



Tartesso
City of Buckeye

Well No. 3 Specifications

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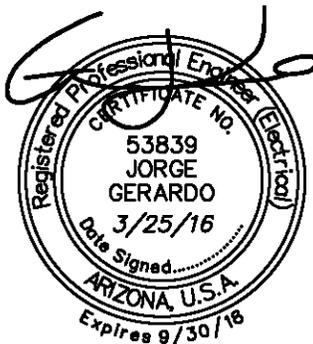
**TARTESSO WELL 3
BUCKEYE, ARIZONA
TECHNICAL SPECIFICATIONS**

DIVISION 16

16010..... Basic Electrical Requirements
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DIVISION 17

17500..... General Instrumentation
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17550..... Control Descriptions



SECTION 01000
GENERAL INFORMATION

PART 1 GENERAL

1.01 CONTRACT/SPECIFICATION CONFLICTS

- A. In the event of any conflict between these specifications and the contract, the contract shall govern.

1.02 WARRANTY

- A. The Contractor shall guarantee all work in accordance with MAG section 108.8, which requires a period of 1 year from the date of City acceptance, or as required by the sections of these specifications. The longer warranty period shall govern between conflicting MAG and project specifications.

1.03 REVIEWS, INSPECTIONS, AND APPROVALS

- A. The Contractor shall coordinate any reviews, inspections, and approvals required by the plans and/or specifications with the City of Buckeye. This requirement shall pertain to any reviews, inspections, observations, and approvals required by the Owner, Inspector, Contracting Agency, Engineer, City, City Representative, etc.

1.04 SCHEDULE AND UPDATES

- A. The Contractor shall submit a Gantt style schedule at the pre-construction meeting for review and update the schedule based on any comments.

1.05 SITE MEETINGS

- A. The Contractor's superintendent shall be available to attend any required field meetings with the City, Owner, or Engineer during construction.

1.06 DIVISION 01 BID TABULATION

- A. All efforts to meet the requirements of the Division 01 specification sections shall be captured by the General Requirements item under the Miscellaneous heading in the bid tab. This bid item will also include all efforts to construct the well site and improvements defined in the project plans and specifications in its entirety that are not listed elsewhere.

END OF SECTION

SECTION 01100

REFERENCES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the Work, unless otherwise specified. Refer uncertainties and requirements that are different, but apparently equal, to ENGINEER for a decision before proceeding. Reference standards include, but are not necessarily limited to, the following:
1. American Association of State Highway and Transportation Officials (AASHTO).
 2. American Concrete Institute (ACI).
 3. American Gear Manufacturers Association (AGMA).
 4. American Institute of Steel Construction (AISC).
 5. American Iron and Steel Institute (AISI).
 6. American National Standards Institute (ANSI).
 7. American Petroleum Institute (API).
 8. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 9. American Society of Mechanical Engineers (ASME).
 10. American Society for Testing and Materials (ASTM).
 11. American Water Works Association (AWWA).
 12. American Welding Society (AWS).
 13. Center for Cold-Formed Steel Structures (CCFSS).
 14. Concrete Reinforcing Steel Institute (CRSI).
 15. Construction Specifications Institute (CSI).
 16. Expansion Joint Manufacturers Association, Inc. (EJMA)
 17. Factory Mutual (FM).
 18. Fluid Controls Institute (FCI).
 19. Hydraulics Institute (HI)
 20. International Concrete Repair Institute, Inc. (NCRI)
 21. Institute of Electrical and Electronics Engineers (IEEE).
 22. National Association of Corrosion Engineers (NACE)
 23. National Concrete Masonry Association (NCMA)
 24. National Electrical Manufacturer's Association (NEMA).
 25. National Ready Mixed Concrete Association (NRMCA)
 26. National Sanitation Foundation International (NSF)
 27. National Fire Protection Association (NFPA).
 28. Occupational Safety and Health Administration (OSHA).
 29. Pre-stressed Concrete Institute (PCI).
 30. Society for Protective Coatings (SSPC)
 31. Underwriters' Laboratories, Inc. (UL).
 32. All other applicable standards listed in the Specifications and the standards of utility service companies, where applicable.
 33. Maricopa Association of Governments (MAG), Uniform Standard Specifications for Public Works Construction, as supplemented or revised by the City of Buckeye publications. References to MAG Standard Details refer to most recent version "Uniform Standard Details for Public Works Construction" sponsored and distributed by the Maricopa Association of Governments, Arizona.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01340
OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers submittal requirements to the ENGINEER for the purpose of compiling a Project Operations and Maintenance (O&M) manual. Compile and submit data and related information in manuals appropriate for manuals of each item of equipment identified in other Specification sections and as shown on the drawings. Provide data on a CD-ROM in searchable Adobe Acrobat (latest version) format.
- B. NOTE: TARTESSO 1261, LLC (OWNER), the CITY OF BUCKEYE (CITY) and ENGINEER will review the CONTRACTOR's Final Equipment O&M Manuals. After the OWNER's comments and revisions are incorporated into the Final Equipment O&M Manual documents, the CONTRACTOR shall combine the individual Equipment O&M Manuals into one Project Manual. The CONTRACTOR shall provide the entire Project Manual on one CD in **SEARCHABLE** pdf format. A non-searchable pdf will not be accepted. The CONTRACTOR shall provide two (2) copies of the Project Manual in binder form with a CD in each and six (6) additional copies of the Project Manual in CD form.

1.02 QUALITY ASSURANCE

- A. Collection and preparation of data shall be performed and compiled by CONTRACTOR's personnel:
1. Trained and experience in O&M preparation of described equipment.
 2. Familiar with requirements of this section and all applicable sections.
 3. Skilled as technical writer to extent required to communicate essential technical and non-technical data. Writing must be concise and accurate.
 4. Skilled in using AutoCAD, latest version, competent to prepare required drawings. All drawings shall be in AutoCAD dwg format. Graphics and drawings use for insertion into word processing document can be in approved bitmap formats.
- B. CONTRACTOR shall meet with the CITY'S O&M personnel to establish format and requirements.

1.03 FORM OF MANUALS

- A. Components:
1. Size: 8-1/2 in. by 11 in., or 11 in. by 17 in. folded, with standard 3-hole punching. Plastic pockets must be used for full sized (24" x 36") drawings, one drawing per pocket.
 2. Paper: 20-lb minimum, white brightness 88 or better, for typed pages.
 3. Text: Manufacturer's printed data, or neatly typewritten. Handwritten data is not acceptable, except for clarification on manufacturer's printed documents. Minimize the use of handwritten notes.
 4. Drawings:
 - a. Bind in with text. Legible 11" x 17" are encouraged.
 - b. Fold larger drawings and place in clear plastic pockets punched for inserting into binder. Place identification on outside of each pocket and corresponding number printed on drawings. Fold drawings in such manner that title or identification number is visible.

- B. Cover Label: Label each binder spine with typed or printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", "project name", "year of final completion", "volume number" and the following information on the cover:
1. Project title.
 2. Name of equipment as set forth in Contract Documents.
 3. Specification section number for equipment as set forth in Contract Documents. Name of design ENGINEER, CONTRACTOR and CITY.
 4. Volume number, year of final completion and other pertinent information.
- C. Binders:
1. Commercial quality, white D-Ring binder with durable and cleanable plastic covers. Paperboard and laminated paperboard covers are not acceptable. 2-inch, maximum.
 2. Do not fill binders to more than 75% of capacity.
 3. When multiple binders are used for an item of equipment, organize contents into related groupings. Each binder cover shall bear identification of specific contents. Use dividers and tabs where necessary.

1.04 SUBMITTAL SCHEDULE

- A. Submit 3 Preliminary copies of complete O&M data, bound in binders bearing identification label, for review within 30 days after time CONTRACTOR receives approved Shop Drawings and other submittals for equipment from ENGINEER, but no later than 30 days prior to substantial completion. Each copy shall contain filled out forms A and B.
- B. The ENGINEER will review and return one Preliminary O&M manual to the CONTRACTOR marked with comments. If the Preliminary O&M manual is not acceptable to the ENGINEER, the CONTRACTOR shall resubmit the Preliminary manual (3 copies) with the ENGINEER's comments incorporated into the revision. When the Preliminary O&M manual is acceptable to the ENGINEER, the CONTRACTOR will submit 2 Final copies of the manual with the ENGINEER's comments addressed within 2 weeks.
- C. ENGINEER will forward the two final copies to the OWNER and CITY for review and comments. OWNER's and CITY's review comments will be sent to the CONTRACTOR. After the OWNER's and CITY's comments and revisions are incorporated into the Final Equipment O&M Manual documents, the CONTRACTOR shall combine the individual Equipment O&M Manuals into one Project Manual. The CONTRACTOR shall provide the entire Project Manual on one CD in pdf format. The CONTRACTOR shall provide four (4) copies of the Project Manual in binder form and four (4) copies of the Project Manual in CD form.
- D. ENGINEER'S review and acceptance of O&M data will be only for conformance with requirements of this section, for form of submittal and organization of data and completeness of information provided, but not for technical content or coordination between individual suppliers of equipment or system(s).
- E. CONTRACTOR shall review O&M submittal and complete Forms A and B, Contractor Submittal Form, Equipment Data Form, attached to this section (computer disk of the forms are available at no charge from the ENGINEER) indicating requirements of this section have been met before submitting to ENGINEER. ENGINEER will reject submittals without completed Forms A and B.
- F. ENGINEER will be sole judge of completeness of data and information submitted to the ENGINEER for review.

- G. Following ENGINEER's acceptance, the manuals will be transmitted to the CITY for the CITY's review and Comments.

1.05 PAYMENTS

- A. Progress payment for equipment delivered, stored or installed under these Contract Documents shall not exceed 90% of the equipment cost until O&M data is accepted by ENGINEER.
- B. Progress payments for control systems packaged with equipment shall not exceed 90% of the cost until control system manual is accepted by ENGINEER.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 GENERAL CONTENTS OF DATA

- A. Each manual shall contain equipment data pertaining to not more than one Specification section number indicated in Contract Documents. Each section can consist of more than one type of equipment. Submittal will be accepted by the ENGINEER one complete section at a time.
- B. Title Sheet: First page in data listing following:
 - 1. Title: "OPERATION AND MAINTENANCE INSTRUCTIONS."
 - 2. Title of Project: As shown on Contract Documents.
 - 3. Name(s) of applicable building(s) or structure(s) in which equipment is located.
 - 4. Name of equipment as described in Contract Documents.
 - 5. Specification section number for equipment.
 - 6. CONTRACTOR's name, address, fax and telephone number.
 - 7. Subcontractor's name, address, fax and telephone number if equipment is provided by Subcontractor.
 - 8. CONTRACTOR's or Subcontractor's purchase order number, manufacturer's shop order number or other such numbers required for parts and service ordering.
 - 9. Manufacturer's name, address, and telephone number.
 - 10. **In BOLD letters, provide name, address, and telephone number for local source of supply for parts and service.**
 - 11. List websites and email addresses.
- C. Equipment List: Immediately following title sheet containing following:
 - 1. Completed Form A, Contractor's Submittal Form.
- D. Table of Contents: Immediately following equipment list. Arrange in logical, systematic order and shall include as minimum each tabbed divider. Each page shall be numbered.
- E. Tabbed Dividers: Insert tabbed section dividers between each major section.
 - 1. Provide title of section on each tab.
 - 2. Provide table of contents for each tabbed section, arranged in systematic and/or numeric order.
- F. Equipment Data Sheets (Form B): Provide catalog sheets showing configuration, manufacturer's specifications, models, options, and styles of equipment and major components being provided.

Product data sheets will show project specific information with inapplicable information deleted by crossing out or removal. Include in tabbed section(s).

G. Text:

1. Include only those sheets applicable to Project.
2. Each sheet shall:
 - a. Identify specific equipment or part installed.
 - b. Identify text applicable to equipment or part installed.
 - c. Do not include inapplicable information. Cross or delete out all non-pertinent information.

H. Drawings:

1. Supplement text with drawings to clearly illustrate following:
 - a. Equipment and components.
 - b. Relations of component parts of equipment and systems.
 - c. Control and flow diagrams.
 - d. All design drawings shall be in AutoCAD format. Illustrations and pictures can be in bitmap formats. If AutoCAD drawings are not available, CONTRACTOR shall provide a scanable 8 ½" x 11" drawing.
2. Actual drawings of equipment from manufacturer. "Typical" drawings are not acceptable, unless they accurately illustrate actual installation.

I. Specially written information, as required to supplement text for particular installation.

1. Provide explanation of interrelationships of equipment and components, and effects one component has on another or entire system. Coordinate with design ENGINEER on design intent to ensure that system work as a unit process as intended.
2. Provide overall instructions and procedures for equipment tying in instructions and procedures for separate components into unified instructional package.
3. Provide glossary of special terms used by manufacturer.
4. Organize in consistent format under separate headings for different procedures.
5. Provide logical sequence of instructions for each procedure.

J. Copy of each warranty, bond, or expiration of warranty/guarantee. Copy of each service contract issued. List manufacturer standard and upgraded service contract by "Services Provided", and associated "costs". If manufacturer does not provided service contract, indicate on equipment submittal. Inability to provide annual service contract at a fair market price may be grounds for rejection of equipment.

1. Provide information sheet for CITY's personnel to explain following.
 - a. Proper procedures in event of failure or malfunction to prevent voiding warranty.
 - b. Instances affecting validity of warranties or bonds.
 - c. Provide startup sequence in the event of power or system failure.

