

**TECHNICAL SPECIFICATIONS  
FOR  
CONSTRUCTION  
OF  
ROMERO PARK WATERLINE**

Wilson & Company Project No. 23-600-155-00

PREPARED FOR:

*Santa Fe County  
424 NM Highway 599, Building H  
Santa Fe, NM 87507*

CONSTRUCTION DOCUMENTS PREPARED BY:

*Wilson & Company, Inc., Engineers & Architects  
4401 Masthead St. NE, Suite 150  
Albuquerque NM 87109*

*December 2024*

**WILSON  
& COMPANY**



These Plans and Contract Specifications, for the ROMERO PARK WATERLINE, were prepared by:

**Wilson & Company, Inc., Engineers & Architects**  
**4401 Masthead St. NE, Suite 150**  
**Albuquerque NM 87109**

The Technical Material and data contained in the specification were prepared by or under the supervision and direction of **Mr. William Chapman, P.E., (NMPE 27625)** whose seal as a Professional Engineer, licensed to practice in the State of New Mexico is affixed below.



Date: 12-23-2024

(Seal)

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

## **SPECIFICATION INDEX:**

INCORPORATION OF NEW MEXICO STANDARD SPECIFICATIONS: The New Mexico Standard Specifications for Public Works Construction, 2006 Edition, Technical Specifications, as updated, and the New Mexico State Department of Transportation Supplemental Specifications are in effect during this project are incorporated by reference, the same as if fully written herein and shall govern this project except where revised, updated or supplemented by the Supplemental Technical Specifications.

### **SUPPLEMENTAL TECHNICAL SPECIFICATIONS**

STS 801.3.7.1 Add sentence to the front of section 801.3.7.1 FIRE HYDRANTS as follows:

Fire Hydrants shall be Mueller Super Centurion 250- Model: A4235-1/4” main valve opening 3-way (2 hose nozzle / 1 pumper nozzle) or approved equal by the engineer to meet the requirements of this section. Note: pipe cover requirements on this project is typically 3-feet minimum to top of pipe, so the fire hydrant bury length is not typical.

STS 801.17 add sentence at the end of the paragraph of 801.17 DISINFECTION, FLUSHING, AND BACTERIA TESTING OF WATER LINES:

“CONTRACTOR is required to submit a detailed disinfection plan for approval by the engineer.”

STS 801.17.1 add sentence at the end of the paragraph of 801.17.1:

“CONTRACTOR is required to submit a signed notarized affidavit that the disinfection was done in conformance with appropriate AWWA standards C651.”

STS 701.8.1 Replace portion of the third sentence of section 701.8.1 “if a saw cut would fall with 30 inches of” with the following:

“All saw cuts will be at”. Remove in its entirety the fourth and fifth sentences of section 701.8.1

STS 701.3.5 Add sentence to the end of the paragraph 701.3.5 “Clean is defined in the soils classification as refers to bedding and trench backfill material should be of clean, uncontaminated imported materials”



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- 64 1000 Utility Construction Traffic Control

## SECTION 01 0100

### SUMMARY OF WORK

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Contract Description
- B. Sequence Of Work
- C. Owner Occupancy

##### 1.02 CONTRACT DESCRIPTION

- A. BASE BID: The project work includes the installation of approximately 2,714 LF of 12" waterline, 2,347 LF of 8" waterline, 8 fire hydrants, an 8" meter in a custom pre-cast concrete vault with backflow preventer, abandonment of an existing municipal well, and connections to existing facilities. This project also includes electrical and SCADA connections to the master meter.
- B. All work is to be limited to the location, as shown on the contract drawings.
- C. Existing valves shall only be operated by OWNER's operating personnel.
- D. The Schedule of work and the Contractors work plan shall be Cooperate with OWNER to minimize conflict, and to facilitate OWNER's operation. Schedule the work to accommodate this requirement.

##### 1.03 WORK SCHEDULE

- A. Conduct all work during normal work hours, typically defined as 8 A.M. to 5 P.M., Monday through Friday, unless otherwise defined by the OWNER or ENGINEER during the Pre-Construction Conference.
- B. Deviation from this work schedule shall be specifically requested at least 24-hours in advance, and approved by the OWNER.
- C. Holidays when offices are closed:
  - 1. New Year's Day
  - 2. Memorial Day
  - 3. Independence Day
  - 4. Labor Day
  - 5. Thanksgiving Day
  - 6. Day after Thanksgiving

7. Christmas Eve (1/2 Day)
8. Christmas Day

#### 1.04 CONSTRUCTION CONDITIONS

- A. Temporary Construction and Utilities Facilities: Provide all temporary facilities required to perform the Work at no additional cost to the OWNER, but not intrusive to surrounding lands. Such facilities will include but not be limited to sanitary facilities, access to telephone, electricity, and water. Water for construction purposes, and land for temporary sanitary facilities may be available from the owner, if arrangements are made prior to construction. Temporary power or other utilities shall not be taken from adjacent private landowners without specific written authorization from the respective property owners.
- B. Environmental Protection: The contractor and his subcontractors shall comply with applicable federal, state and local laws and regulations concerning environmental pollution control, sediment runoff control and abatement. The contractor will be required to maintain all excavations, embankments, stockpiles, haul roads, plant sites, and waste areas, borrow areas and all other work areas free from dust which would cause a hazard or nuisance to others. Methods of soil stabilization shall be approved by the ENGINEER or his representative. Additional requirements may be detailed in the General Construction Notes in the Plan Drawing set.

#### 1.05 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish at all times.
- B. Remove waste materials at least bi-weekly and dispose off-site.

#### PART 2 PRODUCTS/ EXECUTION – (NOT USED)

END OF SECTION

## SECTION 01 0190

### CONTRACT CONSIDERATIONS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Application for Payment.
- B. Change procedures.

##### 1.02 APPLICATIONS FOR PAYMENT

- A. Content and Format: Utilize Bid Tab for listing items in Application for Payment.
- B. Payment Period: As specified in the Agreement.
- C. Include an updated construction progress schedule and construction photographs as specified.

##### 1.03 CHANGE PROCEDURES

- A. Engineer will advise of minor changes in the Work not involving an adjustment to Contract Sum/Price or Contract Time as authorized by issuing supplemental instructions.
- B. Engineer may issue a Notice of Change that includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor will prepare and submit an estimate within 10 days.
- C. The Contractor may propose a change by submitting a request for change to the Engineer, describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, and the effect on the Contract Sum/Price and Contract Time.
- D. Stipulated Sum/Price Change Order: Based on Notice of Change and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by owner/Funding agency.
- E. Work Directive Change: Engineer may issue a directive signed by the Owner, instructing the CONTRACTOR to proceed with a change in the work, for subsequent inclusion in a Change Order. Document will describe changes in work,

and designate a method of determining any change to the Contract Sum/Price or Contract Time. Promptly execute the change.

- F. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract. Engineer will determine the change allowable in Contract Sum/Price and Contract Time as provided in the Contract Documents.
- G. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- H. Change Order Forms: Shall be submitted using a County approved Change Order form.
- I. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

#### 1.04 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Engineer, it is not practical to remove and replace the Work, the Engineer will direct an appropriate remedy or adjust payment.

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION – (NOT USED)

END OF SECTION

## SECTION 01 0200

### ALLOWANCES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Procedure for administration of Allowances.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01 0190: Contract Considerations

##### 1.03 CASH ALLOWANCE

- A. The cash allowance is a sum of money included in the Contract Price to cover the cost of a service, all inclusive, to be provided under the Contract by a party other than the Contractor.
- B. The allowance is included in the Bid Form.
- C. The sum of a cash allowance is an estimated amount.
- D. The Contractor will be reimbursed only for the costs invoiced by the party providing the service, and no mark up, such as overhead and profit shall be charged by the Contractor.
- E. Services may be less than, equal to, or greater than, the estimated allowance amount. Contractor will be paid only the actual cost of the services.

##### 1.04 ADJUSTMENT OF BONDS AND INSURANCE

- A. Adjustment to Contractor's bonds and insurance on account of adjustment to cash allowance will only be dealt with in the final pay application considering the final cost of the project in comparison to the Bid Price.

##### 1.05 ENGINEER RESONSIBILITIES

- A. Consult with Contractor in consideration of supplier of services.

##### 1.06 CONTRACTOR RESPONSIBILITIES

- A. Execute purchase agreement with designated supplier.

- B. For additional information, refer to specific specification sections referenced in Part 3 of this section.

#### 1.07 PAYMENT PROCEEDURES

- A. Payment will be made under the Bid Item for the specified allowance.
- B. Contractors submit invoices on a monthly basis with pay application.
- C. Pay application will not be accepted without invoices for allowance services performed during the pay application pay period.
- C. Pay invoice on approval of Owner.

#### PART 2 PRODUCTS – (NOT USED)

#### PART 3 EXECUTION

##### 3.01 PROJECT ALLOWANCES

- A. Relocation of Existing Utilities: Allow the amount of \$5,000.00.
- B. Laboratory Testing: Allow the amount of \$5,000.00 for additional information, see Section 01 4100 – Testing Laboratory Services.
- C. Subsurface Utility Relocation: Allow the amount of \$10,000.00.
- D. Community Center Irrigation Cistern Connection Locate: Allow the amount of \$10,000

END OF SECTION

SECTION 01 0250

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. Payment for work performed by the CONTRACTOR under these Contract Documents will be made at the approved contract unit price for each of the several items listed in the bid and measured as hereinafter specified. Such payment shall compensate the CONTRACTOR for all costs in connection with furnishing all labor, equipment and material required and performing the operations to complete the several items in accordance with the Contract Documents. All incidental work essential to completion of the project in a skillful manner, including cleanup and disposal of waste or surplus material, shall be accomplished by the CONTRACTOR at no additional cost to the OWNER.
- B. Quantities listed in the Bid Tabulation are not guaranteed and are indicated only for convenience in comparing bids. Payment will be made for actual quantities constructed or installed, be they more or less than those listed in the Bid Tabulation.

1.2 UNIT PRICE DESCRIPTIONS

- A. The bid items that are associated with the New Mexico Standard Specifications for Public Works Construction (NMAPWA), 2006 Edition will use their measurement and payment sections.
- B. The other specifications in the contract documents will use their measurement and payment section of that specification if section is in the specification. All other specifications without a measurement and payment section are inclusive to the work in the contract documents with the bid items listed below for measurement and payment below.

PART 2 MATERIALS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION



## SECTION 01 0390

### COORDINATION AND MEETINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Field engineering.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Pre-installation conferences.

##### 1.02 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of the various Sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical and electrical Work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

#### 1.03 FIELD ENGINEERING

- A. Employ a Land Surveyor registered in the State of New Mexico and acceptable to the Engineer.
- B. Contractor to locate and protect survey control and reference points.
- C. Control datum for survey is that shown on Drawings.
- D. Confirm drawing dimensions and elevations.
- F. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

#### 1.04 PRECONSTRUCTION MEETING

- A. Engineer will schedule a conference after Notice of Award.
- B. Attendance Required: Owner, Engineer, and Contractor.
- C. Agenda:
  - 1. Submission of executed bonds and insurance certificates.
  - 2. Distribution of Contract Documents.
  - 3. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
  - 4. Designation of personnel representing the parties in Contract, and the Engineer.
  - 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders.
  - 6. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, participants, and those affected by decisions made.

#### 1.05 SITE MOBILIZATION MEETING

- A. Engineer will schedule a meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required: Engineer, Contractor, Contractor's Superintendent, and major Subcontractors.

- C. Agenda:
1. Use of premises by Owner and Contractor.
  2. Owner's requirements.
  3. Construction facilities and controls provided by Owner.
  4. Temporary utilities provided by Owner.
  5. Survey and site layout.
  6. Security and housekeeping procedures.
  7. Schedules.
  8. Application for payment procedures.
  9. Procedures for testing.
  10. Procedures for maintaining record documents.
  11. Requirements for start-up of equipment.
  12. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, participants, and those affected by decisions made.

#### 1.06 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals, or as directed by Owner.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Engineer, as appropriate to agenda topics for each meeting.
- D. Agenda:
1. Review minutes of previous meetings.
  2. Review of Work progress.
  3. Field observations, problems, and decisions.
  4. Identification of problems which impede planned progress.
  5. Review of submittals schedule and status of submittals.
  6. Review of off-site fabrication and delivery schedules.
  7. Maintenance of progress schedule.
  8. Corrective measures to regain projected schedules.
  9. Planned progress during succeeding work period.
  10. Coordination of projected progress.
  11. Maintenance of quality and work standards.
  12. Effect of proposed changes on progress schedule and coordination.
  13. Other business relating to Work.

- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, participants, and those affected by decisions made.

#### 1.07 PREINSTALLATION MEETING

- A. When required in individual specification Sections, convene a pre-installation meeting at the site prior to commencing work of the Section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific Section.
- C. Notify Engineer seven days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of installation, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, participants, and those affected by decisions made.

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION – (NOT USED)

END OF SECTION



## SECTION 01 0470

### COORDINATION WITH PUBLIC

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS

- A. Before, after, and special construction notices.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01-0390: Coordination and Meetings

##### 1.03 NOTICES

###### A. Before Construction:

1. Delivered between seven (7) calendar days (maximum) and four (4) calendar days (minimum) prior to actual physical construction on each line or line segment.
2. Corrected notices delivered if construction does not start within 48 hours of date given in notice.
3. Written notice to state:
  - a. Contractor's name, address, and local telephone number
  - b. Nature of work to be done
  - c. Disruptions that resident or business might expect
  - d. Expected duration of construction
  - e. Contractor's local telephone number to which complaints can be made during normal working hours
  - f. Contractor's local telephone number to which emergency conditions can be reported during non-working hours

###### B. After Construction:

1. Delivered not more than seven (7) calendar days following construction on each line or line segment
2. Written notice to state:
  - a. Contractor's name, address, and telephone number
  - b. Thank residences and businesses for cooperation and report work is completed in applicable area.

###### C. Special Notices:

1. Inform residences and businesses personally and by written notice whenever access to property will be impaired stating scheduling of such impairment.

