

**TECHNICAL SPECIFICATIONS  
FOR  
CONSTRUCTION  
OF  
TURQUOISE TRAIL WATERLINE**

Wilson & Company Project No. 23-600-156-00

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*

AUGUST 2024

**WILSON  
& COMPANY**



These Plans and Contract Specifications, for the TURQUOISE TRAIL 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 **Lidia Cepeda, P.E.**, whose seal as a Professional Engineer, licensed to practice in the State of New Mexico is affixed below.



(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.

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# **TECHNICAL SPECIFICATIONS**

## **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 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”

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 801.22.10 Add sentence at the end of the paragraph of 801.22.10 FIRE HYDRANTS:

“payment shall include 6” Gate valve with gate valve housing per detail and the length of 6” pipe required from the main.”

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 4-feet minimum to top of pipe, so the fire hydrant bury length is not typical.

## TABLE OF CONTENTS

### SPECIFICATIONS

#### **DIVISION 1 – GENERAL REQUIREMENTS**

- 01 0100 Summary of Work
- 01 0190 Contract Considerations
- 01 0200 Allowances
- 01 0390 Coordination and Meetings
- 01 0470 Coordination with Public
- 01 0600 Regulatory Requirements
- 01 3000 Submittals
- 01 4000 Quality Control
- 01 4100 Testing Laboratory Service
- 01 4300 Video Recording
- 01 5000 Construction Facilities and Temporary Controls
- 01 6000 Delivery, Storage and Handling
- 01 6100 Material and Equipment
- 01 6200 Construction Mobilization
- 01 6500 Starting of Systems
- 01 7000 Execution and Closeout Requirements

#### **DIVISION 2 - NOT USED**

#### **DIVISION 03 – Concrete**

- 03 1000 Concrete Forms and Accessories
- 03 2000 Concrete Reinforcement
- 03 3000 Cast-in-Place Concrete

#### **DIVISION 4-25 NOT USED**

#### **DIVISION 26 – ELECTRICAL**

- 26 0000 Electrical

#### **DIVISION 27-32 NOT USED**

**DIVISION 33 – UTILITIES**

33 1300 Santa Fe County Utility Water Main Disinfection

33 1400 Bulk Water Dispensing Station

**DIVISION 34-39 NOT USED**

**DIVISION 40 – PROCESS INTERCONNECTIONS (VALVES)**

40 0567.35 Pressure Reducing Control Valve

40 0567.36 Pressure Reducing Control Valve With Low Flow By-Pass

**DIVISION 41-46 NOT USED**



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## 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: Project is to install 13,0320-feet of 12-inch PVC waterline via open trench in Santa Fe County, New Mexico. The project also includes transfer of one service line from Fire Station to main and decommissioning the pressure reducing tanks, and 144-feet of 4-inch PVC waterline leading to a new bulk water loading station. The new bulk water loading station site includes an access road, a driving pad, a building pad, a bulk water loading station package, site electrical and communication line from Fire Station, and new electrical utility coordination. This project is all within Santa Fe County-owned property or NMDOT ROW.
- 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. See mitigation requirements as listed in the permit documents titled NMDOT Permit included in this bid package.

#### 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. Submit three copies of each application. Contractor's electronic media driven form similar to EJCDC document may be considered.
- B. Content and Format: Utilize Bid Tab for listing items in Application for Payment.
- C. Payment Period: As specified in the Agreement.
- D. 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, Work Change 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 the Work, and designate method of determining any change in 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: SFC 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 RESPONSIBILITIES

- 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. Utility Relocation – Allowance: allow the amount of \$15,000.
- B. Laboratory Testing Services -Allowance: Allow the amount of \$25,000 or additional information, see Section 01 4100 – Testing Laboratory Services.
- C. Subsurface Utility Locating – Allowance: allow the amount of \$15,000.
- D. Electrical Utility Allowance – Allowance: allow the amount of \$20,000.

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.
- E. 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 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 1.3 A., B., and C. above are required.
- B. Notice delivery under Paragraph 1.3 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\\_fin\\_alpermit.pdf](http://water.epa.gov/polwaste/npdes/stormwater/upload/cgp2012_fin_alpermit.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 SWPPP 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.
- G. Reviewed samples which may be used in the Work are indicated in individual specification Sections.
- H. 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.
- C. 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

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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.
- D. 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

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## 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



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## 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 **Santa Fe County**. 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

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## 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.

#### 1.4 Insurance Requirements

- A. Contractors shall carry “builders risk” insurance to apply for payments of stored materials.

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

- $P_m$  = Mobilization payment.
- $M$  = Total amount bid for mobilization.
- $f$  = Mobilization payment percentage factor –  
0.25, or 0.50, or 1.0, as applicable
- $P_m$  =  $M \times f$

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	$f \times M = P_m$
<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	$f \times M = P_m$
<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 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. Owner 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.
  - 7. AIS Documentation required by funding.
- 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.
  - 6. The final As-Built Drawings should be submitted to the Engineer for review and

acceptance before delivering copy sets to the owner

- 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 03 1000

### CONCRETE FORMS AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

##### 1.02 RELATED SECTIONS

- A. Section 03 2000 - CONCRETE REINFORCEMENT.
- B. Section 03 3000 - CAST-IN-PLACE CONCRETE.

##### 1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2005.
- C. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute International; 2004.

##### 1.04 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.
- B. Concrete forms shall be mortar tight and sufficiently rigid to prevent deformation. Formwork shall be constructed to prevent joints from opening.
- C. The surface of forms when used for concrete surfaces exposed to public view shall be smooth and not leave unintended texture, marks, or unsightly finishes. Loose dirt, laitance and debris shall be removed from all surfaces before placing concrete.

##### 1.05 SUBMITTALS

- A. See Section 01 3000 - SUBMITTALS for submittal procedures.
- B. Product Data: Provide data on void form materials and installation requirements.

## 1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.

## 1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection and removal of formwork.

## PART 2 PRODUCTS

### 2.01 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.
- B. Forms shall be properly wetted before placing concrete.

### 2.02 FORMWORK ACCESSORIES

- A. Form Release Agent: Colorless mineral oil that will not stain concrete.
- B. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- C. Formwork waterstops: Preformed mineral colloid strips, 3/8 inch (9 mm) thick, moisture expanding.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

### 3.02 EARTH FORMS

- A. Except where indicated, earth forms are not permitted.
- B. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

### 3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.



- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Provide 3/4-inch fillet strips on external corners of beams, joists, and columns.
- G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing. Rigid insulation can be used in place of void forms in specific circumstances, submit use of rigid insulation intentions to engineer for approval.
- H. Coordinate this section with other sections of work that require attachment of components to formwork.
- I. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Engineer before proceeding.

#### 3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

#### 3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, ringlets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install permanent waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

### 3.06 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.

### 3.07 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

### 3.08 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not use wedge pry bars, hammers, or tools against finished concrete surfaces. Damaged concrete surfaces shall be repaired at the Contractors expense and at no cost to the owner.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION

## SECTION 03 2000

### CONCRETE REINFORCEMENT

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This section specifies furnishing and placing of concrete reinforcing steel of the strength, size and quantity shown on the Drawings.

##### 1.02 REFERENCES

- A. The following publications are a part of these specifications and are referenced by designation elsewhere in this Section:
  - 1. American Concrete Institute (ACI) Publications:
    - a. ACI 315 "Details and Detailing of Concrete Reinforcement."
    - b. ACI 318 "Building Code Requirements for Reinforced Concrete."
  - 2. American Society of Testing and Materials (ASTM) Standards:
    - a. ASTM A 82, Cold-Drawn Steel Wire for Concrete Reinforcement.
    - b. ASTM A 185, Welded Steel Wire Fabric for Concrete Reinforcement.
    - c. ASTM A 325, Carbon Steel Externally and Internally Threaded Standard Fasteners High Strength.
    - d. ASTM A 615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."
    - e. ASTM A 706, "Deformed Low Alloy Steel Bars for Concrete Reinforcement."
  - 3. Concrete Reinforcing Steel Institute (CRSI), Manual of Standard Practice for Reinforcing Concrete Construction.

##### 1.03 SUBMITTALS

- A. Shop drawings for reinforcement detailing fabrication, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing for openings through concrete structures.
- B. Certificates: Submit a notarized certificate that the reinforcement conforms to the appropriate ASTM Standards and/or ACI Publications.

#### 1.04 QUALITY ASSURANCE

- A. All work covered by this Section shall conform to ACI Publications and ASTM Standards referenced except as modified by this Section.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reinforcement: Protect reinforcement from excessive rusting and fouling with grease, oil, dirt, or other objectionable materials which would reduce or destroy bond with the concrete.
- B. Identify bundles of reinforcing steel with stamped metal tags wired to steel.

### PART 2 - PRODUCTS

#### 2.01 REINFORCEMENT AND ANCHOR BOLTS

- A. Reinforcing Steel:
  - 1. Steel Reinforcing Bars: ASTM A 615, Grade 60, deformed.  
ASTM A 706, Grade 60
  - 2. Wire: ASTM A 82, plain, cold-drawn, steel.
  - 3. Plain Welded Wire Fabric: ASTM A 185, welded steel wire fabric.  
AASHTO M 55
  - 4. Deformed Reinforcing Wire: ASTM A 496.
- B. Reinforcing Accessories: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications. Wood spacers or supports shall not be used.

- C. Anchor Bolts: ASTM A 325

## 2.02 FABRICATION

- A. General: Bars should be fabricated and bent in the fabrication shop following approved methods as outlined by the Concrete Reinforcing Steel Institute (CRSI). Reinforcing may be cold bent around a pin when shop bending is not possible. Bend diameters shall be in accordance with the CRSI Manual of standard practice current edition.
  - 1. Do not use bars with kinks or bends not indicated on Drawings.
  - 2. Perform bar shape fabricating in a manner that will not injure the material or lessen the member strength.
  - 3. Use a designed bending machine, either hand or power-operated.
  - 4. Bend bars in accordance with Chapter 7, ACI 318 except do not field bend bars partially embedded in concrete unless approved by the Engineer.
- B. Welded wire fabric shall be fabricated in sheets or mats only. Roll-type is not acceptable.
- C. Field cutting is permitted by shearing or sawing. Flame cutting is not permitted. The bar ends after cutting shall be relatively smooth.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Notify the Engineer 48 hours before placing concrete so that the Engineer can inspect placement of steel reinforcement.
- B. Verify that items to be embedded in concrete are secured in place as required prior to pouring concrete.

