavation.

D. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property.

E. Contractor is responsible for the condition of any pipe or conduit he uses for drainage; all drainage pipes, ditches, etc. shall be left clean and free of sediment.

3.04 BLASTING

A. Blasting is not allowed.

3.05 SHEETING

A. If used, cut off at top of pipe and leave in place unless removal is specifically reviewed by Engineer.

3.06 STABILIZATION

A. Thoroughly compact and consolidate trench bottoms so they remain firm, dense, and intact during required construction activities.

B. Remove all mud and muck during excavation.

C. Reinforce trench bottom with crushed rock or gravel if it becomes mucky during construction activities.

D. Allow no more than ½-inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon.

E. Where trench bottoms-out in rock, rock is to be removed to 8 inches below bottom of pipe and replaced with bedding material.

3.07 TRENCH EXCAVATION

A. Slope, bench, or support all trenches in conformance with OSHA Excavation Regulations, and follow all specified safety requirements.

B. Do not open more trench in advance of pipe laying than is necessary to expedite the Work; not more than 400', unless otherwise authorized by Engineer.

C. Except where jacking and boring is indicated on the Drawings, specified or permitted by Engineer, excavate trenches by open cut from the surface.

D. Alignment, Grade, and Minimum Cover:
   1. Establish alignment and grade or elevation from offset stakes.
   2. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the Drawings.
   3. Comply with pipe specification sections regarding vertical and horizontal alignment and max joint deflection.
   4. Water lines to have minimum bury as shown on the Drawings, and in general, grade shall follow surface contours unless otherwise shown on the Drawings.

E. Limiting Trench Widths:
   1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, embedment.
   2. If needed to reduce earth loads to prevent sloughing cut banks back on slopes which extend not lower than 1' above the top of the pipe.
   3. Trench widths and minimum clearances between installed pipe and trench wall:

Pipe Size	Minimum Trench Width	Minimum Clearance	Maximum Trench Width at Top of Pipe
18" or less	O.D. plus 16"	8"	O.D. plus 24"
Larger than 18"	O.D. plus 24"	12"	O.D. plus 24"

F. Mechanical Excavation:
   1. Do not use where its operation would damage trees, buildings, culverts, or other existing property, structures, or utilities above or below ground; hand-excavate only in such areas.
   2. Use mechanical equipment of a type, design, and construction and operated so that:
      a. Rough trench bottom elevation can be controlled.
      b. Uniform trench widths and vertical sidewalls are obtained from 1' above the top of the installed pipe to the bottom of the trench.
      c. Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench sidewalls.
      d. Do not undercut trench sidewalls.

G. Cuts in Existing Paved Surfaces:
   1. Applies to streets, sidewalks, curbs, driveways, and other existing paved surfaces.
   2. No larger than necessary to provide adequate working space.
   3. Cut a clean groove not less than 1-1/2" deep along each side of trench or around perimeter of excavation area.
   4. Remove pavement and base pavement to provide shoulder not less than 6" wide between cut edge and top edge of trench.
   5. Do not undercut trenches, resulting in bottom trench width greater than top widths.
   6. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation.
   7. Where the trench crosses existing paved surfaces, remove and replace the paved surface between saw cuts as specified for pavement.

H. Excavation Below Pipe:
   1. Except as otherwise required, excavate trenches below the underside of pipes as indicated on the Drawings to allow placement of granular pipe bedding material.
   2. Where excavating in earth for 6-inch and smaller pipe, Contractor has the following options for excavating trench bottoms:
      a. Excavate below pipe subgrade and place granular embedment.
      b. Grade trench bottom to provide uniform and continuous support between bell holes or end joints.

I. Excavation for Bell Holes:
   1. Excavate to provide adequate clearance for tools and methods of pipe installation.
   2. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined.

J. Excavated Material: Place stockpiled excavated materials in a manner that will not obstruct work or endanger personnel or the public.
   1. Excavated materials shall not obstruct sidewalks or driveways for extended periods of time.
   2. Excavated materials shall not obstruct hydrants, valve pit covers, valve boxes, or other utility controls.
   3. Excavated materials shall not obstruct gutters, unless other temporary provisions have been made for street drainage.
   4. Excavated materials shall not obstruct natural drainage ways.

K. Surplus Excavated Material: Excavated material in excess of that needed to backfill to the limits indicated in the Contract Documents shall be properly disposed off-site in compliance with regulatory requirements at no additional cost to the Owner.

3.08 PIPE BEDDING

A. Class D per ASTM C12

B. Class C per ASTM C12

C. Class B per ASTM C12

D. Crushed Stone Encasement per ASTM C12

E. Class A-I: ASTM C12 Class A-1 using plain concrete.

F. Class A-II: ASTM C12 Class A-1 using reinforced concrete; No. 4 A-36 steel reinforcing bars parallel to pipe with steel area not less than 0.4% of the area of concrete above top of pipe.

G. Class A-III: ASTM C12 reinforced concrete encasement; 3000 psi concrete; No. 4 A-36 steel reinforcing bars; reinforcing parallel to pipe with steel area not less than 0.4% of the area of concrete above and below pipe; reinforcing bars wrapped around parallel bars at 36" maximum spacing.

H. Bedding class or type as scheduled.

I. Carefully place bedding in accordance with ASTM C12 to provide uniform and continuous support to pipe barrel, except at bell holes in all cases. No bridging will be allowed.

3.09 MANHOLE SUBGRADE

A. Subgrade Material: Use same bedding class as specified for adjacent pipe bedding.

B. Compaction: 90 percent AASHTO T-180.

3.10 TRENCH BACKFILL

A. Material as defined by applicable reference for installation for type of pipe used.

B. Bedding, Initial Backfill, and Backfill: If native materials cannot meet the requirements of Part 2 specified herein or if the specified field compaction cannot be obtained, Contractor shall import suitable material at no additional cost to the Owner.

C. Bedding: Carefully "shovel-slice" or tamp bedding so that the material fills and supports the haunch area under the pipe without voids.

D. Initial Backfill: Place in layers that do not exceed 8 inches in height of backfill material in its uncompacted state.

E. Backfill: Place in layers heights suitable to enable the Contractor to achieve the specified compaction throughout the full depth of backfill using Contractor's selected means and methods and without damaging the pipe.

F. All Areas:
1. 90 percent AASHTO T-180 compaction.
2. Top 12" below subgrade, 95 percent AASHTO T-180 compaction.

G. Water Settled Backfill: Use only where permitted by Engineer:
1. Where permitted, apply to obtain effective settlement with a minimum of water.
2. Do not permit trench to overflow.
3. Do not settle by water puddling until after trench has been backfilled to ground surface.
4. Introduce water above the pipe embedment through a long pipe nozzle so disturbance of granular embedment or compacted material is held to an absolute minimum.
5. Add backfill material to compensate for settlement below surface grade and settled during puddling operations.

H. Install identification tape in backfill 24 inches directly above top of all buried pipe, unless otherwise scheduled or shown on Drawings. Use tape with metallic foil stripes for all non-metallic pipes.

I. Upper 18 inches of trench shall contain no particles larger than 6 inches in any dimension.

J. Surface Finish:
1. For placement of paving or gravel surfacing, subgrade where applicable.
2. Match existing and surrounding contours.
3. Graded finished appearance.

3.11 FIELD QUALITY CONTROL

A. Provide access to site for Owner's testing laboratory personnel.

3.12 PIPE BEDDING SCHEDULES

A. Ductile Iron Pipe:

1. Minimum Bedding Class:

Pipe Diameter	Trench Depth To Top of Pipe	Bedding Class
14" or less	5' or less	D
	5' – 12'	C
	More than 12'	B
Larger than 14"	12' or less	C
	More than 12'	B

END OF SECTION

SECTION 40 27 00

PROCESS PIPE SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipes, materials, and appurtenances for all buried and exposed lift station, pump station, and force main piping and similar facilities.

B. Installation of necessary valves and accessories.

C. Pipe anchors and supports.

D. Pipe insulation.

1.02 GENERAL REQUIREMENTS

A. Pipes, Fittings, and Materials to be New.

B. Use Appropriate Equipment Methods for Unloading, Reloading, and Handling the Pipe.

C. Pipe, Fittings, and Appurtenances of the Same Type: Made by the same manufacturer.

D. Provide Labor, Equipment and Materials for Field Pipe Testing.

E. All interior valves to have flange connections except where otherwise indicated.

1.03 QUALITY ASSURANCE

A. Ductile Iron Pipe and Fittings:
   1. Tests:
      a. ASTM E8: Tension Testing of Metallic Materials.
      b. ASTM E23: Impact Test.
   2. Marking: Cast on each pipe length.
   3. Weight, class, nominal thickness, and casting period.
   4. Manufacturer's name, year of production, and letters "DI" or "Ductile Iron".

B. PVC Pipe and Fittings:
   1. Tests: ASTM D3034, ANSI/AWWA C900, ASTM D 1784, and ASTM D 1785, as applicable.
   2. Marking: Indelible, in each pipe.
      a. Nominal pipe diameter and cell classification.

b. Manufacturer's name or trade name, PVC, ASTM and SDR designation, AWWA pressure class, and date of production.
c. Service designation.

1.04 REFERENCES

A. American Society for Testing and Materials International:
1. ASTM A183 - Carbon Steel Track Bolts and Nuts.
2. ASTM A307 - Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
3. ASTM A536 – Ductile Iron Castings.
4. ASTM B633 – Electrodeposited Coatings of Zinc on Iron and Steel.
5. ASTM C335 – Steady-State Heat Transfer Properties of Pipe Insulation.
6. ASTM C356 - Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
7. ASTM C411 - Hot-Surface Performance of High-Temperature Thermal Insulation.
8. ASTM C547 – Mineral Fiber Pipe Insulation.
9. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
10. ASTM C585 - Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
11. ASTM D1784 - Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
12. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
13. ASTM D2241 - Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
14. ASTM D2464 - Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
15. ASTM D2466 – Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
16. ASTM D2467 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
17. ASTM D2564 – Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
18. ASTM D2672 - Joints for IPS PVC Pipe Using Solvent Cement.
19. ASTM D3139 - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
20. ASTM E8 – Tension Testing of Metallic Materials.
21. ASTM E23 - Notched Bar Impact Testing of Metallic Materials.
22. ASTM E84 - Surface Burning Characteristics of Building Materials.
23. ASTM F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association:
1. ANSI/AWWA C104/A21.4 – Cement Mortar Lining for Ductile-Iron Pipe and Fittings.
2. ANSI/AWWA C105/A21.5 – Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. ANSI/AWWA C110/A21.10 – Ductile-Iron and Gray-Iron Fittings.
4. ANSI/AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. ANSI/AWWA C115/A21.15 – Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
6. ANSI/AWWA C116/A21.16 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fitrtings.
7. ANSI/AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast.
8. ANSI/AWWA C153/A21.53 – Ductile-Iron Compact Fittings.
9. AWWA C200 – Steel Water Pipe-6 In. (150 mm) and Larger.
10. AWWA C203 – Coal-Tar Protective Coatings and Linings for Steel Water Pipe.
11. AWWA C207 – Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
12. ANSI/AWWA C208 – Dimensions for Fabricated Steel Water Pipe Fittings.
13. ANSI/AWWA C213 – Fusion-Bonded Epoxy Coating for the Interior of Steel Water Pipelines.
14. ANSI/AWWA C219 – Bolted, Sleeve-Type Couplings for Plain-End Pipe.
15. ANSI/AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
16. ANSI/AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
17. ANSI/AWWA C606 – Grooved and Shouldered Joints.
18. ANSI/AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
19. ANSI/AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm).

1.05 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples:

B. Product Data for pipe materials and appurtenances.

C. Manufacturer’s installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS AND FABRICATION

A. Ductile Iron:
1. Pipe:
   a. ANSI/AWWA C151/A21.51: ASTM A536, Grade 60-42-10.
   b. Thickness: Pressure Class 350 for pipes 12” diameter or smaller; Pressure Class 250 for pipes 14” diameter or larger unless otherwise scheduled.

2. Fittings: Cast from ductile iron: ANSI/AWWA C110/A21.10 full body or ANSI/AWWA C153/A21.53 short body.
3. Joints: ANSI/AWWA C111/A21.11:
    a. Mechanical Joint: 350 psi working pressure.
    b. Flange: Also ANSI/AWWA C115/A21.15 and ANSI/ASME B16.42, ductile iron; 150 lb. pattern, unless scheduled otherwise.
    c. Bolts, Tie Bolts, and Nuts:
        1) Low carbon steel, ASTM A307.
        2) Bolts smaller than ¾-inch: With heavy hex heads for flange and T-head for MJ, and heavy hex nuts.
        3) Bolts ¾-inch and larger: With hex heads for flange and T-heads for MJ, and heavy hex nuts.
        4) Coating, Exposed Service: Grade B zinc coat per ASTM A153.
        5) Coating, Buried Service: Liquid applied fluoropolymer coating matrix consisting of lubricating compounds, UV stabilizers and coloring agents or pigments, heat cured, 0.7 to 1.0 mil total DFT.
    d. Gaskets for mechanical joints, push-on and flanged joints:
        1) Conformance: ANSI/AWWA C111/A21.11.
        2) Material: Synthetic rubber as specified in referenced standard. Natural or reclaimed rubber not acceptable.
        3) High Temperature Air Service Piping: Viton rubber rated for 350 degrees F.
    e. Lubricant: In conformance with ANSI/AWWA C111/A21.11.
4. Joint Restraint: Furnish external mechanical restraint devices, including restrained flange adaptors for exposed piping as specified herein, or integral joint restraints for buried joints if specified herein. Furnish restraint devices where scheduled or noted on Drawings, as specified in Part 2 of this Specification.
5. Tapping Saddles:
    a. Ductile iron with galvanized steel straps and rubber sealing gasket.
    b. Pressure rating: 250 psi.
6. Thickness: Pressure Class 350 for pipes 4-12” and Pressure Class 250 for pipes ≥ 14” unless otherwise scheduled.
7. Corrosion Protection:
    a. Outside Coating (buried or submerged service):
        1) Pipe: Bituminous per ANSI/AWWA C151/A21.51.
        2) Fittings: Bituminous per ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53 or fusion-bonded epoxy per ANSI/AWWA C116/A21.16.
    b. Outside Coating, Exposed Service (not submerged): Prepare surface with SSPC-SP6-commercial blast cleaning and shop coat with rust inhibiting modified alkyd shop primer equivalent to Tnemec Series 4 Versare Primer or Sherwin-Williams Kem Kromik Universal Metal Primer. Field coat in accordance with Section 09 97 01 – Industrial Coatings, Service Conditions F8, unless scheduled otherwise.

c. Inside Coating, Process Liquid Service: Cement mortar lining with bituminous seal coat, ANSI/AWWA C104/A21.4, unless scheduled otherwise.

B. Polyvinyl Chloride (PVC):
1. Pipe and fittings:
a. Pipe sizes 3.5-inch and smaller:
1) If scheduled or shown on the Drawings:
a) Schedule 40 and 80 Pipe Dimensions and Workmanship: ASTM D1785.
b) Schedule 40 minimum unless otherwise scheduled or shown on Drawings.
c) Material: ASTM D 1784, Class 12454-B.
d) Fittings:
i. ASTM D 2464, Schedule 80, threaded.
ii. ASTM D 2467, Schedule 80, socket type.
2. Joints:
a. Solvent Cement: ASTM D2564 only where specifically allowed by Engineer, schedules or Drawings.
b. Solvent Cement Bell End: ASTM D2672.