3.02 SPECIFIC DATA FOR EACH EQUIPMENT AND SYSTEM

A. For each item of equipment and system include:

1. Completed Equipment Data Form typewritten on copy of Form B of Section 01340. Computer format of Form B is available at no cost from the ENGINEER and sent via email.
2. Description of equipment and component parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, and tests as applicable.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Complete nameplate data.
 - e. P&ID numbers for equipment as indicated on Drawings.
3. Operating Procedures:
 - a. Startup, break-in, and normal operating instructions.
 - b. Regulation, control, stopping, shutdown, and emergency instructions.
 - c. Summer and winter operating instructions, as applicable.
 - d. Special operating instructions.
4. Maintenance Procedures:
 - a. Routine maintenance operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, repair, and reassembly instructions. Videotape instruction can be used to supplement written instructions.
 - d. Alignment, adjusting, and checking instructions.
5. Servicing and Lubrication Schedule:
 - a. List of lubricants required and quantity to be applied.
 - b. Schedule of lubrication.
 - c. Schedule for other routine maintenance.
6. Manufacturer's printed instructions regarding safety precautions for both (a) protection of personnel operating equipment and systems and (b) prevention of damage to equipment and systems.
7. Description of sequence of operation of controls.
8. Manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts and quantities of same. Provide most current price list.
9. Approved control diagrams such as ladder diagrams, instrumentation loop diagrams, and electrical schematics as appropriate. The ladder logic programs shall be fully documented with unique symbol names for each program element (coils, contacts, inputs, outputs, etc.) and comments for every 3 rungs of logic, so that another Programmer can understand the logic and be able to debug and modify the programs at a later date." Or your own description, such that the PLC programs are well documented with internal comments and explanations of what each function block and ladder rung is doing to control the well equipment.

10. Bill of material. Do not show "typical" materials. Indicate materials used specifically for this project.
 11. Other data as required under applicable Specification sections.
- B. Each electric and electronic system, as applicable to equipment such as switchgear, motor control centers, panelboards, switchboards, starters, breakers, and relays shall include:
1. Description of System and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, rating tables, and tests as applicable.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Complete nameplate data.
 - e. P&ID numbers for equipment as set forth on Drawings.
 2. Circuit Directories of Panelboards:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 3. Complete instrumentation loop diagrams with tabulated listing of components in each control circuit or loop.
 4. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
 5. Maintenance Procedures:
 - a. Routine maintenance operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, repair, and reassembly instructions.
 - d. Adjustment and checking instructions.
 6. Manufacturer's printed instructions regarding safety precautions for both (a) protection of personnel operating equipment and systems and (b) prevention of damage to equipment and systems.
 7. List of original manufacturer's spare parts and recommended quantities maintained in storage.
 8. Other data as required under pertinent sections of Specifications.
- C. Prepare and include additional data when need for such data becomes apparent during instruction of CITY's personnel or as requested by CITY.

3.03 INSTALLATION CERTIFICATION, INSTRUCTION CERTIFICATION

- A. Installation certification to be provided by the manufacture of equipment where specified. Manufacturer or authorized representative of manufacturer to certify that the installation is per

manufacturer's recommendation. Representative to sign the Installation certification form found at the end of this section.

- B. Instruction services to be provided by the manufacturers authorized representative. Training of CITY's personnel will be provided by qualified representatives. Contractor to submit a resume of the individual that is designated to train. An outline of the training plan is to be submitted 30 days prior to the scheduled training. The training lesson is to be video taped and the video is to be submitted as a supplement to the O & M manual. Training is to be based on the O & M manuals. Training certification form is found at the end of this section.

**FORM "A" TO SECTION 01340
CONTRACTOR SUBMITTAL FORM**

TO: GHD 4747 North 22 nd Street Suite 200 Phoenix, Arizona 85016	PROJECT NAME:	Tartesso Well No. 3
	DATE:	
	SPECIFICATION SECTION TITLE:	
	SECTION NO.:	
	MANUFACTURER/VENDOR:	
FROM: (Contractor) (Address) (City, State, Zip)	NO. OF COPIES SUBMITTED TO ENGINEER:	
	SIGNATURE OF CONTRACTOR:	

GENTLEMEN:

We have checked the O&M manual submittal dated _____, 20__, and have found it to be in accordance with the requirements of your Specification and as noted below.

Contractor Signature:
Contractor Stamp:

**FORM "A" TO SECTION 01340
CONTRACTOR SUBMITTAL FORM**

Provided	Not Applicable	Page No.	
GENERAL CONTENTS			
			<input type="checkbox"/> Conformed specification only
			<input type="checkbox"/> Title Page
			- Title
			- Project title
			- Building/structure number
			- Equipment name
			- Specification section number
			- Contractor name and contact person/information
			- Subcontractor name and contact person/information
			- Purchase order data
			- Manufacturer name and contact information
			- Service/parts supplier name and local representative
			<input type="checkbox"/> Product List
			<input type="checkbox"/> Table of Contents
			<input type="checkbox"/> Tabbed Sections
			- Pertinent data sheets
			- Annotated as needed
			<input type="checkbox"/> Text
			- Pertinent to project
			- Annotated / section
			<input type="checkbox"/> Drawings
			- Illustrate product and components
			- Control and flow diagrams

**FORM "A" TO SECTION 01340
CONTRACTOR SUBMITTAL FORM**

Provided	Not Applicable	Page No.	
GENERAL CONTENTS			
			O Special Information
			- Interrelationships of equipment and components
			- Instructions and procedures provided
			- Instructions organized in consistent format
			- Instructions in logical sequence
			- Glossary/index
			O Warranty, guarantee, Bond, Service Contract, time period
SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			O Description of Unit and Components
			- Equipment name/functions
			- Normal operating characteristics/loop description
			- Limiting conditions/equipment caution
			- Performance curves/limitations of equipment
			- Engineering data/parts list/materials of construction
			- Test data/factory/on-site test
			- Replaceable parts list (with numbers) and phone no.
			- Nameplate data
			- P&ID numbers
			O Operating Procedures
			- Startup / startup sequence /caution
			- Routine/normal operation
			- Regulation and control
			- Stopping and shutdown
			- Emergency shutdown / emergency manual operation
			O Operating Procedures (continued)
			- Seasonal operation (high flows/low flows/future)
			- Special instructions (manual operation)

**FORM "A" TO SECTION 01340
CONTRACTOR SUBMITTAL FORM**

Provided	Not Applicable	Page No.	
SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			O Maintenance Procedures
			- Routine/normal instructions/frequency
			- Troubleshooting guide/contact number/information
			- Disassembly/reassembly/repair
			O Servicing and Lubrication
			- List of lubricants
			- Lubrication schedule
			- Maintenance schedule
			O Safety Precautions/Features
			O Sequence of Operation of Controls
			O Assembly Drawings (hardcopy or computer format)
			O Parts List and Illustrations
			- Predicted life
			- Spare parts list
			O Control Diagrams/Schematics
			O Bill of Materials (indicate materials used for this project)
			O Completed Equipment Data Form per Specification
			O Other Data as Required
			O Panelboard Directories
			- Electrical
			- Controls
			- Communications
			O Instrumentation Loops
			- Diagrams
			- Components list each circuit/loop
			O Additional Data

**FORM "B" TO SECTION 01340
EQUIPMENT DATA FORM**

Page 1 of 4

PROJECT NAME	Tartesso Well No. 3		
CONTRACT NO.			
CONTRACTOR			
EQUIPMENT/TAG NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	
LOCATION			
MANUFACTURER			
PURCHASED FROM			Tel: () -
VENDOR ORDER NO.		PURCHASE \$	
DATE OF PURCHASE			
LOCAL SUPPLIER			
ADDRESS			
PHONE NO.			
MODEL NO.			
NO. OF UNITS		SERIAL NOS.	
*By CITY			

**FORM "B" TO SECTION 01340
EQUIPMENT DATA FORM**

NAMEPLATE DATA			
ELECTRIC MOTOR		PUMP/HVAC UNIT	
MANUFACTURER		MANUFACTURER	
TYPE	[] AC [] DC	TYPE	
HORSEPOWER		SIZE	
RPM		CAPACITY	
VOLTAGE		PRESSURE/UNITS	
AMPERAGE		ROTATION/RPM	
PHASE		IMPELLER SIZE/TRIM	
FRAME		IMPELLER MATERIAL	
DRIVE/REDUCER		OTHER (I&C)	
MANUFACTURER		MANUFACTURER	
TYPE	[] GEAR [] V-BELT [] CHAIN [] VARIDRIVE	TYPE/NEMA RATING	
		SIZE	
SERVICE FACTOR		CAPACITY	
RATIO		RANGE	

**FORM "B" TO SECTION 01340
EQUIPMENT DATA FORM**

LUBRICANT/RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	

LUBRICANT LIST

REFERENCE SYMBOL	LUBRICANT TYPE	RECOMMENDED LUBRICANT AND MANUFACTURER
List symbols in "maintenance operation" (Pg 3 / 4).	List general lubricant type.	List specific lubricant name, viscosity, and manufacturer.

RECOMMENDED SPARE PARTS LIST

PART NO.**	DESCRIPTION	UNIT	QUANTITY	UNIT COST

ADDITIONAL DATA AND REMARKS

* By CITY

** Identify spares or replacement parts provided by this contract with two asterisks on shop drawings/cutsheets.

Note: Attach additional sheets if necessary; identify each sheet at top with equipment number and description.

INSTALLATION CERTIFICATION FORM

Contract No.		
Specification Section		
O&M Volume No.		
Equipment Name		
Manufacturer		
Equipment Name		
Manufacturer		
Equipment Name		
Manufacturer		
Equipment Name		
Manufacturer		
CONTRACTOR		
<p>The undersigned CONTRACTOR's representative hereby certifies the equipment item(s) described above have been provided and installed in accordance with the Manufacturer's recommendations, and the trial of the equipment item(s) has been satisfactory.</p>		
DATE	COMPANY	SIGNATURE OF AUTHORIZED REPRESENTATIVE
ADDITIONAL DATA AND REMARKS		

END OF SECTION

SECTION 01400
GENERAL OPERATIONS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Tartesso Well Site No. 3 will provide water to Tartesso Unit 1 Water Supply Facility (WSF) for the Tartesso development in the City of Buckeye, Arizona. The development will ultimately consist of single family and multi-family residences, commercial and industrial properties, and schools.
- B. The well site consists of one well pump, a dry well, and all the required appurtenances.

1.02 SUMMARY OF WATER SYSTEM COMPONENTS

- A. The well site generally consists of the following components:

- 1. Well

- a. The well will be part of a network of proposed wells that will supply water to the existing and proposed water supply facilities within the Tartesso development. The proposed well shall operate according to the following parameters. Further details are provided in Section 11070 of these specifications.

Capacity:	1300 gpm
TDH:	590 feet
Motor HP:	250 hp

- 2. Dry Well

- a. The dry well will capture pump to waste water from the well along with storm water from the site. Further details are provided in Section 02711 of these specifications.

- 3. CONTROLS AND OPERATION

- a. The controls and operation of the proposed well are discussed in Section 17550.

END OF SECTION

SECTION 01500
TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES

PART 1 GENERAL

1.01 QUALITY ASSURANCE

- A. This section covers temporary construction facilities and utilities, such as electrical power, water, lighting, fire protection, fencing, and other temporary items required for this project. Items provided under this section shall be listed or labeled by UL (Underwriters' Laboratory) or other Nationally Recognized Testing Laboratory (NRTL).
1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- B. Regulatory Requirements:
1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.
 2. Meet all applicable Local Agency, County and State codes for temporary structures.
- C. Comply with Federal, State, County and Local Agency codes and regulations, and with utility company requirements.

PART 2 PRODUCTS

2.01 TEMPORARY ELECTRICITY AND LIGHTING

- A. General:
1. Temporary lighting shall be sufficient to enable CONTRACTOR and subcontractors to complete Work and enable ENGINEER to observe Work as it is being performed. Illumination shall meet or exceed state code requirements.
 2. CONTRACTOR shall contact the utility company and make all arrangements for temporary power to the project site. CONTRACTOR shall pay for all application fees and usage directly to the utility company.
- B. CONTRACTOR's Responsibilities:
1. Provide, maintain, and remove temporary electric service facilities. CONTRACTOR shall pay for all fees and costs of all utilities used during the construction period up to final acceptance. CONTRACTOR shall be required to apply for electrical services and make all necessary arrangements for bringing electrical service to the project site for the exclusive use by the CONTRACTOR, subcontractor, and ENGINEER.
 2. Facilities exposed to weather shall be weatherproof type and electrical equipment enclosure locked to prevent access by unauthorized personnel.
 3. Pay for installation of temporary services including poles, transformer charges, conduits, conductors, and metering.
 4. Arrange with local electric utility for temporary electric service subject to their requirements and approval.
 5. Register temporary meter in CONTRACTOR's name. Pay for all services.
 6. Provide and maintain lamps, wiring, switches, sockets, and similar equipment required for temporary lighting and small power tools.
 7. Pay for electrical energy consumed for construction purposes including operation of ventilating equipment for buildings, and for testing and operating of equipment after

permanent wiring has been installed, until final acceptance by ENGINEER and until final acceptance and occupancy by CITY.

8. Provide and pay for services to temporary offices, if required.
9. CONTRACTOR, upon approval of the ENGINEER, may use diesel generator to generate temporary power for lighting, and tools.
10. Provide temporary heat and/or air conditioning for chemicals prone to freezing or any equipment requiring constant temperature storage.