###### D. Notice Delivery:

1. Hand delivery to each residence and business adjacent to or which may be

reasonably expected to be affected by construction.

#### 1.04 SERVICE LINE CONNECTIONS

- A. Contractor shall follow plan set design regarding final alignment and connection location of the service line to each house, business or other infrastructure served with the property owner.
- B. Contractor shall adjust service connection point to the main service line as needed to facilitate the most direct and least obtrusive service line alignment.

#### PART 2 PRODUCTS – (NOT USED)

#### PART 3 EXECUTION

##### 3.01 NOTICES REQUIRED FOR THIS PROJECT

- A. Notice delivery under Paragraph 1.03 A., B., and C. above are required.
- B. Notice delivery under Paragraph 1.03 D shall inform all residents adjacent to and near project site of regular construction activities and of construction activities that will run around the clock (as during startup) and that noise abatement measures will be implemented full time.
- C. Notices shall be delivered up to five days before the start of regular and round the clock construction activities.

END OF SECTION

## SECTION 01 0600

### 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, fire, 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, grating, hoists, equipment guards, ladders, etc., shall meet OSHA requirements whether or not such requirements are specifically indicated or described in 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.

##### 1.03 PREPARATION OF STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS

- A. Storm Water Pollution Prevention Plan: The contractor shall install temporary erosion control measures to protect ditches and drainage ways as shown on the drawings, indicated on the Storm Water Pollution Prevention Plan in this section, or as directed by the Project Engineer. The following temporary erosion control devices are allowable:
  - 1. Erosion Waddles: Erosion waddles shall be placed at right angles to the direction of flow. The waddles shall be securely anchored with stakes or steel reinforcing bars. The waddles shall be removed after the soil has been stabilized or as directed by the Project Engineer.
  - 2. Silt Fencing: Silt fencing shall be constructed in a manner approved by the Project Engineer. Silt fencing shall be placed in an arc or horseshoe shape with the ends pointing up towards the slope.
  - 3. Rip Rap: Approved rock spoils from rock excavation shall be placed along the trench surface in locations and in a manner approved by the Project Engineer.



Erosion control shall be considered incidental to excavation. No separate payments shall be made for erosion control.

- B. Storm Water Pollution Prevention Plan: The Contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the latest requirements of the Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges from Large and Small Construction Activities. The SWPPP must be prepared in accordance with good engineering practices and must 1) Identify all potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges from the construction site; 2) Describe practices to be used to reduce pollutants in storm water discharges from the construction site; and 3) Assure compliance with the terms and conditions of the NPDES General Permit.
- C. A copy of the NPDES General Permit can be obtained from the EPA web site at the following location  
[http://water.epa.gov/polwaste/npdes/stormwater/upload/cgp2012\\_finalpermit.pdf](http://water.epa.gov/polwaste/npdes/stormwater/upload/cgp2012_finalpermit.pdf) or by requesting a digital copy from the Owner or Owner's Representative.
- D. If the Contractor is not experienced in the preparation of SWPPP, the Contractor will retain the services of an environmental firm regularly engaged in the preparation of SWPPP to perform said service. The completed SWPPP must be approved by the Owner or Owner's Representative at least 14 calendar days before the start of construction so that a Notice of Intent can be sent to EPA.
- E. The Contractor shall fully implement the SWPPP from the commencement of construction until final stabilization, as defined in the NPDES General Permit, is achieved. The Contractor shall maintain and update the SWPPP, as required in the NPDES General Permit, for the life of the project. Updates shall include amendments required as a result of ineffective controls discovered through the course of inspections or investigations conducted by the Owner or Owner's Representative, site staff, or by local, state, tribal, or federal officials. The Contractor shall submit a Notice of Intent to the EPA to obtain permit coverage, modify the coverage as necessary, and terminate permit coverage once final stabilization is achieved.
- F. Measurement and Payment:
  - 1. Preparation of Storm Water Pollution Prevention Plan: Payment for the Preparation of the SWPPP shall be on a lump sum basis listed on Bid Schedule. Payment shall be full compensation for plan preparation including required revisions for Owner's acceptance and updates to the SWPP for the life of the project.
  - 2. Implementation of Storm Water Pollution Prevention Plan: Payment for the Implementation of the SWPPP shall be paid on a lump sum basis listed in the Bid Schedule. Payment shall be full compensation

for implementation of the SWPPP including, but not limited to, Permit applications, inspections, installation and maintenance of controls, modification of controls as determined by inspections, removal of pollutants due to failed controls, and Permit termination.

END OF SECTION



## SECTION 01 3000

### SUBMITTALS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed Products list.
- D. Product data.
- E. Shop Drawings.
- F. Samples.
- G. Design data.
- H. Test reports.
- I. Certificates.
- J. Manufacturer's instructions.
- K. Manufacturer's field reports.
- L. Erection drawings.
- M. Construction photographs.

##### 1.02 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer accepted form.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with a sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing and detail number(s), and specification Section number, as appropriate.

- D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite the Project, and deliver to Engineer at business address. Coordinate submission of related items.
- F. For each submittal for review, allow 15 calendar days excluding delivery time to and from the contractor.
- G. Identify variations from Contract Documents and Product or system limitations, which may be detrimental to successful performance of the completed Work.
- H. Provide space for both Contractor and Engineer review stamps.
- I. When revised for resubmission, identify all changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- K. Submittals not requested will not be recognized or processed.

### 1.03 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial Construction schedule in triplicate within 10 days after date of Notice to Proceed.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Submit a CPM-based, computer-generated, horizontal bar chart with separate line for each major section of Work or operation identifying first work day of each week, or other Engineer accepted chart.
- E. Progress Schedule shall, at a minimum, contain the following:
  - 1. Progress Schedule Heading:
    - a. Name of Contractor
    - b. Name of Engineer
    - c. Name and Address of Project
    - d. Engineer Project Number
    - e. Current Date of submitted schedule

2. Calendar Months of construction
  3. Start date of each task/activity
  4. "Milestone" dates for each required inspection
  5. Start and completion dates for critical tasks or activities
  6. Percentage of total costs or work for each task/activity, etc.
  7. Duration of time for each task/activity, start to finish
  8. Percentage of completion, updated monthly
  9. Proposed Construction Curve marked in black an actual construction curve marked in red
  10. Payments project to expected per month
  11. Accumulation of project payments per month
  12. Actual payments per month
  13. Submit updated Progress Schedule each month in conjunction with Certificate of Payment
- F. CPM Software: Computer based programs which lend themselves to construction management and which are acceptable to the Owner are: Microsoft Project. Use of other software shall be approved by the Owner.
- G. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- H. Indicate estimated percentage of completion for each item of Work at each submission.
- I. Indicate submittal dates required for Shop Drawings, product data, samples, and product delivery dates, including those furnished by Owner and under Allowances.

#### 1.04 PROPOSED PRODUCTS LIST

- A. Within 15 calendar days after date of the Recommendation of Award submit complete list of major Products proposed for use as defined in the Technical Specifications. Included in the list shall be the name of manufacturer, trade name, model number of each Product, and corresponding Section of the Contract Documents.
- B. For Products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

#### 1.05 PRODUCT DATA

- A. Product Data for Review:
  1. Submitted to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in

the contract documents.

2. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01 7000 – EXECUTION AND CLOSEOUT REQUIREMENTS.
- B. Product Data for Information:
1. Submitted for the Engineer's knowledge as contract administrator or for the Owner.
- C. Product Data for Project Close-Out:
1. Submitted for the Owner's benefit during and after project completion.
- D. Submit the number of copies which the Contractor requires, plus three copies which will be retained by the Engineer. The number of copies submitted shall be no less than five copies.
- E. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- F. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- G. After review, distribute in accordance with Submittal Procedures article above and provide copies for Record Documents described in Section 01 7000.

#### 1.06 SHOP DRAWINGS

- A. Shop Drawings for Review:
1. Submitted to the Engineer for distribution for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  2. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES above and for record documents purposes described in Section 01 7000.
- B. Shop Drawings for Information:
1. Submitted for the Engineer's knowledge as contract administrator for the Owner.
- C. Shop Drawings for Project Close-Out:
1. Submitted to the Engineer for the Owner's benefit during and after project completion.

- D. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. Submit the number of opaque reproductions which Contractor requires, plus three copies which will be retained by Engineer. The number of copies submitted shall be no less than five copies.

#### 1.07 MANUALS

- A. Operations and Maintenance Manuals shall be submitted in accordance with section 01 7000 – execution and closeout requirements.

#### 1.08 SAMPLES

- A. Samples for Review:
  - 1. Submitted to the Engineer for distribution for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  - 2. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01 7000.
- B. Samples for Information:
  - 1. Submitted for the owner's project representative's knowledge as contract administrator for the Owner.
- C. Samples for Selection:
  - 1. Submitted to owner's project representatives for aesthetic, color, or finish selection.
  - 2. Submit samples of finishes, textures, and patterns for Owner's selection.
  - 3. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES above and for record documents purposes described in Section 01 7000.
- D. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- E. Include identification on each sample, with full Project information.
- F. Submit the number or samples specified in individual specification Sections; one of which will be retained by Engineer.
- H. Reviewed samples which may be used in the Work are indicated in individual



specification Sections.

- I. Samples will not be used for testing purposes unless specifically stated in the specification section.

#### 1.09 DESIGN DATA

- A. Submit to the Engineer's knowledge as contract administrator or for the Owner.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

#### 1.10 TEST REPORTS

- A. Submit to the Engineer's knowledge as contract administrator or for the Owner.
- B. Submit test reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

#### 1.11 CERTIFICATES

- A. When specified in individual specification Sections, submit certification by manufacturer, installation/application Subcontractor, or the Contractor to the Engineer, in quantities specified for Product Data.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

#### 1.12 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification Sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing to the Engineer, in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- C. Refer to Sections 01 4000 - Quality Control article.

#### 1.13 MANUFACTURER'S FIELD REPORTS

- A. Submit reports to the Engineer's knowledge as contract administrator or for the Owner

- B. Submit report in duplicate within 30 days of observation to the Engineer for information.
- C. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

#### 1.14 ERECTION DRAWINGS

- A. Submit drawings for the Engineer's benefit as contract administrator or for the Owner.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- B. Data indicating inappropriate or unacceptable Work may be subject to action by the Owner or Engineer.

#### 1.15 CONSTRUCTION PHOTOGRAPHS

- A. Twice monthly submit photographs with Application for Payment.
- B. Photographs: Two prints; color, matte; 8 x 10-inch size; mounted on 8-1/2 x 11 inch soft card stock, with left edge binding margin for three hole punch.
- C. Take photographs of site and construction, as directed by the Engineer or Construction Supervisor throughout progress of Work.
- D. Identify photographs with date, time, orientation and project identification

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION – (NOT USED)

END OF SECTION



SECTION 01 4000  
QUALITY CONTROL

PART 1      GENERAL

1.01    SECTION INCLUDES

- A.    Quality assurance-control of installation.
- B.    Tolerances.
- C.    References and standards.
- D.    Mock-up.
- E.    Testing services.
- F.    Inspection services.
- G.    Manufacturers' field services.

1.02    QUALITY ASSURANCE-CONTROL OF INSTALLATION

- A.    Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B.    Comply fully with manufacturers' instructions, including each step in sequence.
- C.    Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D.    Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E.    Perform work by persons qualified to produce required and specified quality.
- F.    Verify that field measurements are as indicated on Shop Drawings or as instructed by the manufacturer.
- G.    Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

### 1.03 TOLERANCES

- A. Monitor fabrication and installation tolerance of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

### 1.04 REFERENCES AND STANDARDS

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.
- C. Obtain copies of standards when required by product specification sections.
- D. Neither the contractual relationship, duties, nor responsibilities of the parties in the Contract, nor those of the Engineer, shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

### 1.05 MOCK-UP

- A. Tests will be performed under provisions identified in this Section and identified in the respective product specification sections.
- B. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.
- E. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.

### 1.06 TESTING SERVICES

- A. Contractor will appoint/employ and pay for specified services of an independent firm to perform testing. Cost for testing services shall be by Contractor and included in the Contract Sum.

- B. Testing firm to be employed shall be named prior to employment and is subject to approval of the Owner.
- C. The independent firm will perform tests and other services specified in individual specification Sections and as required by the Engineer or the Owner.
- D. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Engineer or the Owner.
- E. Reports will be submitted by the independent firm to the Engineer in triplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
  - 1. Notify Engineer and independent firm 24 hours prior to expected time for operations requiring services.
  - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- G. Testing does not relieve Contractor to perform Work to contract requirements.
- H. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for retesting will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- I. Owner reserves the right to request additional testing. Additional testing that is found to be of non-conformance to specify requirements shall be paid for by contractor. Additional testing that is found to meet specified requirements shall be paid for by Owner.

#### 1.07 INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection. Inspection services do not include field services and inspections provided by manufacturers as specified in specific sections herein.
- B. The independent firm will perform inspections and other services specified in individual specification Sections and as required by the Engineer or the Owner.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Engineer in triplicate,

indicating inspection observations and indicating compliance or non-compliance with Contract Documents.

- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
  - 1. Notify Engineer and independent firm 24 hours prior to expected time for operations requiring services.
- F. Inspecting does not relieve Contractor to perform Work to contract requirements.

#### 1.08 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, and adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 3000 - SUBMITTALS, MANUFACTURERS' FIELD REPORTS article.

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION – (NOT USED)

END OF SECTION

## SECTION 01 4100

### TESTING LABORATORY SERVICES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Employ and pay for the services of an independent testing laboratory to perform specified services and testing associated with soil and density, concrete, and asphalt.

##### 1.02 ADDITIONAL REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approval of public authorities.
- B. Section 01 0190: Contract Considerations
- C. Section 01 0200: Allowances

##### 1.03 SUBMITTALS

- A. Submit to Wilson & Company Inc, Engineers and Architects for review of the name of proposed Laboratory to perform required testing and their statement of qualifications.
- B. Submit to engineers for review the fee schedule of the proposed laboratory.