C. External Mechanical Restraint Devices:
1. Works on principle of multiple wedging action against pipe, which increases its resistance as line pressure increases while maintaining joint flexibility. Split follower glands behind bells are acceptable. Set screw devices are not acceptable. Split serrated restraint rings are not acceptable, except on spigot of bell restraint harness of ANSI/AWWA C900 PVC pipe. EBAA Iron Sales, Inc. or Engineer reviewed equivalent.
2. Gland: Ductile iron with dimensions which match standard mechanical joint bells per ANSI/AWWA C153/A21.53, ASTM A 536, Grade 65-45-12.
3. Wedges: Heat-treated ductile iron with minimum Brinnel hardness of 370 BHN.
4. Wedges tightened during installation via twist-off nuts.
5. Devices shall be designed for the following working pressure:
a. 250 psi for 18” to 48” DIP, 2:1 safety factor.
b. 350 psi for 3” to 16” DIP, 2:1 safety factor.
c. Meets or exceeds standardized pressure rating of host PVC piping.
6. Devices shall be designed for the type of pipe material and pipe joint being harnessed.
7. An identification number shall be cast into each gland body with the following information: Date and shift of manufacture, and plant location.
8. All physical and chemical test results shall be made available to Engineer for review upon request by referencing the identification number.

9. Coating for wedges, wedge actuators, bolts, tie bolts, nuts, and related fastener and gripping components:
    a. Surface Preparation: Cleaner wash, phosphatizing, rinse, and drying.
    b. Coating: Liquid applied fluoropolymer-matrix consisting of lubricating compounds, UV stabilizers, and coloring agents or pigments. Heat cured. Two coats, 0.7 to 1.0 mil total DFT.
    c. Low VOC, resin bonded and thermally cured, single film, dry lubricant, primarily formulated for use on fasteners.
    d. Designed to prevent corrosion and facilitate make-up torque.
    e. Provide lubricity of coating for proper dispersion of PTFE.
10. Coating for Cast Bodies:
    a. Surface Preparation: Cleaner wash, phosphatizing, rinse, and drying.
    b. Coating: Electrostatically applied TGIC polyester-based powder. Heat cured. 1.5 to 4.0 mils total DFT.
    c. Designed to prevent corrosion, impact and UV resistance.
    d. Appearance: Class 5 (orange peel) PCI smoothness standard; 75% to 85% gloss at 60 degrees per ASTM D523; pinhole free.

D. Couplings:
1. Use only where indicated on Drawings or reviewed by Engineer. Do not use where restrained fittings are specified.
2. For buried service, furnish factory applied fusion-bonded epoxy coating in accordance with ANSI/AWWA C213, and corrosion-resistant alloy bolts equivalent to Dresserloy.
3. Shall meet ANSI/AWWA C219: Described by reference to couplings manufactured by Dresser Industries, Inc., Bradford, PA; equivalent couplings by Brico Industries, Atlanta, GA or by other manufacturers may be used:
    a. Dresser Style 38 for exposed steel, cast iron, and ductile iron pipe unless indicated otherwise on Drawings or scheduled.
    b. Dresser Style 253 cast iron couplings for buried steel, cast iron, ductile iron, and asbestos cement pipe, unless indicated otherwise on Drawings.
    c. Dresser Style 40 long couplings where long couplings are indicated.
    d. Dresser Style 62 Type reducing couplings where reducing couplings are indicated.
    e. Dresser Style 162 couplings for transition between different pipe materials.
    f. Dresser Style 63 expansion coupling where expansion coupling is indicated; type as indicated on Drawings or scheduled.
    g. Dresser Style 227 and 128 coupling with flanged adaptor where indicated on Drawings.
    h. Dresser Style 131 dismantling joint.

E. Pipe Sleeves for Carrier Pipes 22-inch Diameter or Smaller:
1. Manufactured from non-metallic, non-corrosive, thermoplastic material.

2. Formed to have a water stop and anchor plate at least 4 inches larger than the main outside diameter and position, unless otherwise specified, in the middle of the sleeve body.
3. Seal shall provide electrical insulation barriers between the pipe and wall.
4. Link-Seal Century Model CS, Thunderline Corporation, or Innerlynx Model PWS.

F. Mechanical Seals:
1. Watertight, synthetic rubber seal composed of interlocking links joined by bolts, modular sealing element when sleeve is placed in slabs with one side against soil or as shown on Drawings.
2. Rubber links shall completely fill the annular space between pipe and sleeve to provide water tight seal capable of resisting a hydrostatic pressure of 20 psi.
3. Pipe Sleeve Installations: Link-Seal LS for sleeve model CS or Innerlynx Model IL-C.
4. Core Drilled Installations: Link-Seal LS or Innerlynx IL-C.

2.02 ACCESSORIES

A. Supports and Anchors:
1. Clevis Hangers: FS WW-H-171E, as appropriate or as shown on Drawings.
2. Hanger Rods: ASTM A307, Grade R.
3. Fabricated Supports: Galvanized steel with stainless steel hardware.
4. Beam Clamps: FS WW-H-171E, as appropriate or as shown on Drawings.
5. Concrete Inserts:
   a. Individual: FS WW-H-171E, as appropriate or as shown on Drawings.
   b. Continuous:
      1) Channel 12 gauge, galvanized 1-5/8” x 1-5/8”.
      2) Anchor lugs on 4” centers, 2 minimum.
6. Wall Supports and Frames: FS WW-H-171E, as appropriate or as shown on Drawings.
7. Floor Supports:
   a. 6” and smaller: FS WW-H-171E, Type 38.
   b. Larger than 6”: FS WW-H-171E, Type 36 or 39.
8. Other: As indicated on Drawings.

B. Pressure Gauges: As specified in Section 40 91 19.30 – Pressure Gauges, and as shown on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
1. Install as indicated on Drawings.

2. Trenching, Backfilling and Compacting: Section 31 23 33 – Trenching and Backfilling.
3. Pipe cutting measurement taken at site.
4. Clean all pipe, accessories, and appurtenances before use.

B. Flanged Joints:
1. Flange faces to bear uniformly on the gasket and bolts tightened in progressive crisscross order.
2. Tighten flange bolts with a properly calibrated torque wrench set at the following ranges unless otherwise agreed by the Engineer:

Flange Size	Torque Range (ft-lbs)
4" through 24"	75 – 90
30" through 36"	100 – 120
>36"	120 - 150

3. All flange bolts at each connection to be uniformly tightened to the specified range.

C. Other Joints:
1. Manufacturer's recommendations.
2. Lubricants: Vegetable soap solution.
3. Solvent cementing of PVC pipe only where scheduled.

D. Clean all lines by repeated flushings after installation.

E. Pipe Sleeves:
1. For pipes passing through concrete or masonry.
2. Install before concrete is placed where practical.
3. Use on all penetrations for line sizes 20" or smaller unless otherwise shown on Drawings or indicated on Schedule.

F. Mechanical Seals:
1. To be used with pipe sleeves and core drilled penetrations.
2. Use only where indicated on Drawings or Schedule for wall penetrations.

G. Wall Pipe:
1. Only where indicated on Drawings or scheduled, provide wall pipe with continuously welded intermediate flange for pipes passing through concrete walls.
2. Install when concrete is placed.
3. Material, thickness, ends, and size to match connecting piping.
4. Provide tapped holes where wall pipes with flanges are flush with concrete.

H. Floor Penetrations:
1. Install pipe sleeve through floor sized to provide 0.25" to 1.0" annular space around pipe and maximum of 1" projection above top of floor.
2. Pipe sleeve shall be heavy wall PVC or galvanized steel.
3. Pipe sleeve shall contain a 1" wide collar located in center of floor slab.
4. Fill annular space with watertight resilient seal: Type A urethane sealant with joint backer, as specified in the Elastomeric Sealants section.
5. Use on all penetrations unless otherwise shown on Drawings or indicated on Schedule.

I. Buried Pipe Anchorage:
1. Furnish and install anchors, joint restraint devices, or other acceptable means of preventing pipe movement at all of the following locations, whether shown on the Drawings or not:
   a. Unlugged bell and spigot or all unflanged tees.
   b. Y branches.
   c. Bends deflecting 22-1/2 degrees or more.
   d. Plugs.
   e. Fittings in fills or unstable ground.
   f. Above grade or exposed structure.

J. Valves: Installed as shown on Drawings with valve boxes and blocking.

3.02 FIELD QUALITY CONTROL

A. All pipes and fittings tested in presence and to the satisfaction of the Engineer.

B. Test Conditions:
1. Exposed Pressurized Pipes: 80 psi hydrostatic test, no visible leakage for 1 hour.
2. Buried Force Mains Except HDPE: ANSI/AWWA C600 for ductile iron pipe and ANSI/AWWA C605 for pressure rated PVC pipe, except as specified herein. Hydrostatic test at 80 psi for two-hour minimum; allowable leakage shall be less than that determined by the following formula:
   a. L = (N) (D) (P^0.5) / 133,200
   b. Where
      1) L = allowable leakage in gallons per hour.
      2) N = length of pipeline tested in feet.
      3) D = nominal diameter of pipe in inches.
      4) P = average test pressure during test, psig.

C. Procedure:
1. Disconnect fixture, equipment, and accessories which may be damaged by test pressure.
2. Plug ends as required.
3. If leakage is indicated, locate and repair leaks.

4. Retest repaired joints, piping, and fittings until system complies with above criteria for allowable leakage.

3.03 PIPE SCHEDULE

A. Exposed and Buried Piping and Fittings: Ductile Iron Pipe (DIP) and Ductile Iron Fittings.

B. Air Release Piping and Fittings: Solvent welded Schedule 80 PVC.

END OF SECTION

SECTION 40 27 02.01

PLUG VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Plug Valves, Actuators, and Accessories

1.02 REFERENCES

A. AWWA Standards as referenced in Part 2 of this Specification.

B. ANSI Standards as referenced in Part 2 of this Specification.

C. ASTM Standards as referenced in Part 2 of this Specification.

1.03 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples
   1. Product data.

B. Section 01 78 23 – Operation and Maintenance Data

C. Proof of Design in accordance with AWWA C517.

D. Pressure ratings established by hydrostatic tests: ANSI B16-1

1.04 SERVICE CONDITION

A. Raw and partially treated sewage and sewage sludge or other uses as scheduled.

1.05 ADDITIONAL REQUIREMENTS

A. All plug valves provided by same manufacturer.

B. Manufacturer's name and pressure ratings cast on body.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. DeZurik. The Contract Drawings are laid out using DeZurik valve laying lengths. If Contractor selects a different valve manufacturer, Contractor shall provide, at no additional cost to the Owner, any changes in piping required to accommodate different laying lengths.

B. Val-Matic, Cam-centric

C. Or Engineer approved equivalent.

2.02 DESIGN REQUIREMENTS

A. Drip-tight shut-off under following pressures in either direction:
   1. Sizes through 12": 175 psi

B. Materials and Construction:
   1. Valve type: Non-lubricated, eccentric.
   2. Valve body and plug: ASTM A126 Class B cast iron and AWWA C517.
   3. Resilient plug facings:
      a. Neoprene or Buna-N for sewage, sludge or water.
   4. Flanged valves: Faced and drilled to the ANSI 125/150 lb. standard.
   5. Mechanical joint ends: AWWA C111.
   6. Seats: Nickel or Stainless Steel Type 304, AWWA C517.
   7. Sleeve type bearings in upper and lower journals: Replaceable.
   8. Bearing material: Stainless steel or Teflon with Non-Metallic Backing, AWWA C517.
   9. Valve shaft seals: AWWA C517.
   10. Port areas: At least 100% of full pipe area.
   11. Exposed nuts, bolts, springs, washers: Zinc plated.

C. Valve Operators:
   1. Buried:
      a. AWWA 2" direct opening nut for 6" to 4" valves.
      b. Manufacturer's standard manual valve box actuator for 3" and smaller.
      c. Enclosed waterproof gear operator with 2" nut for 8" and larger.
      d. Furnished with stem extension, valve box, and valve position indicator.
   2. Exposed:
      a. Within 5 feet of operating floor:
         1) Wrench operated for 6" and smaller valves, unless otherwise indicated on the Drawings.
         2) Enclosed gear operator with handwheel for 8" and larger valves.
      b. Located more than 5 feet above operating floor: Enclosed gear operator equipped with chainwheel and sufficient length of chrome plated chain to reach within 4 feet of operating floor.
      c. Unless otherwise indicated on Drawings.
   3. Floor stands:
      a. Located directly over valve.
      b. Enclosed gear operator with handwheel mounted to floor stand.
   4. Enclosed Gear Operators: Traveling nut-type to produce required unseating torque at the maximum differential pressure listed at the end of this Section with not more than 80 lbs. of pull.
   5. Manual Operation: Open left (counter clock-wise).

2.03 PROTECTIVE COATINGS

A. Corrosion Protection – Exposed Valves:
   1. Manufacturer's standard shop coating.
   2. Field painting of exposed valves: Section 09 97 01 – Industrial Coatings.

B. Corrosion Protection – Buried Valves:
   1. Factory Surface Preparation (Exterior): SSPC-SP10 Near-White Blast Cleaning.
   2. Factory Coating (Exterior): Coal tar epoxy, 15-20 mils dry film thickness.

2.04 MAINTENANCE MATERIALS

A. Spare Parts: As scheduled at the end of this Section.

2.05 ASSEMBLY REQUIREMENTS FOR BURIED VALVE INSTALLATIONS

A. Valve manufacturer required to supply complete assembly, including valve, valve accessories, valve box, and integral position indicator; refer to Section 40 27 02.10 – Valve Boxes, for valve box and position indicator requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Manufacturer's recommendations.

B. In horizontal pipelines: Plug in horizontal position whenever possible with plug above flow when valve is open.

C. Seat to be located on downstream side of flow except at pumps. At pumps, seat to be located on pump side.

3.02 SCHEDULE

A. As shown on the Drawings.

END OF SECTION

SECTION 40 27 02.09

MISCELLANEOUS VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install all miscellaneous valves specified herein.

1.02 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples: Product data for all items listed in PART 2 PRODUCTS, except for hose bibbs and plug cocks.

B. Section 01 78 23 – Operation and Maintenance Data: Operation and Maintenance Manuals for all items listed in Part 2 PRODUCTS, except for hose bibbs, plug cocks, stop gates, gate valves under 4 inches, and elastomeric check valves.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Same manufacturer for each type of valve throughout where practical.

B. Manufacturer's name or initials and working pressure ratings cast on valve body.

2.02 DESIGN REQUIREMENTS

A. General: Unless otherwise indicated, use valves suitable for 125 minimum psi WOG and 150 degrees F.

B. Lead Free: All materials in contact with potable water shall be lead-free, as certified by the Water Quality Association to comply with NSF/ANSI 372, and shall be NSF 61 certified.

C. Flap Check Valves (Flap-Style Swing Check Valve with Disc Accelerator):
1. Conformance: AWWA C508.
2. Rated Working Pressure:
   a. 2" to 24": 250 psi at 150 degrees F.
   b. 30" to 36": 150 psi at 150 degrees F.
3. Body and Cover: ASTM A536 grade 65-45-12 ductile iron, full dome access cover.
4. Flanges: ANSI B16.1 Class 150.
5. Design: Full port flow area, seating surface on 45 degree angle, 35 degree disc stroke.