2.02 TEMPORARY TELEPHONE SERVICE

- A. (Not Used)

2.03 WATER FOR CONSTRUCTION

- A. Make arrangements and pay costs for water used during the construction period. Obtain all necessary permits and pay for all initial and monthly costs. Provide approved backflow preventors that meet City codes and requirements. If hydrants are used, CONTRACTOR shall operate hydrants according to procedures. Line breaks caused by abruptly shutting down hydrants shall be repaired immediately by the CONTRACTOR at no cost to the CITY (OWNER). Make hydrants accessible to Fire Department at all times. Report valve/hydrant malfunction to Fire Department immediately, and then to OWNER.
- B. Provide temporary piping per Local Agency codes. Obtain water meter(s) from the CITY to measure all flows. The CONTRACTOR will pay all fees and costs associated with obtaining temporary water.
- C. Disinfect temporary water lines, if needed for potable use.
- D. Water for testing pipes shall be provided by the CONTRACTOR, prior to acceptance of Work.

2.04 SANITARY FACILITIES

- A. Provide temporary sanitary toilet facilities conforming to state and local health and sanitation regulations, in sufficient number for use of OWNER's, ENGINEER's, CONTRACTOR's and subcontractor's employees.
- B. Maintain in sanitary condition and properly supply with toilet paper.
- C. Arrange for portable toilet units and holding tanks, if needed. All wastes from trailer offices shall be piped to a holding tank, if a sewer connection is not available.
- D. Arrange for routine vacuum services and maintenance.
- E. Proper sanitary, vector and odor control shall be required and maintained at all times.

2.05 TEMPORARY FIRE PROTECTION

- A. CONTRACTOR shall be required to contact local fire department and meet all necessary fire codes at the project site.
- B. CONTRACTOR shall make arrangements for fire department audits
- C. Make roadways accessible to fire trucks.

2.06 TEMPORARY SITE AND OTHER ROADS

- A. Construct and maintain temporary site roadways in drivable condition necessary to carry out construction operations.
- B. Maintain OWNER's existing roads and public roads used during construction free from accumulations of dirt, mud and construction debris resulting from construction operations. Roads shall be considered "maintained" when material has been removed by a mechanical sweeper.
- C. Paved roads damaged during routine and normal construction shall be repaved at CONTRACTOR's costs per Local Agency and MAG paving requirements.
- D. Provide photographs of road conditions before start of project.

2.07 SECURITY

- A. Security will not be provided by OWNER.
- B. CONTRACTOR shall be responsible for loss or injury to persons or property where Work is involved, and shall provide security and take precautionary measures to protect CONTRACTOR's and OWNER's interests.
- C. CONTRACTOR shall provide insurance against loss of materials, equipment and other property at the project site.
- D. CONTRACTOR shall provide ENGINEER with one, or more, keys as needed by the ENGINEER, for site entrance gate and all constructed facilities.

2.08 TEMPORARY PARKING

- A. Temporary parking areas shall be provided by the CONTRACTOR at no additional cost. Project area may not have adequate parking areas for all workers. Off-site parking may be necessary. CONTRACTOR shall make arrangements for additional parking without additional costs to the OWNER.

2.09 TEMPORARY FENCING

- A. Provide temporary fencing sufficient to prevent trespass by CONTRACTOR's employees and suppliers onto private property and by public onto construction site. Provide fencing that is sufficiently secure against trespass of children and stray animals. Follow requirements of MAG and Local Agency codes.
- B. Materials shall be sufficiently durable to be effective for duration of construction period.
- C. Fencing around the project site will be removed and new fence will be constructed in place.

2.10 PROJECT IDENTIFICATION

- A. Provide signs suitably supported and erected on Project site to indicate all construction areas. Locate signs where designated by ENGINEER on behalf of OWNER.

2.11 FIELD OFFICES AND BUILDINGS

- A. CONTRACTOR shall provide and maintain in good condition, if needed, temporary field office, tool, and storage buildings or trailers at no additional cost.
 - 1. Tool storage buildings or trailers shall be of ample size to provide space for tools and equipment.

2. Buildings or trailers shall be neat and well constructed, surfaced with plywood, drop aluminum siding, masonite, or other similar material, well painted and void of advertisements. Trailer shall be constructed with 3 ½ inch foil-backed fiberglass insulation. Interior shall have paneling and vinyl flooring.
3. Provide one washroom equipped with sink and toilet. Trailer must have holding tank. Provide heated water supply, wall mirror and fan ventilation.
4. At least 1 window per room, equipped with wrought iron security bars and insect screen. Provide horizontal mini-blinds on all windows.
5. Provide 2 exterior doors with cylinder deadbolt, and exterior lighting.
6. Provide wood decking to connect all job trailers.
7. Provide adequate exterior lighting.
8. Submit trailer layout and trailer/storage area layout to the ENGINEER for approval.
9. The top of all trailers and storage facilities shall not exceed the top of the PV ARF perimeter fence.

2.12 CITY'S USE

- A. Upon acceptance of Work, or portion of Work defined and certified as Substantially Completed by ENGINEER, and CITY commences full-time successful operation of facility or portion thereof, CITY will pay cost for utilities used for CITY's operation. CONTRACTOR shall continue to pay for utilities used until final acceptance of Work, except as provided herein.

PART 3 EXECUTION

3.01 GENERAL

- A. Comply with applicable requirements of these specifications.
- B. Maintain and operate systems to ensure continuous service.
- C. Modify, move and/or extend systems as Work progress requires.

3.02 REMOVAL AND RESTORATION

- A. Completely remove temporary materials, equipment, signs, and structures when no longer required.
- B. In unfinished areas, clean and repair damage caused by temporary installations or use of temporary facilities, restore drainage, and evenly grade, seed or plant as necessary to provide appearance equal to or better than original.
- C. In finished areas, restore existing or permanent facilities used for temporary services to specified or original condition.

3.03 DAMAGE TO EXISTING PROPERTY

- A. CONTRACTOR is responsible for replacing or repairing damage to existing buildings, structures, sidewalks, roads, parking lot surfacing, landscaping, irrigation, and other existing assets in kind to the satisfaction of the OWNER.
- B. CONTRACTOR shall have option of having OWNER contract for such Work and have cost deducted from Contract price. OWNER's cost may be considerably higher than market price.

END OF SECTION

SECTION 01501
TRAFFIC CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes:
 - 1. Traffic Control.
- B. Traffic regulation shall conform to Local Agency, County, and State requirements.
- C. Do not disturb natural vegetation and drainage washes outside limits of construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials used for traffic regulation shall conform with all Local Agency, County and State requirements.

PART 3 EXECUTION

3.01 EXECUTION

- A. The Contractor shall perform all construction activities in a manner that allows at least 12 feet of vehicular access in both directions at all times.
- B. The Inspector and the City shall approve any noncompliance with these requirements in writing.
- C. Comply with MAG, Local Agency, and County requirements.
- D. Follow traffic controls at all times.
- E. Follow speed control signage.
- F. Provide ingress and egress for affected residents.
- G. Inform residents of construction schedule and project summary if approached. Provide a copy of all information distributed to ENGINEER, along with a distribution listing.

END OF SECTION

SECTION 01600
PRODUCT DELIVERY, STORAGE, & HANDLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the procedural requirements for product delivery, storage, and handling.
- B. Related Sections include the following:
 - 1. Divisions 2 through 17 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.03 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. The City may reject any delivery based on the appearance of the product or material delivered.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products to allow for inspection and measurement of quantity or counting of units.
 - 6. Store materials in a manner that will not endanger Project Site.
 - 7. Store products that are subject to damage by the elements, under cover in a weather tight enclosure above ground, with ventilation adequate to prevent condensation.
 - 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 9. Protect stored products from damage.
- B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's representatives. Coordinate location with Owner.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01640
PRODUCT SUBMITTALS AND SUBSTITUTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Procedural requirements for Project-related submittals including Construction Progress Schedules, piping layout, Shop Drawings, product data, samples, operation and maintenance (O&M) data, construction photographs, design data, test reports, manufacturer's instructions, pre-fabrication drawings, schedule of values and other miscellaneous Work-related submittals.
2. Submittal requirements per items listed in Part 1, of all Sections in these specifications.
3. Items requiring ENGINEER's approval in these specifications.
4. Items shown on drawings which require approval by ENGINEER.

1.02 DEFINITIONS

A. Submittal for Review or Approval:

1. Submittal for ENGINEER's review in accordance with requirements of Contract Documents.

B. Submittal for Record:

1. Submittal for inclusion into CITY's records prior to Substantial Completion. Submittals will not be reviewed by ENGINEER.

C. Products:

1. Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "materials," "equipment," "system" and terms of similar intent.

D. Substitutions:

1. Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by CONTRACTOR.

- E. CONTRACTOR shall provide a submittal to the ENGINEER for approval for all equipment, furnishings, appurtenances, etc. The CONTRACTOR shall be responsible for determining the number of submittals to be made. Any submittal, not provided to the ENGINEER for approval is considered a "Not Approved" submittal. Subcontractors are to submit their means and methods through the CONTRACTOR to the ENGINEER for record purposes only.

1.03 CONSTRUCTION PROGRESS SCHEDULES

- A. Provide monthly/weekly project schedules as specified.

1.04 SHOP DRAWINGS AND PRODUCT DATA

A. Scheduling:

1. Provide submittal schedule for items of materials and equipment for which submittals are required by Specifications or requiring approval of the ENGINEER as shown on the

plans. Adjust submission schedule to reflect revisions to Construction Progress Schedule and submit to ENGINEER.

2. Prepare and transmit each submittal sufficiently in advance of scheduled performance of Work and other applicable activities.

B. CONTRACTOR's Responsibilities:

1. Review Shop Drawings and product data prior to submittal. CONTRACTOR shall verify correctness and completeness of all submittals prior to forwarding same to ENGINEER for review. CONTRACTOR shall provide approval/review stamp, signature and date. Identify deviations in the submittal from the plans and specifications.
2. Determine and verify following.
 - a. Field measurements.
 - b. Field construction criteria.
 - c. Catalog numbers and similar data.
 - d. Conformance with Specifications.
 - e. Delete (Strike out) items NOT used in supplier's brochure and highlight the model/make of equipment used specifically for the project.
3. Coordinate each submittal with requirements of Work and Contract Documents.
4. Notify ENGINEER in writing, at time of submittal, of deviations in submittals from requirements of Contract Documents.
5. Begin no fabrication or Work requiring submittals until return of submittals with ENGINEER approval.
6. Designate in Construction Progress Schedule, dates for submittal and receipt of reviewed shop drawings and samples.
7. Submittals received but not requested in Specifications shall be returned without review.

C. Submittals shall contain:

1. Date of submittal and dates of previous submittals.
2. Project title and number.
3. Contract identification.
4. Names, telephone, and fax numbers of:
 - a. CONTRACTOR.
 - b. Supplier.
 - c. Manufacturer and Manufacturer Technical Department or Staff.
 - d. Local/Regional representative(s).
5. Identification of product, with identification numbers, and Drawing and Specification section numbers. CONTRACTOR shall be required to bind submittals by each section number shown in these specifications. When a section contains more than one type of equipment, CONTRACTOR shall provide tabs and a table of contents. Submittals can be made one section at a time within the time frame shown on the project schedule. Submittals with portions of each section will not be allowed, unless approved by ENGINEER.
6. Field dimensions, clearly identified.
7. Identify details required on Drawings and in Specifications.
8. Show manufacturer and model number, give dimensions, and provide clearances and tolerances.
9. Relation to adjacent or critical features of Work or materials.
10. Applicable standards, such as ASTM or Federal Specification numbers. Identification of deviations from Contract Documents.
11. Identification of revisions on re-submittals.

12. 8 in. by 3 in. blank space for CONTRACTOR and ENGINEER review stamps.
13. CONTRACTOR's stamp, signed, certifying review of submittal, verification of products, field measurement, field construction criteria, and coordination of information within submittal with requirements of Work and Contract Documents.
14. Product related data. Refer to O&M submittal requirements by ENGINEER.
15. Samples, actual, color charts or cutouts.
16. Personnel qualifications.
17. Training plans
18. Installation requirements and procedures.
19. Performance test requirements and procedures.
20. Material certification.
21. Warranties and guarantees.
22. Tools and parts list. Include current price lists.

D. Re-submittal Requirements:

1. Comply with submittal requirements.
2. Make corrections or changes in submittals required by ENGINEER. Re-submittals required until approved.
3. Identify on transmittal form that submittal is a resubmission.
4. Shop Drawings and Product Data:
 - a. Revise initial drawings or data and resubmit as specified for initial submittal.
 - b. Indicate changes made other than those requested by ENGINEER.

E. Distribute reproductions of Shop Drawings and copies of product data which carry ENGINEER's stamp approval to following:

1. Jobsite file.
2. Record documents file.
3. Other affected Contractors.
4. Subcontractors.
5. Supplier or fabricator.
6. Submit a minimum of six (6) copies of submittals for review by ENGINEER.
7. Furnish additional copies for use by CONTRACTOR.

F. ENGINEER's Duties:

1. Review submittals in accordance with schedule.
2. Indicate requirements for re-submittal or approval of submittal.
3. Return submittals to CONTRACTOR for distribution or for re-submittal.

1.05 TEST RESULTS REPORTS AND CERTIFICATIONS

- A. Submit test results, reports, and certifications as required.
- B. Submit test results upon completion of test or submittal of results from testing laboratory.
- C. Test results and certifications are submitted for review of conformance with specified requirements and information.

1.06 CONSTRUCTION PHOTOGRAPHS

- A. Taken at regular intervals during course of the project. Refer to Construction Photographs section of these specifications.