##### 1.04 QUALIFICATION OF LABORATORY

- A. Meet basic requirements of ASTM E329, "Standard Specification Agencies Engaged in Testing and/or Inspection of Materials Used in Construction."
- B. Authorized to operate in the State in which the Project is located by the local governing authority for the AASHTO Accreditation Program.
- C. Testing Equipment:
  - 1. Calibrated at reasonable intervals by devices of accuracy traceable to either:
    - a. National Bureau of Standards
    - b. Accepted values of natural physical constants
- D. Office Location: The location at which specified services and testing will be performed or from which Testing Laboratory staff will mobilize to perform field work shall be within 50 miles of the project site.



## 1.05 LABORATORY DUTIES

- A. Cooperate with the Owner and Contractor; provide qualified personnel after due notice
- B. Perform specified inspections, sampling and testing of materials and methods of construction:
  - 1. Comply with specified standards
  - 2. Ascertain compliance of materials with requirements of Contract Documents
- C. Promptly notify Owner's Project Manager and Contractor of observed irregularities or deficiencies of work or products.
- D. Promptly submit written report of each test and inspection; two (2) copies to the Owner's Project Manager, and copies as required to Contractor. Each report shall include:
  - 1. Date issued
  - 2. Project title and number
  - 3. Testing laboratory number, address, and telephone number
  - 4. Name and signature of laboratory inspector
  - 5. Date and time of sampling and inspection
  - 6. Record of temperature and weather conditions
  - 7. Date of test
  - 8. Identification of product and specification section
  - 9. Location of sample or test in the project
  - 10. Type of inspection or test
  - 11. Results of tests and compliance with Contract Documents
  - 12. Interpretation of test results when requested by the Owner's Manager.
- E. Perform additional tests as required by the Owner's Project Manager.
- F. In all cases, the Owner shall determine the number, type and location of tests.
- G. Provide signature and seal of a Professional Engineer, licensed in the State where work is being performed, and who is employed by the Laboratory on all test results.

## 1.06 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
  - 1. Release, revoke, alter or enlarge on requirements of Contract Documents
  - 2. Approve or accept any portion of the Work
  - 3. Perform any duties of the Contractor

## 1.07 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel; provide access to Work, and manufacturer's operations.

- B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other material mixes which require control by the testing laboratory.
- D. Furnish copies of Product test reports as required.
- E. Furnish Incidental Labor and Facilities:
  - 1. To provide access to Work and Facilities
  - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
  - 3. To facilitate inspections and testing
  - 4. For storage and curing of test samples
- F. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience and retests required for previously failed tests.
- G. Notify testing laboratory at least 48 hours in advance of all testing required by job progress or conditions, or the Owner's Project Manager.
- H. Provide on-site facilities as required for initial curing of concrete cylinders.

#### 1.08 PAYMENT

- A. An allowance is included in the Bid Proposal to cover field testing performed by an independent testing laboratory. In accordance with Section 01 0200 - Allowances, the Owner shall reimburse the Contractor for the actual cost of all such testing based on invoices received from the laboratory for passing test only. Failed test will not be paid for and will be responsibility of the Contractor to pay for such test.
- B. The testing allowance stated in the Bid Proposal is an estimated dollar amount. The final dollar amount reimbursed to the Contractor for testing may be less than, equal to, or greater than the stated allowance.
- C. Actual reasonable sample shipping costs will be paid to the Contractor in the same manner and under the testing allowance.
- D. Costs for testing described in Paragraph 1.7 F. are not eligible for reimbursement.

END OF SECTION



## SECTION 01 4300

### VIDEO RECORDING

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. Video record areas affected by construction prior to construction for record purposes.
- B. Perform additional video recordings during project as directed by the Engineer.
- C. Have video recordings available for viewing by The Owner, The Engineer, and Contractor when required.
- D. Video recording requirement part of Contractor's general overhead for which separate payment shall not be made.

##### 1.02 RELATED REQUIREMENTS

- A. Video Recordings shall be digital video files of standard file type and format (\*.mpg, mp4, avi, mkv, or similar). Contractor shall provide recordings in other formats if requested by the Engineer or Owner.
- B. Video Recordings shall be at a minimum HD 1080P/30 (1920 x 1080 pixels @ 30 frames per second), 24 Mbps or greater.
- C. Video recording file names shall include a 2-digit sequence number, starting station number, and ending station number (e.g. 01\_STA 10+00\_STA 12+00.mp4)
- D. Video recording shall avoid using digital zoom where possible; walking closer to the object is preferred to maintain video quality.

##### 1.03 EQUIPMENT REQUIREMENTS

- A. Video Recording Equipment:
  - 1. Color picture
  - 2. Audio
  - 4. Indexing of locations on recordings for easy reference
- B. Video Viewing:
  - 1. Color picture

2. Audio
3. Indexing
4. Slow motion
5. Stop video for viewing single picture
6. Reversing

C. The contractual relationship, duties, and responsibilities of the parties in the Contract, or those of the Owner, shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

#### 1.04 SYSTEM OPERATOR REQUIREMENTS

A. Familiar and experienced with equipment and equipment operations.

#### 1.05 AVAILABILITY

A. Recordings shall be available at meetings as scheduled or when scheduled by the Owner. Recordings shall also, on request, be available on an FTP server, streaming media service, or other file sharing platform.

#### 1.06 VIDEO RECORDING DESCRIPTIONS

- A. All existing Facilities in and around areas of work
- a. Walls
  - b. Driveways
  - c. Roadside Drainages
  - d. Fencing
  - e. Acequias, Irrigation Ditches
  - f. Asphalt, Curbs, Sidewalks
  - g. Manholes and valve boxes
  - h. Existing Equipment, Controls, and Appurtenances
  - i. Grading and Site Civil in and around temporary construction facilities

#### PART 2 PRODUCTS – (NOT USED)

#### PART 3 EXECUTION

##### 3.01 VIDEO RECORDING REQUIRED FOR THIS PROJECT

A. Provide video recording as described and outlined in Part 1.06 A of this spec section.

END OF SECTION

## SECTION 01 5000

### CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Temporary Utilities: Electricity, telephone service, water, and sanitary facilities.
- B. Temporary Controls: Protection of the Work and water control.
- C. Construction Facilities: Access roads, parking, progress cleaning, and temporary buildings.

##### 1.02 DELIVERY, STORAGE, AND PROTECTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas

#### PART 2 PRODUCTS

##### 2.01 FIELD OFFICES

- A. Contractor shall install and maintain a field office on-site throughout the duration of construction. Office shall be of sufficient size and furnishings to hold small meetings, maintain record drawing markups, shop drawing files, payment files, and other materials required to be maintained on-site. On-site field office shall be heated and cooled. Utilities specified herein shall be installed and maintained throughout work.

Provide, install, and remove Contractor's field offices on-site. Electrical requirements are 200 amp, 120-volt, single-phase.

## 2.02 TEMPORARY ELECTRICITY

- A. Cost: By Contractor; provide and pay for power service required for field office and construction activities.
- B. Provide temporary electric feeder from electrical service at location as directed.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
- D. Provide meter.

## 2.03 TELEPHONE SERVICE

- A. Provide, maintain, and pay for telephone service to field office and at time of project mobilization.

## 2.04 TEMPORARY WATER SERVICE

- A. Provide, maintain and pay for suitable quality water service required for construction operations at time of project mobilization.
- B. Water meters shall be obtained by the Contractor from the Ohkay Owingeh. Acquisition of the water meter and cost of water shall be incidental to the contract.

## 2.05 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures, minimum two toilets. Provide at time of project mobilization.

## 3 EXECUTION

### 3.01 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- C. Collect and remove waste materials, debris, and rubbish from site weekly and dispose of site.

### 3.02 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, and prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

END OF SECTION





## SECTION 01 6000

### DELIVERY, STORAGE AND HANDLING

#### PART 1 GENERAL

##### 1.1 SCOPE OF WORK

- A. This Section specifies the general requirements for the delivery handling, storage and protection of all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

##### 1.2 TRANSPORTATION AND DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.
- B. Deliver products to the site in manufacturer's original sealed containers or other packaging systems complete with instructions for handling, storing, unpacking, protecting and installing.
- C. All items delivered to the site shall be unloaded and placed in locations designated for equipment storage, as determined during the Site Mobilization Meeting. Equipment shall not be placed in locations where it will impede construction or daily operations of the facility.
- D. Provide necessary equipment and personnel to handle all items delivered to the site.

##### 1.3 STORAGE AND PROTECTION

- A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Instruction shall be carefully followed and a written record of this kept by the Contractor.
- B. Store sensitive Products in weather-tight, climate controlled enclosures, in an environment favorable to Product.
- C. For exterior storage of fabricated Products, place on sloped supports, above ground.

- D. Provide off-site storage and protection when site does not permit on-site storage or protection.
- E. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation and degradation of Products.
- F. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- G. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weather-tight enclosure or building to prevent injury. Maintain temperature and humidity within range required by the manufacturer.
  - 1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.
  - 2. Lubricants shall be changed upon completion of installation.
- H. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of Products to permit access for inspection. Periodically inspect to assure Products are undamaged and are maintained in acceptable condition.

PART 2 PRODUCTS - (NOT USED)

PART 3 EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 6100  
MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Transportation and handling.
- C. Storage and protection.
- D. Product options.
- E. Substitutions.

1.2 PRODUCTS

- A. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- B. Provide interchangeable components of the same manufacturer for components being replaced.

1.3 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that Products comply with requirements, quantities are correct, and Products are undamaged.
- C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.4 STORAGE AND PROTECTION

- A. Store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible.
- B. Store sensitive Products in weather tight, climate controlled enclosures, in an environment favorable to Product.

- C. For exterior storage of fabricated Products, place on sloped supports, above ground.
- D. Provide off-site storage and protection when site does not permit on-site storage or protection.
- E. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation and degradation of Products.
- F. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of Products to permit access for inspection. Periodically inspect to assure Products are undamaged and are maintained in acceptable condition.

#### 1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers followed by words indicating no substitutions: No options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.

#### 1.6 SUBSTITUTIONS

- A. Engineer will consider requests for Substitutions only within time limits set forth in General Conditions.
- B. Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Contractor:

1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
  2. Will provide the same warranty for the Substitution as for the specified Product.
  3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  4. Waives claims for additional costs or time extension which may subsequently become apparent.
  5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
  2. Submit Shop Drawings, Product data, and certified test results attesting to the proposed Product equivalence. Burden of proof is on Contractor.
  3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION



SECTION 01 6200

CONSTRUCTION MOBILIZATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Mobilization shall consist of, but not be limited to, all preparatory work, preliminary operations, and incurred costs necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; and for the establishment of all offices, buildings, and other facilities needed for the project – prior to beginning work on project.

PART 2 MOBILIZATION ADMINISTRATION REQUIREMENTS

2.01 DEFINITIONS

- A. Total original contract amount shall mean the total amount bid as compensation for the contract.
- B. Total original contract amount less mobilization shall mean the total amount bid as compensation for the contract, less the amount bid for mobilization.

2.02 GENERAL

- A. It is the intent of this specification to provide for the Contractor to receive 100% of the amount bid for mobilization by the time the Contractor has performed 10% of the total original contract amount bid, less the amount bid for mobilization.

If the Contractor's bid for mobilization is over 10% of the total original contract amount bid, less mobilization, payment for the amount over the 10% of the total original contract amount bid, less mobilization, will be made upon completion of all work under the contract.

2.03 PAYMENT PROCEDURES

- A. When Contractors are eligible for payment of less than 5% of the total original contract amount bid, less mobilization, they will be paid 25% of the amount bid for mobilization.
- B. When Contractors are eligible for payment of from 5% to less than 10% of the total original contract amount bid, less mobilization, they will be paid 50% of the amount bid for mobilization.
- C. When Contractors are eligible for payment of 10% or more of the total original contract amount, less mobilization, they will be paid 100% of the amount bid for mobilization, minus any mobilization amount already paid, except for the noted 10% limitation.



2.04 PAYMENT CALCULATIONS

- P<sub>m</sub> = Mobilization payment.
- M = Total amount bid for mobilization.
- f = Mobilization payment percentage factor –  
0.25, or 0.50, or 1.0, as applicable
- P<sub>m</sub> = M x f

Example 1  
MOBILIZATION LESS THAN 10%

Total Original Contract Amount Bid .....	\$110,000
Amount Bid for Mobilization .....	8,000
Total Original Contract Amount Less Mobilization .....	102,000

Percent of Work Completed	f x M = P <sub>m</sub>
<5% of \$102,000	0.25 x 8,000 = \$2,000
>5% to <10% of \$102,000	0.50 x 8,000 = \$4,000
≥10% of \$102,000	1.00 x 8,000 = \$8,000*
*Minus previously paid amounts	

Example 2  
MOBILIZATION MORE THAN 10%

Total Original Contract Amount Bid .....	\$100,000
Amount Bid for Mobilization .....	10,000
Total Original Contract Amount Less Mobilization .....	90,000
10% OF total Original Contract Amount Less Mobilization .....	9,000

Percent of Work Completed	f x M = P <sub>m</sub>
<5% of \$90,000	0.25 x 10,000 = \$2,500
≥5% to <10% of \$90,000	0.50 x 10,000 = \$5,000
≥10% of \$90,000	1.00 x 9,000 = \$9,000*
*Minus previously paid amounts. Remaining \$1,000 paid upon completion of the work.	

PART 3 – EXECUTION - (NOT USED)

END OF SECTION

## SECTION 01 6500

### STARTING OF SYSTEMS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Starting systems.
- B. Demonstration and instructions.

##### 1.2 STARTING SYSTEMS

- A. Coordinate schedule for start up of various equipment and systems.
- B. Notify Engineer seven days prior to start up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of responsible manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to startup, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01 3000 that equipment or system has been properly installed and is functioning correctly.
- I. Manufacturer's representative shall remain on site to observe operation of equipment and further advise plant personnel the minimum number of days specified in each Section.
- J. Contractor shall be responsible for complete coordination of manufacturer's representatives while on-site as well as any and all issues that may arise relating to start-up of the plant until substantial completion is granted.