6. Check Mechanism: One piece, precision molded flexible elastomeric disc with alloy steel and nylon reinforcement, integral O-ring sealing surface, and leaf spring accelerator for rapid closure in high head applications.
7. Flexible Disc Material: Buna-N (NBR), ASTM D2000-BG, flexible portion warranted for 25 years.
8. Disc Accelerator: Type 302 stainless steel, field adjustable and replaceable without removal of valve from the pipe.
9. Certification:
    a. Operation: Tested by independent laboratory for 1,000,000 cycles in accordance with AWWA C508 without leakage, wear, cracking, or distortion.
    b. Headloss: Tested by independent laboratory.
10. Factory Testing: All valves hydrostatically tested in accordance with AWWA C508.
11. Accessories: Mechanical exterior position indicator with pre-wired limit switch, NEMA 4, UL rated 5 A, 125 VAC contact.
12. Coating: Fusion bonded NSF approved epoxy interior and exterior.
13. Manufacturer's Qualifications:
    a. At least five years experience in the manufacture of resilient, flexible disc check valves.
    b. ISO 9001:2000 certified.
14. Manufacturer: Val-Matic Valve & Manufacturing Co., Series #7200 Surgebuster, or Engineer reviewed equivalent.

2.03 PROTECTIVE COATING

A. Factory enamel paint unless specified otherwise.

PART 3 EXECUTION

3.01 INSTALLATION

A. Manufacturer's recommendations.

B. Per code or best trade or industry practice.

C. As indicated on Drawings.

3.02 SCHEDULE

A. As indicated on Drawings.

B. Flap Check Valves:
    1. Val-Matic Model 7206.3

END OF SECTION

SECTION 40 80 00

PLANT PROCESS CONTROL COMMISSIONING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control system commissioning.

1.02 SUBMITTALS

A. Commissioning scheme; individual test procedures.

B. Assemble completed test procedures, which have become test reports in the field, into ring binders. File in order of Tag Number. Place project information on binders. Submit three copies. The information in the reports having been field verified, this submittal will be reviewed only for completeness.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 PROCEDURE

A. Meet with the Engineer to define the broad outline for commissioning, such as the extent of the breakdown of the testing into sub-systems and systems, each system having a separate test procedure. Also discuss the order of testing for organizational purposes.

B. Submit preliminary test procedures, which list step-by-step testing for subsystems and for systems at each facility. Provide space on the procedures for checking off the completion of logical portions of the testing and for showing results thereof.

C. Submit an overall commissioning scheme for use in efficiently executing the test procedures.

D. The Engineer will review the procedures and overall scheme and prepare comments.

E. Meet with the Engineer to review comments and agree on disposition of comments during the meeting.

F. Revise procedures and overall scheme in accordance with comments and prepare final test procedures and overall scheme for use during testing.

3.02 PREREQUISITES

A. Conditions:
1. Commence system commissioning for each facility only after
   a. Complete installation of process equipment, associated piping, and associated electrical power, control, and instrumentation systems.
   b. Certifications from process equipment manufacturers' field service representatives are submitted as specified under the respective Sections.
   c. Test procedures and overall commissioning scheme are ready.
   d. Contractor has arranged the schedule with the Owner and the Engineer.

B. Tests:
1. Commence commissioning only after performing these tests and submitting specified reports:
   a. Mechanical/process equipment testing.
   b. Tests required under Section 40 80 10 and 40 80 20.
   c. Megger testing as required under Section 26 08 00.
   d. Testing of all equipment to show that is operates properly in HAND. Include the completion of this testing as line items on the test procedures.
   e. Testing of miscellaneous individual control devices not already tested. Include the completion of this testing as line items on the test procedures.

3.03 EQUIPMENT

A. Provide all necessary test equipment to perform system startup.

B. Provide all equipment as may be necessary to simulate process conditions during startup.

3.04 SYSTEM TEST

A. Use the test procedures and commissioning scheme as a guide to testing. Enter progress and results. Add printed names and signatures of test personnel and witnesses then submit six copies as Test Reports.

B. Furnish Contractor personnel who are familiar with the project for the duration of the Commissioning to operate valve, pumps, and other equipment, as well as to adjust, repair, or replace defective equipment. Do not pull testing personnel away from testing for these activities unless their expertise is needed for troubleshooting or re-calibration.

C. Furnish Contractor personnel, including Field Service Representative(s) of the manufacturer(s) of control panels:
1. Test all systems in conjunction with the programmable logic controller and OIU hardware and software.
2. After the above is finished, then schedule with the Owner and Engineer, then demonstrate correct operation of systems to the Owner and the Engineer.

D. Test each system not directly associated with a PLC, Plant control Panel, or OIU then demonstrate correct operation to the Owner and the Engineer.

E. Test and demonstrate all remaining controls.

END OF SECTION

SECTION 40 80 10

INSTALLATION, TESTING, AND CALIBRATION OF INSTRUMENTATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Installation and testing of instrument circuits.

B. Installation, calibration, and testing of instruments.

C. Test equipment for testing and calibration of instrumentation.

1.02 SYSTEM REQUIREMENTS

A. For purposes of this section, "instrument" means:
   1. A transmitter which measures a process variable and produces an analog signal, such as 4 to 20 mA, 1 to 5 V, or similar.
   2. Other analog devices which produce or utilize mA or similar signals, such as indicators and isolators.
   3. A switch which measures a pressure, temperature, or similar, in an analog fashion but produces a discrete output. This does not include float switches.

B. Instrumentation refers to the entire system of instruments and associated indicators, circuits, and accessories.

C. Provide minor pipe, fittings, adapters, valves, tubing, supports, and accessories to make a complete, operating installation for each instrument, whether shown on the Drawings or not.

D. Provide labor to accomplish a complete, tested, calibrated, and correctly operating installation.

1.03 SUBMITTALS

A. Assemble calibration reports into ring binders, filed in order of Tag Number. Place project information on each binder. Submit three copies. The information in the reports having been field verified, this submittal will be reviewed only for completeness.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 INSTALLATION OF CIRCUITS

A. Use type and size of wire or cable specified in Section 26 05 19 – Low Voltage Wire and Cables, or as shown on the Drawings, whichever is larger.

B. Color code and label every wire end as specified in Section 26 05 19 – Low Voltage Wire and Cables.

C. Run instrumentation circuits unbroken, such as from instrument to TVSS to indicator to PLC, with no intermediate connection except:
   1. Where terminal boards are shown on the Drawings.
   2. Where terminal boards with appropriate enclosures are proposed by the Contractor and allowed in writing by the Engineer.

D. Connect to remote terminal unit (RTU), remote control panel (RCP), programmable logic controller (PLC), or similar controller I/O terminals only after testing specified below is complete.

E. Maintain physical separation between DC instrumentation circuits and all AC circuits.

F. The quantity, type, and AWG of wire and cable called for on the Drawings is for facility equipment as designed. If equipment is furnished which requires a greater quantity of, different type or larger AWG wire or cable than called for, then furnish the correct quantity, type and AWG plus appropriate conduit at no additional cost to the Owner. Submit proposed changes to Engineer for review.

3.02 TESTING OF CIRCUITS

A. Conduct testing to verify that analog circuits and associated DC power circuits are properly installed and connected, that there are no shorts, and that there are no unintentional grounds on the signal conductors. Lift intentional grounds from shields and verify that there are no unintentional grounds on the shields.

B. Connect circuits to the terminals of the controller and connect shield grounds.

C. Provide all test equipment.

3.03 INSTALLATION OF INSTRUMENTS

A. Coordinate installation of instruments such that instruments are installed by appropriately skilled workers and such that all necessary labor and materials are included in the Bid. For example, determine the appropriate trade for the installation of a 24” electromagnetic flow element versus the transmitter and the installation of a conductivity analyzer probe versus the transmitter and assign the work accordingly. Also determine which trade will provide and install such adapters and hardware as

needed for a complete, working installation. For another example, determine in advance which trades will install thermal wells versus temperature transmitter elements.

B. Follow recommendation and instructions of equipment manufacturer in addition to requirements of Drawings and Specifications in handling and installation of instrumentation equipment.

C. Cleaning: Before assembly or installation, thoroughly clean equipment of temporary protective coatings and foreign materials. After installation of equipment, clean external surfaces of oil, grease, dirt, or other foreign material.

D. Mount instrumentation equipment approximately where shown on the Drawings. Propose exact locations to the Engineer in advance of mounting. Mount with pipe stands, brackets, or strut as specified and as shown on the Drawings. If not detailed on the Drawings, propose bracket details in the field. Provide floor stands where instruments are located away from walls or other building structure. Provide manufacturers' mounting adapters as needed.

E. Painting: Paint ferrous, custom or field-fabricated brackets, stands, and miscellaneous mounting members as specified in Division 9. Painting is not required for aluminum, galvanized steel, or stainless steel.

F. Transmitters Which are Separate from their Sensing Element:
   1. Transmitters not in a building:
      a. Mount the transmitter so the display faces north.
      b. If not practical to face north, so demonstrate to the Engineer, then face east.
      c. Only with written approval from the Engineer, face the display south or west.
   2. Mount the transmitter at a convenient height (approximately 64" centerline) above the finished walking surface (grade).
   3. Mount the transmitter so it is easily accessible for reading, testing, and calibration.
   4. Provide manufacturer-furnished or recommended cable for connection of sensing element to transmitter.

G. Transmitters Which are Integral with their Sensing Element:
   1. If piping run or structure permits, mount the transmitter between 18" and 72" above grade and so the transmitter is easily accessible for reading, testing, and calibration.
   2. Where the Drawings show transmitters more than 72" above grade or where the piping run or structures require mounting the transmitter more than 72" above grade, locate the transmitter where access by means of a ladder is convenient.
   3. Transmitters in a building:
      a. If the transmitter is mounted high and is adjustable, face the display downward, angled for operator convenience.

b. If the transmitter is at an intermediate height and is adjustable, adjust angle for operator convenience.
c. If the transmitter is mounted low and is adjustable, face the display upward, angled for operator convenience.

4. Transmitters not in a building:
   a. If the transmitter is mounted high and is adjustable, face the display downward, angled for operator convenience.
   b. If the transmitter is mounted at an intermediate height, if practical, mount the transmitter so the display faces north. If not practical to face north, so demonstrate to the Engineer, then face east. Only with written approval from the Engineer, face the display south or west.
   c. If the transmitter is mounted low, face upward unless shown otherwise on the Drawings. Provide sun shade similar to the requirements below but with a hinged portion on top to protect the display from the sun. Mount sun shade to a bracket which is independent of the process pipe or vessel.

H. Local Indicators:
1. Mount the indicator at a convenient height (approximately 64" centerline) above the finished walking surface (grade).
2. Mount the indicator so it is easily accessible for reading, testing, and calibration.
3. Face the display the same as required for separately mounted transmitters.

I. Sun Shades:
1. Provide sun shades for all LED and LCD displays of separately mounted transmitters and local indicators which are not within a building and which are not facing north, whether sun shades are shown on the Drawings or not. Also provide sun shades for other transmitters where noted on the Drawings.
2. The purpose of sun shades is to protect the readout from direct sun and to allow easier reading of the display by an operator. Fabricate and install accordingly. An acceptable design is 14 gage aluminum plate with two bends formed in it and mounted so it extends three to four inches beyond the front of the transmitter or indicator on the left, top, and right, complete with a top-hinged flap which completely shades the display except when lifted by hand. Make all corners smooth, especially the upper two corners. Mount so the sun shade stands off from the enclosure of the transmitter or indicator to allow for air circulation. Mount with SS hardware. Other designs may be proposed for review by the Engineer.

J. Nameplates:
1. Install an engraved nameplate to identify each instrument.
2. If text is not shown on the Drawings, show function and tag number of instrument.

3.04 CALIBRATION OF INSTRUMENTS

A. Provide all test and calibration equipment. Unless equipment is new for this project, provide current National Institute of Standards and Technology traceable calibration information for it.

B. Calibrate the following instruments in place and demonstrate correct calibration as installed, under simulated operating conditions. For calibration range, see Instrument Tag List. If not shown, see Drawings. If not shown, obtain information from Engineer during construction.
   1. Temperature transmitters.
   2. Pressure transmitters.
   3. Level transmitters.
   4. Open channel flow meters.
   5. Other flow meters offering field calibration capability.
   6. Analyzers, such as dissolved oxygen, pH, ORP, TDS, and similar process analyzers.
   7. Valve position analog indicators.
   8. Transmitters for electrical values, such as voltage, current, and watt transducers.
   9. Temperature switches, pressure switches, and the like.

C. Provide certificates of factory calibration for instruments for which the manufacturer provides no means of field calibration, such as the flow element of an electromagnetic flow meter.

D. Some instruments contain small meters or gages, which can not be calibrated in the field, to indicate output signals. Record the performance of these indicators as if an external indicator.

E. Verify that the instrument is working while isolated.

F. Perform other testing of instrumentation as required by Section 40 80 00 – Process Control Commissioning.

G. Notify Owner and Engineer minimum six working days in advance of calibrating an instrument. The Owner or Engineer will witness the calibration and sign the calibration report, but only to denote presence as a witness.

H. Calibration Procedure:
   1. Remove shipping stops/plugs from instruments before starting.
   2. Have instruction manuals available, and install miscellaneous components which have been supplied separately but are integral parts of equipment.
   3. Nameplate check: Verify data on nameplate with respect to conditions of range, operating temperature, specific gravity, and other ratings required by the Specifications and as submitted. Correct discrepancies before proceeding.
   4. For analyzers, use standard solutions or mix solutions strictly in accordance with manufacturer’s instruction.

5. Calibrate each instrument in accordance with manufacturer's calibration procedures over full operational range. Prove instruments to be within published specification and accuracy. Then calibrate the entire loop, including wiring, remote indicators, loop isolators, and SPD. Prove each item in loop to be within published accuracy.
6. Where an instrument loop controls a plant variable, such as return activated sludge flow rate, calibrate the loop as a system (i.e., transmitter, controller, and VFD). Components which have adjustable features shall be carefully set for specific conditions and applications of this project.
7. Place a calibration sticker on each active component of the loop, showing
    a. Calibration report number and date.
    b. Equipment identification tag number.
    c. Printed name of person who performed calibration.
8. Prepare and submit a calibration report for each loop, showing the below information. Provide serial number where shown on the equipment name plate, although it is recognized that not all items will bear a serial number.
    a. Calibration report number and date.
    b. Owner's name and project name.
    c. Service of instrument, such as "RAS flow."
    d. Equipment identification tag number.
    e. Engineering name of variable of interest, such as "Level," even though it is being measured by a pressure transmitter.
    f. List of equipment used to independently measure process variable.
    g. For analyzers:
        1) Manufacturer's name and catalog number for standard solutions.
        2) Method of use of solutions.
    h. For transmitters:
        1) Manufacturer's name, model number(s), and serial number(s) for transmitter and element.
        2) Range of capability of transmitter.
        3) Calibrated range for this project.
        4) Table showing actual value of measured variable versus mA output of transmitter. Show minimum of two such points. Some Sections may require more than two calibration points.
    i. For signal isolators in the loop:
        1) Manufacturer's name, model number, and serial number.
        2) Table showing mA in versus mA out at 0%, 50%, and 100%.
    j. For signal converters in the loop:
        1) Manufacturer's name, model number, and serial number.
        2) Table showing signal in versus signal out at 0%, 50%, and 100%.
    k. For indicators in the loop:
        1) Manufacturer's name, model number, and serial number.
        2) Table showing signal in versus reading at 0%, 50%, and 100%.
    l. For switches:
        1) Manufacturer's name, model number, and serial number.
        2) Table showing value of process variable versus contact action.

m. Date of calibration.
n. Printed name of person who performed calibration. Signature.
o. Printed name of person who witness calibration. Signature.

END OF SECTION

SECTION 40 80 20

INSTALLATION AND TESTING OF CONTROL CIRCUITS AND DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Installation and testing of control circuits.