- 1.07 GUARANTEE, WARRANTIES, MAINTENANCE AGREEMENTS AND WORKMANSHIP BONDS
- A. Refer to Specification sections for requirements. Submittal considered final when submittal is returned by ENGINEER, marked "Approved" or "Approved as Noted."
- B. In addition to copies desired for CONTRACTOR's use, furnish 6 executed copies to ENGINEER.
- 1.08 OPERATION AND MAINTENANCE (O&M) DATA
- A. Compile product data and related information appropriate for CITY's maintenance and operation of products per requirements of these specifications.
- 1.09 ACTION ON SUBMITTALS
- A. ENGINEER'S Action:
1. General:
 - a. Except for submittals for record and similar purposes, where action and return on submittals is not required or requested, ENGINEER will review each submittal, mark with appropriate action, and return. Where submittal must be held for coordination, ENGINEER will so advise CONTRACTOR without delay.
 - b. ENGINEER will stamp each submittal with action stamp, appropriately marked with submittal action.
 2. Notification of Insufficient Information:
 - a. If information submitted is not sufficient to complete review of submittal, ENGINEER will send transmittal to CONTRACTOR notifying CONTRACTOR that additional information is required.
 - b. Submittal will not be returned. Submittal will be placed in an "on hold" status until CONTRACTOR provides additional information.
- B. Action Stamp:
1. Marking: Approved.
 - a. Final Unrestricted Release: Where submittals are marked as "Approved," Work covered by submittal may proceed provided it complies with Contract Documents. Acceptance of Work depends on that compliance.
 2. Marking: Approved As Noted.
 - a. Final-But-Restricted Release: When submittals are marked as "Approved With Noted Exceptions," Work covered by submittal may proceed provided it complies with ENGINEER'S notations or corrections on submittal and with Contract Documents. Acceptance of Work depends on that compliance. Resubmittal is not required.
 3. Marking: Not Approved.
 - a. Submittal Not Accepted: When submittals are marked as "Not Approved," do not proceed with Work covered by submittal. Work covered by submittal does not comply with Contract Documents.
 - b. Prepare new submittal for different material or equipment supplier or different product line or material of same supplier complying with Contract Documents.

4. Marking: Revise and Resubmit.
 - a. Returned for Re-submittal: When submittals are marked as "Revise and Resubmit," do not proceed with Work covered by submittal. Do not permit Work covered by submittals to be used at Project site or elsewhere where Work is in progress.
 - b. Revise submittal or prepare new submittal in accordance with ENGINEER's notations. Resubmit without delay. Repeat if required to obtain different action marking.

1.10 SUBSTITUTIONS

- A. Timing: Engineer will consider requests for substitution if received within 60 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Engineer.
- B. Conditions: Engineer may consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully .documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.
 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 11. Requests for substitution shall be submitted to the Town for approval prior to the Engineer's Review.

1.11 COMPARABLE PRODUCTS

- A. When a product (i.e., any material, process or equipment) is specifically identified by patent, proprietary name, trade name or by name of manufacturer- and regardless of whether or not is followed by the words "or equal", "or approved equal", or "or equivalent" - it is done to establish a standard of quality for the protection of the Owner, is intended to be descriptive, and is not intended to limit competition or to restrict the use of materials which may be equal to or better than the named product.
- B. A bidder may substitute an alternative product for a product specifically identified, provided that approval of the alternative product has been obtained from the Engineer.
- C. A bidder desiring to substitute an alternative product for a product specifically identified shall submit a written request for approval to the Engineer. Each such request shall include the name of the identified product for which the substitution is proposed and complete description of the proposed alternative product, including (a) the name or other identification of the product, (b) any

drawings, cut sheets or performance technical and test data for the product, and (c) any other information, reports and reviews relevant and necessary for the evaluation of the proposed alternative product.

- D. The burden of proving the equality or superiority of the alternative product proposed for substitution is upon the Contractor. Any proposed alternative product must be compatible with, and have the capability of tying into, existing systems where they occur. Contractor shall pay for all modifications or alterations required in the use of any approved substituted products.
- E. The Engineer shall consider and either approve or reject all alternative product proposals.
- F. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
 - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
 - 5. Samples, if requested.

1.12 SPARE PARTS

- A. The manufacturer's spare parts shall be defined as that recommended list of spare parts he has developed and made part of the Operations and Maintenance Manual for the product in addition to those specifically identified in the Detailed Specifications. The spare parts shall be transmitted to the Owner in a Form submitted, acceptable to the OWNER and delivered to a point within the facility designated by the OWNER or other OWNER facility. The Submittal Form shall contain as a minimum, a description of the Spare Parts, Catalogue Number, Serial Numbers, and quantities involved, Manufacturer's name, address and telephone number and actual cost.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 SUBMITTAL REQUIREMENTS

- A. Provide complete copies of required submittals as follows.
 - 1. Construction Progress Schedule:
 - a. 6 copies of initial schedule.
 - b. 6 copies of each monthly revision.
 - 2. Shop Drawings and Product Data: 6 copies.
 - 3. Test Results: 6 copies.
 - 4. Construction Photos: 2 CD ROM copies with index file.
 - 5. Operation and Maintenance Manuals: 3 Preliminary copies; 6 Final copies.
 - 6. Other Submittals:
 - a. 6 copies if required for review and all 6 copies shall be retained by the ENGINEER.

- b. CONTRACTOR shall furnish extra copies in addition to the six for CONTRACTOR's use.
7. CONTRACTOR shall furnish a minimum of 6 copies of submittals. All copies will be retained by ENGINEER.

END OF SECTION

SECTION 01650
EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 GENERAL

- A. Equipment testing and startup are required for satisfactory completion of the contract and, therefore, shall be completed within the contract time.

1.02 EQUIPMENT TESTING

- A. Start-up is a highly complex operation requiring the combined technical expertise of the Contractor, manufacturers, subcontractor, the CITY and the ENGINEER. Coordinate all parties necessary for the successful facility startup.
- B. Contractor is responsible for the complete test, check out, start-up, and commissioning of all elements of the project. Verify these activities through daily inspection reports, test records, on-site vendor certifications, and by other appropriate means. The test and start-up requirements below are complementary to those indicated elsewhere in the Contract Documents.
1. Component test and check out is the verification that each component of the Work is in compliance with the Contract Documents and is ready to perform its intended function.
 2. Sub-system test and start-up is the verification that a discrete group of related components is functioning as intended within itself and is ready to perform its intended function in the overall system.
 3. System end to end test and start-up is the operation and verification that all related components and sub-systems are functioning as intended and are ready for final commissioning and operation.
 4. Commissioning is placing a complete system or project into service.
- C. Conduct all tests, check out, and start-up requirements indicated in the Contract Documents and provide documentation of same to the CITY prior to commissioning. Where vendor on-site inspections are required prior to or during start-up, require vendor to provide a written statement that the installation and check out is complete and proper and that the item(s) are ready for start-up and/or commissioning.
- D. It is not the intent of the ENGINEER to instruct or support the Contractor in the start-up..
- E. The Contractor shall be on-site during the first 7 days following the initial start-up. The intent of the 7-day monitoring period is to demonstrate that each and all of the components and systems that have been constructed and installed function individually and collectively in accordance with the Contract Documents. During the monitoring period, The Contractor shall perform a 7-day test on the well site equipment at a daily operating interval as directed by the CITY. The Contractor shall coordinate with the Community for the disposal location of the well test water. The Contractor is responsible for insuring that the well test water exits the site as directed by the Community. After the test water leaves the site, the Contractor is still responsible for its impacts and effects.
- F. The 7-day monitoring period shall demonstrate the ability of the entire facility to operate continuously for 7 days without failure. In the event of a failure of any of the facility components, the cause of the failure shall be determined and repaired, and the 7-day monitoring period shall be restarted from time zero.

1. The Contractor shall prepare a plan that details the operating procedures during the 7-day monitoring period. The Contractor shall provide adequate personnel needed to operate and monitor all components to be evaluated during this time. The plan shall identify all personnel needed to complete the 7-day monitoring period and shall identify the shift that each person will work during the operation of the facility.
 2. As part of the plan for the 7-day monitoring period, the Contractor shall define, subject to the CITY's approval, what will constitute a failing operation. At a minimum, an operation shall be considered to have failed if any of the following events occur at any time during the 7-day functional test.
 - a. Failure of a pumping unit or motor
 - b. Performance of a pumping unit (including pump and motor) outside of its specified acceptable ranges for vibration, noise, temperature, cavitation, efficiency, and capacity.
 - c. A failure of any ancillary component system that cannot be returned to service within 30 minutes of failure.
 - d. Three failures of an ancillary component or system regardless of the amount of time it takes to return it to service and regardless of whether or not the failures are due to the same cause.
 - e. Three failures of equipment of the same model, regardless of the amount of time it takes to return each to service and regardless of whether or not the failures are due to the same cause.
 3. During the 7-day monitoring period, it shall not be acceptable to bypass, deactivate, or in any way disable a protective device, alarm, or control to facilitate the completion of the test.
 4. The pump shall be run under automatic control during the 7-day monitoring period to verify the ability to operate as required by the Contract Documents provided that the communications system is available.
 5. The Contractor shall have adequate staff on site to monitor the facility and shall make factory Personnel available to assist in resolving problems as needed at no additional cost to the OWNER.
 6. Readings shall be taken every hour of the 7-day monitoring period to record equipment operation, operating speeds, flow rates, temperature of equipment components, system pressures, operating voltage, current, power draw of each operating unit, and any problems encountered during the previous hour. The readings shall be supplied to the CITY each morning for the previous day's run for evaluation and acceptance of the preceding day as being satisfactorily completed for the 7-day monitoring period.
- G. Not less than one month prior to start-up, submit to the CITY for review, a detailed schedule of operations which will be necessary to effect a successful initial operation and sustained period of operation for the duration of the required start-up period.

- H. Furnish operating personnel for the duration of the start-up. Additionally, furnish all water, power, chemicals, and other consumables required for the monitoring period.
- I. The startup shall not be commenced until all required leakage tests, equipment tests, control system, and end to end tests have been completed to the satisfaction of the CITY.
- J. All defects in materials or workmanship which appear during this monitoring period shall be immediately corrected by the Contractor. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the start-up may, at the discretion of the CITY, be justifiable cause for extending the start-up monitoring duration.
- K. During the start-up, furnish the services of authorized representatives of the manufacturers, in addition to those services required under operations testing, as necessary, to correct faulty equipment operations.
- L. During the start-up, keep records of the operations in accordance with the instructions of the CITY.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01651
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section covers requirements by the CONTRACTOR to test and demonstrate items of equipment and systems installed under this contract that all items are in proper operational mode. All systems shall be tested and demonstrated to work collectively as a unit and as intended by the design ENGINEER. All testing and demonstration shall be done prior to substantial completion and ENGINEER's approval of substantial completion status. Conduct testing and operation demonstrations on following systems. The order of testing shall be established by the CONTRACTOR and shown on project schedule:

1. System 1 – Well Piping
 - a. Pump startup and shutdown.
 - b. Controls, instrumentation and communication.
 - c. Flow metering.
 - d. Valve system including check valve, isolation valves, control valves, and waste valves.

2. System 2 – Electrical Power/ Instrumentation/ SCADA System
 - a. Well site facilities.
 - b. Coordinate with the existing Water Supply Facility.

B. Installation Services:

1. Installation services are required for all mechanical and electronic equipment. Provide competent and experienced technical representatives of manufacturers of material or equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.
2. After equipment is installed, representatives shall perform initial equipment and system adjustment break in, and calibration to conform to Specifications and manufacturer's requirements and instructions. Verify that equipment is installed according to manufacturer's requirements and meet warranty/guarantee stipulations. CONTRACTOR shall be responsible for arranging and documenting installation services and approval of installation by the representative.
3. Provide "Certificate of Installation Services" stating proper adjustments have been made to equipment or system and equipment or system is ready for startup and system demonstration.

C. Coordination:

1. Designate representative of CONTRACTOR to be responsible for testing and operation demonstration of systems.
2. CONTRACTOR shall submit schedule of systems testing and operation demonstrations for review by ENGINEER and OWNER 10 days prior to system tests and demonstrations.
3. Notify ENGINEER at least 5 days before tests and system operation demonstrations are to begin so ENGINEER can make arrangements with OWNER to witness testing and demonstration.
4. Reschedule cancelled tests and operation demonstrations 3 days in advance.

1.02 SUBMITTALS

A. Operation and Maintenance (O&M) Data:

1. CONTRACTOR shall provide complete O&M information to ENGINEER prior to start of testing and demonstration. Demonstration procedures shall be the same as "step-by-step" procedures submitted by the CONTRACTOR as part of O&M Information. Any deviation from O&M procedures shall be sufficient reason for ENGINEER to terminate further demonstration until O&M procedures are compiled and/or revised.

B. Reports:

1. Testing of Components and Systems.
 - a. Prepare report for each system on results and activities encompassing testing as required by this section. Submit report within 2 days of completion of tests. All test report shall be verified by the ENGINEER.
 - b. As minimum, report shall describe findings of inspections; revisions, modifications or replacement of equipment; calibrations; test results; dates and names of persons involved and observing inspections, testing, and other activities pertaining to components and systems; and statement regarding operational condition of components and systems.
2. Total System Functional Operation Demonstration.
 - a. Prepare report for each system on results of activities encompassing operation demonstration as required by this section. Submit report within 2 days of completion of 30 days demonstration.
 - b. Report shall describe operational conditions; daily results of systems operation; dates and names of persons involved and observing operation; and statement regarding system ability to meet operational criteria. Report shall be verified by ENGINEER.