### 1.3 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of final inspection.
- B. Demonstrate Project equipment by a qualified manufacturers' representative who is knowledgeable about the Project.
- C. Perform start up and demonstration of all equipment within six months of substantial completion.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate start up, operation, control, adjustment, trouble shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time at project site location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

## SECTION 01 7000

### EXECUTION AND CLOSEOUT REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Adjusting.
- D. Project record documents.
- E. Operation and maintenance data in book form.
- F. Spare parts and maintenance Products.
- H. Maintenance service.

##### 1.02 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer review.
- B. Provide submittals to Engineer that are required by governing or other authorities, including those specified in the General Conditions and including but not limited to the Certification of Labor standard.
- C. Submit final Application for Payment identifying total adjusted Contract Sum/Price, previous payments, and amount remaining due.

##### 1.03 FINAL CLEANING

- A. Contractor will provide final cleaning after final acceptance.
- B. Clean interior and exterior facility surfaces exposed to view; remove temporary labels, stains and foreign substances, and polish transparent and glossy surfaces.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

- D. Clean or replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

#### 1.04 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

#### 1.05 PROJECT RECORD DOCUMENTS

- A. Maintain on site, or in site vehicles one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed Shop Drawings, Product Data, and Samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store Record Documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and modifications.
- F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured depths of foundations in relation to finish floor datum.
  - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 4. Field changes of dimension and detail.
  - 5. Details not on original Contract Drawings.

- G. Submit documents to owner's project representative with claim for final Application for Payment.
  - 1. Submittal shall include the following:
    - a. One complete set of record drawings
    - b. Record Specifications
    - c. Close-out documentation, including:
      - 1. All previously approved change orders, in sequential order
      - 2. Listing of approved shop drawings
      - 3. Consent of Surety form, provided by surety
      - 4. Certificate and Release of Lien Form
      - 5. Affidavit of Wages Paid.
      - 6. Lien Waivers from sub-contractors and suppliers

#### 1.07 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections during the warranty period.
- B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- D. Maintenance services shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION – (NOT USED)

END OF SECTION



SECTION 02 4100  
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Demolishing designated structures
- B. Removal of materials from site.
- C. Removal of foundations and floor slabs.
- D. Disconnecting, capping, removal of, and identifying utilities.

1.01 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.
  - 1. Identify horizontal and vertical locations of the top and/or bottom of utilities referenced from the project survey control datum.
  - 2. Identify outside diameter of piping.
- B. Submit demolition and removal procedures and schedule under provisions of Section 01 3000- Submittals

1.2 EXISTING CONDITION

- A. Conduct demolition to minimize interference with adjacent structures and underground utilities and piping.
- B. Provide, erect, and maintain temporary barriers and security devices.
- C. Conduct operations with minimum interference to public or private thoroughfares. Maintain protected egress and access at all times.
- D. Do not close or obstruct roadways without permits or prior authorization.

PART 2- PRODUCTS - (NOT USED)

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.



1. Obtain required permits.
  2. Comply with applicable requirements of NFPA 241.
  3. Use of explosives is not permitted
  4. Do not close or obstruct roadways or sidewalks without permit.
- 
5. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  6. Provide, erect, and maintain temporary barriers and security devices.
- B. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- C. If hazardous materials are discovered during removal operations, stop work and notify Engineer and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

### 3.02 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.

### 3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- C. Remove existing work as indicated and as required to accomplish new work.

### 3.04 SERVICES (INCLUDING BUT NOT LIMITED TO PLUMBING, FIRE PROTECTION, ELECTRICAL, AND TELECOMMUNICATIONS): REMOVE EXISTING SYSTEMS AND EQUIPMENT AS INDICATED.

- A. Protect existing work to remain.

### 3.05 DEMOLITION, DEBRIS AND WASTE REMOVAL

- A. Remove demolition, debris, junk, and trash from site.

END OF SECTION

**SECTION 26 0000****ELECTRICAL****PART 1 - GENERAL****1.1 SCOPE**

- A. This section includes requirements for all electrical work.
- B. Refer to paragraph 3.5 for electrical work not shown on the electrical drawings.

**1.2 PROJECT SERVICE CONDITIONS**

- A. Environmental Conditions:
  - 1. Ambient Temperature: 0°F minimum 110°F maximum.
  - 2. Altitude: 5500 ft AMSL.
- B. Seismic Conditions:
  - 1. Seismic Zone 2.

**1.3 SUBMITTALS**

- A. Product Data:
  - 1. Illustrate and indicate style, model, materials, loads, connections, support fastening provision, and finish for each type and size of electrical component used.
  - 2. Provide descriptive information that states conformance to building codes and recognized testing, manufacturing, and performance standards.
  - 3. Provide manufacturer's name and catalog data listing type, catalog number, accessories, and options.
- B. Shop Drawings:
  - 1. Scaled drawings with dimensions and sizes showing information particular to this project for each item with differences.
  - 2. Scaled plan drawings showing locations, necessary installation and maintenance clearances, and inter-connection routing between components.
  - 3. Diagrams and renderings showing relationships and inter-connections necessary between components.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Review submittals for equipment furnished under other sections prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.
- E. Contractor shall note any deviations from the requirements of the contract plans and specifications. Contents of the submittal documents that are not applicable to this project, particularly product options, accessories, and alternate models, shall be clearly marked as not applicable or redacted.
- F. Contractor shall note any deletions and highlight any changes and additions on resubmittal documents.

#### 1.4 QUALITY ASSURANCE

- A. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction such as Underwriters Laboratories, Inc. (UL), and marked for the intended use.
- B. Perform the work in accordance with the current edition of the National Electrical Code (NEC) and the National Electrical Safety Code (NESC).
- C. Perform the work in accordance with local ordinances, building codes, and statutes.
- D. Work shown and specified in these Contract Documents establishes the minimum standard of construction. Comply with any additional requirements of the building codes or local requirements.

#### 1.5 EXISTING FACILITIES AND EQUIPMENT

- A. Existing water operations and process equipment shall not be disturbed.
- B. The existing SCADA system will utilize the new devices in this project. SCADA system programming changes to incorporate the new devices is not included in the scope of this project.

#### 1.6 ELECTRICAL SERVICE

- A. The existing electric service will remain unchanged.

### PART 2 - PRODUCTS

#### 2.1 SUPPORTING DEVICES

- A. Continuous Slot Channel (Strut) Steel Support Systems: Comply with Metal Framing Manufacturers Association Standard MFMA-3, factory-fabricated components for field assembly.
  - 1. Materials
    - a. Structural grade cold-formed steel ASTM A1011 SS GR 33 or ASTM A653 GR 33 according to MFMA-3
    - b. Cold-formed stainless-steel ASTM A240 (type 304)
  - 2. Finishes (galvanized finishes do not apply to stainless-steel)
    - a. Hot-dip galvanized: Hot-dip galvanized after fabrication and applied according to MFMA-3.
    - b. Pre-galvanized: Hot dip galvanized prior to fabrication applied according to MFMA-3.
  - 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items. Provide end caps on all support channels. End caps shall be gray, PVC plastic, manufactured for the specific size of channel furnished.
  - 4. Fitting and Accessory Materials: Same as channels and angles, except metal items shall be stainless steel.
  - 5. Channel Dimensions: Selected for structural loading.
  - 6. Rated Strength: Selected to suit structural loading.
- B. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
- C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following requirements.
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel as required in Part 3 of this specification, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

3. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A325.
4. Toggle Bolts: All-steel springhead type.
5. Hanger Rods: Plated threaded steel.

## 2.2 GROUNDING AND BONDING CONDUCTORS

### A. Conductors

1. For insulated conductors, comply with paragraph 2.6
2. Material: Copper.
3. Equipment Grounding Conductors: Insulated with green-colored insulation.
4. Grounding Electrode Conductors: Stranded cable.
5. Underground Conductors: Bare stranded soft drawn copper.
6. Bare Copper Conductors: Comply with the following:
  - a. For Solid Conductors: ASTM B 3.
  - b. For Assembly of Stranded Conductors: ASTM B 8.
7. Ground Conductor and Conductor Protector for Wood Poles:
  - a. No. 4 AWG minimum, soft-drawn copper conductor.
  - b. Conductor protector: Wood, use pressure-treated fir, or cypress or cedar.
8. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.
9. Protect exposed ground conductors in exterior locations to a height of 3'-0" minimum above grade with Schedule 40 PVC conduit or wood molding designed for the purpose.

### B. Grounding Connector Products

1. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
2. The following type of connectors may be used:
  - a. Bolted pressure-type.
  - b. Compression-type connectors, terminals and lugs shall be tin plated copper.
  - c. Exothermic-welded type, in kit form, and selected per manufacturers written instructions.

### C. Grounding Rods

1. Ground Rods: Sectional type; copper-clad steel unless otherwise noted.
  - a. Size: 3/4-inch diameter by 10-feet (19 by 3000 mm).

## 2.3 DISCONNECT SWITCHES

- A. Fusible and Non-Fusible Disconnect and Manual Transfer Switches, 1200 amp and smaller: Provide heavy duty Type HD conforming to NEMA KS-1 and Federal Specification W-S-865C, 600-Volts, horsepower rated for motors as required. Provide number of poles and ampacity as noted or required by code. Switches shall be fused where indicated, or where required by UL labeling or listing of equipment served. Handle shall have provisions for padlocking in the off position and the door shall have provisions for padlocking closed.
- B. All disconnect switches and manual transfer switches in publicly accessible spaces, or where indicated on the drawings, shall have provisions for padlocking in the ON position.
- C. Switch blades shall be visible when the switch is in the "OFF" position and the door is open.
- D. Provide factory installed neutral assembly for switches installed on circuits with a neutral.
- E. Provide factory installed ground lug kits.
- F. Disconnect switches shall have door interlock mechanisms with a tool-operated spring-loaded defeat feature that prevent the door from opening when the handle is in the ON position. Defeat mechanisms shall be accessible.
- G. Fusible switches 30-amp through 600-amperes shall be furnished with rejection type Class "R" fuse clips. Fusible switches 601-amp through 1200-amperes shall be furnished with Class "L" fuse clips unless otherwise indicated.

- H. The following factory modifications are to be included:
  - 1. Factory installed auxiliary contacts
  - 2. Double line and load lugs for parallel feeders

## 2.4 RACEWAY SYSTEMS

- A. Metal Conduit and Tubing
  - 1. Rigid Metal Conduit - Steel (GRC): ANSI C80.1.
  - 2. Electrical Metallic Tubing (EMT) and Fittings: ANSI C80.3.
    - a. Fittings: Compression type only. Hydraulically crimped or set screw connections are not acceptable.
    - b. Maximum size: 3" trade.
  - 3. Intermediate Conduit (IMC) and fittings are not acceptable.
  - 4. Flexible Metal Conduit (Flex): Zinc-coated steel.
  - 5. Liquid-tight Flexible Metal Conduit (LT): Flexible steel conduit with oil-proof PVC jacket.
- B. Nonmetallic Conduit and Tubing
  - 1. Rigid Non-metallic Conduit (PVC): NEMA TC2, Schedule 40 and Schedule 80 PVC.
  - 2. PVCC Fittings: NEMA TC 3; match to conduit type and material.
  - 3. Electrical Nonmetallic Tubing (ENT) is not acceptable.
- C. Metal Wireway
  - 1. Material and Construction: Sheet metal sized and shaped as indicated. Indoor enclosures shall be rated NEMA 1 and outdoor or wet location enclosures shall be rated NEMA 3R unless otherwise indicated.
  - 2. Fittings and Accessories: Include couplings, offsets, elbows, hangers, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wire-ways as required for complete system.
  - 3. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
  - 4. Wire-way Covers: Screw-cover type.
  - 5. Finish: Manufacturer's standard finish.
- D. Factory Finishes
  - 1. Finish: Provide manufacturer's standard paint applied to factory-assembled surface raceways before shipping.

## 2.5 BOXES AND ENCLOSURES

- A. Enclosure ratings: NEMA 250.
  - 1. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
  - 2. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with cover gaskets.
  - 3. Nonmetallic Outlet and Device Boxes: Shall not be used.
  - 4. Junction and Pull Boxes:
    - a. Boxes less than 100 cubic inches: NEMA OS 1.
    - b. Boxes larger than 100 cubic inches: UL 50.
    - c. Screw covers shall be used unless otherwise indicated on drawings.
  - 5. Outdoors, damp:
    - a. Boxes and Enclosures: NEMA 3R/12 unless otherwise indicated.
  - 6. Outdoors, wet:
    - a. Boxes and Enclosures: NEMA 3R/12 unless otherwise indicated.
  - 7. Indoors, dry:
    - a. Boxes and Enclosures: Type 1 or 12 unless otherwise indicated.
  - 8. Indoors, damp:
    - a. Boxes and Enclosures: Type 12 unless otherwise indicated.
  - 9. Indoors, wet:
    - a. Boxes and Enclosures: Type 4 unless otherwise indicated.
  - 10. Corrosive Locations:
    - a. Boxes and Enclosures: NEMA 4X, Non-Metallic, or stainless steel.

11. Hazardous Locations:
  - a. Boxes and enclosures shall be rated NEMA 7 or 9 as required by the hazard and dual rated for NEMA 3 or 4 or 4X.

B. Factory Finishes

1. Finish: For raceway, enclosure, or cabinet components provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

## 2.6 CONDUCTORS AND CABLES

A. General

1. Power and Lighting Circuits: Provide No. 12 AWG minimum conductors.
2. 120-volt Control and Alarm Circuits: Provide No. 14 AWG minimum conductors.
3. Conductor Material: Copper complying with ICEA S-95-658 /NEMA WC70, solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
4. Service entrance, feeders, branch circuits and field wired control circuits operating at 120 volts or greater: 600 Volt THHN or THWN insulation unless otherwise indicated.
5. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
6. NM and NMC cable shall not be used.
7. 600-Volt Interlocked Armored Cable, Type MC: Not permitted.