### 3.02 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.

1. Avoid cutting or puncturing vapor retarder/barrier during reinforcement placement operations. Repair damages before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Bars are to be placed according to the contract drawings. Bars shall be tied into place with wire not less than 16 gauge. Wire tie shall not damage any reinforcing coating.
- D. The Contractor shall tie all intersections where bar spacing is greater than or equal to one (1) ft in either direction. The Contractor shall tie alternate intersections where bar spacing is less than one (1) ft in either direction.
- E. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. The contractor may elect to use of adobe style or concrete blocks to support the bottom mat of reinforcing. The contractor shall ensure that the blocks are small in area and strong enough to support the weight of the wet concrete being placed.
- F. Reinforcement clear cover for slabs shall not be less than ½" the clear cover shown on the plans.
- G. Steel reinforcing shall not be welded unless it is called out in the plans. Welding shall be according to the Reinforcing Steel Welding code, AWS D1.4. Only bar meeting the specifications of ASTM A 706 bars are to be welded unless call for otherwise in the contract documents.
- H. Accurately position, support and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by the Engineer.
- I. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not towards exposed concrete surfaces. Unless otherwise specifically required by drawings, maintain the following cover:
  1. 3/4" for all slabs.
  2. 1-1/2" for other faces exposed to interior.

- 3. 2" for faces exposed to exterior or vertical faces in contact with earth.
- 4. 3" for horizontal faces of concrete deposited against ground.
- J. Install welded wire fabric in longest practicable lengths. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.
- K. Lap splices of reinforcing bars in accordance with ACI 318.
- L. Welding of crossing bars (tack welding) is not permitted.

### 3.03 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached. Secure in place to prevent movement during concrete pours.

END OF SECTION

## SECTION 03 3000

### CAST-IN-PLACE CONCRETE

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Related Sections: Refer to the following sections for related work:
  - 1. Section 02200, “Earthwork.”

##### 1.02 REFERENCES

- A. American Concrete Institute (ACI)
- B. American Society for Testing and Materials (ASTM)
  - 1. A82 Specification for Cold-Drawn Steel Wire for Concrete Reinforcement
  - 2. A185 Specification for Steel Welded Wire Fabric, Plain for Concrete Reinforcement
  - 3. A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - 4. C31 Practice for Making and Curing Concrete Test Specimens in the Field
  - 5. C33 Specification for Concrete Aggregates
  - 6. C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
  - 7. C42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
  - 8. C94 Specification for Ready-Mixed Concrete
  - 9. C143 Test Method for Slump of Hydraulic Cement Concrete
  - 10. C150 Specification for Portland Cement
  - 11. C172 Practice for Sampling Freshly Mixed Concrete
  - 12. C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
  - 13. C260 Specification for Air-Entraining Admixtures for Concrete
  - 14. C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
  - 15. C494 Specification for Chemical Admixtures for Concrete
  - 16. C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
  - 17. C1107 Specification for Packaged Dry, Hydraulic-Cement Grout (non-shrink)
  - 18. C1116 Specification for Fiber-Reinforced Concrete and Shotcrete
  - 19. D994 Specification for Preformed Expansion Joint Filler for Concrete



20. D1751 Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction
21. D1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

- C. Concrete Reinforcing Steel Institute (CRSI)
- D. PS 1 US Product Standard for Construction and Industrial Plywood

### 1.03 SUBMITTALS

- A. General: Submit the following items in accordance with the Conditions of Contract and Section 01330, "Submittal Procedures."
- B. Product Data: Submit product data for the following materials and items.
  1. Reinforcement
  2. Forming Accessories
  3. Admixtures
  4. Patching Compounds
  5. Hardener
  6. Joint Systems
  7. Curing Compounds
  8. Sealants
  9. Concrete mix design.
    - a. Concrete mix supplier
    - b. Aggregate gradations
    - c. Water/cement ratio
- C. Shop Drawings: Submit detailed shop drawings for fabrication, bending and placement of concrete reinforcement.
  1. Show bar schedules, stirrup spacing, diagrams of bent bars and arrangement of reinforcement including bar overlap.
  2. Include special reinforcement required for openings through concrete structures.
- D. Laboratory Test Reports: Submit concrete materials test reports and mix design reports certifying that each material or item complies with or exceeds the specified requirements.

### 1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:
  1. ACI 301 "Specifications for Structural Concrete for Buildings"
  2. ACI 302 "Guide for Concrete Floor and Slab Construction"

3. ACI 304 “Guide for Measuring, Mixing, Transporting and Placing Concrete”
4. ACI 305 “Hot Weather Concreting”
5. ACI 306 “Cold Weather Concreting”
6. ACI 308 “Standard Practice for Curing Concrete”
7. ACI 309 “Standard Practice for Consolidation of Concrete”
8. ACI 315 “Details and Detailing of Concrete Reinforcement”
9. ACI 318 “Building Code Requirements for Reinforced Concrete”
10. ACI 347 “Recommended Practice for Concrete Formwork”
11. CRSI “Manual of Standard Practice”
12. SP-66 “ACI Detailing Manual”

B. Quality Control Testing During Construction: Owner will engage concrete testing service for quality control testing during concrete operations.

1. Notify Engineer at least two (7) working days in advance of field operations requiring concrete testing, or of resumption of operations after stoppages.
2. Coordinate concrete operations with testing service to facilitate quality control testing.
3. Sample and test concrete during placement of concrete as follows:
  - a. Sampling Fresh Concrete: ASTM C172; except modified for slump to comply with ASTM C94.
  - b. Slump: ASTM C143; one test for each concrete load at point of discharge and one for each set of compressive strength test specimens.
  - c. Air Content: ASTM C231; pressure method; one for each set of compressive strength specimens.
  - d. Compression Test Specimens: ASTM C31; one (1) set of six (6) standard cylinders for each compressive strength test, unless otherwise directed. Accommodate testing service to store cylinders on site for the first twenty-four hours after molding.
  - e. Concrete Temperature: Test hourly when air temperature is 40 degrees F (4 degrees C) and below, and when 90 degrees F (27 degrees C) and above; and each time that a set of compression test specimens is made.
  - f. Compressive Strength Tests: ASTM C39; one (1) set for each 125 cubic yards (115 cubic meters) or fractions thereof, of each concrete class placed in any one day or for each 5000 sq. ft. (465 square meters) of surface area placed; two (2) specimens tested seven (7) days, three (3) specimens tested 28 days and one (1) specimen retained in reserve for later testing if required.
4. If the average strength of six (6) consecutive cylinders tested at 28 days falls below the required compressive strength or if any individual strength test (average of two test cylinders) falls more than 500 psi (3.5 MPa) below the specified strength, the in-place concrete represented by the low-strength cylinders shall be tested at the Contractor’s expense by one of the following methods as directed by the Engineer by a laboratory acceptable by the Engineer.

- a. Core Drilling: ASTM C42; “Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete,” and ACI 318, Section 5.6.4.
- b. Load Testing: Load tests shall be performed in accordance with ACI 318, Chapter 20, “Strength Evaluation of Existing Structures.”

## PART 2 - PRODUCTS

### 2.01 FORM MATERIALS FOR STRUCTURAL COMPONENTS

- A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork with plywood, metal, metal framed plywood faced or other acceptable panel type materials to provide continuous, straight, smooth, exposed surfaces. **Provide steel forms for the construction of the walls of the treatment basin tank.**
  1. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Contract Drawings.
  2. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
  3. Provide forms that comply with US Product Standard PS 1 and the following:
    - a. B-B High Density Overlaid Concrete Form, Class I.
    - b. B-B (Concrete Form) Plywood, Class I, exterior grade or better, mill oiled, and edge sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Provide forms of plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.
- C. Forms for Textured Finish Concrete: Provide forms with units of face design, size, arrangement and configuration as shown on Contract Drawings, or as required to match control sample. Provide solid backing and form supports to ensure stability of textured form liners.
- D. Cylindrical Columns and Supports: Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.
- E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

- F. Form Ties: Provide factory-fabricated, adjustable-length, removable or snap off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
  - 1. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1/2 inch (12.7 mm) inside concrete for steel ties and 1/4 inch (6.35 mm) for wire ties.
  - 2. Unless otherwise shown, provide form ties which will not leave holes larger than 1 inch (25 mm) diameter in concrete surface.

### 2.03 REINFORCING MATERIALS

- A. Cold-drawn steel wire: ASTM A82.
- B. Welded wire fabric: ASTM A185, welded steel wire fabric. Furnish in flat sheets, not rolls, unless rolls are acceptable to the Engineer.
- C. Reinforcing Bars: ASTM A615, deformed.
  - 1. Provide Grade 60 bars No. 3 and 4 for stirrups and ties.
  - 2. Provide Grade 60 bars No. 3 to 18, except as otherwise noted.
- D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place.
  - 1. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood. Brick, stone, broken block or pieces of concrete are acceptable for slab-on-grade.
  - 2. For concrete-on-grade, use supports with sand plates or horizontal runners if base material will not adequately support chair legs.
  - 3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected, stainless steel protected, or special stainless complying with CRSI Classes, C, D, or E respectively.
- E. Fibrous Reinforcement : ASTM C1116.
- F. Shop fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors, do not bend or straighten reinforcement in manner that will injure or weaken material.
- G. Unacceptable Materials: Defective reinforcement shall not be permitted in work:

1. Bar lengths, depths and bends exceeding specified fabrication tolerances.
2. Bends or kinks not indicated on Contract Drawings or final shop drawings.
3. Bars with reduced cross section due to excessive rusting or other cause.
4. Bars bent in the field and bars bent by heating.

## 2.04 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150 Types I-II and III, "Low-Alkali" cement, unless otherwise specified. Use one brand of cement throughout project unless otherwise acceptable to the Engineer.
- B. Aggregates: ASTM C33; provide aggregates from single source for exposed concrete. Do not use sandstone aggregates.
  1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay lumps or other deleterious substances. Do not use dune, bank run, or manufactured sand.
  2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:
    - a. Crushed stone processed from natural rock or stone.
    - b. Natural or crushed gravel. Do not use pit or bank run gravel.
  3. Maximum Aggregate Size: Not larger than one-fifth (1/5) of the narrowest dimension between side or forms, one-third (1/3) of the depth of slabs, or three-fourths (3/4) of the minimum clear spacing between individual reinforcing bars or bundles of bars. If workability and consolidation methods indicate concrete can be placed without honeycomb or voids, limitations may be waived if approved by Engineer.
- C. Water: Potable, clean, fresh, free from oil, acid, organic matter or other deleterious substances.
- D. Fly Ash: ASTM C618, Class F; use one brand of fly ash throughout project unless otherwise acceptable to the Engineer.
- E. Admixtures: All admixtures shall be specified in the mix design.
  1. Air-Entraining Admixture: ASTM C260
  2. Water-Reducing Admixture: ASTM C494, Type A.
  3. High Range Water-Reducing Admixture (Super Plasticizer): ASTM C494, Type F or Type G.
  4. Water-Reducing, Retarding Admixture: ASTM C494, Type D.
  5. Chloride-containing admixtures are not permitted.