C. Submit in accordance with Section 01640.

PART 2 PRODUCTS

A. Instruction Program:

1. Program structure: Develop an instruction program that includes individual training sessions for each system and equipment not part of a system, as required by individual Specification Section, and as follows:
 - a. Pump.
 - b. Valves.
 - c. Motor Control Center.
 - d. Drywell.
 - e. Generator

B. Develop a learning objective and teaching outline for each session. Include a description of specific skills and knowledge that participant is expected to learn. For each session, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following as applicable:
 - a. System, subsystem, and equipment descriptions.

- b. Operating standards.
 - c. Regulatory requirements.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Shutdown instructions for each type of emergency.
 - c. Operating instructions for conditions outside of normal operating limits.
 - d. Sequences for electric or electronic systems.
 - e. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Normal shutdown instructions.
 - h. Operating procedures for emergencies.
 - i. Operating procedures for system, subsystem, or equipment failure.
 - j. Seasonal and weekend operating instructions.
 - k. Required sequences for electric or electronic systems.
 - l. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.

- b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Dissassembly; Component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 EXECUTION

3.01 TESTING OF COMPONENTS & SYSTEM

- A. Subject each system, process, mechanical, instrumentation, and electrical equipment components, including related piping tests and control systems, to individual inspection and testing by CONTRACTOR and certified by CONTRACTOR to be ready for operations before beginning system operation demonstration.
- B. Inspection and tests shall be made to determine if equipment is properly assembled, aligned, adjusted, calibrated, wired or connected. Changes, adjustments or replacements of equipment due to errors or omissions on part of CONTRACTOR, or otherwise necessary to comply with requirements of Contract Documents shall be done without additional cost to OWNER.
- C. Complete training required. Minimum training requirements are specified in equipment specifications sections. For equipment and instrumentation that do not have a stipulated minimum training requirement, CONTRACTOR shall provide a minimum of 1 hour instructional session.
- D. Training shall be covered in two half day sessions, which must be documented and recorded by the CONTRACTOR.
- E. Training certificates for each attendee are to be provided, documenting time, date, hours of training, and major topics covered.
- F. Complete process control system testing, 7 calendar days before testing and demonstration.
- G. Complete testing of remote I/O communication 14 days before system operation demonstration.

3.02 SYSTEM OPERATION DEMONSTRATION

- A. Upon completion of inspection and testing of individual components in each system, demonstrate operation and performance of each system for 30 days in accordance with requirements of Contract Documents.
 - 1. Where no specific performance requirements are stated in Specifications, demonstrate to show equipment operates in accordance with acceptable industry standards for application of equipment.
 - 2. System operation demonstration shall show equipment operates within manufacturer's tolerances for noise and vibration, equipment is responsive to manual and automatic

- controls, control and protective devices are properly set, and equipment runs on controlled or intermittent basis when such operation is intended.
3. System operation demonstration shall include checkout from each remote control point. Demonstrate alarm and safety lockout systems for proper function and process instrumentation and control.
 4. Use clean water for all demonstration.
 5. CONTRACTOR shall provide all chemicals and materials required for demonstration.
- B. During testing and system operation demonstration, CONTRACTOR shall arrange for presence of qualified representatives of Suppliers of each piece of equipment and instrumentation included in system necessary to conduct test and demonstration. Representatives shall be present at total system startup; as needed during the test periods; and at end of test period.
- C. Temporary facilities and services are CONTRACTOR's responsibility. Electrical power for equipment inside existing buildings and/or structure will be supplied by CONTRACTOR. CONTRACTOR shall provide temporary connections if necessary. If bypass pumping and/or other operation is required, CONTRACTOR shall provide piping, pumping, power, etc. at no additional cost to the OWNER.
- D. Successful completion of system demonstration for each system will be when performance requirements established in Contract Documents are met while running for 30 consecutive days of normal operation conditions.
- E. If during demonstration system is not meeting performance requirements established in Contract Documents, CONTRACTOR shall stop demonstration, adjust, calibrate or replace equipment or instrumentation and re-start and run demonstration until 30 consecutive days have been completed.

3.03 DETERMINATION OF SUBSTANTIAL COMPLETION

- A. Substantial completion of Work as described in this section.
1. Upon successful completion of testing of system components and system, system operation demonstrations, and delivery of submittals specified in this section, CONTRACTOR shall notify OWNER and ENGINEER in writing that components and system are substantially complete.
 2. Retainage, if used, will not be reduced at substantial completion of components and system.
 3. Substantial completion of system will not entitle CONTRACTOR reduction or elimination of liquidated damages.
 4. CONTRACTOR shall complete all punchlist items prior to acceptance of Work and issuance of Final Completion.

END OF SECTION

SECTION 01900
CONSTRUCTION SURVEYING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall provide the survey services required to stake line and grades for the proposed improvements.
1. Stake Property Controls – hubs will be set at all property corners if requested by the City.
 2. Stake Pregrade:
 - a. Pad stakes - hubs marked cut/fill will be set at 5' blowup for all pads
 - b. Pad Bluetops – one bluetop stake per pad will be set approximately centered.
 - c. Gradebreaks - hubs marked cut/fill will be set at spot shots along grade breaks.
 3. Retention basins will be staked every 25' along the top of slope, marked to top and toe of slope and at horizontal bends or corners.
 4. Stake Water:
 - a. Mark centerline at all fittings and deflections
 - b. Waterline 25' on center
 5. Stake Concrete Equipment Slabs at 5' blow up from corners, marked cut/fill to top of slab
 6. Stake Perimeter Walls:
 - a. Perimeter walls will be offset at each wall feature including drainage openings.

PART 2 - EXECUTION

2.1 CONSTRUCTION STAKING

- A. The Contractor shall verify the depth, location and size of existing utilities and other work identified by Blue Staking, that is evident from surface features, or shown on the plans. Contractor shall call Blue Stake before any work is performed.
- B. The Contractor shall provide the survey services required to stake line and grades for the proposed improvements once. Any stakes or hubs lost shall be replaced at the Contractor's expense.

END OF SECTION 01900

SECTION 01901
PROJECT RECORD DRAWINGS

PART 1 GENERAL

1.01 SUMMARY

A. Maintain at site one record copy of:

1. Drawings and Specifications.
2. Project Manual and ENGINEER's design information.
3. Addenda.
4. Change orders, written amendments, Work change directives, and other modifications to Contract.
5. ENGINEER field orders, written instructions, or clarifications.
6. Approved submittals.
7. Field test records.
8. Construction photographs.
9. Associated permits.
10. Certificates of inspection and approvals.
11. Conformed drawings.
12. Project Schedule.
13. Contact person and emergency telephone number listing.

1.02 SUBMITTALS

A. At Substantial Completion:

1. Prepare one set of "As-Built" Drawings using AutoCAD. Submit for review by ENGINEER, OWNER, and CITY.
2. CONTRACTOR shall address all comments and prepare a revised set of "As-Built" Drawings. This process shall continue until ENGINEER, OWNER, and CITY is satisfied that the Drawings are complete and correct.
3. Once the ENGINEER, OWNER, and CITY have accepted the "As-Built" Drawings the completed set shall be sealed by the Contractor's Registered Land Surveyor (RLS).
4. Two (2) full size sets, six (6) half size sets, six (6) CDs in PDF format, and three (3) CDs in AutoCAD format of Final "As-Built" shall be submitted to ENGINEER, OWNER, and CITY.

B. Accompany submittals with transmittal letter containing following.

1. Date.
2. Project title and number.
3. CONTRACTOR's name and address.
4. Title of record document.
5. Company seal and signature of CONTRACTOR or authorized representative.

PART 2 PRODUCTS

2.01 Working Plans

- A. The Contractor shall exercise extreme care in handling the originals. In the event the originals are damaged or determined by the ENGINEER or OWNER to be unacceptable, the Contractor shall replace the originals by having new drawings produced. All costs incurred as the result of replacing the originals shall be borne by the Contractor. The ENGINEER and OWNER will be the

sole judge in determining whether the working plans are acceptable.

- B. The Contractor will provide the OWNER and ENGINEER with the working plans for review prior to preparing final as-builts. Information shall be shown on these plans in red opaque ink, depicting the constructed dimensions, elevation, grades and materials including locations of existing underground utilities found during construction.

PART 3 EXECUTION

3.01 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in CONTRACTOR's office or at designated location apart from documents used for construction. Designated location office shall be less than 30 miles from project site.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide secure storage space for storage of samples.
- B. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes. Redline all drawings. Changes made to a detail or drawing shall be redlined in all other views, P&ID, electrical, etc.
- C. Make documents and samples available for inspection by ENGINEER.
- D. Failure to properly maintain record documents may be reason to delay a portion of progress payments until records comply with Contract Documents.

3.02 RECORD DOCUMENTS

- A. Label each document "PROJECT RECORD" in neat, large printed letters.
- B. Maintain record set of Drawings and Specifications legibly annotated to show all changes that are made during construction.
 - 1. Graphically depict changes by modifying or adding to plans, details, sections, elevations, specifications, or schedules.
 - 2. Make changes on each sheet affected by changes.
- C. Record information concurrently with construction progress.
 - 1. Do not conceal Work until required information is recorded and verified by OWNER or ENGINEER.
 - 2. Record changes made by Written Amendment, Field Order, Change Order, Work Directive Change, or addition by others and/or OWNER.
- D. Drawings:
 - 1. General:
 - a. Depths of various elements of foundation in relation to catch basin rim.
 - b. Depths of all underground utilities, including utilities not shown on plans.
 - c. Horizontal and vertical locations of underground utilities, corners, and appurtenances, referenced to permanent surface improvements.
 - d. Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

- e. Field changes.
 - f. Details not on original Drawings.
 - g. Location and identification of exposed interior piping, including those shown schematically on Drawings.
 - h. Size of equipment and location including connections.
2. Specifications:
- a. Mark Specification sections: to show substantial variations in actual Work performed in comparison with test of Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation.
 - b. Note related record drawing information and Product Data.
3. Electrical and Instrumentation:
- a. Horizontal and vertical locations and size of underground cable and conduit run dimensioned from established building lines.
 - b. Plan location and size of interior concealed and exposed feeders.
 - c. Size and location of access panels.
 - d. Departures from original Drawings and electrical work revisions.

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Earth and borrow excavation.
- B. Site preparation.
- C. Field quality control.
- D. Finish grading and protection.

1.02 MATERIAL OWNERSHIP

- A. Except for materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.03 SUBMITTALS

- A. Photographs or videotapes, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction and site improvements that might be misconstrued as damage caused by site clearing. If the Owner believes that the Contractor damaged an existing improvement and the Contractor does not have preconstruction photos of that improvement, it will be the Contractor's responsibility to restore or replace the improvement to the City's satisfaction. This term applies to the entire site and its surrounding streets and landscaping areas.

1.04 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks and other adjacent occupied or used facilities during site-clearing operations. Follow specifications in Section 01501.
 - 1. Do not close or obstruct streets, walks or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 PRODUCTS

2.02 BORROW MATERIAL

- A. Borrow materials shall be free from debris, roots, organic, or other unstable or unsuitable materials.

PART 3 EXECUTION

3.01 EARTH EXCAVATION

- A. Grading shall consist of excavation, removal and satisfactory disposal of excess excavated materials taken from within Project area, construction of backfill, subgrades, ditches, and

incidental work; and removal and satisfactory disposal of unstable and unsuitable materials and their replacement with satisfactory materials where needed.

- B. Remove unstable material encountered and replace with suitable material.
- C. Unstable material shall not to be used under structures or drive areas.
- D. The Contractor shall be responsible for disposing of all excess spoils off site.

3.02 BACKFILL CONSTRUCTION

A. Preparation of surfaced to receive fill:

1. After stripping of organic material or foreign matter, proof-roll areas to receive fill by making three passes with a roller.
2. If unsuitable or unstable material in encountered under fill area, remove material and replace with suitable material prior to placing material.

B. Moisture control:

1. Moisture content of embankment materials prior to, and during compaction shall be uniform throughout each layer of material.
2. Place earth materials at or within 2% of optimum moisture content as determined by ASTM D698; wet granular materials thoroughly during or immediately prior to compaction.
3. Add supplementary water to materials on fill by sprinkling and missing uniformly throughout layer as required.
4. Spread temporarily excavated materials too wet for placing until moisture content is acceptable.

C. Placing:

1. Place backfill materials in manner permitting drainage, and in continuous, approximately horizontal layers, not exceeding 8" loose thickness.
2. Avoid abrupt changes in backfill levels.
3. If surface of previously placed materials is too dry or smooth to provide satisfactory bonding surface with new material, moisten and/or scarify in manner and to depths required to avoid shear plane.
4. If compacted surface of any layer of fill is too wet for proper compaction of next succeeding layer to be placed:
 - a. Allow materials to dry or work with suitable equipment
 - b. Compact to provide satisfactory bonding surface for next succeeding layer of fill to be placed.
5. When each layer of material has been conditioned to moisture content specified, compact as follows:
 - a. Compact backfill to minimum of 95% of maximum dry density as determined by ASTM D698.

- D. Grade areas disturbed by construction operation to smooth, uniformly sloping surfaces.

3.03 BORROW EXCAVATION

- A. Borrow excavation shall consist of excavating, transporting, and placing of earth materials obtained from location furnished by CONTRACTOR necessary for construction of subgrades and other parts of work.
- B. CONTRACTOR shall furnish and pay for borrow sites, or other sources of borrow, and obtain from property owners necessary agreements for removal of excavated material. Borrow material shall have a Standard Dry Density of not less than 95 lb/cu. ft. when tested in accordance with AASHTO T99 and shall not possess and organic content greater than 10% when tested in accordance with AASHTO T194.