B. Installation and testing of control devices.

1.02 SYSTEM REQUIREMENTS

A. Definition of a Control Device:
1. A device which measures a process variable, such as a level switch, and produces a discrete signal. Certain switches which respond to analog process variables, such as pressure switches and temperature switches, are treated as if they are instruments under Section 40 80 10 – Installation, Testing, and Calibration of Instrumentation.
2. Hand switches that are field mounted. Hand switches in control panels are covered under Section 40 95 13.23 – Control Panels, and Sections referenced therein.
3. Relays that are field mounted. Relays in control panels are covered under Section 40 95 13.23 – Control Panels, and Sections referenced therein.
4. Indicator lights, horns, alarm strobes, and similar discrete operator interface devices that are field mounted.
5. Other devices which produce a discrete signal.
6. Other similar devices that are neither instrumentation nor power devices.

B. Controls refers to the entire system of control devices and to all circuits associated with the plant control system in the larger sense, except for those circuits covered under Section 40 80 10 – Installation, Testing, and Calibration of Instrumentation.

C. Provide labor to accomplish a complete, tested, and correctly operating installation.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 INSTALLATION OF CIRCUITS

A. Use type and size of wire or cable specified in Section 26 05 19 – Low Voltage Wire and Cables, or as shown on the Drawings, whichever is greater.

B. Color code and label every wire end as specified in Section 26 05 19 – Low Voltage Wire and Cables.

C. Run control circuits from control device to control device to control panel with no intermediate connection except:
   1. Where terminal boards are shown on the Drawings.
   2. Where terminal boards with appropriate enclosures are proposed by the Contractor and allowed in writing by the Engineer.

D. Connect to remote terminal unit (RTU), remote control panel (RCP), programmable logic controller (PLC), or similar controller I/O terminals only after testing specified below is complete.

E. Maintain physical separation between DC instrumentation circuits and all AC circuits.

F. The quantity, type, and AWG of wire and cable called for on the Drawings is for facility equipment as designed. If equipment is furnished which requires a greater quantity of, different type or larger AWG wire or cable than called for, then furnish the correct quantity, type and AWG plus appropriate conduit at no additional cost to the Owner. Submit proposed changes to the Engineer for review.

3.02 TESTING OF CIRCUITS

A. Conduct testing to verify that control circuits and associated power circuits are properly installed and connected, that there are no shorts, and that there are no unintentional grounds on the conductors. Lift intentional grounds for and verify that there are no unintentional grounds on the neutral conductors.

B. Connect circuits to the terminals of the controller and connect intentional grounds.

C. Provide all test equipment.

3.03 INSTALLATION OF CONTROL DEVICES

A. Coordinate installation of control devices such that devices are installed by appropriately skilled workers and such that all necessary labor and materials are included in the Bid. Also determine which trade will provide and install such adapters and hardware as needed for a complete, working installation. For another example, determine in advance which trades will install concrete that might be needed for support of stands for control devices.

B. Follow recommendation and instructions of equipment manufacturer in addition to requirements of Drawings and Specifications in installation of control devices.

C. Cleaning: Before assembly or installation, thoroughly clean equipment of temporary protective coatings and foreign materials. After installation of equipment, clean external surfaces of oil, grease, dirt, or other foreign material.

D. Mount control devices approximately where shown on the Drawings. Propose exact locations to the Engineer in advance of mounting. Mount with pipe stands, brackets,

or strut as specified and as shown on the Drawings. If not detailed on the Drawings, propose bracket details in the field. Provide floor stands where control devices are located way from walls or other building structure.

E. Painting: Paint ferrous, custom or field-fabricated brackets, stands, and miscellaneous mounting members as specified in Division 9. Painting is not required for aluminum, galvanized steel, or stainless steel.

3.04 Mount control devices at a convenient height (approximately 54" centerline) above the finished walking surface (grade), where it is easily accessible to the plant operator and for maintenance.

3.05 TESTING OF CONTROL DEVICES

A. First, test control devices individually.

B. Then, test control devices as part of a system, such as operating a motor in HAND. Verify that every motor operates correctly in HAND and that control devices such as float and limit switches operate correctly as part of the system.

C. Perform other testing of control devices as required by Section 40 80 00 – Process Control Commissioning.

D. Notify Engineer minimum six working days in advance of testing control devices as part of a system. The Engineer will either witness the testing or notify the Contractor that witness testing is waived for all or part of the devices.

END OF SECTION

SECTION 40 91 19.30

PRESSURE GAUGES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install pressure gauges and gauge accessories as specified and as shown on the Drawings.

1.02 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples:
   1. Product Data for Gauges and Accessories.

1.03 OPERATION AND MAINTENANCE DATA

A. Section 01 78 23: Operation and Maintenance Data.

B. Manufacturer's complete operations and maintenance manuals, including the following items as a minimum:
   1. Operating Instructions.
   2. Maintenance Instructions.
   3. Calibrating Instructions.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES FOR SEWAGE/SLUDGE AND NON-POTABLE WATER SERVICE

A. Accuracy Requirements: ±1.5% of span.

B. Materials of Construction and Design Features:
   1. Bourdon Tube and Socket: Type 316 stainless steel.
   2. Case liquid filled at factory, glycerine.
   3. Case: Stainless steel.
   4. Overload and underload stops.
   5. Dial Size: 2 ½".
   6. Process Connection: 1" NPT lower connection on gauge-seal assembly.

C. Scale: As shown on Drawings.

D. Manufacturer: WIKA Type 233.54; ¼" NPT process connection; factory welded to diaphragm seal to form a single unit. See Drawings for gauge connection mounting and required installation.

E. Gauge Diaphragm Seal: WIKA Model L990.10 diaphragm type chemical seal with 1" process connection.
   1. Instrument connection size: ¼".
   2. Body and Diaphragm: 316L stainless steel.
   3. Gasket: Viton.

PART 3 EXECUTION

3.01 INSTALLATION

A. Per manufacturer's instructions.

3.02 SCHEDULE

A. As indicated on Drawings.

END OF SECTION

SECTION 40 91 25.30

LIMIT SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Limit switches.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts.

PART 2 PRODUCTS

2.01 MAGNETICALLY OPERATED LIMIT SWITCH

A. Switch:
1. UL 634 listed industrial duty SPDT hermetically sealed reed-type switch completely enclosed and encapsulated in aluminum housing.
2. Surface mounted, using integral, through-case mounting holes.
3. Switch leads factory soldered to switch.
4. Leads connection by 3' stainless steel armored cable.
5. Closed loop.
6. 3" gap ± 20%.
7. Switch ratings 100V AC/DC and 0.5A.

B. Magnet:
1. Surface mounted rare earth material magnet.
2. Surface mounted, using integral, through-case mounting holes.

C. Sentrol GE Interlogics 2500A switch and 1920 magnet or Engineer approved equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. For switches with armored cable, install a conduit box nearby with miniature terminal board for connection of leads to field wiring.

B. Box and TBs may or may not be shown on the Drawings. Use box suitable for the area installed. Connect cable to box with connector having compression bushing which grips the armored cable.

END OF SECTION

SECTION 40 91 25.40

LIQUID LEVEL FLOAT SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Float switches.

1.02 SUBMITTALS

A. Submittal not required if specified material is furnished.

B. Submit manufacturer's literature if any substitution is proposed.

PART 2 PRODUCTS

2.01 FLOAT SWITCH

A. Switch: SPDT, 16A 250VAC mechanical micro-switch in eccentrically weighted hermetically sealed pear-shaped float with plastic jacketed cable.

B. Operating Point Rising: 37 degrees from vertical.

C. Operating Point Descending: 17 degrees from vertical.

D. Maximum angular displacement fully immersed: 60 degrees from vertical.

E. Switch shall not float.

F. Flygt (www.flygt.com) ENM-10 or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install floats as shown on Drawings and in accordance with manufacturer's recommendations.

B. Float Switches:
1. Set level as scheduled, as shown on Drawings, or as directed by Engineer in field.
2. Conduit sizes for float cables are based on a maximum of 0.38 inch outside diameter cable. Increase conduit size if required for larger cable.

END OF SECTION

SECTION 40 95 13.13

LIFT STATION CONTROL PANEL EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. LSCP, Lift Station Control Panel

B. RTU radio and accessories

C. Yagi antenna and accessories

D. Coaxial transmission lines and accessories

1.02 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems

B. NEMA ICS 3 – Industrial Systems

C. NEMA ICS 6 – Enclosures for Industrial Controls and Systems

D. NFPA 70 – National Electrical Code

1.03 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Incorporated, as suitable for purpose specified and shown.

1.04 SUBMITTALS FOR REVIEW

A. Submit in accordance with Specification Section 40 95 13.23: Control Panels.

B. Catalog Data: Submit catalog literature data sheets for items specified in Part 2. Include complete manufacturer's part and model numbers.

C. Shop Drawings: Indicate electrical characteristics and connection requirements, including layout of completed assemblies, interconnection cabling, dimensions, weights, and external power requirements.

D. Product Data: Provide data for each component specified, showing electrical characteristics and connection requirements.

E. Bill of Material: Key line items in the BOM to the respective volume and tab number in submittal binders.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.05 OPERATIONS AND MAINTENANCE MANUALS

A. Submit in accordance with Section 01 78 23.05 – Operation and Maintenance Data.

B. Submit manufacturer's standard installation, operation and maintenance manuals for the components specified herein.

C. Include all items listed for submittals above.

PART 2 PRODUCTS

2.01 LIFT STATION CONTROL PANEL

A. Sections 40 95 13.23 – Control Panels, and 40 95 43.10 – Control Hardware

B. Enclosure:
1. NEMA 4 metallic, painted as shown on Drawings.
2. Door-over-door design with no devices on the outer door.
3. Provide equipment mounting panel [back plate].
4. Padlockable
5. Fluorescent lighting package
6. Closed looped cooler
7. Heater
8. Hoffman or Engineer approved equivalent.

C. Separate voltages inside enclosure. DC, Low voltage, 120Vac, 240Vac.

D. Exterior Door Equipment: Intrusion switch. Switch to open when outer door opens, not inner door.

E. Interior Door-Mounted Equipment:
1. Breakers inside cabinet, mounted on back plate
2. Running time meters: 1 for each pump
3. Indicator pilots per pump: run, over temperature
4. Hand-Off-Auto selector switches: 1 for each pump
5. Alarm reset push-button

2.02 RTU RADIO

A. Catalog numbers are Motorola.

B. ACE3600 for CM20/CM140/EM200/GM3188 VHF Part No F7563. NO SUBSTITUTIONS.

C. CDM750, 25W radio Part No V851. NO SUBSTITUTIONS.
1. Radio Frequency: 173.39625 MHz.
2. Mount radio rack/chassis directly onto PCP back plate.

D. 3 I/O slots frame Part No V103. NO SUBSTITUTIONS.

E. 16 Bit DI Fast 24 Volt DC Part # V265. NO SUBSTITUTIONS.

F. Mixed I/O 16 DI 4 DO EE 4 AI, +/- 20 mA. Part # V245. NO SUBSTITUTIONS.

G. No FET Cards in this station.

H. No EE Relay Cards in this station.

I. AC power supply 85-264V w/ battery charger Part # V261. NO SUBSTITUTIONS.

J. 6.5AH battery Part # V114. NO SUBSTITUTIONS.

K. No uninterruptible Power Supply (UPS) in this station.

L. Spare Parts: One (1) of each identified above.

2.03 YAGI ANTENNA

A. Laird Model Y1505. NO SUBSTITUTIONS.
1. Frequency: 173.39625 MHz

2.04 COAXIAL TRANSMISSION LINES AND ACCESSORIES

A. Cable: 50 Ohm, UV resistant, weatherboard coaxial cable.
1. Radio Feed System: ½" foam dielectric "super flexible" coaxial cable. Manufacturer's Reference: Andrew FSJ4-50B. NO SUBSTITUTIONS.

B. Connectors:
1. Type: Low VSWR, Type-N with watertight "O" ring seals.
2. Gender: As required to mate with equipment specified.

C. Coaxial Cable Grounding Kit: ½" cable, 24" long, factory attached one-hole lug. Manufacturer's Reference: Andrew 204989-1

D. Weatherproofing Kit:
   1. Application: Outdoor exposed connectors and grounding strap attachments
   2. Type: 3M Cold Shrink
   3. Manufacturer's Reference: Andrew

E. Cable Hanger: Standard stainless steel hangers and mounting hardware.

F. Impulse Suppressor, Polyphaser Corp., P/N IS-50NX-C2:
   1. Freq. Range 125-1000 MHz, 50 Ohm Impedance, 50-375 Watts, Female Input/Output connectors, VSWR 1.1:1.
   2. Install according to manufacturer's recommendations inside the Pump Control Panel on hinge side. NO SUBSTITUTIONS.

G. Miscellaneous: Provide miscellaneous hardware and connectors to provide a complete installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment and products in accordance with manufacturer's instructions, unless otherwise indicated.

B. Label all wiring, terminals, and devices.

END OF SECTION

SECTION 40 95 13.23

CONTROL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control panels.

1.02 NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL)

A. Underwriters Laboratories, Inc. (UL), Electrical Reliability Services, Inc., Division of Emerson Electric, (ERS), or other organization that is recognized by the State of New Mexico and is acceptable to the Engineer.

B. NRTL is used below to refer to UL and/or ERS. Other organizations may request inclusion. Submit information minimum 10 working days before the Bid date for review by the Engineer. Include minimum 25 year company history, company qualifications similar to UL or ERS, a detailed description of the NRTL requirements which apply to a panel shop, including follow-up inspections, plus documentation showing recognition by the State of New Mexico. NRTL found to be acceptable will be added by addendum.

1.03 STANDARDS

A. For panels which will be installed in ordinary locations with an ambient temperature of up to 40 degrees C, comply with the requirements of UL508A, Standard for Industrial Control Panels, latest edition.

B. For panels which will be installed in hazardous locations, comply with the requirements of UL 698, Standard for Industrial Control Equipment for Use in Hazardous (Classified) Locations, latest edition.

C. For panels which incorporate intrinsic safety barriers and are intended for connection to circuits residing in hazardous locations, comply with the requirements of UL 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations, latest edition.

D. UL 508A is used in paragraph 1.04 to refer to UL508A, UL698, or UL698A depending on the type of panel. It is recognized that there may be standards similar to UL508A, UL698, UL698A which are published by a NRTL not listed above. The Engineer will review such standards for acceptability only if a complete, original, current copy of both the UL standard and the proposed alternate standard are submitted a minimum of 10 working days before the Bid date. Also submit information about the NRTL itself, as required above. Standards found acceptable will be added by addendum.

1.04 MANUFACTURING AND LABELING

A. Provide control panels that are manufactured and labeled by a company which:
   1. Specializes in the manufacture of panels which are:
      a. Designed and manufactured to comply with the requirements of UL508A,
      b. Labeled to certify compliance with UL508A;
   2. Is currently and directly authorized by a NRTL to regularly apply labels of the NRTL which certify compliance with UL508A;
   3. Has successfully passed a factory inspection conducted by the NRTL Follow-Up Services, including inspection of NRTL-certified product then being manufactured, during the calendar quarter previous to or during the calendar quarter of the bid date and successfully passes all such inspections which may occur during the period of manufacturing of the panels for this project.
   4. Also specializes in the supply and startup of instrumentation and control systems.
   5. Has on staff a field service representative who is currently certified as a Certified Control Systems Technician, Level 3, by the National Institute for Certification in Engineering Technologies.