B. Connectors and Splices

1. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. Soldered and taped connections are not acceptable.
2. Connections: For No. 10 AWG wire and smaller, provide solderless connectors, Ideal "Wire Nuts," 3M "Scotchlok", or equal. For No. 8 AWG wire and larger, provide solderless connectors, Burndy, O.Z. Gedney, Penn-Union or equal. All uninsulated joints shall be taped over with plastic tape, 3M "Scotch Brand" No. 33 Plus or equal, to provide an insulation value greater than or equal to that on the wire.

C. Terminations

1. Compression type solderless lugs shall be tin plated cast copper and UL listed for the application. Terminal lugs shall have a temperature rating that is equal or greater than that of the wire and terminal equipment.

D. Conductors in Vertical Conduit

1. Support for Conductors in Vertical Conduit: Provide a factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Bodies shall be malleable iron.

E. Signal and Control Conductors

1. Provide the necessary I/O wiring (raceway, supports, connectors, conductors, terminations, etc.) and identification labeling to connect devices to the existing RTB and PLC.
2. Provide surge protection (signal protector) on each analog input.
3. Provide interposing isolation control relay on each discrete output with DO terminal strip.
  - a. Relay: General purpose slim-line plug-in, SPDT form C, 300Vac 10A contacts, 24Vdc coil, LED pilot light, screw terminal DIN rail socket, Allen-Bradley #700-HK36Z24-4 or equal.
  - b. Diode: Provide rectifier (diode) across each relay coil, 400V peak 280 Vrms working reverse voltage, Diodes #1N4004 or equal.
  - c. Provide 24Vdc power supply for discrete inputs DI and discrete output DO relays. DIN rail mount, 120Vac input, 24Vdc 10A output, Sola #SDN10-24-100P or equal.
4. Terminal strips
  - a. Finger-safe single circuit high density 600Vac/dc #30-#12 AWG box terminals, with end barriers. Allen-Bradley #1492-HM1 or equal.

5. Wireway
  - a. 3" deep x 1.5", 2", and 3" widths, light gray with snap-on cover, Thomas & Betts (T&B) #TYxx3WPG6 or equal.
6. DIN rail
  - a. Slotted steel 35mm wide slot. Allen-Bradley #199-DR1 or equal.
7. Conductors
  - a. Discrete I/O:
    - 1) #14 AWG stranded tinned copper MTW 75°C 300V colored jacket. Belden #1015 or equal.
  - b. Analog I/O:
    - 1) #16 AWG stranded tinned copper twisted shielded pair 75°C colored jacket. Belden #8719 or equal.
  - c. Ethernet:
    - 1) #24 AWG solid 4-pair UTP CAT 5e TIA/EIA-568-B.2 350 MHz blue jacket RJ45 terminations.
8. Identification
  - a. Nameplates
    - 1) 1/16" thick engraved phenolic black with white core (letters). Rowmark #322-402 or equal.
  - b. Labels
    - 1) Machine printed heat-shrink type, #10-#18 AWG. Tyton #THS-620W or equal.

## 2.7 SECURITY AND ACCESS INSTRUMENTATION

- A. Magnetic door switches.
  1. Surface mount – hinged or sliding door.
    - a. GE Interlogix 2707AD-L. Anodized aluminum alloy housing, interlocked stainless steel armored cable (0.28"Ø x 36" whip), hermetically sealed SPDT reed switch, 30 Vac/dc max., polyurethane potting into housing, Alnico V magnet, suitable for use on steel doors, ½" maximum gap, 4.25"L x 1.5"W x 0.75"H.

## 2.8 PANEL BOARDS

- A. Enclosures: Flush- or surface-mounted cabinets as indicated on drawings. Enclosure ratings shall be per NEMA 250.
  1. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  2. Door: Provide all panels with hinged door and keyed lock.
  3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
  4. Directory Card: With transparent protective cover, mounted in metal frame, inside panel board door.
  5. Hinged Front Cover: Where indicated provide entire front trim hinged to box and with standard door within hinged trim cover (door-in-door).
- B. Phase, Neutral, and Ground Buses:
  1. Material: Hard-drawn copper, 98 percent conductivity, tin-plated.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
  3. Provide lugs suitable and in quantity as necessary for the indicated feeder conductors.
- C. Service Equipment Label: UL labeled for use as service equipment for panel boards used as the service equipment.
- D. Future Devices: Provide mounting brackets, bus connections, circuit breaker stabs and all necessary appurtenances required for future installation of circuit breakers in all positions indicated as a numbered space or blank.



- E. Short-circuit rating
  - 1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Series rating is not acceptable.
- F. Overcurrent Protective Devices
  - 1. Molded-Case Circuit Breaker:
    - a. Circuit breakers shall meet the requirements of UL 489.
    - b. Interrupting Capacity: Provide circuit breakers with interrupting capacities equal to or greater than the available fault currents shown on the Drawings. Minimum allowable interrupting capacity of 120- and 240-volt circuit breakers is 10,000 RMS symmetrical amperes. Minimum allowable interrupting capacity of 277- and 480-volt circuit breakers is 14,000 RMS symmetrical amperes.
    - c. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
    - d. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long- and short-time time adjustments.
      - 4) Where indicated provide Ground-fault pickup level, time delay, and I<sup>2</sup>t response.
      - 5) Provide with a sealable cover over the adjusting means, except for adjustable magnetic trips on thermal magnetic breakers which do not require covers.
    - e. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers for Personnel Protection: Provide UL Class A ground fault protection in addition to thermal magnetic protection. Circuit breaker shall conform to UL 943.
    - f. Ground Fault Circuit Breakers for Equipment Protection: Provide 30 mA ground fault protection in addition to thermal magnetic protection.
    - g. Multi-pole units enclosed in a single housing or factory-assembled to operate as a single unit.
  - 2. Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
    - a. Lugs: Suitable for number, size, and conductor materials.
    - b. Application listing: Appropriate for application; Type SWD for switching fluorescent lighting loads.
    - c. Ground-fault protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - d. Handle lock-off devices: As shown on the drawings and in schedules.
    - e. Shunt Trip: As shown on the drawings and in schedules.
    - f. Under-voltage Trip: As shown on the drawings and in schedules.
    - g. Auxiliary Contacts: As shown on the drawings and in schedules.
    - h. Key Interlock Kit: As shown on the drawings and in schedules.

## 2.9 DEVICE CONNECTIONS

- A. Provide suitable lugs or connectors to accommodate line and load side conductors shown on the drawings. Where available device connections are inadequate for the number and/or size of conductors required, provide bus extensions, adapter plates or power distribution blocks as required.

## 2.10 TOUCH-UP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

## 2.11 FIRE STOPPING

- A. Fire stopping materials shall meet the requirements of section "Fire Stopping".



## 2.12 CONCRETE BASES AND HOUSEKEEPING PADS

- A. Concrete Forms and Reinforcement Materials: As specified in section "Cast-in-Place Concrete".
- B. Concrete: Minimum of 3000-psi (20.7-MPa), 28-day compressive strength or as specified in section "Cast-in-Place Concrete".
- A. Luminaires
  - 1. The luminaire schedule indicates the types required. Equivalent luminaires by other manufacturers may be submitted for review unless "no substitutions" is indicated in the schedule. The luminaires have been specified on the basis of Owner/Client requirements and review, performance, suitability for the particular application, quality of construction, materials of construction, unit cost, maintainability, technical support by the manufacturer and local representative, aesthetics, compatibility with architecture, interior design, and other luminaire types, color schemes, etc. Acceptance of proposed substitutions will be made with the same criteria.
- B. General
  - 1. Comply with UL 1598.
  - 2. Metal Parts: Free of burrs and sharp corners and edges.
  - 3. Sheet Metal Components: Steel, unless otherwise indicated. Formed and supported to prevent warping, sagging, and damage during installation and maintenance.
  - 4. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to facilitate lamp replacement. Designed to prevent doors, frames, lenses, diffusers, and other components from falling during service and when secured in the operating position.
  - 5. Plastic Diffusers, Covers, and Globes:
  - 6. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High-resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation. Styrene is not acceptable.
  - 7. Lens Thickness: At least 0.125 inch minimum unless less thickness is indicated.
  - 8. Lens: All fixtures using metal halide or quartz halogen lamps shall have a lens which will contain all fragments from a lamp failure.

## PART 3 - EXECUTION

### 3.1 MOBILIZATION

- A. Perform voltage and load current measurements of existing service(s) and feeders to document loading and condition prior to commencement of construction. Photograph existing equipment, user markings/indices, meter readings, and any unusual conditions or arrangements; particularly for items that are to remain, are to be disconnected and reconnected, or are to be removed and relocated.
- B. Report any observed existing conditions for electrical items that are not included in the scope of project work that may pose potential safety or damage risk during project construction.

### 3.2 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow:
  - 1. Set inserts and sleeves in cast-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Coordinate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning before closing in the building.

- C. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrate ceilings or is supported by them, including luminaires, HVAC equipment, fire-protection systems, and partition assemblies.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Comply with the requirements of the NEC.
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

### **3.3 ELECTRICAL EQUIPMENT INSTALLATION**

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Working clearance. Provide working clearance as required by NEC Article 110.
- E. Dedicated space. Provide dedicated space for electrical equipment as required by NEC Article 110.

### **3.4 UTILITY COMPANY ELECTRICAL METERING EQUIPMENT**

- A. Install equipment according to PNM's written requirements. Provide grounding and empty conduits as required by PNM.

### **3.5 MECHANICAL SYSTEMS COORDINATION**

- A. Provide power circuits and connections to actuators, solenoids, controllers, processors, switches, sensors, etc. necessary for the required controls for plumbing, HVAC, and fire protection systems. These devices and circuits are generally not shown on the electrical drawings. Power for control system devices is to be generally supplied by the same branch circuit supplying the equipment being controlled, or by control power supplied from the equipment controller, such that disconnecting the power to the equipment also disconnects power for the controls.
  - 1. Refer to Div. 46 specifications and system submittals for control diagrams, sequence of operation descriptions, and power requirements.
- B. Coordinate with each system installer the locations and arrangements of control system components.
- C. Any control system device requiring more than 120-volt or 100-watts shall be brought to the attention of the Engineer. Any control system requiring more than 120-volt or 1000-watts shall be brought to the attention of the Engineer.

### **3.6 GROUNDING**

- A. Application
  - 1. Use only copper conductors.
  - 2. In raceways, use insulated equipment grounding conductors.
  - 3. Direct Buried and Underground Connections: Use exothermic-welded connections, except those at ground wells.
  - 4. Connections to Structural Steel: Use exothermic-welded connections or bolted pressure connections.
  - 5. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
  - 6. Ground Rod Clamps at Ground Wells: Use bolted pressure clamps with at least two bolts.

- B. Equipment Grounding Conductors
  1. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
  2. Install equipment grounding conductors in all feeders and circuits.
  3. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding rod in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
  4. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor.
- C. Signal and Communication Systems
  1. For telephone, communication, security, and other signal systems provide No. 6 AWG minimum insulated grounding conductor from the grounding electrode system to each service equipment location, terminal cabinet, wiring closet, and central equipment location.
- D. Installation
  1. Ground Rods: At exterior locations drive ground rods until tops are 12 inches (300 mm) below final grade, unless otherwise indicated. Where multiple ground rods are required to meet resistance requirements, install ground rods a minimum of 20 feet apart. Interconnect ground rods with grounding electrode conductors.
  2. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
  3. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
  4. Metal Water Service Pipe: Provide grounding electrode conductor from the building's grounded service conductor at the main electric service equipment to the building's main metal water service entrance. Connect grounding electrode conductors to main metal water service pipe with grounding clamp connectors. Where a dielectric main water fitting is installed, do not connect grounding electrode conductor to the street side of the water service pipe. Bond interior metal water piping system as required by the NEC.
  5. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
  6. When grounding conductors are run in metal conduit bond conduit at each end to the grounding conductor.
  7. Bond interior metal piping systems, including above ground gas piping system as required by the NEC.
- E. Connections
  1. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  2. Use electroplated or tinned materials.
  3. Make connections with clean, bare metal at points of contact.
  4. Coat and seal connections having dissimilar metals with silicone mastic or similar waterproofing material to prevent future penetration of moisture to contact surfaces.
  5. Exothermic-Welded Connections: Comply with manufacturers written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable. Pull conductor and tap connection with a hammer to confirm a good weld. Molds shall be designed for the connection being made.
  6. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

7. If metallic raceways terminate at metal housings without an electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
8. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
9. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
10. Moisture Protection: If insulated grounding conductors are connected to ground rods or ground buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.
11. Underground connections shall be UL listed for underground use.
12. Twisting ground wires together as the only mechanical means of connection is not acceptable.

F. Field Quality Control

1. Testing: Perform the following field quality control testing:
  - a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
  - b. Maximum ground resistance shall be as follows:
    - 1) Equipment Rated 500 kVA and less: 10 ohms.
  - c. Excessive Ground Resistance: When the required ground resistance is not met, additional electrodes shall be provided to achieve the specified ground resistance. The additional electrodes shall be a minimum of 20 feet apart and meet the requirements of this specification.

### 3.7 DISCONNECT SWITCHES

- A. Provide each motor with a disconnecting means as permitted by the NEC. Mount plumb and rigid without distortion of enclosure.
- B. Enclosures
  1. Provide enclosures rated for environmental conditions at their installed location.
    - a. Outdoors, damp or wet: NEMA 250, Type 3R/12.
    - b. Indoors, dry: NEMA 250, Type 1.
    - c. Indoors, damp or wet, or industrial occupancy: NEMA 250, Type 3R/12.
- C. Identification
  1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Identification for Electrical Systems".
  2. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Section "Identification for Electrical Systems".
- D. Cleaning
  1. On completion of installation, vacuum dirt and debris from interiors.
  2. Inspect exposed surfaces and repair damaged finishes.

### 3.8 RACEWAY

- A. Application
  1. General: Use of any of the conduit types in accordance with NEC Articles 342 through 360 is acceptable, with the following exceptions.
    - a. EMT shall not be installed in concrete, in wet locations as defined by NEC, in wet locations as noted on the drawings, or in direct contact with the earth.