3.04 SITE PREPARATION

- A. Prepare the ground surface in fill areas and cut areas to grade by scarifying, moisture conditioning and compacting the exposed surface soil to a depth acceptable to the City.
- B. Moisture condition and place all fill and backfill material required to achieve specified grades. Fill materials should be moisture conditioned, placed and compacted in horizontal lifts of thicknesses compatible with the compaction equipment being used.

3.05 FIELD QUALITY CONTROL

- A. Moisture-density laboratory tests: Minimum of one test on each type of soil to be used in embankment construction; conform to ASTM D698. Perform tests prior to placement of embankment materials.
- B. In-place density tests for backfill: Perform tests on structures, areas that will surround vehicles, and trench backfill during course of work on subgrade for each successive 8" lift conforming to ASTM D1556 or ASTM D2922.

3.06 FINISH GRADING

- A. Finish fill, excavated areas, and other disturbed areas to uniform grade and section normally obtainable with blade grader.
- B. Allowable template tolerances: +0.10'.
- C. Finish grade to neat appearance and to provide positive drainage.

3.07 PROTECTION

- A. Water shall be used as controlling agent to prevent operations from polluting air with dust in accordance with County permit acquired by the Contractor.
- B. Regulations as set forth by OSHA and other jurisdictional agencies shall govern.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals required to perform all excavating, backfilling, testing, filling and grading, and disposing of earth materials as shown, specified, and required for construction of structures, conduits, pipelines, drive surfaces, and other facilities required to complete the Work in every respect.
2. All necessary preparation of subgrade for slabs and foundations is included in this Section.
3. All temporary means needed to prevent discharge of sediment to water courses from dewatering systems or erosion are included in this Section.
4. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.
5. CONTRACTOR shall perform all earthwork as specified in this Section.
6. CONTRACTOR shall conform to the requirements of City of Buckeye for regrading, grading, erosion and sediment control.
7. Finished grade shall match the surrounding existing grades as approved by the Owner.

B. Related Sections:

1. Section 01410, Testing Laboratory Services.
2. Section 02050, Demolition, Removal and Disposal.
3. Section 02110, Clearing and Grubbing
4. Section 02230, Crushed Stone and Gravel.
5. Section 15051, Buried Pipe Installation.
6. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Standard Specification and Details:

1. CONTRACTOR shall conform to all applicable requirements of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG).

B. Testing Services:

1. General: Testing of materials, testing for moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of the Specifications shall be performed by a testing laboratory.
2. CONTRACTOR'S Testing Agency Scope:
 - a. Test CONTRACTOR'S proposed materials in the laboratory and field for compliance with the Specifications.
 - b. Perform field moisture content and density tests to assure that the specified compaction of backfill materials has been obtained.
 - c. Report all test results to the OWNER and CONTRACTOR.
3. Authority and Duties of CONTRACTOR'S Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field and perform tests and shall report their findings to the OWNER and CONTRACTOR. When the materials furnished or Work performed fails to fulfill Specification requirements, the technician will direct the attention of the OWNER and CONTRACTOR to such failure.
 - a. The technician shall not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect any defective Work or

materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the OWNER for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Contract Documents, nor to approve or accept any portion of the Work.

4. Responsibilities and Duties of CONTRACTOR:
 - a. The use of testing services shall in no way relieve CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
 - b. To facilitate testing services, CONTRACTOR shall:
 - 1) Secure and deliver to the testing agency, preliminary representative samples of the materials he proposes to use and are required to be tested.
 - 2) Furnish such casual labor as is necessary to obtain and handle samples at the Work site or at other sources of material.
 - 3) Advise the OWNER and testing agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
 - c. CONTRACTOR'S Testing Service shall inspect and approve subgrades and fill layers before further construction Work is performed thereon.
 - d. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by confirmation tests to verify and confirm that he has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
 - e. The frequency of CONTRACTOR'S confirmation tests shall be not less than as follows; each test location for trenches shall include tests for each layer, type, or class of backfill from bedding to finish grade.
 - 1) For trenches:
 - a) In open fields: 2 locations every 1,000 linear feet. A minimum on 2 locations will be tested per trench for all piping and conduit.
 - b) Along dirt or gravel roads or off traveled right-of-way: 2 locations every 500 linear feet. A minimum on 2 locations will be tested per road or drive.
 - c) Crossing paved or unpaved roads: 2 locations along each crossing.
 - d) Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.
 - 2) For structural backfill: 1 every 20 cubic yards. A minimum of 1 test will be performed within any backfill area.
 - 3) In embankment or fill: 1 every 200 cubic yards. A minimum of 1 test will be performed within any fill area.
 - 4) Base material: 1 every 50 cubic yards. A minimum of 1 test will be performed in any site.
 - f. Copies of the test reports shall be submitted promptly to the OWNER. CONTRACTOR'S tests shall be performed by a soils testing laboratory acceptable to the OWNER. The CONTRACTOR shall submit the testing agency's qualifications to the OWNER for approval at the construction kick-off meeting.
 - g. CONTRACTOR shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
 - 1) 200 linear feet of trench backfill.
 - 2) 10 cubic yards of structural backfill.
 - 3) 10 cubic yards of embankment work.
 - 4) 10 cubic yards of base material.
 - h. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
 - i. Periodic compliance tests may be made by the OWNER to verify that compaction is meeting the requirements previously specified at no cost to CONTRACTOR. CONTRACTOR shall remove the overburden above the level at which the OWNER wishes to test and shall backfill and recompact the excavation after the test is complete.
 - j. If compaction fails to meet the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or shall bring the density up to specified level by

other means acceptable to the OWNER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR'S confirmation tests shall be performed in a manner acceptable to the OWNER. Frequency of confirmation tests for remedial Work shall be double that amount specified for initial confirmation tests.

C. Permits and Regulations:

1. Obtain all necessary permits for Work. Also obtain permits as required by local, state and federal agencies for discharging water from excavations.
2. Perform excavation Work in compliance with applicable requirements of governing authorities having jurisdiction.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM A36, Specification for Structural Steel.
2. ASTM A328, Specification for Steel Sheet Piling.
3. ASTM D422, Method for Particle-Size Analysis of Soils.
4. ASTM D423, Liquid Limit of Soils.
5. ASTM D427, Shrinkage Factors of Soils.
6. ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil.
7. ASTM D 1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
8. ASTM D2922, Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
9. AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.
10. OSHA Standard, Title 29, Code of Federal Regulations, Part 1926, Section .650 (Subpart P - Excavations).
11. ASTM D2166, unconfined compressive strength of soils.

1.3 SUBMITTAL

A. Excavation Plan: Prior to start of excavation operations, submit written plan to demonstrate compliance with OSHA Standard 29 CFR Part 1926.650. As a minimum, excavation plan shall include:

1. Name of competent person.
2. Excavation method(s) or protective system(s) to be used.
3. Copies of "manufacturer's data" or other tabulated data if protective system(s) are designed on the basis of such data.

B. CONTRACTOR shall prepare drawings for the following items:

1. Sheeting and bracing, or other protective system(s).
2. Dewatering system.
3. Underpinning.

C. Drawings and calculations shall be prepared by a Registered Professional Engineer licensed in the State of Arizona and recognized as expert in the specialty involved. Drawings and calculations shall be submitted to OWNER for record purposes only. Drawing and calculation submittal will not be checked and will not imply approval by OWNER of the Work involved. CONTRACTOR shall be solely responsible for designing, installing, operating and maintaining whatever system is necessary to satisfactorily accomplish all necessary sheeting, bracing, protection, underpinning and dewatering.

D. Test Reports - Borrow, Backfill, and Grading:

1. Testing laboratory shall submit copies of the following reports directly to OWNER, with one copy to CONTRACTOR:
 - a. Tests on borrow material.

- b. Tests on footing subgrade.
 - c. Field density tests.
 - d. Optimum moisture - maximum density curve for each soil used for backfill.
 - e. Reports of observations for conformance of borrow material to the Project Geotechnical Report.
- E. Samples of all materials, including select backfill, general backfill, granular embedment, crushed stone, and sand shall be submitted to the OWNER and the testing service. Samples of the proposed material shall be submitted at least fourteen (14) days in advance of its anticipated use.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Backfill and Fill Materials - Walls, Foundations and Piping:
1. Materials acceptable for use as backfill against walls, foundations and above piping shall be stockpiled native sandy or granular soils obtained from onsite excavations and which are uniformly mixed, contain no organic matter, nor contain rocks or fragments greater than 3-inches in size, nor have greater than 40 percent passing the 200 sieve. The maximum expansion of off-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D 698 at 2-percent below optimum moisture content under a 100 psi surcharge pressure.
 2. Backfill and fill materials from off-site sources shall consist of silty or clayey sand soils which are uniformly mixed, contain no organic matter and which have a Plasticity Index less than ten (10). The maximum particle size of imported soils shall be 4-inches or less, if required to satisfy trenching, landscaping, or other requirements. The maximum expansion of off-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D 698 at 2 percent below optimum moisture content under a 100 psi surcharge pressure.
 3. All materials for use as backfill and fill material shall be tested by the CONTRACTOR'S laboratory and approved by the OWNER.
 4. If on-site material is unsuitable as determined by the CONTRACTOR'S testing agency and/or OWNER, select backfill or approved off-site fill shall be used.
 5. Fill adjacent to structures is classified as backfill to a distance measured horizontally from the structure that is equal to the depth from the finished grade. Outside these limits the fill is classified as embankments, unless otherwise specified.
- B. Select Backfill: Select Backfill for use beneath concrete slabs and asphaltic pavements shall be well graded sand and gravel materials conforming to the requirements of Aggregate Base Course (ABC) as specified in Section 702 of the MAG Specifications.
- C. Embankments:
1. Fill materials for use as embankments, as fill under drive areas, and as miscellaneous landscaping materials exterior to plant facilities, shall consist of soils obtained from on-site excavations or off-site sources which are uniformly mixed, contain no organic material, rocks or fragments greater than 3-inches in size.
 2. All materials for use as described above shall be tested by the CONTRACTOR'S laboratory and approved by the OWNER.
- E. Sand:
1. Sand for use as embedment material around plastic pipes shall consist of natural or manufactured granular material.

2. Sand material shall contain no organic material. Sand shall be nonplastic, when tested in accordance with ASTM D 4318, 100 percent shall pass a ½-inch screen and no more than 20 percent shall pass a No. 200 screen.
3. The sand shall be deposited in uniform layers not to exceed 6-inches in uncompacted thickness. The backfill shall be compacted to not less than 95 percent of laboratory maximum density as determined by ASTM D 698.
4. All material for sand must be tested by the CONTRACTOR'S laboratory and approved by the OWNER.
5. No sand shall be placed without the approval of the OWNER.

F. Granular Embedment:

1. Granular embedment material shall be well graded sand and gravel materials and shall conform to the requirements of MAG Specification Section 702, Aggregate Base.

G. Controlled Low Strength Material (CLSM):

1. CLSM shall consist of a mixture of Portland cement, aggregate, fly ash, water and approved admixtures conforming to the following requirements:
 - a. Portland Cement: ASTM C150, Type V, 94 lbs minimum per cubic yard.
 - 1) Aggregate: Clean imported sand and gravel or selected material from the excavation, imported material, or a combination thereof as approved by the OWNER. Maximum aggregate size shall be 1-inch. The soluble sulfate content of the aggregate in the mixture shall not exceed 0.3 percent by dry weight.
 - 2) Water: Potable quality.
 - 3) Fly Ash: Class C, ASTM C618, or approved by OWNER.
 - 4) The minus 200 sieve fraction shall be nonplastic, as defined by ASTM D4318.
 - a. Proportion the CLSM to be flowable, nonsegregating, self-consolidating low shrink slurry. The CONTRACTOR shall determine the materials and proportions used to meet the requirements of the Specifications.
 - b. The unconfined compressive strength at 28 days shall be a minimum of 100 psi and a maximum of 300 psi.
 - c. The temperature of the CLSM discharged into the trench shall be below 85-degrees F.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Provide OWNER with sufficient notice and with means to examine the areas and conditions under which excavating, filling, and grading are to be performed. OWNER will notify CONTRACTOR if conditions are found that may be detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to OWNER.

3.2 TEST PITS

- A. General: CONTRACTOR shall excavate and backfill, in advance of the construction, test pits to determine conditions or location of the existing utilities and structures. CONTRACTOR shall perform all Work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, backfilling and replacing pavement for the test pits.
 1. CONTRACTOR shall be responsible for the definite location of each existing facility involved within the area of his excavation for Work under this Contract. Care shall be exercised during such location work to avoid damaging and disrupting the affected facility. CONTRACTOR shall be responsible for repairing, at his sole expense, damage to any structure, piping, or utility caused by his Work.