B. A control panel which is manufactured by a company which is not currently and directly authorized by a NRTL to regularly apply labels of the NRTL will not be acceptable, except as provided in paragraph 1.04 D.

C. A control panel which is manufactured by a company which did not successfully pass a factory inspection conducted by the NRTL Follow-Up Services, including inspection of NRTL-certified product then being manufactured, during the calendar quarter previous to or during the calendar quarter of the bid date or which does not successfully pass all such inspections which may occur during the period of manufacturing of the panel(s) for this project will not be acceptable except as provided in paragraph 1.04 D.

D. A control panel manufacturer which would propose to provide panels which are labeled on a one-by-one basis by a NRTL may be acceptable. Submit information to the Engineer to show compliance with the following requirements a minimum of 10 working days before the Bid date. Provide complete information in well-organized, indexed, tabbed ring binders. Lack of compliance with the previous sentence will be a basis for rejection. Insufficient or confusing information will be a basis for rejection. No subsequent information for purposes of this paragraph will be requested or accepted. Nothing will be returned. A manufacturer found to be acceptable will be added by addendum.
   1. Requirements for an acceptable control panel manufacturer:
      a. Company specializes in the manufacture of panels which are designed and manufactured to comply with the requirements of UL508A, and labeled by the proposed NRTL to certify compliance with UL508A. Provide a list of at least 20 such panels, giving project name, panel name, and description of function of panel.

b. Company specializes in the supply and startup of instrumentation and control systems. Provide a list of at least 6 projects for which the company supplied and started up the complete instrumentation and control system. Include name of owner, name of project, name of installing contractor, name of prime contractor, and name and telephone number of a contact of each above organization.

c. Company has on staff a field service representative who is currently certified as a Certified Control Systems Technician, Level 3, by the National Institute for Certification in Engineering Technologies. Provide a copy of the certificate.

d. Company understand requirements of the specifications for this project related to submittals and O&M Manuals. Provide a sample submittal package and a sample O&M Manual, addressing each particular element of the specification requirements.

2. Also provide standard, published information about the inspection and labeling process used by the NRTL and a copy of three different, specific reports prepared by the NRTL as a result of having labeled panels for the proposed panel manufacturer. Delete or change information as needed in order to conceal the identity of the owner of the subject panel.

1.05 SUBMITTALS

A. For a company which complies with the requirements of paragraph 1.04 A. 2. and 3., provide a certificate from the NRTL showing such compliance. For a company added under the provisions of paragraph 1.04 D., provide two additional sets of the information provided in response to the requirements of paragraph 1.04 D. 1. a., b., and c. and 1.04 D. 2.

B. Provide contact information - name, postal address, email address, land telephone number, mobile telephone number, and fax number for:
1. Project Manager for each control panel.
2. Project Engineer for each control panel.
3. Programmer for each control panel.
4. Field Service Representative for each control panel.
5. Create in Word™ or Excel™ format.

C. Bills of Material:
1. One for each control panel. Remote cabinets that are part of a larger control system, such as those containing remote inputs/outputs for a PLC may be shown separately or in a comprehensive Bill Of Material that is thoroughly indexed.
2. One for field instrumentation and controls.
3. Key line items in the BOM to the respective volume and tab number in submittal binders.
4. Create in Microsoft Word™ or Excel™ format.

D. Manufacturer's literature for power devices, control devices, panel front devices, indicators, terminal boards, etc.

E. Shop Drawings:
   1. Dimensioned front views showing devices, legend plates, and nameplates.
   2. Dimensioned interior views showing components, terminal boards, and nameplates.
   3. Back views of doors showing switches, pilots, etc., and nameplates.
   4. Engraving list for legend plates and nameplates.
   5. Create in AutoDesk™ AutoCAD format, except engraving list may be in Word™ or Excel™.

F. Schematic Drawings:
   1. Furnish schematic drawings for all electrically controlled systems and equipment included in this contract whether or not control schematics for the equipment have been shown on construction drawings. This requirement includes, but is not limited to, pump motor controls, valve motor operators, lighting controls, environmental control equipment, and other equipment with packaged controls.
   2. This set of schematic drawings requires coordination of all submittals containing electrical control information.
   3. Schematics for equipment with packaged control systems may or may not be shown in the Drawings.
      a. For equipment which is controlled in part by a PLC, obtain schematics from suppliers of equipment and submit under this Section, showing interface with PLC in coordination with drawings required by this section.
      b. For equipment which is not controlled by a PLC furnished under this Section, such as hypochlorite generators and furnaces, provide the schematic as part of the submittals for that equipment, in the manufacturer' standard format.
   4. Comply with > Section 01 33 23 – Shop Drawings, Product Data, and Samples, regarding schematic drawing format and content.
   5. Minimum text height for full-size schematic drawings: 1/8 inch.
   6. Create in AutoDesk™ AutoCAD format.

G. Connection Diagrams:
   1. Internal connection diagrams for each panel.
   2. Diagrams showing connection of external devices to the respective panel. Notes which refer to equipment manufacturer's drawings for interconnection information will not be acceptable. It is acceptable to combine internal and external information on the same drawing(s).
   3. Create in AutoDesk™ AutoCAD format.

H. Where specified in a Section, include submittal information for that Section as a package with this Section.

1.06 OPERATION AND MAINTENANCE DATA

A. Additional paper copies of submittal information which has been modified in response to Engineer's comments and/or to match actual construction.
   1. Paragraph 1.05 C., contact information.
   2. Paragraph 1.05 D., BOM.
   3. Paragraph 1.05 E., manufacturer's literature.
   4. Paragraph 1.05 F., shop drawings.
   5. Paragraph 1.05 G., schematic diagrams.
   6. Paragraph 1.05 H., connection diagrams.
   7. Connection diagrams.

B. Paper copies of :
   1. Factory Test Reports.
   2. Calibration and Field Test Reports as required under Sections 40 80 03 – Process Control Commissioning, 40 80 10 – Installation, Testing, and Calibration of Instrumentation, 40 80 20 – Installation and Testing of Control Circuits and Devices, and 26 08 00 – Electrical Testing.

C. Furnish information on write-once DVD+R which can be read by the OIU furnished with the project. If no OIU is furnished, propose a format for Engineer review.
   1. Adobe Acrobat™ "pdf" files for 1.05 B., NRTL.
   2. Word™ or Excel™ files for 1.06. B. 1., contacts, and 1.06 B. 2., BOM.
   3. Adobe Acrobat™ "pdf" files for 1.06 B. 3., literature.
   4. AutoCAD 2006 "dwg" files and corresponding "dxf" files for 1.06 B. 4. through 7., shop, schematic, connection drawings.
   5. Adobe Acrobat™ "pdf" files of factory test reports and of field test reports required under Sections 40 80 03 – Process Control Commissioning, 40 80 10 – Installation, Testing, and Calibration of Instrumentation, 40 80 20 – Installation and Testing of Control Circuits and Devices, and 26 08 00 – Electrical Testing.
   6. Excel™ file of Tag List, Section 40 96 20 – Process Control Tag List.

1.07 EXTRA MATERIALS

A. Section 26 00 60 – Extra Materials for Electrical Systems

B. Relays: Minimum 2 of each type but more if required in other sections.

PART 2 PRODUCTS

2.01 ENCLOSURE

A. Section 26 27 16 – Cabinets and Enclosures

B. If so scheduled, provide a Lexan™ window in the door of a PLC type panel:
   1. Construct as to preserve NEMA rating of enclosure.
   2. For a PLC, locate so diagnostic and indicator lights on face of PLC are easily visible.

3. For a recorder, locate so full face of recorder is easily visible.

C. As scheduled, as shown on Drawings, or in individual sections.

2.02 CABINET COOLERS

A. Provide one or more coolers in a given Control Panel if:
1. The schedule calls for coolers, or
2. A component having an ambient temperature rating that is two degrees C lower than other components is furnished, or
3. The panel manufacturer recommends coolers.

B. Cooler Requirements:
1. Two fans, each minimum 215 CFM and rated for 10 years life.
2. Sealed heat pipes, rated for 30 years of life.
3. Designed and installed to preserve the NEMA Rating of the panel and to have the same NEMA Rating as or better NEMA Rating than the panel.
4. Models available rated from 16.5 watts per degree C (delta temperature) up to 110 watts per degree C.
5. Rated for operation in ambient temperatures from minus 40 degrees C to plus 70 degrees C.
6. Size the cooler to extract heat from the panel at a rate sufficient to prevent the panel interior from being more than 6 degrees C higher than the local ambient.
7. Minimum manufacturer's standard warranty: Four years
8. Minimum cooler: Noren (650-322-9500) CC Series, or the equal Thermal Edge series (888-580-0202); no others.

2.03 GROUND BARS

A. Enclosure Ground Bar:
1. Tin-plated copper.
2. Solidly bond to enclosure.
3. Use for connection of:
   a. Grounding electrode conductors.
   b. Equipment grounding conductors.
   c. Other grounds not connected to the Shield Ground Bar.
4. Provide separate screw, bolt, or terminal point for connection of each conductor.

B. Shield Ground Bar:
1. Tin-plated copper.
2. Mount on standoff insulators, close to and parallel to Enclosure Ground Bar.
3. Use for connection of shields of TWSH cable carrying analog signals to ground. Connect shield to terminal board point adjacent to the signal conductors. Connect from there to Shield Ground Bar with green, stranded #14.

4. Provide separate screw, bolt, or terminal point for connection of each conductor.
5. Connect Shield Ground Bar to Enclosure Ground Bar with 2 #10 stranded at each end (4 total). Arrange these connections for easy removal and replacement for purposes of testing.

2.04 PANEL ALARM HORN

A. Provide steady-tone piezoelectric alarm horn in control panels as scheduled or shown on the Drawings.

B. Sonalert or ENGINEER approved equivalent.

2.05 SWITCHES, PUSHBUTTONS, PILOT LIGHTS

A. Section 40 95 43.10 – Control Hardware.

2.06 RECORDERS, INDICATORS

A. Sections 40 93 30.13 – Paperless Programmable Chart Recorders and 40 93 30.15 – Analog Indicators.

2.07 LEGEND PLATES

A. Provide for switches, pushbuttons, and pilot lights. Text:
1. As shown on the Drawings.
2. If not shown on the Drawings, show on submittals.

2.08 CONTROL COMPONENTS

A. Section 40 95 43.10 – Control Hardware.

B. As shown on the Drawings.

2.09 NAMEPLATES

A. Section 26 05 53 – Electrical Identification.

B. Furnish the following nameplates (NP):
1. Main NP:
   a. Black with 1/2” white letters.
   b. Text as on Drawings.
2. Component and device NP (internal):
   a. Adjacent to each terminal board, switch, pushbutton, pilot light, control component, and the like.
   b. Black with 1/8” white letters.
   c. Text: Same as on schematic.

3. Warning NP:
    a. On panel front.
    b. Red with 1/4” white letters.
    c. Text: WARNING. THERE MAY BE VOLTAGE IN THIS PANEL FROM MULTIPLE SOURCES.
4. Panel front indicating and display devices:
    a. Provide for each panel front mounted meter, recorder, and the like.
    b. Black with 1/4” white letters.
    c. Text: Same as on Drawings.
5. As called for on the Drawings.

2.10 TERMINAL BLOCKS

A. Section 26 27 27 – Wire Connectors and Accessories.

2.11 INCOMING POWER

A. Where hard-wired, connect to terminal blocks.

B. Where AC power comes from a UPS which is external to the panel and which has receptacles for load connections, provide an SO cord with attachment cap. Provide strain relief connector with rubber bushing at penetration of the control panel enclosure wall.

2.12 FACTORY WIRING

A. Wire Type:
1. Internal AC Wire: MTW, THHN, THWN.
2. Analog Signal Wire: TWSH.
3. Other DC wire: TWSH, MTW, THHN, THWN.

B. Color Coding:
1. Neutral: White; ground: green.
2. 480V phases: Brown, orange, yellow (A, B, C, respectively).
3. 120/240V that is controlled by the panel: Black, blue.
4. 120/208V that is controlled by the panel: Black, blue, violet (A, B, C, respectively).
5. 120V that is used in control circuits:
    a. Where derived from a control power transformer in the panel whose primary is disconnected by an overcurrent device handle on the panel that is interlocked with the door: red.
    b. Foreign source: yellow.
6. 24VDC: TWSH as required in Section 26 05 19 – Low Voltage Wire and Cables.

C. Except where fuses are shown on the Drawings, provide DIN-rail mounted circuit breakers (not shown on Drawings) for AC power to all devices requiring AC power.

D. Provide multiple TB points and route wire such that removing the power wiring to any given device does not interrupt HOT or NEUTRAL to any other device.

E. Do not make connections by means of wire nuts or other similar means of splicing. If a component is factory equipped with integral leads, provide terminal boards nearby rather than splicing onto the leads.

F. Make field connections to panels onto terminal boards, not to devices. Provide 25 percent spare terminals.

G. Label each terminal board.

H. Mark each terminal board (TB) point. Use numbering as shown on Drawings. Where not shown on Drawings, assign a logical number, submit to Engineer for review. Show all numbering on submittals.

I. Mark Each Wire End as Follows:
1. Control conductors associated with MCC: Mark each conductor with tag number appended with MCC terminal point (i.e., M7101-X2).
2. Control conductors not associated with MCC: Mark each conductor with tag number and terminal board number. If conductor is routed between two devices without going to a terminal board, mark wire with tag number and an arbitrary number not used on terminal block.
3. Instrumentation (all ends of complete run of all digital and analog inputs and outputs to/from PLC whether in PLC, integrated control panels, termination panels, MCC, local control panels, or field device): Tag number. Also use black wire for + (plus) polarity and white for - (minus).
4. Show all wire numbering on submittals.
5. Marking method: Section 26 05 19 – Low Voltage Wire and Cables.

J. Install wiring in plastic wiring duct.

K. Route DC wiring minimum 3” separated from AC wiring.

L. Route analog wiring separately from all other wiring except DC Digital Inputs (DI).

M. Where wiring crosses a hinge or other flex point, bundle wires with plastic spiral wrap so bundles twist in a direction roughly parallel to hinge pin rather than folding or flexing perpendicular to hinged panel or door.

2.13 TRANSIENT VOLTAGE SURGE SUPRESSORS: SINE WAVE TRACKING, 120VAC SINGLE PHASE, DIN RAIL MOUNT

A. UL labeled, showing compliance with UL 1449, Third Edition.

B. Features:
1. Protection modes: Line to neutral, line to ground, and neutral to ground.
2. Green LED Status indicator and form C alarm contact.

3. Sine wave tracking.
4. Thermal fusing to prevent MOV overheating.

C. Ratings:
1. Nominal Voltage: 120 volt, 1 phase, 3 wire.
2. Continuous current rating: 20 A.
3. UL 1449, Third Edition, Suppressor Classification, 120 VAC normal/common mode: 400 VAC.
4. Minimum peak surge current capability (8 X 20 microsecond):
   a. Line to neutral: 10 kA.
   b. Line to ground: 20 kA.
   c. Neutral to ground: 10 kA.
5. Noise attenuation per UL 1283:
   a. Normal mode: 50 dB, minimum.
   b. Common mode: 40 dB, minimum.
   c. Let-through voltage of not more than 50 volts above the sine wave for Category A1 Ringwave and not more than 500 volts L-N/900 volts L(N)-GND for a B3/C1 Impulse Wave.
6. Maximum Continuous Operating Voltage (MCOV): 150 volts RMS. Control power transformers do not closely regulate the secondary voltage. Therefore, suppressors with lower MCOV may not function properly to protect these circuits.