## 2.05 RELATED MATERIALS

- A. Expansion Joint Materials

1. Typical Building and Concrete Paved Roadway Joints: ASTM D994, preformed strips of a bituminous mastic composition.
  2. Slabs-in-Ground, Sidewalks, and Curb and Gutter Joints: ASTM D1751, preformed expansion joint filler having relatively little extrusion and substantial recovery after release from compression.
  3. Hydraulic Structure Joints: ASTM D1752, preformed expansion joint fillers as specified on the Contract Documents.
- B. Non-Shrink Grout: ASTM C1107, factory pre-mixed, non-metallic grout.
- C. Liquid Membrane-Forming Curing Compound: ASTM C309, Type I or I-D, Class A.
- D. Chemical Hardener: Hardener shall be a colorless, aqueous solution of zinc or magnesium fluosilicate. Approved proprietary hardeners shall be delivered ready for use in the manufacturer's original containers.
- E. Bonding Compound: Polyvinyl acetate, wettable type.

2.06 CONCRETE MIX DESIGN

- A. General: Provide "Ready-Mixed" concrete, unless otherwise approved or specified; in accordance with ASTM C94.
1. Compressive Strength
    - a. Structural Concrete: Minimum 4000 psi (31.1 MPa) compressive strength at 28 days.
    - b. Site Concrete: Minimum 4000 psi (27.6 MPa) compressive strength at 28 days.
  2. Select water-to-cementitious materials ratio required to produce 28-day strength corresponding to over designed mix which is supported by sufficient experience data to assure that test results will fall within limits established in specification. Unless otherwise specified, the following proportions apply:

Strength Ratio	Min. Cement	Max. W/(C+FA) * Ratio	Max. W/(C+FA) *
<u>psi</u> 4000	<u>Non-Air-Entrained</u> 0.50	<u>Air-Entrained</u> 0.45	

\* W/(C+FA) = Water to cementitious material, cement plus fly ash by weight.

3. Slump due to water content alone (without the addition of super plasticizer) shall be as follows:

Allowable Slump	<u>Min-Max (inch)</u>
Reinforced foundation walls and footings	6 – 8-inches, (+/- 1")

Reinforced slabs, beams and walls	6 – 8-inches, (+/- 1”)
Building columns	6 – 8-inches, (+/- 1”)
Sidewalls, driveways and slabs-on-ground	6 – 8-inches, (+/- 1”)
Heavy mass construction	6 – 8-inches, (+/- 1”)
Sidewalks, curbs and gutters	6 – 8-inches, (+/- 1”)

After the addition of super plasticizers, slumps may range from 3 to 11 inches provided that the concrete mix is cohesive and non-segregating, has controlled time of set and minimal bleed water.

B. Aggregate: ASTM C33:

1. Coarse Aggregate: ASTM C33, Table 2, Grading Requirements for Coarse Aggregates.
2. Fine Aggregate: ASTM C33, Section 5.1 Sieve Analysis, Fine Aggregate.

C. Admixtures

1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in all concrete.
2. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Use air content of 3.5 to 6.5%.
3. When air-entraining admixture is used solely for increasing workability of mix, use air content of 3 to 5%.
4. Fly Ash: Fly ash shall be used in all concrete mixes. Class F fly ash shall be proportioned by weight of cement to provide fly ash to Portland cement ratio not less than 15%, or greater than 30% of the sum of total weight of fly ash and cement.
5. Add 5-10% silica fume (by weight) as a supplementary cementitious material to all water-bearing concrete.
6. A cementitious, crystalline waterproofing (XYPEX) shall be added to all water bearing concrete per manufacturer's specifications. Concrete waterproofing and protection system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure within the pores and capillary tracts of the concrete. This crystalline system causes the concrete to become sealed against the penetration of liquids from any direction, and protects the concrete from deterioration due to harsh environmental conditions. The system is used for above or below-grade walls and slabs of all water bearing structures and where enhanced chemical resistance is required.

- D. High early strength concrete shall have compressive strength at 7 days equal to that specified for ordinary concrete at 28 days.

2.07 PLANT, EQUIPMENT, MACHINES, AND TOOLS

- A. General: Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.
1. Provide equipment with capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified.
  2. Use of equipment shall be discontinued if it produces unsatisfactory results.
  3. Engineer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.
- B. Slip Form Equipment: Self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to desired cross section in one pass. Slip form paver or curb-forming machine will be approved based on trial use on the job.
- C. Soft-Cut Saw: Designed and shown to be able to cut concrete shortly after final set without causing raveling or other untoward effect upon the concrete finish. Provide



diamond blade with thickness no greater than 1/8 inch (3.18 mm) to soft-cut joint of size indicated.

### PART 3 - EXECUTION

#### 3.01 FORM SETTING FOR STRUCTURAL COMPONENTS

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure.
- B. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- C. Provide for openings, keyways, chamfers, inserts and other features required in work.
- D. Maintain formwork construction tolerances, unless otherwise indicated:
  - 1. Variation from Plumb:
    - a. In the lines and surfaces of columns, piers, walls, and in arrises:  
In any 10 feet (3 m) of length ..... 1/4 inch (6.35 mm)  
Maximum for the entire length ..... 1 inch (25 mm)
    - b. For exposed corner columns, control-joint grooves, and other conspicuous lines:  
In any 20-foot (6 m) length ..... 1/4 inch (6.35 mm)  
Maximum for the entire length ..... 1/2 inch (12.7 mm)
  - 2. Variation from level or from grades specified in Contract Drawings:
    - a. In slab soffits, ceilings, beam soffits and in arrises, measured before removal of supporting shores:  
In any 10 feet (3 m) of length ..... 1/4 inch (6.35 mm)  
In any bay or in any 20-foot (6 m) length ..... 3/8 inch (9.53 mm)  
Maximum for the entire length ..... 3/4 inch (19.1 mm)
    - b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:  
In any bay or in 20-foot (6 m) length ..... 1/4 inch (6.35 mm)  
Maximum for the entire length ..... 1/2 inch (12.7 mm)
  - 3. Variation of the linear building lines from established position in plan and related position of columns, walls, and partitions:  
In any bay ..... 1/2 inch (12.7 mm)  
In any 20 foot (6 m) of length ..... 1/2 inch (12.7 mm)  
Maximum for the entire length ..... 1 inch (25 mm)
  - 4. Variation in the sizes and location of sleeves, floor openings, and wall openings ..... 1/4 inch (6.35 mm)
  - 5. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls:  
Minus ..... 1/4 inch (6.35 mm)

- Plus.....1/2 inch (12.7 mm)
  - 6. Footings\*:
    - a. Variations in dimensions in plan:
      - Minus .....1/2 inch (12.7 mm)
      - Plus ..... 2 inches (51 mm)
    - b. Misplacement or eccentricity:
      - 2% of the footing width in direction of misplacement but not more than ..... 2 inches (51 mm)
    - c. Thickness:
      - Decrease in specified thickness.....5%
      - Increase in specified thickness..... No limit
  - 7. Variation in Steps:
    - a. In a flight of stairs:
      - Rise ..... +1/8 inch (+3.18 mm)
      - Tread ..... +1/4 inch (+6.35 mm)
    - b. In consecutive steps:
      - Rise ..... +1/16 inch (+1.588 mm)
      - Tread ..... +1/8 inch (+3.18 mm)
- \* Tolerances apply to concrete dimensions only.

- E. Design and fabricate formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- F. Chamfer all exposed corners and edges  $\frac{3}{4}$ " to produce uniform smooth lines and tight edge joints, unless otherwise indicated in the Contract Drawings.
- G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades.
  - 1. Determine size and location of openings, recesses and chases from trades providing such items.
  - 2. Accurately place and securely support items built into forms.

### 3.03 PLACING REINFORCEMENT

- A. Comply with CRSI's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified. Field bending of grade 60 bars is not permitted.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, oil, concrete splatter from previous pours, and other materials which reduce or destroy bond with concrete.

- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- D. Install welded wire fabric of same gage in as long of lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps of adjacent widths to prevent continuous laps in either direction.
- E. Provide minimum cover for reinforcement of cast-in-place concrete, unless otherwise indicated.

Concrete cast against and permanently exposed to earth ..... 3 inches (76 mm)  
 Concrete exposed to earth or weather  
     #6 and larger ..... 2 inches (51 mm)  
     #5 and smaller ..... 1-1/2 inches (38 mm)

Concrete not exposed to weather or in contact with earth  
     Slabs, walls, joists ..... 3/4 inch (19 mm)  
     Beams, columns ..... 1-1/2 inches (38 mm)

### 3.04 JOINTS

- A. Construction Joints: Locate construction joints on slab floor, which are not shown on Contract Drawings, and notify Engineer for approval. At contractor's option wall control joints can be substituted by wall construction joints for the treatment basin tank walls.
  - 1. Provide keyways at least 1-1/2 inches (38.1 mm) deep in construction joints in walls and between walls and footings; accepted preformed keyways designed for this purpose may be used for slabs.
  - 2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints.
- B. Isolation Joints: Construct isolation joints in slabs-on-ground at points of contact between slabs on ground and foundations as shown on Contract Drawings. Unless otherwise indicated, install 90# felt paper between slab and vertical surface.
- C. Contraction (Control) Joints
  - 1. Contraction Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8 inch (3.18 mm) wide by one-fourth of slab depth or inserts 1/4 inch (6.32 mm) wide by one-fourth of slab depth, unless otherwise indicated.
    - a. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with

- slab surface. Tool slab edges round on each side of insert. Remove inserts and clean groove of loose debris after concrete has cured.
- b. Form contraction joints in unexposed floor slabs by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate. Contraction joints formed by soft-cut saw shall be made no greater than eight hours after placement of concrete.
  - c. If joint pattern is not indicated in Contract Drawings, provide joints at intervals not exceeding 30 times the slab thickness in either direction, and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

#### D. Expansion Joints

1. Slabs-on-Ground: Expansion joint material shall be placed around utility access openings within the slab, including clean outs and utility valves, and between new concrete slab and adjacent masonry.
  - a. Provide premolded, asphalt impregnated joint material 1/2 inch (12.7 mm) thick.
  - b. Extend joint material to full depth of concrete.
2. Sidewalks: Place joints in sidewalks at point of tangency (PT) and point of curvature (PC) of sidewalk returns, between sidewalk and building or structure, in sidewalk returns, between sidewalk and back of curb returns and around utility poles.
  - a. Provide joint material 1/2 inch (12.7 mm) thick.
  - b. Extend joint filler strips to full depth of concrete being placed at PT, PC, and around utility poles,
  - c. Provide joint filler strips between sidewalk and curb to full depth of sidewalk with top of filler strip set flush with top of curb.
  - d. Provide transverse sidewalk joints at spacing not to exceed 30 feet (9 m).
3. Curbs and Gutters: Form expansion joints with preformed expansion joint filler material 1/2 inch (12.7 mm) wide. Cut and shape to curb and gutter cross section.
  - a. Provide expansion joints in curb and gutter at end of returns except where cross gutters are being constructed.
  - b. Provide expansion joints at ends of cross gutter transitions and along line of work at regular intervals, not to exceed 36 feet (11 m).
  - c. Provide joints in gutter continuous with those in adjacent curb.