3.3 EXCAVATION

- A. Perform all excavation required to complete the Work as shown, specified and required. Excavations shall include earth, sand, clay, gravel, hardpan, boulders, rock, pavements, rubbish and all other materials within the excavation limits.
- B. Excavations for structures and pipelines shall be open excavations. Provide excavation protection systems required by ordinances, codes, law and regulations to prevent injury to workmen and to prevent damage to new and existing structures or pipelines.
- C. Where the structure or pipeline is to be placed below the ground water table, well points, cofferdams or other, acceptable methods shall be used to permit construction of said structure or pipeline under dry conditions. Dry conditions shall prevail until concrete has reached sufficient strength to withstand earth and hydrostatic loads and until the pipelines are properly jointed, tested and backfilled. In addition, protect excavation from flooding until all walls and floor framing up to and including grade level floors are in place and backfilling has begun. Water level shall be maintained below top of backfill at all times.
- D. Pumping of water from excavations shall be done in such a manner to prevent the carrying away of unsolidified concrete materials and to prevent damage to the existing subgrade.
- E. The elevation of the bottom of footings shown shall be considered as approximate only and OWNER may order such changes in dimensions and elevations as may be required to secure a satisfactory footing. All structure excavations shall be hand-trimmed to permit the placing of full widths and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.
- F. When excavations are made below the required grades, without the written order of OWNER, they shall be backfilled with compacted select fill or concrete, as directed by OWNER, at the sole expense of CONTRACTOR.
- G. Excavations shall be extended sufficiently on each side of structures, footings, etc., to permit setting of forms, installation of shoring or bracing or the safe sloping of banks.
- H. Subgrades for drive areas, roadways, structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with select fill. The finished elevation of stabilized subgrades shall not be above subgrade elevations shown.
- I. Pipe Trench Preparation:
 - 1. No more than 100 feet of trench may be opened in advance of pipe laying.
 - 2. Trench width shall be minimized to greatest extent practical but shall conform to the following:
 - a. Sufficient to provide room for installing, jointing and inspecting piping, but in no case wider at top of pipe than pipe barrel outside diameter plus 3 feet.
 - b. Enlargements at pipe joints may be made, if required, and approved by OWNER.
 - c. Sufficient for shoring and bracing, or shielding and dewatering.
 - d. Sufficient to allow thorough compaction of backfill adjacent to bottom half of pipe.
 - e. Do not use excavating equipment that requires the trench to be excavated to excessive width.
 - 3. Depth of trench shall be as shown or directed by the OWNER. If required and approved by OWNER, depths may be revised.
- J. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations.

2. Dispose of excess soil material and waste materials as specified hereinafter.
3. Stockpiled excavated soils for use as subsequent fill shall be classified by laboratory as on-site granular or sandy soils. Use and placement of fill shall be performed as specified for each class.
4. Excess soil from excavations shall be disposed of off-site. Disposal shall be in accordance with state and local regulatory requirements.

K. Where OWNER considers the existing material beneath the bedding material unsuitable, CONTRACTOR shall remove same and replace it with select backfill.

3.4 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown, and which is not approved by OWNER, together with the removal and disposal of the associated material shall be at CONTRACTOR'S expense. Unauthorized excavations shall be filled and compacted with select backfill by CONTRACTOR at his sole expense.

3.5 EROSION CONTROL AND DEWATERING

A. Erosion Control:

1. In general, the construction procedures outlined herein shall be implemented to assure minimum damage to the environment during construction. CONTRACTOR shall take any and all additional measures required to conform to the requirements of applicable codes and regulations.
2. Whenever possible, access and temporary roads shall be located and constructed to avoid environmental damage. Provisions shall be made to regulate drainage, avoid erosion and minimize damage to vegetation.
3. Where areas must be cleared for storage of materials or temporary structures, provisions shall be made for regulating drainage and controlling erosion, subject to the OWNER'S approval.
4. Temporary measures shall be applied to control erosion and to minimize the siltation of the existing waterways, and natural ponding areas. Such measures shall include, but are not limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains and other methods. These temporary measures shall be applied to erodible materials exposed by any activities associated with the construction of this Work.
 - a. Special care shall be taken to eliminate depressions that could serve as mosquito pools.
 - b. Temporary measures shall be coordinated with the construction of permanent drainage facilities and other Work to the extent practicable to assure economical, effective, and continuous erosion and siltation control.
 - c. CONTRACTOR shall provide special care in areas with steep slopes. Disturbance of vegetation shall be kept to a minimum to maintain stability.
5. Remove only those shrubs, grasses and cacti that must be removed for construction. Protect the remainder to preserve their erosion-control value.
6. Install erosion and sediment control practices where required and according to applicable standards, codes and specifications. The practices shall be maintained in effective working condition during construction and until the drainage area has been permanently stabilized.
7. Mulching to be used for temporary stabilization.
 - a. Suitable Materials for Mulching:
 - 1) Unrotted straw or salt hay - 1-1/2 to 2 tons/acre.
 - 2) Asphalt emulsion or cutback asphalt - 600 to 1200 gal./ acre.
 - 3) Wood-fiber or paper-fiber (hydroseeding) - 1500 lbs./ acre.
 - 4) Mulch netting (paper, jute, excelsior, cotton or plastic).
 - b. Straw or salt hay mulches should be immediately anchored using peg and twine netting or a mulch anchoring tool or liquid mulch binders.
8. After stabilization, remove all straw bale dikes, debris, etc., from the site.

9. In the event of any temporary Work stoppage, CONTRACTOR shall take steps any temporary or environmental damage to the area undergoing construction.
10. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, the OWNER reserves the right to employ outside assistance or to use its own forces to provide the corrective measures indicated. The cost of such work, plus engineering costs, will be deducted from monies due CONTRACTOR.
11. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on and off-site damage and health hazards. Control may be achieved by irrigation in which the site shall be sprinkled with water until the surface is moist. The process shall be repeated as needed.

B. Dewatering:

1. CONTRACTOR shall provide and maintain adequate dewatering equipment to remove and dispose of all surface water and ground water entering excavations, trenches, or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein is inspected by the OWNER and backfill operations have been completed and approved.
 - a. The different working areas on the site shall be kept free of surface water at all times. CONTRACTOR shall install drainage ditches and dikes and shall perform all pumping and other Work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations and fill areas. The diversion and removal of surface water shall be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.
 - b. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the water downstream of the point of discharge, shall not be directly discharged. Such waters shall be diverted through a settling basin or filter before being discharged.
 - c. CONTRACTOR will be held responsible for the condition of any pipe, conduit or channel used for drainage purposes and all such pipes, conduits or channels shall be left clean and free of sediment.

C. Disposal of Water Removed by Dewatering System:

1. Dispose of all water removed from the excavation in such a manner as not to endanger public health, property, or any portion of the Work under construction or completed.
2. Dispose of water in such a manner as to cause no inconvenience to OWNER, or others involved in Work about the site.
3. Convey water from the construction site in a closed conduit. Do not use trench excavations as temporary drainage ditches.
4. CONTRACTOR'S Dewatering System shall discharge to an appropriate location, in accordance with State and Federal regulations.

D. SWPPP: The Contract Price shall include all material, labor and other permits and incidental costs related to:

1. Preparing, updating and revising the Stormwater Construction Pollution Prevention Plan (SWPPP) and the AZPDES General Permit for Stormwater Discharge.
2. Installing and maintaining all structural and non-structural items chosen by CONTRACTOR to comply with the construction SWPPP.
3. Clean-up and disposal costs associated with clean-up and repair following storm events or CONTRACTOR caused spills on the Project.
4. Implementing and maintaining Best Management Practices to comply with the OWNER'S stormwater code.
5. Preparing the Notice of Intent and Notice of Termination.

3.6 SHEETING, SHORING AND BRACING

A. General:

1. Used material shall be in good condition, not damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary Work.
2. All timber used for breast boards (lagging) shall be new or used, meeting the requirements for Douglas Fir Dense Construction grade with a bending strength not less than 1500 psi or Southern Pine No. 2 Dense.
3. All steel Work for sheeting, shoring, bracing, cofferdams etc., shall be designed in accordance with the provisions of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the AISC, except that field welding will be permitted.
4. Steel sheet piling shall be manufactured from steel conforming to ASTM A 328. Steel for soldier piles, wales and braces shall be new or used and shall conform to ASTM A 36.
5. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
6. Unless otherwise shown, specified, or ordered, all materials used for temporary construction shall be removed when Work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent Work.
7. Provide permanent steel sheet piling as shown or required. Cut off tops, as required, but at least 3 feet below grade.
8. The clearances and types of the temporary structures, insofar as they affect the character of the finished Work and the design of sheeting to be left in place, shall be subject to the approval of OWNER; but CONTRACTOR shall be responsible for the adequacy of all sheeting, shoring, bracing, cofferdamming, etc.
9. Safe and satisfactory sheeting, shoring and bracing shall be the entire responsibility of CONTRACTOR.
10. All municipal, county, state and federal ordinances, codes, regulations and laws shall be observed.

B. Sheeting Left in Place:

1. Steel sheet piling shall not be left in place.

C. Removal of Sheeting and Bracing:

1. Remove sheeting and bracing from excavations, unless otherwise directed in writing by OWNER. Removal shall be done so as to not cause injury to the Work. Removal shall be equal on both sides of excavation to ensure that no unequal loads are placed on pipe or structure.
2. Defer removal of sheeting and bracing where removal may cause soil to come into contact with concrete until the following conditions are satisfied:
 - a. Concrete has cured a minimum of seven (7) days.
 - b. Wall and floor framing, up to and including, grade level floors are in place.

3.7 TRENCH SHIELDS

- A. Excavation of earth material below the bottom of a shield shall not exceed the limits established by ordinances, codes, laws and regulations.
- B. When using a shield for pipe installation:
 1. Any portion of the shield that extends below the mid-diameter of an installed rigid pipe (e.g., PCCP, etc.) shall be raised above this point prior to moving the shield ahead for the installation of the next length of pipe.
 2. The bottom of the shield shall not extend below the mid-diameter of installed flexible pipe (e.g., Steel, Ductile Iron, PVC, etc.) at any time.
- C. When using a shield for the installation of structures, the bottom of the shield shall not extend below the top of the bedding for the structures.

- D. When a shield is removed or moved ahead, extreme care shall be taken to prevent the movement of pipe or structures or the disturbance of the bedding for pipe or structures. Pipe or structures that are disturbed shall be removed and reinstalled as specified.

3.8 PLACEMENT OF FILL AND BACKFILL

A. General:

1. All select backfill and backfill required for structures and trenches and required to provide the finished grades shown and as described herein shall be furnished, placed and compacted by CONTRACTOR.
2. Backfill excavations as promptly as Work permits, but not until completion of the following:
 - a. Acceptance by the OWNER of construction below finish grade.
 - b. Inspection, testing, approval, and recording of locations of underground piping and ductwork.
 - c. Removal of concrete formwork.
 - d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
 - e. Removal of trash and debris.
 - f. Acceptance of hydraulic testing.
3. Fill containing organic materials or other unacceptable material shall be removed and replaced with approved fill material as specified.

B. Placement of Select Backfill, Backfill and Fill:

1. Select backfill shall be placed to the grades shown on the Drawings. The lift thickness and compaction moisture content range given herein are approximate. These values shall be finally determined from the laboratory test results on the fill materials.
2. All select backfill shall be placed in horizontal loose lifts, not exceeding 8-inches in thickness, and shall be mixed and spread in a manner assuring uniform lift thickness after placing. Each lift shall be compacted by appropriate mechanical methods to 95 percent relative compaction by ASTM D 6998 and at a relative moisture content above its optimum moisture. Select backfill shall be placed to the underside of all concrete slabs. The fill material shall extend a minimum of two feet horizontally beyond the foundation footprint.
3. Backfill and fill around and outside of structures and over select backfill shall be deposited in layers not to exceed 8-inches in non-compacted thickness and mechanically compacted, using platform type tampers. Compaction of structures backfilled by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of select backfill or backfill by inundation with water will not be permitted. All materials shall be deposited as specified and as shown on the Drawings.
4. The material shall be placed at a moisture content and density as specified under Paragraph 3.8.G. CONTRACTOR shall provide equipment capable of adding measured amounts of water to the backfill or select backfill material to bring it to a condition within the range of the required moisture content. CONTRACTOR shall provide equipment capable of discing, aerating, and mixing the soil to ensure reasonable uniformity of moisture content throughout the fill material and to reduce the moisture content of the borrow material by air drying, if necessary. If the subgrade or lift of earth material must be moisture conditioned before compaction, the fill material shall be sufficiently mixed or worked on the subgrade to ensure a uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of the specified limit shall be dried by aeration or stockpiled for drying.
5. No backfill or fill material shall be placed when free water is standing on the surface of the area where the fill is to be placed. No compaction of fill will be permitted with free water on any portion of the fill to be compacted. No fill shall be placed or compacted in a frozen condition or on top of frozen material. Any fill containing organic materials or other unacceptable material previously described shall be removed and replaced with approved fill material prior to compaction.
6. Compaction shall be performed with equipment suitable for the type of fill material being placed. CONTRACTOR shall select equipment capable of providing the minimum density

required by these Specifications. Hand operated compacting equipment shall be used within a distance of 10 feet from the wall of any completed below grade structure. Equipment shall be provided capable of compacting in restricted areas next to structures and around piping. The effectiveness of the equipment selected by CONTRACTOR shall be tested at the commencement of compacted fill Work by construction of a small section of fill within the area where fill is to be placed. If tests on this section of fill show that the specified compaction is not obtained, CONTRACTOR shall increase the amount of coverages, decrease the lift thicknesses and/or obtain a different type of compactor.

7. Levels of backfill against concrete walls shall not differ by more than two (2) feet on either side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs. Particular care shall be taken to compact structure backfill beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structure backfill, the structure backfill shall be placed and compacted to an elevation 12-inches above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.
8. The compaction requirements specified are predicated on the use of normal materials and compaction equipment. In order to establish criteria for the placement of a controlled fill so that it will have compressibility and strength characteristics compatible with the proposed structural loadings, a series of laboratory compaction and compressive strength tests shall be performed on the samples of materials submitted by CONTRACTOR. From the results of the laboratory tests, the final values of the required percent compaction, the acceptable compaction moisture content range, and the maximum permissible lift thickness will be established for the fill material and construction equipment proposed.