D. Environmental:
1. Temperature: minus 40 degrees C to plus 60 degrees C.
2. Humidity: 0% to 95%, non-condensing.

E. Physical:
1. Steel case which mounts on 35mm DIN rail conforming to DIN EN 50022.
2. Easily accessible, front-mounted screw terminals.
   a. Line side: Hot, Neutral, Ground.
   b. Load side: Hot, Neutral, Ground.
   c. Three for form C alarm contact.

F. Warranty: 10 years.

G. Phoenix Contact (www.phoenixcon.com) SFP SPD, Sola/Hevi-Duty (www.solaheviduty.com) STV25K-10S, or Engineer reviewed equivalent.

H. May or may not be shown on Drawings. Show in submittal drawings.

I. Install on each incoming AC circuit that is used for input to DC power supplies and/or other AC powered components, such as recorders.

J. Not required for:
1. Circuits which are not used for power in the panel, such as those switched to control a motor and those used as digital inputs.
2. Lighting, convenience receptacle, fans, heat exchangers.

2.14 DC CURRENT LOOP SPD (DCCL SPD)

A. SPD Proper:
1. Listed under UL 497B.
2. Two part design:
   a. Base terminal block which mounts to DIN rail.
   b. Plug-in surge protection module. Replacing a module shall not require the removal of any wires nor shall it interrupt the signal.
   c. Provide keying between base and plug to make sure that only the correct protection module will fit in the base.
3. Wiring points and plug connections: "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529.
4. Maximum Continuous Operating Voltage (MCOV): 28 V DC.
5. Surge protection module: multistage hybrid circuit with staging inductors or resistors to properly coordinate the components; nominal resistance 10 ohms.
6. Rated continuous operating current: 450 mA.
7. Withstand a 10 kA test current of a 8/20 microsecond waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 Category C Area.
8. Measured Response Time:
   a. L-L: Maximum 1 nanosecond
   b. L-GND: Maximum 100 nanoseconds
   c. Phoenix Contact PT Series, Edco PC-642 Series, or Engineer reviewed substitute.

B. Accessories:
1. 35mm DIN rail conforming to DIN EN 50022.
2. Terminal blocks for grounding of DCCL SPD.
3. Terminal block for carrying shield through ungrounded.
4. End stops; markers; nameplates.

C. Provide positive grounding of SPD assembly as follows:
1. Scrape the pan at the mounting points beneath the rail for good contact and bond the pan to the enclosure ground bar as specified above for the shield ground bar, using green #10 THWN at two places.
2. Attach a green/yellow ground terminal block to the rail and bond the rail to the enclosure ground bar with 2 #12.
3. Make no sharp bends in grounding conductors.

D. Be careful to install field conductors on the field side of the DCCL SPD and equipment conductors on the equipment side. Orient the DCCL SPD so field and equipment pairs do not touch each other.

E. Mark the SPD assembly and the terminal points on the DCCL SPD as required for terminal boards and terminal board points under Section 26 27 27 - Wire Connectors and Accessories.

F. The Drawings and/or the Tag List show field DCCL SPD. Provide all such SPD under this Section for field installation, in enclosures, and complying with the installation requirements above.

G. For each loop which has a field DCCL SPD, provide one in the control panel for that loop, whether shown on the Drawings or not. Show field and panel-mounted devices in submittal drawings.

H. DCCL SPD which are not part of a larger control panel and/or not detailed elsewhere:
1. NEMA 4X SS enclosure with bare SS mounting pan.
2. Connect the SPD grounding screws to the ground bar (if present in the enclosure), a conduit bonding clamp (if lacking a ground bar), or other solidly grounded point (if lacking the previous grounds) with green #10 THWN. Make no sharp bends in grounding conductors.
3. Also comply with the requirements of paragraphs B. through E., above.

2.15 OVERCURRENT AND SHORT CIRCUIT PROTECTION

A. Fuses:
1. Section 26 28 13 – Low Voltage Fuses.
2. Use only:
   a. Where called for on the Drawings.
   b. Where recommended by the manufacturer of a specific piece of load equipment.
   c. If required in order to facilitate UL listing of panel.

B. AC Circuit Breakers:
1. Listed/labeled under UL 489 with 10kA interrupt rating at 120V AC.
2. 120/240V AC, 60 Hertz. Do not use for DC circuits.
3. DIN rail mount; toggle for On/Off/Reset; available in 1, 2, and 3 pole.
4. Trip-free thermal-magnetic trip unit with time/current characteristics:
   a. 50 to 100 seconds at 2 times rated current.
   b. 3 to 10 seconds at 5 times rated current.
   c. Instantaneous at 8 to 10 times rated current.
5. ABB S200U series, or equivalent.

C. DC Circuit Breakers:
1. UL Recognized component with UL 1077 2kA interrupt rating at 65VDC.
2. Use for 24VDC applications only.
3. DIN rail mount; toggle for On/Off/Reset; use only single pole breakers.
4. Trip-free thermal-magnetic trip unit with time/current characteristics:
   a. 20 to 150 seconds at 1.5 times current.
   b. Instantaneous at 2 to 4 times rated current.
5. Phoenix Contact TMC-1 series, or equivalent.

D. Provide circuit breakers where shown on the Drawings. Also provide other breakers, as follows, which are typically not shown in the Drawings. Show in submittals drawings.
   1. DC circuit breaker, 0.2A, in the source for each 4-20 mA analog loop which is powered from a control panel. Mount CB on the DIN rail adjacent to the respective DCCL SPD assembly.
   2. AC circuit breaker of appropriate size for each AC device in a control panel, such as on the input of a DC power supply.

2.16 FACTORY TEST

A. Perform a factory test on each control panel.

B. Perform tests required for compliance with UL standards.

C. Verify correct calibration of all analog instruments and indicators.

D. Test complete hardware system including relays, timers, hand controls, indicators, instruments, and other active components.

E. For PLC Type Control Panels:
   1. Verify that opening and closing system inputs activates the correct PLC points.
   2. Verify that simulated operation of PLC outputs produces the correct hardware actions.
   3. Test all software to verify that it functions as specified.

F. Verify correct communications with the operator interface system. Verify correct operation of software in conjunction with PLC software.

G. Verify that telemetry hardware and radios function properly.

H. Record test results and submit prior to installation of panel in field.

2.17 FACTORY WITNESS TEST

A. First complete Factory Test above and have test reports available, then conduct witness test for representative(s) of Owner. Demonstrate correct operation of all hardware and software.

B. For PLC type control panels, provide hours as scheduled for possible software changes requested by representative of Owner. Change all affected documentation, including markups of the sequence of operation and use updated versions of documentation during field testing. Document software modification time as it is being used. Include hours required for subsequent coordinated change to other documentation and to preparation of finished copies in the Bid as incidental to the time spent making the actual software changes.

C. Arrange the witness test with the Engineer in advance of desired date. For number of days see the Schedule.

PART 3 EXECUTION

3.01 FIELD WIRING

A. Color code field wire as shown on the Drawings. If not shown on the Drawings then color code the same as internal wire if possible.

B. Mark each field wire end except on twisted, shielded pairs, mark jacket, not individual wires.
   1. Text: As shown on submittals.
   2. Method: Section 26 05 19 – Low Voltage Wire and Cables.

3.02 FIELD SERVICE REPRESENTATIVE

A. For purposes of this Section, provide a field service representative who is currently certified as a Certified Control Systems Technician, Level 3, by the National Institute for Certification in Engineering Technologies. The requirements of Section 01 75 01 - Field Service Representative, also still apply.

B. "Panel" is used as singular in the below requirements. If more than one control panel is furnished under this section, interpret "panel" as being plural.

C. If so scheduled, furnish the services of a field service representative to provide services during construction.
   1. Assist installation personnel with technical questions.
   2. Verify that control panel is installed in accordance with the factory recommendations.
   3. Verify that field connections are properly made to control panel.
   4. Provide other services as and if specified in Section 40 80 03 – Process Control Commissioning, Section 40 80 10 – Installation, Testing, and Calibration of Instrumentation, and Section 40 80 20 – Installation and Testing of Control Circuits and Devices.

D. If so scheduled, furnish the services of a field service representative to provide testing services.
   1. Assist in field test of control panel.
   2. Provide other services as and if specified in Section 40 80 03 – Process Control Commissioning, Section 40 80 10 – Installation, Testing, and Calibration of Instrumentation, and Section 40 80 20 – Installation and Testing of Control Circuits and Devices.
   3. Other testing as scheduled.
   4. Provide a written report, certifying that all equipment is properly installed, fully functional, and ready for use.

E. If so scheduled, furnish the services of a field service representative for one trip to the field for operational assistance.
   1. Trip is in addition to other trips required for testing, startup, demonstrations, field programming, or warranty work.
   2. Make trip approximately 8 calendar weeks after beneficial occupancy or as otherwise shown in the schedule.
   3. Provide the minimum number hours of services on-site shown in the schedule.
   4. Besides the hours on-site, provide sufficient additional man-hours as needed for updates to all affected documentation. Resubmit affected documentation.
   5. Provide services from the following list as directed by the Engineer at the time of the trip:
      a. Additional training for panel with a PLC.
      b. Additional training for panel with an OIU.
      c. Additional training for stand-alone OIU.
      d. Software modifications for PLC.
      e. Software modifications for OIU.

3.03 SCHEDULE

A. Provide control panels, including, but not limited to, the following, that comply with this section, with related sections, and with the Drawings. Certain panels may be specified to be furnished under process equipment specification sections, as noted below. All such panels are required to meet the requirements of this Section.

EQUIPMENT NAME	NEMA ENCL. TYPE	AMB. TEMP. DEG C	COOLER REQ'D?	OIP REQ'D?	WINDOW REQ'D?	WITNESS TEST REQ'D?
*Lift Station Interim Controller (LSIC) Control Panel	4X SS	42	NO	NO	NO	NO
LSCP Lift Station Control Panel	4X SS	42	NO	NO	NO	NO
Transmit Radio Panel (TRP)	4X	42	NO	NO	NO	NO
Receive Radio Panel (RRP)	4X	42	NO	NO	NO	NO

*Provided under Section 44 42 56.18 – Submersible Sewage Pumps for temporary control of pump station during fabrication of LSCP.

B. Factory Witness is required:
   1. Arrange schedule with Engineer minimum 6 working days in advance.

C. Provide services during construction.

D. Provide testing services.

E. Provide 8 hours of on-site operational assistance.

F. Provide 12 hours of other remote assistance during the warranty period.

END OF SECTION

SECTION 40 95 43.10

CONTROL HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control hardware: switches, pushbuttons, indicator lights, relays, timers, photoelectric cells, and diodes.

1.02 SYSTEM DESCRIPTION

A. If a component is shown on the Drawings but is not fully identified, and it is reasonable to use one of the components below, then submit as such. If no description is applicable, submit a first class product of a reputable manufacturer.

B. Components of certain equipment are specified under the specification for that equipment and shall be supplied as required.

1.03 SUBMITTALS

A. Catalog cuts. Duplicate submittals of cuts for different applications are not required.

B. Combine with Submittals for Section 40 90 00 – Plant Control System, or Section 40 95 13.23 – Control Panels.

PART 2 PRODUCTS

2.01 SEALED CONTACT SWITCHES AND PUSHBUTTONS

A. Contacts: Hermetically sealed glass reed with NEMA B600 and P300 ratings.

B. Enclosures, operators, contact blocks, legend plates, engraved nameplates, hardware and accessories: Corrosion resistant.

C. All stop pushbuttons shall be lockout type.

D. Enclosures:
1. Class I, Division 1, Class I, Division 2, and Process areas: NEMA 4X.
2. Non-Process Indoor areas: NEMA 12.
3. As shown on Drawings.

E. Operators: NEMA 4X where mounted in NEMA 4X enclosures; NEMA 13 where mounted in NEMA 12 enclosures or control panels.

F. Allen-Bradley Bulletin 800R for 4X application; Bulletin 800T for NEMA 13; or Engineer-approved equivalent.

2.02 LED PILOT LIGHTS

A. High brightness light emitting diode with cartridge holder.

B. Complete with current limiting resistor suitable for DC supply voltage and 400 PRV diode to block reverse voltage.

C. Lighted Pushbuttons or Switches: Not acceptable.

D. Push-to-test type unless specifically shown otherwise on Drawings. Push-to-test wiring may not be shown on schematics.

E. Enclosures:
1. Class I, Division 1 and Class I, Division 2 areas: Copper-free, cast aluminum, NEMA 7.
2. Process areas: NEMA 4X.
3. Non-Process Indoor areas: NEMA 12.
4. As shown on Drawings.

F. Devices:
1. NEMA 7 where mounted in NEMA 7 enclosures.
2. NEMA 4X where mounted in NEMA 4X enclosures.
3. NEMA 12 where mounted in NEMA 12 enclosures.

G. Allen-Bradley Bulletin 800H for 7 or 4X application; Bulletin 800T for NEMA 12 application; or Engineer approved equivalent.

2.03 MINIATURE PLUG-IN RELAY

A. Contacts:
1. SPDT or DPDT as shown on the Drawings.
2. Pilot duty rating: NEMA B300.
3. Rated thermal current: single pole = 10 A; double pole = 5 A.
4. Rated insulation voltage: 250V IEC; 300V UL/CSA.
5. Single pole 120 V AC single phase inductive rating: Make 30 A; Break 3 A; 1/3 HP.
6. Double pole 240 V AC single phase inductive rating: Make 15 A; Break 1.5 A; ½ HP.
7. Make, break, and continuous at 30 V DC: single pole = 10 A; double pole = 5 A.

B. Coil:
1. Nominal 60 Hertz AC coil voltages available: 6, 12, 24, 120, 240 V AC.
2. Nominal DC coil voltages available: 6, 12, 24, 48, 110 V DC.
3. Permissible coil voltage variation:
   a. 85…110% of nominal voltage at 60 Hertz.

b. 80…110% of nominal voltage at DC.

4. Maximum AC power consumption: 1.2 VA.
5. Maximum DC power consumption: 0.53 W.

C. Dielectric withstand voltage: pole to pole or pole to coil => 1500 V AC RMS.

D. Mechanical life operations: minimum 5 million.

E. Switching frequency operations: 1800 per hour.

F. Operating time at nominal voltage at 20 degrees C: pickup = 15 milliseconds; dropout = 15 milliseconds.

G. Environmental:
1. Operating temperature: minus 30 to plus 55 degrees C.
2. Altitude: 2000 meters.

H. Construction:
1. Insulating material: molded high dielectric material.
2. Enclosure: transparent dust cover.
3. Contact material: silver-cadmium oxide.

I. Socket:
1. Screw terminal, DIN-mount.

J. Allen Bradley Bulletin 700 HK with HN socket or Engineer reviewed equal.

K. Use for programmable logic controller output interposing relays except where higher contact current ratings are required.

L. If input interposing relays are used, then use either the above relay or Allen-Bradley Bulletin 700-HL Terminal Board Relays.

2.04 HEAVY DUTY RELAY

A. 600V, industrial type.

B. Contacts: Field convertible by inverting plug-in contact module with captive terminal clamp screws.

C. Contact Rating:
1. Minimum: 7200VA make, 720VA break, 10A continuous.
2. Provide 20A contacts where required on the Drawings.

D. Contact Arrangements: As shown on the Drawings.

E. GE Type CR120B or Engineer approved equivalent.

2.05 PHOTOCELLS

A. Base: Molded phenolic, 3 inch skirt.

B. Dome: Aluminum color (unpainted) translucent tenite butyrate.

C. Contacts: NC, 1500W.

D. Cadmium Sulfide Cell: 1 inch diameter hermetically sealed glass to steel, dissipation power greater than twice demand.