### 3.05 PREPARATIONS FOR PLACING CONCRETE

- A. Remove water from excavations. Before placement of concrete, remove wood chips, shavings, and hardened concrete from forms.
  1. Clean all equipment.
  2. Wet forms, except in freezing weather, or oil forms.

- B. Earth shall be uniformly moist when concrete is placed. Sprinkling method shall not be such as to form mud or pools of water. Watering subgrade immediately prior to placing concrete is not sufficient to make the soil uniformly moist.
- C. Notify other crafts to permit installation of their work. Coordinate installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

### 3.06 PLACING CONCRETE

- A. Notify Engineer 24 hours in advance prior to concrete placement.
- B. Field Inspection: Do not place concrete until forms and reinforcing steel have been inspected and approved.
  - 1. Place Ready-Mix concrete within specified time after batching.
 

Below 40 degrees F (4 degrees C)	See Cold Weather Placing
40 - 85 degrees F (4 - 29 degrees C)	90 minutes
86 - 90 degrees F (30 - 32 degrees C)	75 minutes
Above 90 degrees F (32 degrees C)	60 minutes

Concrete exceeding delivery time may be rejected by the Engineer.
  - 2. Adding Water: Do not add water after initial introduction of mixing water for batch except when slump of concrete is less than that specified upon arrival at job site, and maximum water/cement ratio for mix has not been exceeded.
    - a. Notify Engineer before adding any water.
    - b. Add water to bring slump within specified limits. Turn drum at least 30 additional revolutions at mixing speed. Do not add water to batch at any later time.
    - c. Ensure that concrete strength meets specified requirements, and water does not exceed maximum amount specified in CONCRETE MIX DESIGN.
- C. General: Comply with ACI 304, and as specified herein.
  - 1. Deposit concrete continuously or in layers of such thickness that concrete will not be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness.
  - 2. If section cannot be placed continuously, provide construction joints as specified herein. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches (610 mm) and in a manner to avoid inclined construction joints.
  - 1. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

2. Consolidate placed concrete by high frequency mechanical vibrating equipment, supplemented as necessary by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine.
    - c. Place vibrators to rapidly penetrate placed layer and at least 6 inches (152 mm) into preceding layer.
    - d. Do not insert vibrators into lower layers of concrete that have begun to set.
    - e. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing segregation of mix.
  3. Concrete shall not be allowed to free fall more than 5 feet (1.5 m) unless confined by a closed chute. Concrete placed in walls 10 inches (254 mm) or less in thickness may free fall maximum of 8 feet (2.4 m). **It is recommended to use tremie method to pour concrete onto walls of the treatment basin to avoid concrete segregation.**
  4. The walls of the treatment basin tank shall be poured in one full height pour without any horizontal construction joint.
- E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in continuous operation, within limits of construction joints, until placement of panel or section is completed.
1. Bring slab surfaces to correct level as above, and use floats to smooth surface, free of humps or hollows. Do not use vibratory action that will result in forcing the aggregate away from surface.
  2. Maintain reinforcing in proper position during concrete placement operations.
- H. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures; comply with ACI 306 and these specifications.
1. Mix and place concrete only when temperature is at least 40 degrees F (4 degrees C) and rising, unless permission to pour is obtained from Engineer.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.
  4. When approval is obtained to place concrete at or below an atmospheric temperature of 40 degrees F (4 degrees C), heat water or aggregates, or both. Provide suitable enclosures and heating devices.

- a. Temperature of mixed concrete shall be not less than 50 degrees F (10 degrees C) and not more than 90 degrees F (32 degrees C) at time of placement.
  - b. Record temperature of concrete for each truck as delivered and after placement in forms.
  - c. Provide heating equipment or methods capable of heating water and aggregates uniformly. Heat materials to temperature not greater than 120 degrees F.
5. After concrete placement, provide suitable measures to maintain concrete surface temperature at 40 degrees F (4 degrees C) or above for period not less than seven (7) days.
- I. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F (32 degrees C).
  - 2. Cover reinforcing steel with water-soaked burlap when required to ensure that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
  - 3. Wet forms thoroughly before placing concrete.
  - 4. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.
  - 5. Record temperature of concrete for each truck as delivered and after placing in forms. Record air content and slump for each truck.

### 3.07 CONCRETE FINISHING

- A. General: Do not use tools such as jitterbugs that force the aggregate away from surface.
- 1. Do not spray or sprinkle water onto concrete surface to aid in finishing.
  - 2. Avoid bringing more water than necessary to surface and avoid working surface any more than necessary to obtain required finish.
- B. Monolithic Slab Finishes
- 1. Float Finish: Apply float finish to slabs for driveways, exterior slabs, and interior floor slabs receiving additional coverings.
    - a. After screeding and consolidating concrete slabs, do not work surface until ready for floating.
    - b. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats or by hand floating if area is small or inaccessible to power units.

- c. Check and level surface plane to tolerance not exceeding 1/4-inch (6.35 mm) in 10 feet (3 m) when tested with 10-foot (3 m) straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains.
    - d. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
  2. Trowel Finish: Apply trowel finish to slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, paint or other thin film finish coating system.
    - a. After floating, begin first trowel finish operation. Begin final troweling when surface produces ringing sound as trowel is moved over surface.
    - b. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface plane tolerance not exceeding 1/8-inch (3.18 mm) in 10 feet (3 m) when tested with a 10-foot (3 m) straightedge.
    - c. Grind smooth surface defects which would telegraph through applied floor covering system.
  3. Nonslip Broom Finish: Apply nonslip boom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
    - a. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route.
    - b. Coordinate required final finish with Engineer before application.
  4. Liquid Chemical Hardener Finish: Apply chemical hardener finish to interior concrete floors where indicated after complete curing and drying of the concrete surface.
    - a. Dilute liquid hardener with water and apply in three (3) coats; first coat, 1/3 strength; second coat, 1/2 strength; third coat, 2/3 strength. Evenly apply each coat and allow 24 hours for drying between coats.
    - b. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.
    - c. After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.
    - d. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair

#### C. Finish of Formed Surfaces

1. Rough Form Finish: For formed concrete surfaces not exposed-to-view in finish work or by other construction, unless otherwise indicated.
  - a. Texture for concrete surface is imparted by form facing material used.
  - b. Repair and patch tie holes and defective areas, with fins and other projections exceeding 1/4 inch (6.35 mm) in height rubbed down or chipped off.
2. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with coating material applied directly to concrete, or covering material applied directly to concrete, such as waterproofing, damp proofing, painting or other similar system.



- a. As-cast concrete surface is obtained with selected form facing material, arranged orderly and symmetrically with minimum of seams.
  - b. Repair and patch defective areas with fins or other projections completely removed and smoothed.
  - c. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than 24 hours after form removal.
    - (1) Moisten concrete surfaces and rub with carborundum brick or other abrasive until uniform color and texture is produced.
    - (2) Do not apply cement grout other than that created by rubbing process.
  - d. Grout-Cleaned Finish: Provide grout cleaned finish, in color and texture, to scheduled concrete surfaces which have received smooth form finish treatment.
    - (1) Combine one-part gray Portland cement to 1-1/2 parts fine sand by volume and mix with water to consistency of thick paint. Blend standard gray Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.
    - (2) Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
3. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.08 CONCRETE CURING

- A. General: Immediately after placing or finishing, and as soon as operation will not mar finish, concrete surfaces not covered by forms shall be protected against moisture loss.
  - 1. Maintain protection for period of at least 7 days.
  - 2. Where formed surfaces are cured in forms, forms shall be kept continually wet.
  - 3. If forms are removed before end of curing period, continue curing as on unformed surfaces, using curing materials specified herein.
  - 4. Keep surfaces free of foot and vehicular traffic during curing period.
- B. Curing Methods: Provide curing of concrete by methods specified or by combinations thereof, as approved:

1. Polyethylene Coated Burlap Mats: Cover surfaces with specified mat lapped 12 inches (305 mm). Mat shall be weighted to prevent displacement. Immediately repair tears or holes by patching.
2. Membrane Forming Curing Compound: Apply in two coat continuous operation, using not less than manufacturer's recommended rate of application. If unknown, apply at rate of 1 gallon (3.8 liters) per 200 square feet (18.6 square meters) for each coat.
  - a. Respray surfaces damaged by construction operations during curing.
  - b. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, damp proofing, membrane roofing, flooring, painting and other coatings and finish materials, unless otherwise acceptable to Engineer.
3. Water Curing: Water cure surfaces indicated to receive additional concrete or concrete fill, dustproofing and hardening treatments, stucco, plaster, or painting.

### 3.09 REMOVAL OF FORMS

- A. General: Do not remove forms for any portion of the structure until concrete is strong enough not to be damaged when forms are removed.
  1. Remove forms without damage to concrete.
  2. Do not use bars or heavy tools against concrete in form removal.
  3. Promptly repair concrete found defective after form removal.
- B. If field operations are not controlled by cylinder tests, the following periods, exclusive of days when the temperature is below 40 degrees F (4 degrees C), may be used as a guide for removal of forms and supports:

<u>Guide for Removal of Forms and Supports</u>	
Centering under beams	14 days
Elevated floor slabs	7-14 days*
Walls	12-24 hours*
Columns	1-7 days*
Sides of beams and all other parts	12-24 hours*

\*Longer time dictates unless Engineer approves lesser time.

- C. If field operations are controlled by beam or cylinder tests, forms may be removed from centering under beams and floor slabs when 2500 psi (17.2 MPa) compressive strength is attained and approved by Engineer.
- D. Do not place superimposed loads on or against load carrying members until 2500 psi (17.2 MPa) compressive strength has been attained and approved by Engineer.

- E. Sidewalk Forms: Do not remove side forms for twelve (12) hours after completion of finishing.
- F. Curb and Gutter Forms: Remove forms of curb front not less than two (2) hours nor more than six (6) hours after placement of concrete.
  - 1. Forms of curb back shall remain in place until face and top of curb have been finished as specified for concrete finishing.
  - 2. Do not remove gutter forms while concrete is sufficiently plastic to slump in any direction.

### 3.10 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused in work.
- B. Maintain shape, strength, rigidity, water-tightness, and surface smoothness of reused forms at all times.
- C. Re-size warped or bulged lumber before use.
- D. Do not use unsatisfactory forms.

### 3.11 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Immediately after form removal, cut out honeycomb, rock pockets, voids over 1/4 inch (6.35 mm) in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than one (1) inch (25 mm).
  - 1. Cut edges perpendicular to concrete surface.
  - 2. Thoroughly clean, dampen with water, and brush coat area to be patched with neat cement grout or proprietary bonding agent before placing cement mortar or proprietary patching compound.
- B. Exposed-To-View Surfaces: Blend white Portland cement and standard Portland cement so that patching mortar will match surrounding color when dry.
  - 1. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching.
  - 2. Compact mortar in place and strike off slightly higher than surrounding surface.
- C. Repair of Formed Surfaces: Remove and replace concrete with defective surfaces if defects cannot be repaired to satisfaction of Engineer.

1. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.
  2. Flush out form tie holes fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
  3. Where possible, repair concealed formed surfaces that contain defects that affect concrete durability. If defects cannot be repaired, remove and replace concrete.
- D. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. For unformed surfaces sloped to drain, use template having required slope to test for trueness.
1. Surface defects include crazing, cracks greater than 0.01 inch (0.25 mm) wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop outs, honeycomb, rock pockets, and other objectionable conditions.
  2. Repair finished unformed surfaces that contain defects which affect concrete durability.
  3. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
  4. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish to blend into adjacent concrete. Use only approved proprietary patching compounds.
  5. Repair defective areas, except random cracks and single holes not exceeding 1-inch (25 mm) diameter, by cutting out and replacing with fresh concrete.
    - a. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch (19.1 mm) clearance all around.
    - b. Dampen concrete surfaces in contact with patching concrete and brush with neat cement grout or apply concrete bonding agent.
    - c. Mix patching concrete of same materials to provide concrete of same type of class as original concrete.
    - d. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

### 3.12 CONCRETE TRUCK DISCHARGE

- A. Excess Concrete: Discharge excess concrete in mixer trucks that cannot be immediately used to area where it will not create an obstruction or hazard during

construction. Remove excess concrete from site in a timely manner to site approved by Engineer.

- B. Wash Water Discharge: Discharge wash water from mixer trucks to ground surface in manner and at location where discharge cannot escape construction site, or be washed away to arroyos, storm sewers, or sanitary sewers by precipitation or other surface flows.
1. Prior to project completion, remove wash water residue from site to location approved by Engineer.
  2. Clean wash water discharge site to be free of debris.

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 105°F maximum.
  - 2. Altitude: 6000 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. Coordinate with the local electric utility company, PNM.
  - 1. Install service as indicated on the drawings. PNM will provide service transformer(s), primary conductors, metering, and secondary connections at the transformer.
  - 2. Provide reinforced concrete transformer pad, grounding, and pipe bollards as required by the electric utility. Coordinate the pad size, thickness, openings in the pad (block outs), grounding, and location and size of pipe bollards with the electric utility.
  - 3. Provide secondary conductors from the service equipment to the transformer secondary. Provide trenching, backfill, compaction, conduit, warning tape, and concrete encasement as shown on the drawings.
  - 4. Provide meter base, enclosure, grounding, support, and protection as required by the electric utility.

### 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 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 in publicly accessible spaces shall have provisions for padlocking in the ON position or if indicated on the plans.
- 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. 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  $I^2t$  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".

## **2.13 LUMINAIRES AND COMPONENTS**

- 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.

## **2.14 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICAL METERING**

- A. Meter Base: Comply with PNM requirements.

## **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)
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"/>		Services and Metering	Meter base	Catalog data
<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



## SANTA FE COUNTY UTILITIES

424 NM 599

Santa Fe, New Mexico 87507

PH: (505) 992-9870 Fax: (505) 992-3028



### **33 1300 WATER MAIN DISINFECTION**

**\*Note that all operation of the water system infrastructure must be performed by Santa Fe County Utilities exclusively. Disinfection procedures must be coordinated with Santa Fe County Utilities so that our personnel will be available to operate the water system infrastructure.**

#### **Pre-Disinfection Procedures:**

1. Inspect all materials to be used for the new water main construction to ensure the integrity of the materials.
2. Prevent contaminating materials from entering the new water main during storage, construction or repair and note potential contamination at the construction site.
3. Remove, by flushing or other means, those materials that may have entered the new water main.

#### **Overall Disinfection Procedure:**

All of the disinfection procedures follow the basic approach outlined in 1 – 7 below. Variations of the methods for introducing chlorine are discussed under *Disinfection Methods* further down in this document.

1. Water from the distribution system or other approved source and chlorine are introduced into the new main, ensuring as much uniform mixing and distribution throughout the new main as possible. The main must be completely filled to remove all air pockets. Frequently, the new main is connected directly to the existing distribution system but the two systems remain separated by an isolation valve except when filling the main for disinfection/flushing or during hydrostatic testing, which is conducted only after disinfection of the new main has been successfully completed (see *Special Considerations* at the end of this document). Alternately, the new main may be constructed but remain entirely disconnected from the existing distribution system until disinfection and hydrostatic testing have been successfully completed. In this case, the new main is filled from a potable water truck or other suitable source for the test procedures.
2. A free residual concentration of at least 50 mg/L must be achieved in the new main and verified through testing.
3. The heavily-chlorinated water must be maintained in the new main for 24 hrs during which time all valves, hydrants, etc. along the new main line should be operated to ensure their proper disinfection.
4. At the end of the 24-hour period, a free residual concentration of at least 25 mg/L must remain (as verified by testing).
5. After the 24 hour disinfection period and verification that the 25 mg/L residual remains, the heavily-chlorinated water is flushed out of the end of the new main until the chlorine residual matches that of the distribution system. De-chlorination of the heavily-chlorinated discharge water may be necessary, see below.
6. Samples to be tested for bacteriological quality are then taken and analyzed (using the MMO-MUG procedure). At least one sample must be collected from every 1,200 ft. of new water main, and at least one sample must be collected from each branch off of the main which exceeds 100 ft.
7. Upon negative bacteriological results, successful hydrostatic testing and review/approval from Santa Fe County Utilities, the main(s) can be placed into service.

#### **Disinfection Methods:**

- Continuous-feed method:

The continuous –feed method is generally accomplished by feeding a 10% hypochlorite solution with a chemical pump into the inlet of the new main through a corporation stop as the main is filled with an approved water source. This is the preferred method because it provides the greatest distribution of the chlorine, maximizing the effectiveness of the disinfection.

- Granular Method:

The granular method consists of placing 65% calcium hypochlorite granules in the main at the upstream end of each section of pipe during construction (see quantity in Table 1 below). The main is then slowly filled at a velocity of < 1ft/sec to prevent washing the hypochlorite to the end of the main.

Table 1: *Minimum amount of 65% calcium hypochlorite granules to be placed at beginning of the main and at each 500-ft interval\*\**

Pipe Diameter (d)		Calcium Hypochlorite Granules	
In.	(mm)	oz	(g)
4	100	1.7	57
6	150	3.8	113
8	200	6.7	200
10	250	10.5	300
12	300	15.1	430
14 and larger	(350 and larger)	D <sup>2</sup> x 15.1	D <sup>2</sup> x 427.9

Where D is the inside pipe diameter in feet:  $D = d/12$

\*\*Note that for lengths of piping of < 2,500 ft; intervals of 100 ft are generally recommended to ensure that the test requirements are met. More hypochlorite granules can also be used, but excessive amounts should be avoided.

**Slug method:**

The slug method follows the approach of the continuous-feed method except that the chlorine concentration is increased to 300 mg/L and the contact time is reduced to 3 hrs. The chlorine is applied continuously to create a slug of highly chlorinated water that passes through the lines to be disinfected at a rate that allows a 3 hr contact time. The method is largely used for large-diameter mains or very long mains where the other methods are impractical. Care must be taken to ensure that the slug of highly chlorinated water moves through all parts of the system to be disinfected and that the 3 hr contact time is achieved. The use of the slug method and the details of how it will be applied in a specific situation must have prior approval in writing by Santa Fe County Utilities.

**Final Flushing and Disposal of Heavily Chlorinated Water:**

- Clearing the main of heavily chlorinated water- The heavily chlorinated water should not remain in prolonged contact with the pipe, valves, hydrants, etc. for excessive time beyond the test period or damage may occur. To prevent damage, the heavily chlorinated water should be flushed from all mains, fittings, valves, hydrants and all branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system (typically 0.2 mg/L free residual).
- Disposal of heavily chlorinated water- The environment to which the chlorinated water is to be discharged must be inspected. If there is any possibility that the chlorinated discharge will reach any waterway, arroyo or storm sewer leading to a surface water body, will reach shallow ground waters, or could otherwise cause any damage to the environment, a neutralizing chemical must be applied as the heavily chlorinated water is flushed from the lines. Generally, hydrant diffusers equipped with sodium sulfite tablet feeders are used to neutralize the remaining chlorine. If any doubt exists, the responsible party should contact federal or state regulatory agencies to determine permit requirements or special provisions for the disposal of heavily chlorinated water. The party performing the disinfection procedure bears all responsibility for the proper disposal of heavily chlorinated waters.

**Special Considerations:**

- Water Temperature - If water temperatures of less than 41°F (5°C) are encountered, the heavily chlorinated water must remain in the pipe for at least 48 hrs when using the continuous feed and granular methods. Adaptation of the slug method to cold water temperatures must be discussed with Santa Fe County Utilities.
- Backflow/Backpressure - The existing distribution system must be protected from backflow during disinfection and hydrostatic pressure testing procedures. If the new main is connected to the existing system and separated only by an isolation valve, this requires that the integrity of the isolation valve be known and that the valve be opened only during the fill period for the disinfection procedure until the disinfection procedure has been successfully completed. After successful completion of the disinfection procedure, the hydrostatic pressure testing can be conducted but must be done with the isolation valve closed and in a manner that does not introduce any contaminant into the system. If there is any doubt, Santa Fe County Utilities may require that the disinfection procedure be repeated following hydrostatic testing in these instances.
- Safety - Chlorine compounds and solutions present special handling concerns and safety considerations. When working with chlorine compounds and/or chlorine solutions, all federal, state and local chemical handling and storage requirements should be observed at all times.

	<b>SANTA FE COUNTY UTILITIES</b> 424 NM 599 Santa Fe, New Mexico 87507 PH: (505) 992-9870 Fax: (505) 992-3028	
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## NEW WATER MAIN DISINFECTION FORM

**Project:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Location:** \_\_\_\_\_ **Contractor:** \_\_\_\_\_

**Description of Line Being Disinfected:**

Diameter: \_\_\_\_\_  
Length: \_\_\_\_\_  
Material: \_\_\_\_\_  
Number of Valves: \_\_\_\_\_  
Number of Hydrants: \_\_\_\_\_  
Other Fixtures: \_\_\_\_\_ (Describe)

**Amount/Concentration of Disinfectant Used:**  
Gallons \_\_\_\_\_ (% chlorine)  
OR  
Pounds \_\_\_\_\_ (% chlorine)

**Disinfection Method Used:**

Continuous Feed \_\_\_\_\_  
Granular Method \_\_\_\_\_  
Slug Method \_\_\_\_\_

**Duration of Disinfection Procedure:**

Start Day/Time \_\_\_\_\_  
End Day/Time \_\_\_\_\_

**Type of Disinfectant Used:**

Sodium Hypochlorite \_\_\_\_\_  
Calcium Hypochlorite \_\_\_\_\_

**Chlorine Residual:**

Start of Procedure: \_\_\_\_\_ (mg/L)  
End of Procedure: \_\_\_\_\_ (mg/L)

**Temperature of Water:** \_\_\_\_\_ ° F

**Bacteriological Sample:**

Collection Location: \_\_\_\_\_  
Collection Date/Time: \_\_\_\_\_  
Sample Results: Attach Copy of Results

Note any significant issues encountered while performing disinfection procedure: \_\_\_\_\_

\_\_\_\_\_  
Printed Name and Affiliation of Person Certifying Test Procedure

\_\_\_\_\_  
Signature of Person Certifying Test Procedure (Date)

\_\_\_\_\_  
Acceptance by SFCU (Date)

## SECTION 33 0000

### BULK WATER DISPENSING STATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This section refers work unique to the supply and installation of the Bulk Water Fill Station, including the electrical panel used to control the associated equipment and the software used to configure and collect the data generated by the users of the station.
- B. The CONTRACTOR shall furnish, install and place into operation a complete triple loadout station with a 3” (75mm) overhead loadout, 2” (50mm) lower fill loadout station, and ¾” (0.75” [(20mm)]) lower fill loadout for dispensing bulk potable water. This specification outlines the required backflow preventer, controls and software that shall, as a minimum, identify permitted users, dispense a specified volume of water and communicate the data for each transaction to an administrator’s office PC and other networked PCs (Laptop, IT Database Manager, etc.).
- C. Refer to other sections of this specification for requirements for concrete pad, truck connection fittings, pumps, valves, electrical, and instrumentation.