- b. Nonmetallic conduit shall only be installed underground or encased within poured concrete structures. Nonmetallic conduit shall be adapted to the appropriate type of metal conduit before it emerges from concealment. All elbows shall be metallic.
- c. Raceways embedded in floor slabs is not allowed.
- 2. Sizing:
  - a. Contractor shall verify all conduit trade sizes identified on the drawings do not exceed the maximum conduit fill per NEC Chapter 9 Table 4 for the type of conduit being used prior to placement. Contractor shall increase the conduit trade size as necessary to comply with the NEC.
  - b. Minimum Raceway Size: 3/4-inch trade size (DN 21).
- 3. Bends: Provide conduit bends with centerline radii not less than NEC Chapter 9 Table 2.
- 4. Outdoors:
  - a. Damp locations:
    - 1) Exposed: GRC.
    - 2) Concealed: GRC.
    - 3) Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LT.
  - b. Wet locations:
    - 1) Exposed: GRC.
    - 2) Concealed: GRC.
    - 3) Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LT.
- 5. Indoors:
  - a. Dry locations:
    - 1) Exposed: EMT and GRC.
    - 2) Concealed: EMT and GRC.
    - 3) Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): Flex.
    - 4) Connections to light fixtures above accessible ceilings: Flex.
  - b. Damp locations:
    - 1) Exposed: GRC.
    - 2) Concealed: GRC.
    - 3) Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LT.
    - 4) Connections to light fixtures above accessible ceilings: LT.
  - c. Wet locations:
    - 1) Exposed: GRC.
    - 2) Concealed: GRC.
    - 3) Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LT.
    - 4) Connections to light fixtures above accessible ceilings: LT.
- 6. Conduit installed below floor slabs: Nonmetallic conduit shall conform to PVC Schedule 40 and shall be joined with solvent cement. Where specifically permitted or shown, conduits may be placed a minimum of 4 inches below the slab. Conduits shall be secured in place and supported to prevent sagging or floating when concrete is poured.
- 7. Conduit Penetrations: All conduits penetrating through floor slabs, concrete walls or grade shall be galvanized rigid steel with factory PVC coating or wrapped with PVC tape. Coating shall extend 2 inches minimum above slab or finished grade. PVC tape shall be 3M "Scotchrap 50" (10 mils) or equal. Conduit shall be cleaned and painted with 3M "Scotchrap" pipe primer and tape shall be half-lapped to provide a minimum of 20 mils coating at any point on the conduit. Adapters from buried PVC conduit to galvanized rigid steel conduit shall be wrapped with PVC tape after assembly.
- 8. Conduit Installed Underground (Exterior of Buildings) – Concrete Encased:
  - a. Use: Where indicated on the drawings, underground conduit on the exterior of building foundations shall be concrete encased.
  - b. Material: PVC Schedule 40, PVC type EB, GRC, or coated GRC.



- c. Concrete Encasement: Concrete encasement shall extend at least 2 inches beyond all conduit surfaces.
  - d. Concrete Dye: Concrete mix shall contain red dye to color the concrete a distinctive, permanent, reddish color.
  - e. Minimum Size: 1" trade.
  - f. Depth: Top of concrete encasement at 30 inches minimum below finished grade.
  - g. Marking: Underground conduit routes shall be marked with tape printed with identification lettering as specified in "Electrical Identification". Tape shall be buried 12 inches below the surface over the entire length of the conduit.
  - h. Tracing Wire: Provide a #12 AWG THHN/THWN blue jacket tracing wire placed in the trench with the conduit. Route the wire through intermediate hand-holes and vaults. Route the wire to above grade at each end of the conduit run and coil at least 12 inches at an accessible location and strap to conduit. Identify as "Trace Wire" with a tag or label. Place wire in trench on top of the concrete encasement.
  - i. Cleaning: All conduits including spares shall be cleaned. A mandrel, not less than 12 inches long and diameter of ½ inch less than the diameter of the conduit shall be pulled through the conduit. Following the mandrel, a brush with stiff bristles shall be pulled through the conduit to clean out debris. Blocked conduits shall be replaced.
9. Conduit Installed Underground (Exterior of Buildings) – Direct Buried:
- a. Use: All underground conduit except where concrete encased is identified.
  - b. Material: PVC Schedule 40 or coated GRC. PVC Schedule 80 may be used provided trade sizes are verified prior to placement per paragraph 2.a.
  - c. Minimum Size: 1-inch trade.
  - d. Depth: Top of conduit at 30 inches minimum below finished grade unless indicated otherwise.
  - e. Marking: Underground conduit routes shall be marked with tape printed with identification lettering as specified in "Electrical Identification". Tape shall be buried 12 inches below the surface over the entire length of the conduit.
  - f. Tracing Wire: Provide a #12 AWG THHN/THWN tracing wire placed in the trench with the conduit. Route the wire through intermediate hand-holes and vaults. Route the wire to above grade at each end of the conduit run and coil at least 12 inches at an accessible location and strap to conduit. Identify as "Trace Wire" with a tag or label.
  - g. Cleaning: All conduits including spares shall be cleaned. A mandrel, not less than 12 inches long and diameter of ½ inch less than the diameter of the conduit shall be pulled through the conduit. Following the mandrel, a brush with stiff bristles shall be pulled through the conduit to clean out debris. Blocked conduits shall be replaced.
- B. Installation
- 1. Keep raceways at least 8 inches (200 mm) away from parallel runs of flues and steam or hot-water piping. Install horizontal raceway runs at the same elevation or above water, insulated hot water, or insulated steam piping. Do not install horizontal raceway runs directly above uninsulated hot water or steam piping.
  - 2. Complete raceway installation before starting conductor installation.
  - 3. Install temporary closures to prevent foreign matter from entering raceways.
  - 4. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
  - 5. Make bends and offsets so the inside diameter is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
  - 6. Conceal conduit within finished walls, ceilings, and floors, unless otherwise indicated.
    - a. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
    - b. Conduits in unfinished areas associated with exposed equipment, and raceways on open ceiling construction, may be installed exposed.
  - 7. Provide surface raceway systems for surface wiring in finished areas and in existing construction areas where indicated.
  - 8. GRC: Support and securely fasten in place at intervals not to exceed 10'-0".
  - 9. EMT: Support and securely fasten in place at intervals not to exceed 5'-0".

10. PVC Coated Conduit: Conduit system shall be installed in accordance with manufacturer's recommendations and care shall be used to prevent damage to the coatings. Any damage to interior or exterior coatings shall be repaired with manufacturer-approved materials.
11. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - a. Run parallel or banked raceways together on common supports.
  - b. When bending parallel conduits, all conduit bends shall have the same radius or concentric bends.
  - c. Raceway installation shall not obstruct light fixtures, electrical equipment and mechanical assemblies.
12. Join raceways with fittings designed and approved for that purpose and make joints tight.
  - a. Use insulated throat bushings at all communication conduit stub-outs above accessible ceilings.
13. Terminations:
  - a. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
  - b. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
14. Install pull lines in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 24 inches (600 mm) of slack at each end of pull line and tie to a support so that the line cannot slip into conduit. Provide labels with unique identifiers that match at each end of the conduit for all empty raceways.
15. Telephone and Signal System Raceways, 2-Inch Trade Size (DN 53) and Smaller: In addition to above requirements, install indoor raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
16. Install raceway-sealing "seal off" fittings at suitable, approved, and accessible locations and fill them with UL listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway-sealing fittings at the following points:
  - a. Where conduits pass from warm to cold locations, outside thermal insulation of refrigerated spaces.
  - b. Outside all classified (hazardous) locations.
  - c. Where otherwise required by the NEC.
17. Stub-up connections: Stub-up conduits a minimum of 2" above floor or equipment pad of free-standing equipment. Provide bushings on metallic conduit and provide caps for spare conduits.
18. Flush Stub-up Connections: Where indicated as a flush stub up, extend conduits through concrete floor and install an adjustable top or threaded coupling set flush with finished floor. Provide screwdriver-operated threaded plugs flush with floor finish for future conduit connection.
19. All conduit stub-outs and sleeves for wiring not installed in raceways shall have bushings installed on the end of each conduit not connected to a box or fitting. Bushings shall be securely fastened to the conduit and shall be threaded or hammer-on type.
20. Flexible Connections: Use maximum of 72 inches (1830 mm) of Flexible conduit for recessed and semi-recessed lighting fixtures.
21. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
22. Fire Rated Penetrations: Where conductor raceways or cable trays penetrate fire rated wall or floor assemblies, openings shall be fire-stopped with UL listed sealants, barriers, or other devices specifically listed for the purpose.
23. Temperature:
  - a. Conduits exposed to changes in temperature or attached to structures that may expand or contract shall be provided with expansion fittings.

- b. Nonmetallic or PVC coated conduits shall not be installed in areas where the temperature may exceed 122 °F for extended periods of time.
  - 24. Provide raceway expansion joints where raceways cross building and structural expansion joints.
- C. Penetration Sleeves
  - 1. Sleeves: Furnish sleeves for conduit passing through concrete walls, partitions, beams, floors and roof while same are under construction. A conduit sleeve shall be one size larger than the size of conduit which it serves except where sealing bushings are used in sleeves through walls below grade. Sleeves are not required for conduits installed before the wall, partition, floor, or roof is constructed.
  - 2. Sleeves Set in Concrete Floor: Sleeves shall be 18-gauge galvanized steel or PVC. Sleeves shall extend 2 inches above the finished floor. Conduit passing through concrete or masonry walls shall have Schedule 40 galvanized steel sleeves. Sleeves shall be set flush with finished wall. If holes and sleeves are not properly installed and cutting and patching become necessary, it shall be done at no expense to Owner. Undertake no cutting or patching without first securing approval. Where penetrations must be waterproofed, properly caulk with oakum and run full of asphalt mastic or silicone rubber caulking.
  - 3. Sleeves Penetrating Walls Below Grade: Sleeves shall be Schedule 40 black steel pipe with 1/4-inch thick steel plate secured to the pipe with continuous fillet weld or a factory-made sealing fitting employing pressure rings and sealing grommet. The plate shall be located in the middle of the wall thickness and shall be 1/4-inch wider all around than the sleeve which it encircles. The entire assembly shall be hot-dipped galvanized after fabrication.
- D. Protection
  - 1. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
    - a. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
    - b. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- E. Cleaning
  - 1. After completing installation of exposed factory-finished raceways, inspect exposed finishes and repair damaged finishes. Match factory finish with same material and color.

### 3.9 OUTLETS

- A. Exact location of outlets and equipment shall be governed by structural conditions, obstructions, finishes, trim, and other equipment items. When necessary, relocate outlets so that when fixtures or other devices are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location for all outlets, panels, equipment, etc. with the Architect/Engineer. The Architect/Engineer reserves the right to relocate equipment and outlets prior to installation, without additional cost, if such relocation does not require significant additional materials. Coordinate location of all outlets and equipment with the work of other trades, and so as to allow proper access and clearances for all equipment.
- B. Where luminaires are mounted on or in an accessible type ceiling, provide a junction box and extend flexible metal conduit to each luminaire. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers set flush with the finished surface. Back-to-back outlets in the same wall, or "through-wall" type boxes, are not permitted. Provide 6-1/2" (minimum) long nipple to offset all outlets shown on opposite sides of a common wall to minimize sound transmission.
- C. Surface mounted boxes in finished areas shall not have knock-outs visible on top, bottom, or sides of box.
- D. Locate outlets as follows, unless specifically indicated otherwise on the drawings. Where mounting height notations indicated on drawings vary with those below, height indicated on drawings shall govern. Mounting heights listed are from finished floor to horizontal centerline of outlet box.



Adjust the height of any outlets in masonry walls from any height indicated on the drawings so that the outlet box will be at the bottom or top edge of block or brick.

Device	Height AFF
Convenience, cleaning, or water cooler receptacle:	1'-6" (+18)
Telephone/network outlet:	1'-6" (+18)
Receptacle or telephone/network outlet over base cabinets:	3'-8" (+44)
Refrigerator, vending machine, laundry receptacle:	3'-8" (+44)
Receptacle in mechanical, equipment, shop, janitor, or shell area:	3'-8" (+44)
Light switch:	3'-8" (+44)

- E. Install enclosures and cabinets plumb. Support at each corner.

### 3.10 CONDUCTORS

#### A. Derating

1. Conductors shown on the drawings are based on no more than three current carrying conductors in a raceway. If the contractor chooses to combine homeruns resulting in more than three current carrying conductors in a raceway, then the contractor shall apply the NEC derating factors.

#### B. Installation

1. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
2. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Monitor pulling tension on cables sized 250 MCM and larger on pulls over 300 feet.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

#### C. Connections

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
2. Terminations: Terminate stranded wire at screw terminals with compression type lugs. Terminations made by looping stranded wire around a terminal screw are not acceptable.
3. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

#### D. Tests

1. General: Test all conductors of each feeder or circuit rated 200 amperes and more by applying 500 volts direct-current to the conductor with a megohm meter (megger). Conduct test after conductor is pulled and spliced, but prior to connection to any transformers, switchgear, switchboards, motor control centers, starters, capacitors, surge arresters, motors or any other equipment.
2. Procedure: Test in accordance with the megohm meter manufacturer's instructions.
3. Test Equipment: Provide megohm meter, test personnel, and all other equipment required to perform the tests. Resident Project Representative and/or Owner shall witness each test.
4. Damage during testing: Conduct test in accordance with test equipment manufacturer's instructions. Replace any conductor, materials, or equipment damaged during testing.
5. Test Results: Provide test results that include the following information as a minimum:
  - a. Date of test
  - b. Names of testing personnel
  - c. Temperature at time of test
  - d. Brand, model number, and serial number of test equipment
  - e. Meter calibration report indicating valid and current NIST certification
  - f. Test procedures used
  - g. Conductor designation including circuit and phase

- h. Conductor description
  - i. Megohm meter reading
  - j. Signature of lead testing personnel
  - k. Signature of witness
6. Review of Test Results: Architect/Engineer shall review all test results. Megohm values of less than 20 megohms are not acceptable. Replace any unacceptable conductors or splices and test the conductor when repairs are complete.
- E. Conductors In Vertical Conduit
- 1. Provide support for conductors in vertical conduit where required by Article 300 of the NEC.