E. Surge Protection: 60 degrees C. sparkover - 1500V rms. Critical impulse sparkover: voltage discharge: 10,000A, 1-1/2 to 40 ms wave 2,000V.

F. Time Delay: 15 seconds or more.

G. Temperature Range: Minus 50 to plus 60 degrees C.

H. Operational Level: Factory preset for 3 footcandles. ON/OFF ratio: 1:2.

I. Low profile.

J. 120 Volt: Tork 2003 or Engineer approved equivalent. 208/277 Volt: Tork 2004 or Engineer approved equivalent.

2.06 DIODES

A. Continuous current: 1A.

B. Ifsm: 30A.

C. PRV: 400V.

D. 1N4004.

E. Factory install on the coil terminals of each DC relay, whether shown on the Drawings or not.

PART 3 EXECUTION

3.01 MOUNTING OF SWITCHES AND PILOT LIGHTS

A. On control panel where so shown on detail or implied by schematic.

B. On wall if sufficiently close to controlled equipment or control point.

C. On unistrut bolted to floor or bolted to side of pump base.

D. Location subject to approval of Engineer.

E. Support enclosure independent of conduit.

3.02 MARKING

A. Switches, pilot lights, and other components mounted in/on a control panel: Mark as required in Section 40 95 13.23 – Control Panels.

B. Switches and pilot light not mounted in/on a control panel: engraved nameplate (NP) on or adjacent to enclosure.

C. Other components, such as relays, timers, time clocks:
   1. Engraved NP on the face of the enclosure.
   2. If more than one such component in an enclosure: engraved NP inside the enclosure adjacent to each component.

D. Text:
   1. As shown on Drawings.
   2. If not shown on Drawings, use name and tag number of associated process equipment.

END OF SECTION

SECTION 40 95 60

DC POWER SUPPLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. DC power supplies.

B. DC uninterruptible power supplies/Buffer Modules.

1.02 SUBMITTALS

A. Make combined submittal as part of a larger assembly, such as a control panel with a programmable logic controller.

B. Manufacturer's literature.

C. Battery literature (if applicable).

D. Complete model number.

PART 2 PRODUCTS

2.01 DC POWER SUPPLIES

A. Safety and Performance Requirements:
1. Listed under UL Standard 508.
2. EMC & Noise Emission Directives EN61000-6-2 and EN50081-2
3. CE EMC Directive 89/336/EEC
4. CE LVD Directives 73/23/EEC
5. MTBF greater than 500,000 hours in accordance with IEC 61709 (SN 29500)

B. Housing: IP20, fully enclosed metal housing.

C. Terminations: Plug connection with no exposed live voltage in accordance with IEC 529.

D. Mounting: 35mm DIN-rail conforming to DIN EN 50022.

E. Input Voltage: 85 to 264V AC, 47 to 63 HZ.

F. Operating Temperature Range: -25 degrees C to +60 degrees C.

G. Output current rating for this project:
1. Calculate worst-case load.
2. Furnish model with 60 degrees C current rating of 1.33 times worst-case load.

H. Typical Efficiency: Power Supplies shall have an efficiency of at least 80% with high efficiency models (~90%) available. Voltage adjustment capability:
   1. Nominal 12VDC supply: 12 to 14VDC.
   2. Nominal 24VDC supply: 18 V DC ... 29.5 V DC (> 24 V constant capacity. Output voltage fluctuation: Less than +/- 2% overall (combination line, load, time and temperature-related changes).

I. Residual ripple shall not exceed 100 mV peak-to-peak at nominal current values. Input over-voltage protection: 105%.

J. Inrush Current: 40A maximum.

K. Termination:
   1. Finger-safe in accordance with IEC 529 (EN 60529: 1991).
   2. Wires shall be attached to the power supplies by means of a cable-clamping terminal block activated by a screw or a bi-stable spring clamp. Connections shall be gas-tight, and the terminal block shall be fabricated of non-ferrous, non-corrosive materials.

L. Dielectric Withstand Strength (Insulation Voltage):
   1. Between input and output terminals: Minimum 3,000V AC, 1 minute.
   2. Between input terminals and housing: Minimum 2,000V AC, 1 minute.
   3. Between output terminal and housing: Minimum 500V DC, 1 minute.

M. Status Indication:
   1. Contact for remote indication of failure if input supply power is lost.
   2. “DC Power OK” LED.

N. Ability to limit DC current in case of short circuit or overload event.

O. Thermal Magnetic Circuit Breakers: When used, breakers shall be of selective fuse-breaking technology.

P. Parallel mode operation without external circuitry.

Q. Warranty: Five (5) years.

R. Phoenix Contact QUINT Series, (Third Generation with SFB), PULS Dimension QS Series, or Engineer reviewed equivalent.

2.02 DC UNINTERRUPTIBLE POWER SUPPLIES/BUFFER MODULES

A. General:
   1. DC UPS and buffer modules shall be fully enclosed, and provide screw terminations. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger, in accordance with IEC 529.
   2. Housing : IP20 (minimum).

3. Battery backup time period: Selectable using a switch on the front UPS.
4. MTBF: >500,000 hours according to IEC 1709.
5. Vibration Shock: 30G in all space directions in accordance with IEC 68-2-27 and vibration up to 2.3G 90 min. (<15hz, amplitude = +/-2.5mm/15-150hz) according to IEC 68-2-6.
6. Efficiency: > 95%
7. Electronic short circuit protection on DC output.

B. Mounting:
1. 35mm DIN-rail conforming to DIN EN50022.
2. Battery modules: Metal foot attached to 35mm DIN-rail or tabs that allow for a panel mount configuration.

C. Wire Connections:
1. Cable-clamping terminal block activated by a screw.
2. Fabricated with non-ferrous, non-corrosive materials.

D. Status Indication:
1. "DC Power In OK" LED.
2. Dry contact for “Alarm” status indicating backup period expired, battery presence, and battery quality (UPS only).
3. “Battery Mode” LED indicating where operating on batteries (UPS only).
4. “Battery Charge” display to indicate whether the battery is charging or not (UPS only).

E. UPS Equipment:
1. Be of an intelligent design that facilitates communication between the DC UPS and Battery.
2. Automatic battery presence check once every 60 seconds.
3. Automatic battery quality check once every 180 hours.
4. Batteries:
   a. Maintenance-free, valve-regulated lead-acid.
   b. Hot swappable.
   c. Accepts up to five 1.3AH to 38AH batteries wired in parallel and will not require external circuitry.
   d. Individually fused.
5. Temperature-compensated battery charging.
6. Must be able to indicate current charge level of the connected battery module(s).
7. Must be able to indicate the remaining amount of runtime while in battery backup operation.
8. Must be able to indicate the remaining working lifespan of the battery module(s) before replacement.
9. Configurable parameters through PC Software.
10. Capable of providing up to 150% of its rated output current.

F. Warranty: Five (5) years.

G. DC UPS:
   1. Phoenix Contact QUINT-UPS-IQ series, PULS U-Series DC-UPS, or other Engineer reviewed equivalent.

H. Buffer Modules (40A):
   1. Phoenix Contact QUINT Power, model series QUINT-UPS/24DC/24/DC40 amp, P/N 23 20 24 1, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 SCHEDULE

A. DC UPS required at: Tank Site 1, Tank Site 2, Old Ranch RD BS, and Well Site 9.

B. Program output of DC UPS to alarm when batteries require replacement.

C. Programming software to be delivered to Owner upon completion of the project.

END OF SECTION

SECTION 40 96 20

PLANT PROCESS CONTROL TAG LIST

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tag List.

1.02 SUBMITTALS

A. The Engineer will furnish the Tag List to the Contractor in Excel™ format upon request.

B. Add columns to the file to show programmable logic controller (PLC) input and output (I/O) point assignments. Initially submit in paper format.

C. After the submittal is accepted, furnish a copy of the Excel™ file to the Engineer in Excel™ format.

D. Maintain the Tag List so it is current with changes made during construction. In the header or footer place “Record Version” or similar.

E. Submit paper and electronic copies of the final Record Version.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 MINIMUM REQUIREMENTS

A. The instruments, points, tags, inputs, outputs, and similar shown on the appended Tag List are minimum requirements. Provide others as shown on the Drawings. Provide additional spare inputs and outputs as specified in the control system hardware specification.

END OF SECTION

SECTION 41 22 00

HOISTS AND CRANES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install various types of lifting equipment including hoists, jib cranes, hangers, and sockets at locations shown on Drawings.

1.02 RELATED SECTIONS

A. Section 05 50 01 – Anchor Bolts and Chemical Anchors

1.03 QUALITY ASSURANCE

A. Acceptable Manufacturers:
1. Thern, Inc.
2. R&M Materials Handling, Inc.
3. Hoist and Crane Div. of Robbins and Myers, Inc.
4. Chissom Moore, CM Hoist Div. of Columbus McKinnon Corp "CM"
5. ACCO Industries Inc., Hoist and Crane Division
6. Spanco, Inc.
7. Chester Hoist
8. Gorbel
9. Yale
10. Or Engineer reviewed equivalent.

B. Erector Qualifications:
1. Licensed New Mexico Contractor with appropriate classification to work on overhead crane and hoist systems.
2. Regularly engaged in hoist and crane erecting.
3. Acceptable to manufacturer.

C. Requirements of Regulatory Agencies:
1. OSHA Standards, Subpart N – Materials Handling and Storage, 29 CFR 1910.179 – Overhead and Gantry Cranes
2. Obtain all necessary inspections and certifications.

D. Reference Standards:
1. ANSI B30.11: Monorail Systems and Underhung Cranes
2. ANSI B30.17: Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
3. ANSI B30.2.0: Safety Code for Overhead and Gantry Cranes

4. ANSI MH27.1: Patented Track Underhung Cranes and Monorail Systems – Specifications
5. CMAA (Crane Manufacturers Association of America, Affiliate of Material Handling Industry of America). Specification #74 – Top Running and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist.

E. Standardization: All hoists, trolley, jib cranes, and bridge cranes supplied by a single supplier unless otherwise specifically approved in writing by Engineer.

1.04 SUBMITTALS

A. Product Data: Section 01 33 23 – Shop Drawings, Product Data, and Samples.
1. Sufficient data to verify compliance with specifications.
2. Outline and installation drawings.
3. Data describing materials used, parts, devices, rails, stops, and other accessories.

B. Copies of all required inspection reports, certificates, and load test reports.

C. Operation and Maintenance Manuals: Section 01 78 23 – Operation and Maintenance Data.

1.05 TRAINING FOR OWNER'S PERSONNEL

A. Section 01 79 01 – Manufacturer's Instruction of Owner's Personnel.

1.06 COORDINATION

A. Coordinate with the work of other trades who are furnishing structural supports for bridge crane support rails and/or monorails.

PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Schedule.

2.02 MATERIALS

A. Bridge Crane Truck and Trolley Wheels: Forged steel or cast iron with hardened tread.

B. Axles: Steel

C. Gearing:
   1. General: Steel or cast iron.
   2. Pinions: Heat treated alloy steel.

D. Bearings: Antifriction, oil lubricated or permanently grease-packed.

E. Cable: Improved plow steel.

F. Lifting Hook: Forged steel with safety latch.

G. Chain:
   1. Load Chain: Zinc plated carbon steel.
   2. Hand Chain: Aluminum

2.03 FABRICATION AND MANUFACTURE

A. General: Comply with MMA standards and HMI No. 100 except as specified herein.

B. Trolley:
   1. Hand operated with chain unless otherwise scheduled.
   2. Geared type.
   3. Capacity: See schedule.
   4. Factory labeled per OSHA requirements.

C. Hoists:
   1. Hand Operated Chain Hoists:
      a. 85 lb. maximum pull.
      b. Lifting chain: nickel-plated carbon steel.
   2. Lifting height: See schedule.
   3. Capacity: See schedule.
   4. Low head type unless otherwise scheduled.
   5. Factory labeled per OSHA requirements.
   6. All chain hoists furnished with bucket for storing chain.

D. Jib Cranes:
   1. Jib crane and associated hoist and trolley to be furnished by single manufacturer.
   2. Mast support and anchorage as indicated on Drawings.
   3. Capacity and other requirements: See schedule.
   4. Factory labeled per OSHA requirements.
   5. Free standing base mounted unless otherwise scheduled.
   6. Upper roller assembly radial and thrust bearings: Re-greasable self-aligning tapered roller bearings.

E. Bumpers and Stops: As indicated on Drawings and/or as required to provide a complete, safe, ready to use system.

F. Rails and Girders: Monorails, jib crane hoist rails, bridge crane runway rail beams, and bridge crane main girder are to be nominal dimensions shown on Drawings unless otherwise approved by Engineer; proper rail sizing is responsibility of hoist manufacturer. Install rails in accordance with CMAA specifications.

PART 3 EXECUTION

3.01 ERECTION

A. Erect in accordance with manufacturer's instructions.

B. Complete ready to use installation.

3.02 TESTING

A. Perform initial operational testing in accordance with OSHA standards.
   1. Perform load test at 125 percent of rated load of equipment in conformance with OSHA 1910.179.

3.03 SITE CONDITIONS:

A. Site Elevation: 4960 feet.

3.04 SCHEDULE

A. Jib Hoist for Pump Station:
   1. Type: Portable davit crane with adjustable boom and hand winch.
   2. Boom: Height and reach adjustable with ratchet style screw jack and telescoping boom, 360 degree crane rotation.
   3. Capacity:
      a. 500 lb. minimum for 54-inch boom reach
   4. Winch: Spur gear, brake.
   5. Hook: Swivel type, drop-forged type 304 stainless steel.
   6. Hook Reach: 28" to 54".
   7. Hook Height Above Base Level: 36" to 66".
   8. Lift Below Base Level: 18'.
   9. Material: Type 304 stainless steel boom, mast, and base.
   10. Cable: Type 304 stainless steel.
   11. Mounting: Wall mounted base, 16" square, with through bolts and backing plate as shown on the Drawings.
   12. Design Basis: Equivalent to Thern Commander Series Model 5PT10.
   13. Location: Outdoors.

14. Quantity: One (1) portable davit crane, two (2) wall mount base mounted with through bolts and backing plate as shown on the Drawings.

END OF SECTION

SECTION 44 42 56.18

SUBMERSIBLE SEWAGE PUMPS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Submersible pumps and related accessories for Plant Drain Lift Station.

B. The facilities have been designed to accommodate Flygt pumps as the design basis. All changes or alterations to facilities which are needed to accommodate another pump manufacturer shall be included as work under this specification.

1.02 RELATED WORK

A. Section 26 04 20 – Three Phase Motors

1.03 REFERENCES

A. Hydraulic Institute Standards

B. National Electric Code Standards

1.04 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples:
1. Product data
2. Performance curves, pump and motor
3. Materials of construction
4. Dimensioned pump outline drawings and weights
5. Lift station drawing for accessories
6. Motor drive data
7. Electrical control and power diagrams
8. Written description of control sequence
9. Access cover drawing
10. Warranty
11. Installation instructions

B. Section 01 78 23 – Operation and Maintenance Data

C. Section 01 79 01 – Manufacturer’s Instruction of Owner’s Personnel

D. Certification that Installation is Ready to Use: Part 3 herein

1.05 CONTROL SYSTEM

A. Provide all necessary instrumentation, controls, control panel, and equipment as shown on the Drawings and specified herein.