##### 1.02 QUALITY ASSURANCE

- A. The equipment, control system and software furnished under the section shall be provided by a manufacturer who has been regularly engaged in the design and manufacture of systems for at least 5 years.
- B. The approved manufacturer of this system shall be required to demonstrate a fully functional system that complies with this specification. An Online presentation shall be provided with references and contact information for five (5) installations.
- C. The control systems shall be manufactured in accordance with all local and applicable standards and shall be inspected as an “Industrial Control Assembly” with either UL or CSA label identification.
- D. The manufacturer shall provide documentation necessary for the installation and operation of all associated components of the system.
- E. The products defined in this specification shall be furnished complete, without imposing any obligation onto the SCADA system or proposed SCADA system or the owner to create a database, reports, or other features. Systems that imply

that features are included, yet reference these features as being provided by SCADA shall not be accepted on this project.

### 1.03 WARRANTY

- A. The manufacturer shall guarantee all components furnished as part of this specification for a period of five (5) years from date of shipment.
- B. The manufacturer shall provide software updates and phone support services for a period of one (1) year from date of shipment.

### 1.04 TRAINING AND FIELD SERVICE

- A. The manufacturer shall provide remote online orientation and web-based training for initial software installation and configuration and administrative training and field configuration/testing of the system.
- B. The manufacturer shall provide remote (phone based and web-based Zoom webinar meeting) service for initial administrative training, software installation, and field configuration/testing of the system. Manufacturer shall provide one (1) eight (8) hour day, on-site start up services for training and testing of system by a factory trained Flowpoint representative. Start Up services subject to Federal, State, and Local COVID travel restrictions and require completion of a start up readiness report and three weeks notice to book.

### 1.05 USAGE AND LICENSING

- A. The manufacturer shall provide a multi-user license to the facility to allow the software to be installed on multiple PCs (administrative office, lab, etc.) as is required without additional charge.

### 1.06 APPROVED MANUFACTURER

- A. The products specified shall be a manufactured by Flowpoint Environmental Systems. The software specified is Water +.
- B. This Specification is based on Bulk Water Station design by Flowpoint. Contractor shall be responsible for any and all additional costs of other manufacturers' alternative equipment designs. Additional costs associated with alternative equipment designs may include, but not be limited to, electrical and control modifications, piping, conduit, cable, anchors, and supports.

### 1.07 APPROVED SOFTWARE DEVELOPER/SUPPORT



- A. The cloud software specified shall be a developed, supplied and supported by Flowpoint Environmental Systems Inc.
- B. Software shall be updated regularly and developed and supported by Flowpoint Environmental Systems Inc. Third party software development is not acceptable. Manufacturer must support software in house and have a dedicated in-house support team available along with toll free access during regular business hours.

## PART 2 - PRODUCTS

### 2.01 BULK WATER DISPENSING STATION ENCLOSURE

- A. The entire system must be enclosed in an approved enclosure designed for this purpose. The system shall be housed within a lockable, weatherproof and insulated kiosk style enclosure fabricated from 1.5" (37.5mm) thick panels consisting of a foamed polyurethane core surrounded by a profiled 26 gauge coated galvanized steel exoskeleton on all four sides and insulated for heat and cold protection. The enclosure shall include a 1500W Electric heater to protect the system from extreme cold weather.
- B. The enclosure shall include interior and exterior LED lighting and a 120VAC GFI Convenience receptacle house inside the enclosure.

### 2.02 BULK WATER DISPENSING STATION AND ACCESS TERMINAL

- A. The manufacturer shall provide one (a) access terminal hauler interface to allow for users to dispense water from one of the selected outlets (one 3" [75mm] upper fill point, one 2" [50mm] lower fill point, and one ¾" [0.75" {20mm}]). The access terminal shall include a keypad, and digital display for users to log on and choose their hose, enter a specific volume of water to be dispensed and purchased. The station shall include one combination metering device/valve. The station shall include interior and exterior LED lighting. Exterior lighting shall be over the access terminal. The station shall be constructed and tested as an assembly prior to delivery at the site.
- B. The hauler access terminal shall be an integral part of a comprehensive fully-managed bulk water fill station, including the necessary software as described later in this specification.
- C. The hauler access terminal shall be constructed with corrosion resistant materials, with outer door and access panel that can be closed to enable a wash down without damaging the internal mounted electrical devices. The hauler access terminal shall be NEMA rated Type 3R.
- D. The hauler access terminal shall be provided with a daylight visible display

and outdoor-rated, robust keypad. The display shall prompt the hauler with log-on instruction and display responsive messages that allow the unattended use of the facility.

- E. The hauler access terminal shall continue to function normally without a network connection to the office. All data shall be stored in non-volatile memory. When the network connection is established, all transaction data shall be automatically synchronized and securely stored to the SQL database.
- F. The hauler access terminal shall be maintained without requiring Arc Flash protective clothing. Motor starters or other high voltage devices must be located in a separate control panel. Control circuits greater than 24VDC shall not be accepted.
- G. The bulk water dispensing station shall be provided with the following components:
  - 1. Access Terminal Enclosure
    - a) Marine grade aluminum, rated NEMA 3R
    - b) External swing-out door
    - c) Lockable handle
    - d) External door shall be insulated for severe cold weather installation
  - 2. Access Keypad
    - a) Flowpoint Model FP-KTECK-FUAB16 integrated keypad/HMI
    - b) Secure, robust, and outdoor rated
    - c) Clear, backlit LCD color display, visible in all levels of light.
    - d) Integrated stainless steel backlit buttons with LCD screen c/w
    - e) Lexan Screen Protector manufactured by Flowpoint
  - 3. Programmable logic controller, PLC, including;
    - a) Ethernet connection to Water+ software.
    - b) Allen-Bradley 1769 Compactlogix PLC
    - c) Non-volatile memory

4. Drain Valve (Upper Fill Point)
  - a) ½ (12 mm) Darhor normally open Solenoid Valve, 120VAC
5. Control Valves and Flowmeters
  - a) 3" (75mm) Bermad 900 Series combination flow meter/control valve
  - b) 2" (50mm) Bermad 900 Series combination flow meter/control valve
  - c) One ¾" (20mm) Seametrics MJN-Series Pulse meter and ¾" N.C. Asco Solenoid valve
  - d) Control valves shall have opening and closing speed controls
6. Piping
  - a) All piping shall be 3" (75mm), 2" (50mm), and ¾" (0.75" [20mm]) Stainless Steel 304 piping
  - b) All piping connections shall be Victaulic Rigid Couplings (Style 107) and Victaulic VIC-Flange Adaptors (Style 741)
  - c) Piping shall be secured with adequate supports for the operation of the station. Pipe hangers are not acceptable.
7. Galvanized Overhead Fill Support
  - a) The manufacturer shall provide a galvanized overhead fill support and overhead stainless steel piping for the 3" (75mm) overhead fill point as per drawings.
8. Backflow Preventor
  - a) The manufacturer shall provide an approved backflow device to prevent the contamination of the potable water system from backpressure or backsiphonage.
  - b) The device shall be a 6" (100mm) Wilkins 375 reduced pressure zone assembly. The device shall be constructed with no-lead components. The assembly shall include an easily maintained strainer and shutoff valves for testing.

## 2.03 MANAGEMENT SOFTWARE

- A. The Bulk Water Fill Station shall include the necessary software to allow a web enabled PC to seamlessly interface with one or multiple hauler stations using an Ethernet connection or using a Sierra Wireless RV50 cellular modem connection (Monthly cellular data charges are the responsibility of the owner. Owner to provide an activated SIM card coordinate with Flowpoint to ensure station can communicate with software. Cellular data must be configured with a Public Static IP Address).
- B. The software shall allow the facility to connect and exchange data to one or more hauler stations, located at one or more sites.
- C. The software shall be used to configure the station's access device and enable/disable hauler access codes.
- D. The software shall be used to configure the devices that shall measure the volume.
- E. The software shall monitor each station and automatically upload the hauler's transaction data.
- F. The data shall be stored into a secure SQL database. The data shall include Site ID, Station ID, User ID, Date and Time of Transaction, Volume loaded, Rate ID, and Volume Remaining.
- G. The software shall be installed on any site owned PC using Windows 10 Pro OS with a network card configured to communicate over the Internet with the hauler access stations.

## 2.03 ELECTRICAL

- A. The Bulk Water Fill Station shall operate with 120/240-volt single-phase 100-ampere electric utility service.

## PART 3 – SYSTEM FEATURES

### 3.01 CUSTOMER AND TRUCK FEATURES

- A. The software shall allow the facility to create a list of customers that will be billed for the station/s use. A user-friendly interface shall be provided for entering customer details and account number. The software shall not limit the facility as to the number of customer accounts that can be created.
- B. The software shall allow the facility to create multiple truck accounts and link these accounts to the customer (owner of truck). The software shall not limit

the facility as to the number of trucks that can be assigned to each customer.

- C. User-friendly interface shall be provided to enter the User ID, PIN, and other details regarding the truck, including capacity, weight, and vehicle identification.
- D. The customer shall be provided with a 4-Digit User ID and 4-Digit PIN for each truck that will access the Water Fill Station. PIN assignment can be unique per owned truck or common to all owned trucks, depending on facility and customer preference or allow manual entry of a PIN.
- E. The software shall include an Overview Screen, divided into sections that shall display the Transaction Log, Customers, Truck Status, Customer Balances and quick-link to Reports. Data views shall be configurable to show customer and truck activity using built-in sorting tools.
- F. The software shall allow the facility to enable or disable a truck's access privilege. Once disabled, a Hauler's access shall be denied at all stations and at all sites upon station update. A message shall be displayed to inform the hauler to contact the office.
- G. The software shall have multiple pre-formatted reports that can be printed to a networked printer, emailed or exported using common file formats. As a minimum, the software shall include reports to show Activity with daily totals, Statements, and Customer and Truck usage. Systems that only allow offer manual file retrieval from the station or manipulation of .csv files are not acceptable.
- H. User-friendly interface screens shall be included for the facility to enter billing rates, alarm identification, station name and location. This data shall be used in both the basic and advanced features of the system management.