### 3.11 EQUIPMENT ENCLOSURES

- A. Do not install equipment in a more severe environment than recommended by the equipment manufacturer. When not indicated, provide enclosures suitable for the environment in which they are located in accordance with NEMA Standard No. 250.

### 3.12 PANELBOARDS

- A. Coordination
- 1. Coordinate layout and installation of panel boards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance and code requirements.
  - 2. The minimum nominal wall cavity depth for flush-mounted panel boards is 6-in.
- B. Installation
- 1. Install panel boards and accessories according to NEMA PB 1.1.
  - 2. Provide enclosures rated for environmental conditions at installed location.
  - 3. Mount plumb and rigid without distortion of box. Mount recessed panel boards with fronts uniformly flush with wall finish. Allow sufficient box spacing so that flush trims do not overlap.
  - 4. Set field-adjustable switches and circuit-breaker trip ranges.
  - 5. Install removable filler plates in unused spaces.
  - 6. Flush Mounted Panels: Provide spare conduits installed in size and quantity to accommodate future growth. Spare conduits shall be routed from the panel board to an accessible location suitable for adding conduit extensions, such as above ceilings, in storage and equipment areas, etc. Number and size of conduits for each panel board shall be as follows: at least one 1-inch conduit plus one 3/4-inch conduit for every four spare breakers or unused panel board spaces, minimum of two spare 3/4-inch conduits.
  - 7. Deliver panel board keys to the owner's representative. Obtain signature of owner's representative on a delivery receipt. Include delivery receipt in the closeout documents.
- C. Identification
- 1. Identify each panel board section, interconnecting wiring, and any control/instrumentation/metering wiring.
  - 2. Provide a printed circuit directory for each panel board section indicating final circuit loads. Handwritten directories are not acceptable.
- D. Quality Control
- 1. Load Balancing: After substantial completion, but not more than 60 days after owner occupancy, perform load balance measurements.
    - a. Measure each phase during normal loading.
    - b. Perform circuit changes outside normal occupancy/working schedule of the project and at time acceptable to the owner. Critical functions such as faxing, network maintenance, pumping, treatment, shipping, and receiving must not be interrupted.
    - c. After circuit changes, re-measure phase currents during normal occupancy period. Record new readings.

- d. Tolerance: Phase current differences exceeding 20 percent of the highest reading is not acceptable. Rebalance and re-measure until the tolerance requirement is met. Submit final measurements with the closeout documents.

E. Cleaning

- 1. Upon completion of installation, inspect interior and exterior of panel boards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish. Verify installation of nameplate, directory, circuit numbers, and warning labels.

**3.13 CALIBRATION**

- A. Scale, calibrate, and verify all analog I/Os to and from the PLC.

**3.14 FIRE STOPPING**

- A. Apply UL listed fire stopping materials to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. See architectural drawings for locations of fire rated floors, walls, ceilings and partitions.

**3.15 DEMOLITION**

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Remove all abandoned wiring. In exposed locations, cut and remove buried raceway 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish. In concealed locations, cut raceways flush with surface. Plug or cap raceways.
- D. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

**3.16 CUTTING AND PATCHING**

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestop has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

**3.17 REFINISHING AND TOUCH-UP PAINTING**

- A. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
- C. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- D. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.18 CLEANING AND PROTECTION

- A. On completion of installation, inspect and clean all electrical equipment and enclosures including pane board, switchboard, transformer, motor control center, control panel, and electrical enclosure interiors, light fixtures and lenses, outlet boxes, floor mounted devices, fittings, and wiring devices. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

### 3.19 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp or Wet Locations and Outdoors: Provide slotted or solid stainless steel (Type 304 or 316) channel. Provide stainless steel anchor bolts.
- B. Indoor, Dry Locations: Provide hot-dipped pre-galvanized or electro-galvanized steel slotted or solid channel.
- C. Corrosive Locations: Provide aluminum or stainless steel (Type 304 or 316) slotted channel, or epoxy or non-metallic coated steel slotted channel. Provide stainless steel anchor bolts.
- D. Manholes: Provide nonmetallic slotted channel. Provide galvanized concrete insert type or stainless-steel anchor bolts.
- E. Do not attach aluminum channel directly to concrete. Provide plastic spacers or coat surfaces in contact with concrete with epoxy paint.
- F. For channel attached to aluminum handrails or other aluminum structures, provide aluminum or stainless-steel channels with stainless steel hardware.
- G. Provide stainless steel anchor bolts for stainless steel, aluminum, or epoxy coated steel channels in damp, wet, or outdoor locations.
- H. Field Cuts: Grind all edges smooth. Make cuts square unless angles are required for installation. Paint field cuts of galvanized steel channel with a galvanizing solution or zinc rich paint. Apply epoxy coating to field cuts of epoxy coated steel channel. Apply PVC coating to field cuts of PVC coated steel channel. Install end caps on all exposed channel ends.

### 3.20 SUPPORT INSTALLATION

- A. Install support devices necessary to securely and permanently fasten and support the electrical components.
  - 1. Do not fasten supports to piping, ceiling support wires, ductwork, mechanical equipment, conduit, or cable tray.
  - 2. Install surface-mounted cabinets and panel boards with a minimum of four anchors.
  - 3. Provide metal channel supports to stand cabinets and conduit one inch off walls in wet locations.
  - 4. Bridge studs top and bottom with channels to support flush-mounted cabinets and panel boards at stud walls.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for installation of multiple raceway so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch (6-mm) diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting

and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports. Do not use spring steel fasteners in damp, wet, or corrosive locations.

- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
- K. Install metal channel racks for mounting cabinets, panel boards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure per the following requirements, unless otherwise indicated. Perform fastening according to the following requirements unless other fastening methods are indicated. Verify with manufacturer the suitability of fasteners in subparagraphs below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick. Fasteners that fracture or damage surfaces are not acceptable.
  - 1. Wood: Fasten with wood screws or screw-type nails.
  - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  - 3. New Concrete: Concrete inserts with machine screws and bolts.
  - 4. Existing Concrete: Expansion bolts.
  - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used.
  - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
  - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
  - 8. Light Steel: Sheet-metal screws.
  - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.21 PROJECT CLOSEOUT

- A. All systems furnished or installed under this contract shall be clean and left in first-class operating condition. All work shall be complete. Provide services and/or materials listed herein to assist the Owner in understanding the operation and maintenance of all systems. Provide voltage and current measurements to document actual load conditions.
- B. No temporary markings visible on equipment will be accepted. Repaint or refinish where temporary markings cannot be removed from trims, housing, enclosures, etc. Defaced finishes must be refinished.
- C. Thoroughly clean surface to which pressure-sensitive type labels and nameplates are applied to assure adherence.
- D. Reports
  - 1. Submit written report of voltage and load current measurements for each feeder. Provide current measurements for each leg and neutral after the Owner has occupied each area of the project and installed equipment not furnished under this contract. Submit the readings noting the date, time, and personnel performing each measurement for documentation.

E. Receipts

1. Submit signed receipts or transmittals for keys, media, spare parts, removed components, warranty registrations, user licenses, default usernames and passwords, and any special tools delivered or returned to the Owner's representative. Keys shall be tagged with system and component identifier for easy association.

**3.22 CONCRETE HOUSEKEEPING PADS**

- A. Install all freestanding electrical and control equipment on 4-inch high reinforced concrete pads (top of pads shall be 4 inches above finished floor) with smooth finish. Arrange components in the electrical equipment so that any switch operating handle is not more than 6 feet 7 inches above the surrounding floor to comply with NEC Article 404.8.
- B. Construct concrete housekeeping pads necessary for the footprint of the equipment furnished but not less than 3 inches (100 mm) larger than the equipment footprint and so that anchor bolt inserts will be a minimum of 10 bolt diameters from any edge of the pad. Chamfer exposed edges.

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**END OF SECTION**

ELECTRICAL SUBMITTAL SCHEDULE				
✓	PARA	SECTION TITLE	SUBMITTAL DESCRIPTION	TYPE
<input type="checkbox"/>	2.1	Supports	Channel strut and fittings	Catalog data
<input type="checkbox"/>	2.2	Grounding	Exothermic welds and compression connections	Catalog data
<input type="checkbox"/>	2.3	Equipment Wiring, Disconnect	Safety switches	Catalog data
<input type="checkbox"/>	2.4	Raceway	Conduit and fittings	Catalog data
<input type="checkbox"/>		Raceway	Liquid-tight metal flex	Catalog data
<input type="checkbox"/>	2.5	Outlets	Outlet boxes	Catalog data
<input type="checkbox"/>	2.5	Boxes and Enclosures	Boxes, enclosures, vaults, hand-holes	Catalog data
<input type="checkbox"/>	2.6	Wire and Cables	Conductors	Catalog data
<input type="checkbox"/>		Wire and Cables	Instrumentation terminal strips, wireway, relays	Catalog data
<input type="checkbox"/>	2.7	Security and Access	Magnetic switches	Catalog data
<input type="checkbox"/>	2.8	Panel Boards	Enclosures, buses	Catalog data
<input type="checkbox"/>		Panel Boards	Circuit breakers and accessories	Catalog data
<input type="checkbox"/>	27 5410	Telemetry	Components	Catalog data
<input type="checkbox"/>		Telemetry	System	Shop drawings



## SECTION 27 5410

### INSTRUMENTATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Design, construct, program, commission, and test the control and monitoring of the process equipment included in this project.
- B. Integrate the process equipment included in this project into the existing facility control and monitoring system.
- C. Provide all instrumentation devices, sensors, communication components, wiring, tubing, valves, fittings, terminals, power supplies, batteries, relays, I/O expansion modules, identification, enclosures, sunshades, and supports necessary.
- D. Furnish all tools, installation equipment, calibration and test equipment, consumables, and incidentals necessary for the installation and commissioning.

##### 1.2 SCOPE

- A. Monitor status of the water process equipment in this project and communicate with the existing SCADA system by means of wireless cellular devices.
- B. The telemetry equipment shall provide a distributed multipoint control and communication system. The system shall be an open architecture based using programmable logic controllers (PLC) in the commercially available remote telemetry units (RTUs) and a central access point (CAP). Proprietary or custom RTUs or CAP are not acceptable.
- C. All RTUs shall be capable for store/forward repeater functions. If a radio communications path is not reliable, the contractor shall reconfigure RTUs as needed to store and forward data over the best radio path.
- D. The Central access point shall be the polling master. The equipment at this location shall poll the remote sites. Historical and set-point data and system control shall reside at this unit. Remote systems shall continue to operate on last inputs and set-points without any computer designated as a master computer.
- E. In addition to the status lists maintained by each PLC, a control list shall be provided which determines which computer is the master computer. The master computer designation can be changed by someone with a manager password. All overview screens shall display which computer is designated master.

##### 1.3 QUALIFICATIONS

- A. "System supplier" is the company which assembles the instrumentation, installs and supervises the installation of the equipment, configures the hardware and software, commissions the system, trains Owner's designated operators, and services the completed installation.
- B. System supplier shall meet the following requirements:
  - 1. Successfully installed five (5) similar municipal wastewater treatment systems. Provide a list of completed projects along with contact names addresses, and phone numbers. Indicate complexity of project, for example, number of I/O points, number of RTU's, and software used.
  - 2. Been in business for minimum 5 years. Indicate number of years in business.
  - 3. Be located within 100 miles of the project site



4. Employ a minimum of three service technicians. The technicians shall reside within 200 miles of the project site. Provide resumes of service technicians and the project manager.
5. Submit information indicating financial solvency, such as an audited annual report, if requested.

#### **1.4 SUBMITTALS**

- A. Refer to Section "Basic Electrical Material and Methods" 26 0050 Part 1.
- B. System Supplier Information. Provide documentation indicating compliance with the requirements of paragraph 1.3B.
- C. Product Data:
  1. Illustrate and indicate manufacturer, model, options, style, material, mounting provision, finish, and electrical characteristics for each type and size of component used. Clearly identify and obscure product data in manufacturer's published information that is **not** applicable to this project.
  2. Descriptive information that states conformance to building codes and recognized testing, manufacturing, and operating standards.
- D. Shop Drawings:
  1. Component mounting arrangement, enclosure(s), and protection.
  2. Wiring methods, connection assignments, and conductor identifiers.
  3. Input/output table.
  4. Details of any custom fabricated components, supports, or other construction methods.
  5. Identification methods and nomenclature.
- E. Operation and Maintenance Data: Provide bound manuals per Division 1 and Section "Basic Electrical Materials and Methods" 26 0050 that includes all submittal information corrected for as-built conditions. In addition to items indicated previously in this section, include the following:
  1. Routine maintenance or service requirements for all installed components.
- F. System supplier shall note any deviations from the requirements of these contract documents.

#### **1.5 QUALITY ASSURANCE**

- A. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction such as Underwriters Laboratories, Inc. (UL), and marked for the intended use.
- B. Perform the work in accordance with the current edition of the National Electrical Code (NEC) and the National Electrical Safety Code (NESC).
- C. Perform the work in accordance with local ordinances, building codes, and statutes.
- D. Source Limitations: Obtain system main communications equipment from a single manufacturer.
- E. Work shown and specified in these contract documents establishes the minimum standard of construction. Comply with any additional requirements of the building codes or local requirements.