1.06 QUALITY ASSURANCE

A. Factory Tests: The pump manufacturer shall perform the following inspections and tests on each pump before shipment:
   1. An insulation test of the windings,
   2. A test of the pump motor (run dry for 5 minutes at full load) to check electrical data measurements,
   3. A submerged test of the pump to establish correct rotation and mechanical integrity,
   4. A motor and cable insulation test for moisture content and insulation defects, and
   5. A check of impeller, motor rating, and electrical connections for compliance with purchase order.

B. Manufacturer shall have a local representative located within 200 miles of the jobsite, who shall have been appointed by the manufacturer three (3) years prior to bid date, who maintains a factory-authorized service/repair facility staffed with factory-trained mechanics, stocked with a minimum of $100,000 inventory of manufacturer's repair parts and supported with service trucks, fitted with lifting cranes for jobsite service.

1.07 WARRANTIES

A. In printed form, and apply to all similar units.

B. The manufacturer shall provide a written warranty as standard covering workmanship and defects in materials for a period of five (5) years from date of Substantial Completion. The warranty shall cover parts, labor, and return freight as follows: 1-18 months – 100%, 19-39 months – 50%, 40-60 months – 25%.

C. The warranty does not excuse the Owner from performing scheduled routine preventative maintenance. The Owner shall be required to maintain scheduled service maintenance records for all warranted equipment. The manufacturer shall repair or replace, at its discretion, any warranted equipment that fails within the warranty period. The manufacturer shall not be responsible for equipment damage resulting from misuse, abuse, improper installation or storage, failure to perform or schedule routine preventative maintenance, defective power supply, improper electrical protection, tampering, or the like. The warranty does not include the cost for normal wear and maintenance items and/or parts.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Flygt

B. Or Engineer reviewed equivalent.

C. All pumps specified in this Section by same manufacturer.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Schedule.

2.03 PUMP MATERIALS

A. Volute, Motor Housing, Discharge Elbow, and Other: Gray cast iron ASTM A-48, Class 35 B, with smooth surfaces devoid of blow holes or other casting irregularities.

B. Shaft:
1. Mid Range pumps (12 – 160 hp)_ASTM A479 S43100-T Stainless steel
2. Small range pumps (up to 11 hp), ANSI 431 stainless steel
3. Stainless steel sleeves covering shafting constructed of lesser materials are not acceptable.

C. Motor:
1. Rotor Bars and Short Circuit Rings: Aluminum.
2. Stator Winding and Lead Insulation: Class H monomer-free polyester resin.

D. Mechanical Seal: Tandem seals with all seal faces to be abrasion and corrosion resistant solid sintered tungsten carbide featuring a nickel binder to cement tungsten-carbide particles together during sintering.

E. N Impeller and Volute Insert
1. Standard N impeller: ASTM A-48, Class 35B gray iron, with leading edges of the gray iron impeller hardened to Rc 45.
2. Hard Iron N impeller (if listed in schedule): ASTM A-532 25% chrome cast iron, Alloy IIIA), with the leading edges of the impeller hardened to Rc 60.

F. C impeller: ASTM A-48, Gray cast iron, Class 35B.

G. Wear Rings: Required if C-impeller scheduled.
1. Case Wear Ring: Nitrile rubber molded with steel ring insert.
2. Impeller Wear Ring on 20 Horsepower or Larger Pumps: ANSI 304 SS.

H. Exposed Nuts and Bolts: Type 304 stainless steel.

I. Guide Bars and Guide Bar Brackets: Type 304 stainless steel.

2.04 PUMP CONSTRUCTION

A. Water Tight Sealings: Nitrile rubber O-rings against machined surfaces.

B. Cable Entry Design:
1. Junction chamber to be sealed from motor by a non-hydroscopic, feed through type terminal board and elastomer compression seal.
2. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal.
3. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter.
4. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function.
5. The assembly shall provide ease of changing the cable when necessary using the same entry seal.
6. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top.
7. Epoxies, silicones, or other secondary sealing systems will not be considered equal.
8. Seal: Torque-free mechanical compression type with strain relief (epoxies, silicones or other secondary sealing not acceptable), single grommet type to 11 HP, and double grommet above 11 HP.
9. Junction chamber to be sealed from motor by a non-hydroscopic, feed through type terminal board and elastomer compression seal.

C. Pump Motor:
1. Air filled, NEMA B design, squirrel cage induction type, housed in air-filled watertight chamber.
   a. Stator to be insulated by trickle impregnation to achieve a minimum 95% winding fill factor using monomer free polyester Class H resin rated for 180-deg C (356-deg F) with winding fill factor of at least 95%, and heat shrink fitted into the stator housing (designs requiring penetration of stator housing are not allowed).
2. Sensors:
   a. Pumps 3 to 10 HP: Equipped with winding over-temperature switch in each phase. Set to open at a maximum of 140^{o}C.
   b. Pumps 12 to 105 HP: Equipped with winding thermal sensors and a float switch in the motor housing to detect presence of moisture or oil. Also furnish a control and status monitor (miniCAS) located in the control panel and wired to the pump to monitor the sensors and stop the motor when called for. Monitor unit shall be 24 VDC powered, unless scheduled otherwise.

3. Combined service factor of 1.15 and rated for operation at 40°C AMB.
4. Pump Motor: Connections between cable conductors and stator leads to be made with threaded compression type binding posts permanently affixed to terminal board. Connections via wire nuts or crimping devices are not allowed by this Specification.
5. Inverter duty rated in accordance with NEMA MG1, Part 31.
6. Voltage tolerance of plus or minus 10%.
7. Designed for continuous duty while handling pumped media of up to 104°F.
8. The motor and the pump shall be produced by the same manufacturer.
9. Designed for continuous operation in up to a 40-deg C ambient and shall have a NEMA Class B maximum operating temperature rise of 80-deg C.
10. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.
11. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

D. Motor Cooling System:
1. For pumps up to 10.5 HP: Provide thermal radiators integrally cast into stator housing.
2. For pumps larger than 10.5 HP: Provide cooling jacket to allow circulation of pumped media or propylene glycol around motor housing.

E. Pump Shaft:
1. Rotates in two permanently lubricated ball bearings for pump sizes up to 100HP.
   a. Upper bearing to be single row deep groove ball bearing up to 100HP.
   b. Lower bearing to be a two-row angular contact ball bearing up to 100HP.
2. Completely isolated from pumped liquid.
3. Lower bearing shall contain a temperature sensor for monitoring on units larger than 100HP.

F. Minimum ABMA L10 Bearing Life: 50,000 hours at any point on head-capacity curve.

G. Mechanical Seals:
1. Tandem, independent, run in an oil reservoir using FDA approved, non-toxic paraffin oil or glycol solution and capable of operation in either direction of rotation.
2. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber.

H. Impeller – As Scheduled:
1. N-impeller: Dynamically balanced, semi-open, multi-vane, back-swept, non-clog with vanes of screw shaped leading edges, RC60 hardness, self cleaning by shearing action from grooves in the volute.

2. C-impeller: Double shrouded, non clogging design with long throughlets without acute turns.
3. Coating: Alkyd resin primer.

I. Volute – As Scheduled:
1. N-impeller: Volute bottom designed to be of sharp, spiral shaped grooves integrally cast into the suction side of the volute to provide shearing action from the movement of the leading edges of the impeller vanes. Clearance shall be adjustable for wear.
2. C-impeller: Volute to be of non concentric design with smooth passage ways large enough to pass any solids entering the impeller.

J. Each pump equipped with submersible pump cable:
1. Pump cable sized according to NEC and ICEA Standards.
2. Pump cable shall have at least 3 power leads, a ground lead, and two shielded sensor leads..
3. Pump cable to have oil-resistant, chloroprene rubber jacket.

K. Sliding guide bar bracket to be integral part of pump unit to guide on at least two rails. No portion of the pump or guidance system shall bear on sump floor.

L. Discharge pump/elbow connection seal to be metal to metal. Diaphragm or O-ring type seals are not acceptable.

2.05 PERFORMANCE

A. Pump Motor:
1. Non-overloading throughout pump curve.
2. Capable of thirty evenly spaced starts per hour.
3. Capable of running dry indefinitely without damage.
4. Capable of continuous operation unsubmerged.
5. Motors for use in NEC/500/501, hazardous areas: FM, UL or CSA listed for use in the area specified.

2.06 PROTECTIVE COATING

A. Pump Exterior: Acrylic dispersion zinc phosphate primer with polyester resin paint finish.

B. Impeller: Acrylic dispersion zinc phosphate primer.

2.07 ACCESSORIES

A. Furnish the following accessories associated with pump installation. These accessories shall be furnished by the pump manufacturer:
1. Type 304 stainless steel upper and intermediate guide bar brackets.
2. Type 304 stainless steel safety chain hook.

3. Type 304 stainless steel cable holder/cable hanger rack.
4. Type 304 stainless steel cable support grips for motor cables and float cables.
5. Type 304 stainless steel anchorage.
6. Grip eye lifting system.
7. Wet well access cover, if specified in Schedule.
8. Valve vault access cover, if specified in Schedule.
9. Pump hoist and support mount, if specified in Schedule.
10. Mix – Flush system, if specified in Schedule. System shall consist of a hydraulically operated flush valve, factory installed in the vault, and designed to re-suspend solids and grease in the wet well when the pump turns on. Furnish dash pot to field, and adjust valve closing time from 20 to 50 seconds.

B. Wet Well Access Cover:
1. Materials: Structural galvanized steel cover and frame, unless otherwise scheduled.
2. Hardware:
   a. Stainless Steel.
   b. Recessed padlock hasp.
   c. Recessed lift handle.
   d. Hold-open arm, lock open in 90-degree position.
   e. Stainless steel lift assist for heavy doors so one person can easily open door.
3. Units capable of side-by-side installation using cleats.
4. Nut rail incorporated in frame.
5. H20 rated.
6. Size: Actual clear opening as recommended by pump manufacturer for the pumps being installed in wet well or as shown on Drawings.
7. Hinged grated safety hatch located below doors.
8. Acceptable manufacturers:
   a. Flygt Safe-Hatch
   b. Flygt
   c. USF Fabrication, Inc, Hialeah, FL
   d. Or Engineer reviewed equivalent.

C. Valve Vault Access Cover:
1. Materials: Structural galvanized steel cover and frame, unless otherwise scheduled.
2. Hardware:
   a. Stainless Steel.
   b. Recessed padlock hasp.
   c. Recessed lift handle.
   d. Hold-open arm, look open in 90 degree position.
   e. Stainless steel lift assist for heavy doors so one person can easily open.
3. Units capable of side-by-side installation using cleats.
4. H20 rated.
5. Size: Actual clear opening as shown on Drawings.

6. Acceptable manufacturers:
    a. Flygt
    b. USF Fabrication, Inc, Hialeah, FL
    c. Or Engineer reviewed equivalent.

D. Grip Eye Lifting System: Furnish each submersible pump with one complete lift-chain positive recovery system consisting of the following components:
1. Chain Sling: Short section of stainless steel chain (length as required by manufacturer) of high tensile strength, proof tested; attached to pump lifting handle on lower end and to cable sling on upper end. Stainless steel chain appropriately sized for weight of pump to be lifted.
2. Cable Sling: Continuous stainless steel cable (length as required) attached to end of chain sling at lower end with stainless steel clamp and attached to safety hook fastened to frame under access cover. A small chain (stainless steel) with threaded link repair rings may be used in lieu of stainless steel cable. A nylon line for the sling will not be accepted.
3. Furnish one complete lift-chain positive recovery system compatible with each portable crane serving submersible pumps specified in Specification Section 41 22 00 – Hoists and Cranes, consisting of the following components:
    a. A forged "grip eye" of wrought alloy steel, provided separately to connect to the end of the lifting cable of the pump or mixer lift hoist.
    b. Stainless steel lift cable of sufficient length to reach from jib crane winch to pump in lowest position.
    c. Lower Cable Attachment: Stainless steel hoist hook attached to "grip eye".
    d. Upper Cable Attachment: Stainless steel swaged ball designed to connect to crane drum.
    e. Acceptable manufacturer: Flygt Grip-Eye System or Engineer approved equivalent.
4. A stainless steel shackle as part of the chain sling for connecting to the pump or mixer handle.
5. Acceptable manufacturer: Flygt Grip-Eye System or Engineer approved equivalent.

2.08 CONTROLS

A. Supplied by pump manufacturer or pump supplier, if indicated on schedule.

B. Comply with all requirements of Division 26 and 40, including Section 40 95 13.23 – Control Panels.

C. Control Panel Security Enclosure:
1. Where specified in Schedule, provide a control panel security enclosure for each control panel.
2. Security enclosures designed to prevent unauthorized personnel from accessing panel controls. Provide solid front panel doors.

3. All Type 304 stainless steel construction, conforming to NEMA 4X requirements with stainless steel hardware, hinged access door, and padlock.

PART 3 EXECUTION

3.01 INSTALLATION

A. Manufacturer's recommendations.

B. Level, plumb, accurate alignment, leak-proof pump connection, easily removed without entering wet well as appropriate.

C. No splices allowed in cable.

D. The manufacturer shall provide certification that installation, controls, and initial operation of all components specified herein are in accordance with the manufacturer's requirements.

3.02 FLOATS

A. Suspend on brackets as shown on the Drawings.

B. No splices allowed in cables.

C. Set to levels shown on the Drawings.

D. Provide 12-inches of cable slack for future level adjustments.

3.03 REQUIRED SUPPORT BY FIELD SERVICE REPRESENTATIVE

A. See Section 01 75 01 – Field Service Representative, for qualifications of Field Service Representative.

B. Present to check installation and operation.

C. Provide 2 hours of training to Owner's personnel on operation and maintenance per requirements of Section 01 79 01. Video record training sessions in accordance with Section 01 79 01: Manufacturer's Instruction of Owner's Personnel.

D. Furnish written report to Engineer certifying that equipment is properly installed, fully functional, ready for use, and is operating correctly.

3.04 SCHEDULE

A. Pump Station:
1. Site Conditions:
   a. Site Elevation: 4,960 feet above mean sea level.
2. Acceptable Manufacturers:

a. Flygt Model NP3153.095 with 204-mm, 436-type Hard-Iron™ impeller and volute insert.
b. Or Engineer reviewed equivalent

3. Quantity: 3 (two duty, one standby)
4. Design Operating Point:
   a. 2,333 GPM at 28 ft TDH with two pumps running.
5. Shutoff Head: 65 feet.
6. Maximum Motor Input at Design Point:
   a. 10.2 kW.
7. Minimum Hydraulic Efficiency at Design Point:
   a. 73%
8. Motor:
   a. 15 HP, 460V, 3-phase, constant speed drive, standard efficiency.
   b. FM-explosion proof rated.
9. Discharge Size: 6" nominal.
10. Mix-Flush System: None.
11. Wet Well Access Cover: As indicated on Drawings, 36" x 26" clear opening each hatch, with safety grate.
12. Valve Vault Access Cover: As indicated on Drawings, 42" x 42" clear opening each hatch, with safety grate.
13. Pump Control Panel, NEMA 4X 304 SS UL Listed, including solid front security door, triplex lead-lag-standby alternator, 24 VAC float system, seal leak monitoring, power monitor, surge arrestor, run time meters, high level alarm horn and flashing beacon, NEMA FVNR starters, panel-mounted J-box for generator leads, and dry contacts for remote alarm notification.
14. Junction box to be installed between control panel and wet well, NEMA 4X 304 SS.
15. Level switch floats:
    a. Lead pump on: 50.5" AFF
    b. Lag pump on: 60.5" AFF
    c. High level alarm: 78" AFF
    d. All pumps off: 14" AFF

END OF SECTION