### 3.02 BILLING RATE FEATURES

- A. System software must accept 1000 user definable Carrier Truck account User ID Numbers (with upgrade ability to 9998 users).
- B. System software must allow for software upgrade of extra Carrier Truck account User ID Numbers
- C. System software must maintain information on Truck Carriers (including company name, billing address and billing discount %), Carrier Trucks (including Carrier Truck User ID account number, PIN number, Truck Description, Plate number, Load Capacity, and Driver Name) and account balance.

- D. System software must allow User to configure and communicate with multiple Access Terminal located at any number of Bulk Water Truckfill Stations.
- E. System software must allow User to automatically upload Carrier Truck account information to each Access Terminal at a Bulk Water Truckfill Station via LAN Ethernet.
- F. System software must automatically collect all transactions from each Access Terminal / Bulk Water Truckfill Station at a user defined interval.
- G. System software must have integrated on-line help screens
- H. System software must allow User to define “Volume Units” for bill generation (i.e. m3, ft3, litres, bbl, US Gal, Imp Gal)
- I. System software must allow User to define billing method either by Volume or by Load and by Discountable Rate based on customer.
- J. System software must allow User to manage accounts on either a “Credit” basis or a “Pre-pay/Debit” basis.
- K. System software must allow User to print a detailed Carrier Reports.
- L. System software must allow User to print a batch of Bills for all or one Carrier
- M. System software must allow User to re-print a batch of Bills for all or one Carrier
- N. Each Bill shall include detailed information for each transaction with a date stamp, time stamp, quantity, unit factor, unit rate and total.
- O. Each Bill shall include transactions for each Carrier: by Carrier Truck, Bulk Water Truckfill Station, Subtotals and Totals.
- P. The software shall allow the facility to define a list of allowed billing rates for dispensed water. The billing rate per 1/10/100/1000 units is used by the software to calculate the transaction’s amount. Multiple billing rates offer the facility flexibility to allow volume or residential users a discount. The use of different rates is not required to use the software. Units can be user-defined (Gallons, liters, bbl, etc.).
- Q. The software shall total the truck volume and calculate the total cost for the transaction.

### 3.03 BILLING AND PAYMENT FEATURES

- A. The facility shall be able to use the features of this software to substantiate the data recorded for each transaction and accurately calculate the total cost on a per customer basis.
- B. The facility shall have the option to use the software to create a billing statement or export the data to the primary accounting software. Export options shall include be XML, CSV, Excel or HTML.
- C. The software shall allow the facility to manage each customer on a debit or credit basis. The customer is required to pay in advance or the customer can pay after usage of the station.
- D. The software shall debit the account balance automatically and auto-deactivate the truck's access privilege should the customer's balance drops below a minimum.
- E. The software shall allow the facility to bill on a metered basis.
- F. The software shall allow the facility to enter payments if required. The total balance shall automatically recalculate once a payment is applied. A customer's account that is deactivated shall be automatically activated once money is received.

### 3.04 OTHER FEATURES

- A. The software shall allow the facility to define the Station's Operating Time Schedule. Each day shall be configured with Open and Close times. If closed, station shall prompt the hauler that the station is CLOSED.

## PART 4 - OPERATION

### 4.01 SUMMARY

- A. Customer shall choose a hose – 'UPPER' or 'LOWER' or "3/4 INCH" (labels defined in Water+) and press 'ENTER'
- B. Upon entering "User ID" and "PIN" by customer, system to provide authorization to User and activate system.
- C. Once authorized, the customer shall enter the volume of water desired, and when ready, press, "START" to begin the flow of water.
- D. System controls to open a Flow Control Valve (FCV) and (if Upper fill point was selected) close Drain Valve (DV) to begin the discharge of water.
- E. System must measure the volume of water dispensed by receiving pulse input

from the appropriate flow meter.

- F. Once the requested volume of water has been dispensed, the FCV to close and DV to open (if Upper fill point was selected).
- G. FCV to “close” if there is a No-Flow condition for a predetermined time or the access terminal “STOP” button is pressed.
- H. The Access Terminal to be able to control two fill points (not simultaneously).

#### 4.02 ALARM SHUTDOWN

- A. The system shall automatically disable if an alarm condition is triggered. The valve shall close and the screen shall display out of order.

END OF SECTION



## SECTION 40 05 67.35

### PRESSURE REDUCING CONTROL VALVE

#### INTRODUCTION

This specification covers the design, manufacture, and testing of 1 in. (25 mm) through 36 in. (900 mm) Control Valves

#### PART 1 - GENERAL

1. Standard products - use the same manufacturer for multiple units of same type.
2. "Tying" of equipment into packages for the purpose of thwarting competition shall be considered to be in non-compliance with these specifications.
3. Manufacturers shall price items under different subsections or sections separately.

#### PART 2 - PRODUCTS

##### 2.01 PRESSURE REDUCING CONTROL VALVES

###### A. FUNCTION

The Pressure Reducing Control Valve shall automatically throttle to reduce a higher incoming pressure and maintain an accurate and constant lower downstream pressure regardless of changing flow rate and/or inlet pressure. If downstream pressure increases above the pilot spring setting, the valve shall close.

###### B. MATERIALS

1. Material Specification for the Pressure Reducing Control Valves Main Valve as

follows: Component

Material

Body & Cover	Ductile Iron-ASTM A536
Main Valve Trim	Bronze, Stainless Steel
Seat	Bronze, Stainless Steel
Stem, Nut and Spring	Stainless Steel
Seal Disc	Buna-N® Rubber
Diaphragm	Nylon Reinforced Buna-N® Rubber
Internal Trim Parts	Stainless Steel: Bronze; Brass
End Detail	Flanged (1-1/2" – 36") Threaded (1" – 3") Grooved (1-1/2" – 8")
Pressure Rating	Class 150 lb. (250psi Max.) Class 300 lb.

Temperature Range	(400psi Max.)
Any other wetted metallic parts	Water to 180°F Stainless Steel; Bronze; Brass
Coating	Fusion Bonded Epoxy Coating (Interior and Exterior); ANSI / NSF 61 Approved / AWWA coating specifications C116-03.
Accessories	Position Indicator, Limit Switch, Opening & Closing Speed Controls, Check Feature, Isolation Valves, Gauges

## C. MANUFACTURE

### 1. Main Valve:

- a. The main valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern. The valve shall consist of three major components; the body with seat installed, the cover with bearing installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall comply with NSF/ANSI Standard 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.

### 2. Main Valve End Connections:

- a. End Connections for control valve shall be flanged per ASME/ANSI B16.42, Class 150 or Class 300 (1-1/2" thru 36") or Threaded End Connections (1" thru 3") or Grooved End Connections (1-1/2" thru 8").

### 3. Main Valve Body:

- a. No separate chamber(s) below the diaphragm shall be allowed between the main valve cover and body. No fabrication or welding shall be used in the manufacturing process.
- b. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the discs firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hours-glass shaped disc retainers shall be permitted and no V-type or

slotted-type disc guides shall be used.

- c. The diaphragm assembly containing a non-magnetic stainless steel stem; of sufficient diameter to withstand high hydraulic pressures and shall be fully guided at both ends by a bearing in the main valve cover and an integral bearing in the valve seat. The valve seat shall be a solid, one-piece design and shall have a minimum five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from the line pressure. No bolts or cap screws shall be permitted for use in the construction of the diaphragm assembly.
- d. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The diaphragm's center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 X per layer of nylon fabric and shall be cycled tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position. Bellofram type rolling diaphragms shall not be permitted.

The main valve seat and stem bearing in the valve cover shall be removable. The cover bearing and seat in the 6" and smaller size valve shall be threaded into the cover and body. The valve seat in the 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. The valve shall be designed such that both the cover assembly and internal diaphragm assembly can be disassembled and lifted vertically straight up from the top of a narrow opening/vault. Y-pattern valves shall not be permitted. The seat shall be of the solid one piece design. Two piece seats or seat inserts shall not be permitted. Packing glands and/or stuffing boxes shall not be permitted.

#### 4. Pilot Control System:

- a. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge. Pilot shall comply with NSF/ANSI 61 and certified lead free

to NSF/ANSI 372 as a safe drinking water system component.

- b. The pilot control system shall include a strainer, a fixed orifice closing speed and all required control accessories, equipment, control tubing and fittings. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves sizes 3” and smaller as standard equipment. The pilot system shall include isolation ball valves on sizes 4” and larger as standard equipment. A full range of spring settings shall be available in ranges of 0 to 400 psi. Pilot to be manufactured by control valve manufacturer.
5. Material Specification for Pilot Control:

<u>Component</u>	<u>Material</u>
Body & Cover	Bronze, Low Lead CuZn21Si3P or UNS C87850
Pilot Trim	Brass & Stainless Steel 303
Rubber	Buna-N®
Connections	FNPT
Pressure Rating	400 psi Max.
Temperature Range	Water to 180°F Max.
Control Tubing	Copper
Control Fittings	Brass

6. Factory Assembly:

- a. Each control valve shall be factory assembled.
- b. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008.
- c. For all control valves, the factory assembly shall include the complete main valve, pilot valve(s), and all associated accessories and control equipment.
- d. During factory assembly the control valve manufacture shall make all necessary adjustments and correct any defects.

7. Nameplates:

- a. Each Control Valve and associated pilot(s) shall be provided with an identifying nameplate.
- b. Nameplates, depending on type and size of control valve, shall be mounted in the most practical position possible, typically on the inlet side of the valve body.
- c. Nameplates shall be brass and a minimum of 3/32” thick, 3/4” high and 2-3/4” long.
- d. Pertinent control valve data shall be etched or stamped into the nameplate. Data shall include control valve Catalog number, function, size, material, pressure rating, end-connection details, type of pilot controls used and control adjustment range.

8. Factory Testing:

- a. Each control valve shall be factory tested.
- b. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008
- c. Tests shall conform to approved test procedures.
- d. The standard factory tests shall include a valve body and cover leakage test, seat leakage test and a stroke test. Control valves and pilot valves, in the partially open position, with both ends closed off with blind flanges (valves) and pipe plugs (pilots), shall be subject to an air test. The applied air pressure shall be 90 psi minimum. All air pressure tests shall be applied for a minimum of 15 minutes. No visible leakage is permitted through the valve seat, the pressure boundary walls of the valve body, valve cover, pilot body, pilot cover or the body-cover joint.
- e. Control valve manufacturer shall, upon request, offer additional testing, such as high pressure hydrostatic testing, positive material inspection testing, ferrite testing, liquid penetration inspection testing, magnetic particle examination testing and radiographic examination testing.