#### **1.6 EXISTING FACILITIES AND EQUIPMENT**

- A. Existing wastewater operations and process equipment not directly involved with this project shall not be disturbed.
- C. Flow meter vault
  1. Digital electromagnetic flow meter
- D. Backflow Preventer
  1. No I/Os.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE

- A. Instrumentation shall be designed, selected, and constructed such that each system shall resume normal operation without requiring manual reset after power interruptions.
- B. Devices located in Class 1 Division 1 and Division 2 hazardous areas shall be rated for hazardous location installations per NEC and UL. Conduit seal-offs shall be provided outside the hazardous areas where shown or as necessary.
- C. Serial communications protocol shall be Modbus RTU 1.2-115.2 kbps
- D. Internet protocol shall be IP/Ethernet 10/100 Mbps.
- E. Analog signal output from equipment that is not 4-20mA shall have the output immediately converted to 4-20 mA. Transmission methods such as impulse duration, pulse rate, and voltage regulated are permitted except where specifically noted.
- F. Instrumentation shall display any alarm within five seconds of initiation. The system shall display any change of status within ten seconds.

### 2.2 WIRING

- A. Provide the necessary I/O wiring (raceway, supports, connectors, conductors, terminations, etc) and identification labeling.
- B. Refer to diagrams and the I/O Schedule on the drawings.
- C. Provide surge protection (signal protector) on each analog input. DIN rail clamp, 28V signal peak 4 MHz, 55V peak clamping, 50 pico-seconds response, >100 operations surge life at 200A 10x1000 µsec. Bourns #1820-28-A3 or equal.
- D. Provide interposing isolation control relay on each discrete output with DO terminal strip. Relay: General purpose slim-line plug-in, SPDT form C, 300Vac 10A contacts, 24Vdc coil, LED pilot light, screw terminal DIN rail socket, Allen-Bradley #700-HK36Z24-4 or equal. Diode: Provide rectifier (diode) across each relay coil, 400V peak 280 Vrms working reverse voltage, Diodes #1N4004 or equal. Provide 24Vdc power supply for discrete inputs DI and discrete output DO relays. DIN rail mount, 120Vac input, 24Vdc 10A output, Sola #SDN10-24-100P or equal.
- F. Terminal strips
  - 1. Finger-safe single circuit high density 600Vac/dc #30-#12 AWG box terminals, with end barriers. Allen-Bradley #1492-HM1 or equal.
- G. Wireway
  - 1. 3" deep x 1.5", 2", and 3" widths, light gray with snap-on cover, Thomas & Betts (T&B) #TYxx3WPG6 or equal.
- H. DIN rail
  - 1. Slotted steel 35mm wide slot. Allen-Bradley #199-DR1 or equal.
- I. Conductors
  - 1. Discrete I/O:
    - a. #14 AWG stranded tinned copper MTW 75°C 300V colored jacket. Belden #1015 or equal.
  - 2. Analog I/O:
    - a. #16 AWG stranded tinned copper twisted shielded pair 75°C colored jacket. Belden #8719 or equal.
  - 3. Ethernet:
    - a. #24 AWG solid 4-pair UTP CAT 5e TIA/EIA-568-B.2 350 MHz blue jacket RJ45 terminations.

- J. Identification
  - 1. Nameplates
    - a. 1/16" thick engraved phenolic black with white core (letters). Rowmark #322-402 or equal.
  - 2. Labels
    - a. Machine printed heat-shrink type, #10-#18 AWG. Tyton #THS-620W or equal.

### **2.3 ANALYTICAL INSTRUMENTATION**

- A. None.

### **2.4 FLUID LEVEL INSTRUMENTATION**

- A. None.

### **2.5 FLUID FLOW INSTRUMENTATION**

- A. Electro-magnetic flow meter to record potable water distribution system flow through station. Refer to specification section 40 9101 FLOW METERS.

### **2.6 PRESSURE INSTRUMENTATION**

- A. None.

### **2.7 POSITION OR STATE INSTRUMENTATION**

- A. None.

### **2.8 SECURITY AND ACCESS INSTRUMENTATION**

- A. Magnetic hatch door and hinged cover switches.
  - 1. Surface mount – hinged or sliding door.
    - a. GE Interlogix 2707AD-L. Anodized aluminum alloy housing, interlocked stainless steel armored cable (0.28"Ø x 36" whip), hermetically sealed SPDT reed switch, 30 Vac/dc max., polyurethane potting into housing, 1/2" maximum gap, 4.25"L x 1.5"W x 0.75"H.

### **2.9 UTILITY POWER and STAND-BY POWER GENERATION**

- A. None.

### **2.10 EQUIPMENT CONTROL**

- A. None.

### **2.11 LOGIC OR PROGRAMMING INSTRUMENTATION**

- A. Remote Telemetry Unit (RTU)
  - 1. Modular expandable enclosed telemetry I/O equipment
    - a. Ovarro TBOX LT2-530 – no substitution
    - b. listed or labeled by a nationally recognized testing laboratory
    - c. provisions for discrete inputs and outputs and analog inputs and outputs as scheduled, indicated, or as necessary.
    - d. DIN rail mount
    - e. 1 USB 2.0 type B 12 Mbps port (programming, configuration, firmware updates, and online edits)
    - f. 2 Ethernet full-duplex, 10/100/1000 Mbps ports
    - g. Programming languages: ladder diagram (LD), structured text (ST), function block diagram (FBD), and sequential function chart (SFC)
    - h. User memory: 3 MB

- i. Nonvolatile memory: 8 GB SD card (option 1784-SDHC8)
  - j. 24 Vdc power input, 8.5 Watt power dissipation
  - 2. Sequence of operation: Refer to sequence of operation on the drawings.
    - a. Telemetry system shall have a digital serial interface to cellular communication device. Unit shall have provisions for discrete inputs and outputs, and analog inputs and outputs as scheduled, indicated, or as necessary. Provide diagnostic capability to monitor and troubleshoot signal loss.
    - b. Installation: Telemetry units shall be located where shown on the drawings. System supplier shall provide licensed electricians and the services of a factory trained serviceman for installation, inspection, and to make necessary adjustments at startup. In addition, the factory trained serviceman shall be available and experienced to instruct operating personnel in the proper operation and service of the equipment.
- B. Cellular Communications
- 1. Industrial LTE 4G Wireless (cellular)(Verizon)
    - a. Gateway
      - 1) DIN rail mount
      - 2) 7-36 Vdc input 1 W
      - 3) Sierra Wireless #RV50X with #6001125 omni-directional 3-in-1 panel antenna and RG174 cable – no substitution
- C. Power Supply
- 1. Uninterruptible: Provide a rechargeable battery back-up system at all locations. Unless indicated otherwise, minimum battery capacity shall allow continued normal telemetry functions for a minimum 6 hours. Batteries shall be deep cycle sealed lead-calcium type. Provide battery charger and charge controller. Shop drawing submittal shall include calculations of battery capacity (run time). Shop drawing submittal shall include calculations of battery capacity and system run time.
    - a. Phoenix Contact #TRIO-UPS/1AC/24DC/5 w/ #QUINT-BAT/2DC/7.2AH.

### **PART 3 - EXECUTION**

#### **3.1 COORDINATION**

- A. Review submittals for equipment furnished under other divisions and specification sections prior to installation and electrical rough in. Verify location, size, and type of interface connections. Coordinate details of equipment connections with suppliers and installers.

#### **3.2 FACTORY TEST**

- A. Before the equipment is shipped to the job site, the factory test shall be performed. The test shall occur in the supplier's facility.

#### **3.3 INSTALLATION**

- A. Installation activities shall be scheduled with the Owner a minimum of two weeks in advance for each site.
- B. Provide earth ground and bonding of all metal parts of antenna supports.
- C. Provide dedicated 120V branch circuit for RTU and CAP power supplies from existing facility electrical distribution systems at each site.

#### **3.4 PROGRAMMING**

- A. Water flow station
  - 1. Provide configuration and operation programming to relay pipeline flows and period totals.

### **3.5 CALIBRATION**

- A. Scale, calibrate, and verify all analog I/Os to and from the RTUs.

### **3.6 TRAINING**

- A. The System Supplier shall conduct training courses for personnel selected by the Owner. Training shall be provided at the operator level and shall be conducted by personnel employed by the System Supplier who are familiar with the specific system supplied and who have experience and training in developing and implementing similar instructional courses.
- B. All costs associated with the complete training program shall be the responsibility of the System Supplier and shall be included in the Contract Price. Training schedules shall be coordinated with the Owner to accommodate all personnel.
- C. Training shall be conducted at the Owner's facilities and shall not begin until the system is installed and operational.
- D. An outline of training shall be submitted 15 days in advance for review. Training sessions shall be divided into a minimum of two categories; operator training, and maintenance technician training.
- E. The training program shall include at least eight (8) clock hours of instruction for the Owner's personnel and shall cover at least the following topics:
  - 1. Preventive and scheduled maintenance for all equipment.
  - 2. Function and normal operation of all circuit boards and modules.
  - 3. Diagnosis of hardware failures to the faulted board or module.
  - 4. Removal and replacement of all removable circuit boards and modules.
  - 5. Emergency maintenance and restoration procedures.
  - 6. Graphic display development and editing.
  - 7. PLC troubleshooting including use of laptop computer as a PLC programming tool.
  - 8. Radio troubleshooting and replacement.
  - 9. System debugging.

### **3.7 CLEANING**

- A. On completion of installation, inspect interior and exterior of RTUs. Remove paint splatters and other spots. Vacuum dirt and debris. Repair exposed surfaces to match original finish.

### **3.8 FINAL ACCEPTANCE TEST**

- A. After completion of installation, a test shall be performed and witnessed. The test shall test all hardware and software to confirm compliance with requirements.
  - 1. Operate all inputs and outputs at the RTU's including 4-20ma DC signals. Display these on the computer screen.
  - 2. Demonstrate all graphic screens and print reports.
  - 3. Demonstrate all alarms on system.
  - 4. Demonstrate compliance with sequence of operation.
  - 5. Demonstrate error free communication over all radios.
  - 6. Demonstrate power failure operation of all computers and RTUs and CAP in project.

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**END OF SECTION**

SECTION 64 1000

UTILITY CONSTRUCTION TRAFFIC CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. The Contractor shall retain the services of a qualified traffic control company to develop a traffic control plan that meets the needs of the Contractors construction activities. The traffic control company shall also be responsible for providing comprehensive traffic control services during construction.
2. Traffic Control shall meet the following objectives:
  - a. Be specific to the Contractors construction equipment, sequencing, and activities
  - b. Maintain public safety in accordance with state and federal traffic control standards as identified herein.
  - c. Maintain accessibility for emergency response vehicles.
  - d. Minimize traffic impacts during construction.
3. Comprehensive traffic control services.

B. Related Sections:

1. Division 01 3000 - SUBMITTALS.
2. Division 01 4000 – QUALITY CONTROL

1.02 REFERENCES

- A. Manual for Uniform Traffic Control Devices (MUTCD), latest edition.
- B. New Mexico Department of Transportation (NMDOT) Standard Specifications for Highway and Bridge Construction, 2019 Edition.

1.03 SUBMITTALS

A. Traffic Control Plan:

1. Submit a detailed traffic control plan developed by the traffic control company.
2. Plan must comply with MUTCD and NMDOT standards and specifications.
3. Plan will be reviewed and approved by NMDOT.

B. Qualifications:

1. Submit qualifications of the traffic control company.

2. Include evidence of previous experience with similar projects.

#### 1.04 QUALITY ASSURANCE

##### A. Traffic Control Company:

1. Must be experienced in developing and implementing traffic control plans.
2. Must comply with all applicable local, state, and federal regulations.

##### B. Regulatory Requirements:

1. Comply with MUTCD and NMDOT standards and specifications.

### PART 2 - PRODUCTS

#### 2.01 TRAFFIC CONTROL PLAN

##### A. The Traffic Control Plan shall include the following:

1. Project Information:
  - a. Project Name: Identification of the construction project.
  - b. Project Location: Precise location details, including road names and nearby landmarks.
  - c. Project Description: Brief overview of the project's scope.
  - d. Project Duration: Estimated start and end dates.
  - e. Project Contacts: Contact information for key personnel.
2. Site Plan and Layout:
  - a. Site Boundaries: Clearly defined boundaries of the construction site.
  - b. Work Zones: Delineation of areas for excavation, equipment staging, and work crews.
  - c. Traffic Flow: Arrows and markings showing intended traffic flow.
  - d. Lane Configurations: Details on lane closures, temporary lanes, and shifts.
  - e. Access Points: Locations for construction vehicle and pedestrian access.
3. Traffic Control Devices:
  - a. Traffic Signs: List of required regulatory, warning, and informational signs.
  - b. Barricades: Placement and use of barricades to restrict access.
  - c. Cones and Channelizers: Positioning to direct traffic and indicate lane closures.
  - d. Temporary Traffic Signals: Installation and operation details for temporary signals.

4. Traffic Control Personnel:
  - a. Flaggers: Procedures for flagging operations, including positions and signals.
  - b. Training: Ensuring all personnel are trained in traffic control procedures.
5. Emergency Procedures:
  - a. Emergency Contacts: List of emergency contacts and procedures.
  - b. Access for Emergency Vehicles: Ensuring clear paths for emergency responders.
6. Public Communication:
  - a. Signage: Informing the public about construction activities and detours.
  - b. Notifications: Providing advance notice to affected residents and businesses.
7. Compliance and Monitoring:
  - a. Regulatory Compliance: Adherence to MUTCD and local standards.
  - b. Regular Inspections: Ensuring all devices and procedures are functioning correctly.
  - c. Adjustments: Making necessary changes based on ongoing assessments.

#### 2.01 TRAFFIC CONTROL DEVICES

- A. Provide traffic control devices as required by the approved traffic control plan.
- B. Devices must comply with MUTCD and NMDOT standards.

### PART 3 - EXECUTION

#### 3.01 TRAFFIC CONTROL PLAN IMPLEMENTATION

- A. Implement the approved traffic control plan.
- B. Coordinate with NMDOT for any required inspections or approvals.

#### 3.02 MAINTENANCE OF TRAFFIC CONTROL DEVICES

- A. Maintain all traffic control devices in good working condition.
- B. Replace or repair any damaged or non-compliant devices immediately.

#### 3.03 REMOVAL OF TRAFFIC CONTROL DEVICES

- A. Remove all traffic control devices upon completion of the project.
- B. Ensure the site is left in a safe and orderly condition.

END OF SECTION