D. PRODUCT DATA

1. The following information shall be provided:
  - a. Control Valve manufacturer's technical product data.
  - b. Control Valve manufacturer's Installation, Operation and Maintenance manual (IOM).
2. Provide specific information on all optional features specified above and confirm that these items are provided.
3. The valve manufacturer shall be able to supply a complete line of equipment from 1" through 36" sizes and a complete selection of complementary accessories and equipment.
4. The control valve manufacture shall provide a computerized cavitation analysis report which shows flow rate, differential pressure, and percentage of valve opening. Cv factor, system velocity, and if there will be cavitation damage.
5. The manufacturer must also provide valve noise levels according to International Standards over the flow range of the valve. Noise calculation program will be specific to the control valve manufacturer, and based upon tests conducted by a third party, independent laboratory and will be able to provide dBA values for octave band frequencies between 31.5 and 8000 Hz. (Valves with KO trim calculations are per another industry accepted standard without the octave band frequency noise levels). Generic, third party noise calculation for non-specific control valves will not be accepted.

## PART 3 - EXECUTION

### A. STORAGE AND HANDLING

- a. It is the responsibility of the contractor to store valves and any appurtenances per the manufacturer recommendations.

#### 2. Packing and Shipping

- a. Control valves specified herein shall be factory assembled. Any control valve appurtenances, accessories, parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.
- b. Care shall be taken in loading, transporting and unloading to protect control valves, appurtenances, or coatings from damage. Equipment shall not be dropped. All control valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage(s) shall be repaired.
- c. Prior to shipping, the control valves and all associated accessories shall be acceptably packaged and covered to prevent entry of foreign material.
- d. All packaged control valves shall be shipped, remain covered and stored on site until they are installed and put into use.

### B. FIELD TESTING

1. A direct factory representative shall be made available by the equipment supplier for start-up service, inspection and necessary adjustments.

The Control Valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.

The control valve shall be CLA-VAL Company Model No. 90-01, Pressure Reducing Control Valve with Return Flow feature, as manufactured by Cla-Val Co., Costa Mesa, CA 92627-4416.

END OF SECTION

SECTION 40 05 67.36

PRESSURE REDUCING CONTROL VALVE WITH LOW FLOW BY-PASS

INTRODUCTION

This specification covers the design, manufacture, and testing of 1 in. (25 mm) through 8 in. (200 mm) Control Valves

PART 1 - GENERAL

1. Standard products - use the same manufacturer for multiple units of same type.
2. "Tying" of equipment into packages for the purpose of thwarting competition shall be considered to be in non-compliance with these specifications.
3. Manufacturers shall price items under different subsections or sections separately.

PART 2 - PRODUCTS

2.01 PRESSURE REDUCING CONTROL VALVE WITH LOW FLOW BY-PASS

A. FUNCTION

The Pressure Reducing Control Valve with Low Flow By-Pass, shall automatically throttle to reduce a higher incoming pressure and maintain an accurate and constant lower downstream pressure, regardless of changing flow rate and/or inlet pressure. For low flow conditions, the main pressure reducing valve shall also be equipped with a low flow by-pass direct acting pressure regulating valve, piped in parallel. The low flow by-pass pressure regulating valve shall be set 5 psi higher than the main pressure reducing valve. If downstream pressure increases above the pilot spring setting of the main pressure reducing valve, the valve shall close. Under low flow conditions, the main pressure reducing valve closes and the by-pass regulator stays open, controlling the downstream pressure at very low flows without seat chatter.

B. MATERIALS

1. Material Specification for the Pressure Reducing Control Valve with Low Flow By-Pass Main Valve as follows:

<u>Component</u>	<u>Material</u>
Body & Cover	Ductile Iron-ASTM A536
Main Valve Trim	Bronze, Stainless Steel

Seat	Bronze, Stainless Steel
Stem, Nut and Spring	Stainless Steel
Seal Disc	Buna-N® Rubber
Diaphragm	Nylon Reinforced Buna-N® Rubber
Internal Trim Parts	Stainless Steel: Bronze; Brass
End Detail	Flanged (1-1/2" – 36") Threaded (1" – 3") Grooved (1-1/2" – 8")
Pressure Rating	Class 150 lb. (250psi Max.) Class 300 lb. (400psi Max.)
Temperature Range	Water to 180°F
Any other wetted metallic parts	Stainless Steel; Bronze; Brass
Coating	Fusion Bonded Epoxy Coating (Interior and Exterior); ANSI / NSF 61 Approved / AWWA coating specifications C116-03.
Accessories	Position Indicator, Limit Switch, Opening & Closing Speed Controls, Check Feature, Isolation Valves, Gauges

C. MANUFACTURE

1. Main Valve:

- a. The main valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern. The valve shall consist of three major components; the body with seat installed, the cover with bearing installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall comply with NSF/ANSI Standard 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.

2. Main Valve End Connections:

- a. End Connections for control valve shall be flanged per ASME/ANSI B16.42, Class 150 or Class 300 (1-1/2" thru 8") or Threaded End Connections (1" thru 3") or Grooved End Connections (1-1/2" thru 8").



### 3. Main Valve Body:

- a. No separate chamber(s) below the diaphragm shall be allowed between the main valve cover and body. No fabrication or welding shall be used in the manufacturing process.
- b. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the discs firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hours-glass shaped disc retainers shall be permitted, and no V-type or slotted-type disc guides shall be used.
- c. The diaphragm assembly containing a non-magnetic 303 stainless steel stem; of sufficient diameter to withstand high hydraulic pressures and shall be fully guided at both ends by a bearing in the main valve cover and an integral bearing in the valve seat. The valve seat shall be a solid, one-piece design and shall have a minimum five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from the line pressure. No bolts or cap screws shall be permitted for use in the construction of the diaphragm assembly.
- d. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The diaphragm's center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 X per layer of nylon fabric and shall be cycled tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.
- e. The main valve seat and stem bearing in the valve cover shall be removable. The cover bearing and seat in the 6" and smaller size valve shall be threaded into the cover and body. The valve seat in the 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem,

the valve body and cover shall be machined with a locating lip. No “pinned” covers to the valve body shall be permitted. Cover bearing, disc guide and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. The valve shall be designed such that both the cover assembly and internal diaphragm assembly can be disassembled and lifted vertically straight up from the top of a narrow opening/vault. Y-pattern valves shall not be permitted. The seat shall be of the solid one-piece design. Two piece seats or seat inserts shall not be permitted. Packing glands and/or stuffing boxes shall not be permitted.

4. Pilot Control System:

- a. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge. Pilot shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.
- b. The pilot control system shall include a strainer, a fixed orifice closing speed and all required control accessories, equipment, control tubing and fittings. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves sizes 3” and smaller as standard equipment. The pilot system shall include isolation ball valves on sizes 4” and larger as standard equipment. A full range of spring settings shall be available in ranges of 0 to 400 psi. Pilots to be manufactured by control valve manufacturer.

5. Material Specification for Pilot Control:

<u>Component</u>	<u>Material</u>
Body & Cover	Bronze, Low Lead CuZn21Si3P or UNS C87850
Pilot Trim	Brass & Stainless Steel 303
Rubber	Buna-N®
Connections	FNPT
Pressure rating	400 psi Max.
Temperature Range	Water to 180°F Max.
Control Tubing	Copper
Control Fittings	Brass

6. Material Specification for Low Flow By-Pass Direct Acting Pressure Regulating Valve:

<u>Component</u>	<u>Material</u>
Body and Cover	Bronze, Low Lead CuZn21Si3P or UNS C87850
Pilot Trim	Brass & Stainless Steel 303
Rubber	EPDM
Connections	FNPT
Pressure rating	400 psi Max.
Temperature Range	Water to 180°F Max.

7. Factory Assembly:

- a. Each control valve shall be factory assembled.
- b. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008.
- c. For all control valves, the factory assembly shall include the complete main valve, pilot valve(s), and all associated accessories and control equipment.
- d. During factory assembly the control valve manufacture shall make all necessary adjustments and correct any defects.

8. Nameplates:

- a. Each Control Valve and associated pilot(s) shall be provided with an identifying nameplate.
- b. Nameplates, depending on type and size of control valve, shall be mounted in the most practical position possible, typically on the inlet side of the valve body.
- c. Nameplates shall be brass and a minimum of 3/32" thick, 3/4" high and 2-3/4" long.
- d. Pertinent control valve data shall be etched or stamped into the nameplate. Data shall include control valve Catalog number, function, size, material, pressure rating, end- connection details, type of pilot controls used and control adjustment range.

9. Factory Testing:

- a. Each control valve shall be factory tested.

- b. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008
- c. Tests shall conform to approved test procedures.
- d. The standard factory tests shall include a valve body and cover leakage test, seat leakage test and a stroke test. Control valves and pilot valves, in the partially open position, with both ends closed off with blind flanges (valves) and pipe plugs (pilots), shall be subject to an air test. The applied air pressure shall be 90 psi minimum. All air pressure tests shall be applied for a minimum of 15 minutes. No visible leakage is permitted through the valve seat, the pressure boundary walls of the valve body, valve cover, pilot body, pilot cover or the body-cover joint.
- e. Control valve manufacturer shall, upon request, offer additional testing, such as high-pressure hydrostatic testing, positive material inspection testing, ferrite testing, liquid penetration inspection testing, magnetic particle examination testing and radiographic examination testing.

#### D. PRODUCT DATA

1. The following information shall be provided:
  - a. Control Valve manufacturer's technical product data.
  - b. Control Valve manufacturer's Installation, Operation and Maintenance manual (IOM).
2. Provide specific information on all optional features specified above and confirm that these items are provided.
3. The valve manufacturer shall be able to supply a complete line of equipment from 2" through 36" sizes and a complete selection of complementary accessories and equipment.
4. The control valve manufacture shall provide a computerized cavitation analysis report which shows flow rate, differential pressure, and percentage of valve opening. Cv factor, system velocity, and if there will be cavitation damage.
5. The manufacturer must also provide valve noise levels according to International Standards over the flow range of the valve. Noise calculation program will be specific to the control valve manufacturer, and based upon tests conducted by a third party, independent laboratory and will be able to provide dBA values for octave band frequencies between 31.5 and 8000 Hz. (Valves with KO trim calculations are per another industry accepted standard without the octave band frequency noise levels). Generic, third party noise calculation for non-specific control valves will not be accepted.

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- b. Care shall be taken in loading, transporting and unloading to protect control valves, appurtenances, or coatings from damage. Equipment shall not be dropped. All control valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage(s) shall be repaired.
- c. Prior to shipping, the control valves and all associated accessories shall be acceptably packaged and covered to prevent entry of foreign material.
- d. All packaged control valves shall be shipped, remain covered and stored on site until they are installed and put into use.

### B. FIELD TESTING

1. A direct factory representative shall be made available by the equipment supplier for start-up service, inspection and necessary adjustments.

The Control Valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.

The control valve shall be CLA-VAL Company Model No. 90-48, Pressure Reducing Control Valve with Low Flow By-Pass, as manufactured by Cla-Val Co., Newport Beach, CA 92627-4416.

END OF SECTION