C. Backfill in Pipe Trenches:

1. Pipeline trenches may be backfilled prior to pressure testing, but no structure shall be constructed over any pipeline until it has been tested.
2. All pipe, except plastic pipe, shall be placed on a minimum 4-inch thick layer of granular embedment material. The granular embedment material shall extend 12-inches above the top of the pipe. CPVC and PVC pipes shall be placed on a minimum 4-inch layer of sand. Sand shall extend to 12-inches above top of pipe, and to the trench walls on each side of the pipe.
3. Embedment materials both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment materials shall conform to the following requirements:
 - a. Granular embedment shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle. After each pipe has been graded, aligned, placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and to maintain alignment during subsequent pipe jointing and embedment operations. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement. The embedment material shall then be placed and compacted to an elevation 12-inches above the top of pipe.
 - b. Compacted backfill shall be required for the full depth of the trench above the granular pipe embedment material. Where the trench for one pipe passes beneath the trench for another pipe or electrical duct bank, the lower trench shall be compacted to the level of the bottom of the upper trench.
 - c. Each layer of embedment material shall be compacted by at least two complete coverages of all portions of the surface of each lift using approved compaction equipment. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of the compacting surface of the compactor.

- d. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.
- e. The degree of compaction required for granular embedment is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698.

D. Backfill in Electrical Ductbank Trenches:

- 1. Compacted backfill shall be required for the full depth of the trench above the electrical ductbank. Where the trench for one ductbank passes beneath the trench for another pipe or ductbank select backfill shall be placed to the level of the bottom of the upper trench.
- 2. Placement and compaction of backfill in electrical ductbank trenches shall conform to the requirements of Paragraph 3.8.B.

E. Crushed Stone Placement:

- 1. Crushed stone shall be placed where shown on the Drawings to the limits shown, as required and directed.
- 2. Crushed stone shall be place in hand tamped lifts, not to exceed 6-inches.

F. Sand Placement:

- 1. Sand shall be placed as an envelope around PVC and CPVC pipes and all pipe 2-inches and smaller. Place and compact minimum 6-inches of sand all around pipes, in 6-inch lifts, to a level 6-inches above the top of pipe.

G. Compaction Density Requirements:

- 1. The degree of compaction required for all types of fills shall be as listed below. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction.

<u>Material</u>	<u>Required Minimum Density- Percent Compaction (ASTM D-698)</u>	<u>*Maximum Uncompacted Lift (inches)</u>
Subgrade and Subbase Fill:		
Below concrete slabs on grade	95	8
Below base of footings or mats, structural slabs and tank floors	95	8
Below asphalt concrete paving	95	12
**Structural Backfill:		
More than 5 feet below final grade	100	8
Less than 5 feet below grade	95	8
Aggregate Base Course:		
Below concrete slabs or mats	95	8
Below asphalt and decomposed granite paving	100	8
Trench Backfill above pipe	95	12
Granular Pipe Embedment Material	95	6
Sand Embedment Material	95	6

* Where applicable

** Structural backfill shall not be used for support of facilities which are susceptible to damage from differential settlement of the fill section relative to walls.

All fill must be wetted and thoroughly mixed to achieve optimum moisture content, \pm 3 percent, with the following exceptions: On site clayey soils optimum to plus 3 percent.

Natural undisturbed soils or compacted soil subsequently disturbed or removed by construction operations shall be replaced with materials compacted as specified above.

2. CONTRACTOR'S testing service shall perform tests necessary to provide data for selection of fill material and control of placement water content.
 3. Field density tests, to ensure that the specified density is being obtained, shall be performed by CONTRACTOR'S testing service during each day of compaction Work.
 4. If the tests indicate unsatisfactory compaction, CONTRACTOR shall provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction Work shall be performed by CONTRACTOR, at no additional cost to the OWNER, until the specified compaction is obtained. This Work shall include complete removal of unacceptable (as determined by the OWNER) fill areas and replacement and recompaction until acceptable fill is provided.
- H. Replacement of Unacceptable Excavated Materials: In cases where over-excavation for the replacement of unacceptable soil materials is required, the excavation shall be backfilled to the required subgrade with select backfill material and thoroughly compacted as specified in Paragraph 3.8.G. Sides of the excavation shall be sloped in accordance to the maximum inclinations specified for each structure location.

3.9 EMBANKMENTS

- A. To the maximum extent available, use excess earth obtained from structure and trench excavations for construction of embankments. Obtain additional material from borrow pits, as necessary. After preparation of the embankment area, level and roll the subgrade so that surface materials of the subgrade will be compact and well bonded with the first layer of the embankment. All material deposited in embankments shall be free from rocks or stones, brush, stumps, logs, roots, debris, and organic or other objectionable materials. Construct embankments in horizontal layers not exceeding 8-inches in uncompacted thickness. Spread and level material deposited by excavating and hauling equipment prior to compaction. Thoroughly compact each layer by rolling, or other method acceptable to the OWNER, to 95 percent of the maximum density at optimum moisture content, as determined by ASTM D 698. If the material fails to meet the density specified, compaction methods shall be altered. Wherever a trench passes through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation 24-inches above the top of the pipe before the trench is excavated.

3.10 GRADING

- A. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth subgrade surfaces within specified tolerances, and compact with uniform levels or slopes between points where elevations are shown or between such points and existing grades.
- B. Grading Outside Structures and Equipment: Grade areas adjacent to structures or equipment to drain away and to prevent ponding, as follows:
1. Turf Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than 1-inch above or below the required subgrade elevations.
 2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1-inch above or below the required subgrade elevation.
 3. Pavements: Shape surface of areas under pavement to line, and grade and cross-section with finish surface not more than 1/2-inch above or below the required subgrade elevation.
- C. Grading Surface of Fill Under Slabs: Grade smooth and even, free of voids, compacted as specified and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10-foot straightedge.

- D. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.11 PAVEMENT BASE COURSE

- A. General: Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
 - 1. This section shall apply to pavement shown on the plans or pavement that requires replacement due to construction activities.
- B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each base course layer. Compact and roll at least a 12-inch width of shoulder simultaneously with compacting and rolling of each layer of base course.
- D. Placing: Place base course material on prepared subgrade in layers of uniform thickness conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base material during placement operations.
 - 1. When a compacted base course is shown to be 6-inches thick or less, place material in a single layer. When shown to be more than 6-inches thick, place material in equal layers, except no single layer shall be more than 6-inches or less than 3-inches in thickness when compacted.

3.12 DISPOSAL OF EXCAVATED MATERIALS

- A. Material removed from the excavations, which does not conform to the requirements for fill or is in excess of that required for backfill, shall be hauled away from the Work site and disposed of by CONTRACTOR in compliance with ordinances, codes, laws and regulations at no additional cost to the OWNER.

3.13 RESTORING AND RESURFACING EXISTING ROADWAYS AND FACILITIES

- A. Place 1-1/2-inches of temporary similar material pavement immediately after backfilling trenches in paved roadways. Maintain the surface of the paved area over the trench in good and safe condition during progress of the entire Work, and promptly fill all depressions over and adjacent to the trench caused by settlement of backfill. The permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise specified.
- B. Pavement, gutters, curbs, sidewalks and roadways disturbed or damaged by CONTRACTOR'S operations shall be restored by CONTRACTOR at their own expense to as good condition as was previous to the commencement of the Work and in accordance with applicable local and state highway specifications.

3.14 TEMPORARY FENCING

- A. CONTRACTOR shall furnish and install an 8-foot tall temporary fence surrounding his excavations and the complete work area, including the stock pile and storage areas. Fence shall have openings only at vehicular, equipment and worker access points.

3.15 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: CONTRACTOR'S testing service shall inspect and approve subgrades and fill layers before construction Work is performed thereon. Tests of subgrades and fill layers shall be taken as follows:
 - 1. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one (1) test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to OWNER.
 - 2. Paved Areas, Drive Areas, and Slab Subgrade: Make at least one (1) field density test of subgrade for every 500 square feet, but in no case less than three (3) tests. In each compacted fill layer, make one field density test for every 2000 square feet of overlaying area, but in no case less than three (3) tests.
 - 3. Foundation Wall Backfill: Take at least two (2) field density tests, at locations and elevations as directed.

- C. If testing service reports or inspections show subgrade or fills are below specified density, CONTRACTOR shall provide additional compaction and testing at no additional expense to OWNER. This Work shall include complete removal of unacceptable fill areas (as determined by the OWNER), and replacement and recompaction until acceptable fill is provided.

3.15 EARTHMOVING AND DUST CONTROL

- A. CONTRACTOR shall obtain all earthmoving permits and any other permits required for earthmoving and dust generating operations related to the Work as required by the Maricopa County Air Pollution Control Regulations.

- B. CONTRACTOR shall not cause or allow any dust generating operation, earthmoving operation, use of property, or any other operation which causes fugitive dust emissions that exceed the 20 percent visible emission opacity limit in Rule 300 of Maricopa County's Air Pollution Control Regulations.

- C. If requested by the OWNER, or Maricopa County representative, CONTRACTOR shall conduct opacity observations for visible emissions of fugitive dust in accordance with techniques specified in USEPA Reference Method 9, with no additional cost to the OWNER.

- D. In addition to earthmoving permits, CONTRACTOR shall obtain an approved Dust Control Plan from Maricopa County. At a minimum, the Dust Control Plan shall include the following information:
 - 1. Name(s), address(es) and phone number(s) of the person(s) responsible for the preparation, submittal, and implementation of the Dust Control Plan and responsible for the dust generating operations.
 - 2. A site plan that describes the total area of land surface to be disturbed (in acres); the operations and activities to be performed on the site; actual and potential sources of fugitive dust emissions; and the delivery, transportation, and storage areas for the site (including types of materials stored and appropriate size of material stock piles).
 - 3. Description of the reasonably available control measures.
 - 4. Description of dust suppressants to be applied including product specifications; method, frequency, and intensity of application; type, number, and capacity of application equipment; and certifications related to the suppressant's appropriate and safe use.
 - 5. Description of specific surface treatment(s) and control methods used to control material track-out where unpaved and access points join paved surfaces.
 - 6. Description of at least one alternative RACM for each actual and potential fugitive dust source shall be designated as a contingency measure.

- E. CONTRACTOR shall post a copy of all earthmoving permits as well as the approved Dust Control Plan in a conspicuous location at the worksite.

- F. CONTRACTOR shall maintain a daily written log that records the actual application or implementation of the RACMs described in the approved Dust Control Plan. CONTRACTOR shall maintain this written log and supporting documentation on site and shall make available for review on request by OWNER, or Maricopa County representative. CONTRACTOR shall retain copies of the Dust Control Plan, RACM implementation records, and all supporting documentation for a minimum of three (3) years.
- G. CONTRACTOR, at a minimum, shall provide all necessary equipment and materials to apply sufficient dust suppressants (e.g., water, etc.), properly clean (sweep, etc.) all track-out areas, and provide adequate physical stabilizations (e.g., gravel, recycled asphalt, etc.) to meet all requirements of the earthmoving permit and approved Dust Control Plan. CONTRACTOR shall use these methods to control fugitive dust generation from all CONTRACTOR operations on all CONTRACTOR areas including, but not limited to:
1. Construction areas.
 2. Vehicle and equipment parking areas.
 3. Material storage areas.
 4. Office and trailer areas.
 5. Haul and access roadways.
 6. Track-out areas.
 7. All other areas where CONTRACTOR shall be working, storing, or parking vehicles, equipment, and materials.
- H. CONTRACTOR shall pay all fines issued to the OWNER by the USEPA, ADEQ, and Maricopa County due to violation of CONTRACTOR'S earthmoving permit and Dust Control Plan.

+ + END OF SECTION + +

SECTION 02510
WATER DISTRIBUTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes water-distribution piping and specialties for the following:

1. Water Services
2. Water piping for applications other than water service piping.

1.03 DEFINITIONS

- A. Water-Distribution Piping and Water Service: Domestic-water piping.

- B. The following are industry abbreviations:

1. DIP: Ductile iron piping.
2. PVC: Polyvinyl Chloride Plastic.

1.04 SUBMITTALS

- A. Product Data: For the following:

1. Piping specialties.
2. Valves and accessories.
3. Pressure Gauges.
4. Piping.
5. Pipe supports.
6. Sample Taps.
7. Fittings.
8. Couplings.
9. Polywrap.
10. Meters (see Electrical Sections).
11. Tubing.

- B. FIELD QUALITY-CONTROL TEST REPORTS: FROM CONTRACTOR.

- C. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following.

1. Gate Valves
2. Air/Vacuum Release Valves
3. Pressure Gauges

1.05 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated
- B. Regulatory Requirements:
 - 1. Comply with requirements of utility authorities having jurisdiction. Include tapping of water mains and backflow prevention
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency
- D. NSF Compliance
 - 1. In accordance with AAC R18-4-213, all materials added after January 1, 1993 which may come into contact with drinking water shall conform to National Sanitation Foundation Standards 60 & 61.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
 - 4. All valves shall be delivered to the site with end protectors in place.
- B. During Storage: Use precautions for valves according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary
- C. Handling: Use sling to handle valves. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify City not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without the City's written permission.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. No galvanized pipe shall be used on-site for mechanical piping.

2.03 DUCTILE-IRON PIPE. AND FITTINGS

- A. Manufacturers
1. All fittings shall be manufactured in the USA.
 2. All fittings shall be manufactured by STAR Pipe Products or equivalent.
- B. General Ductile Iron Pipe: Flanged ends on all above ground installations (Class 350) and restrained mechanical or restrained push-on joints on all underground installations (Class 350).
- C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, with ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, with ductile- or gray-iron glands, Field-Lok rubber gaskets or approved equal and steel bolts.
- D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint, bell- and plain spigot end unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber, Field-Lok or approved equal.
- E. Flanged End, Ductile Iron Pipe: AWWA C115
1. Ductile Iron, Flanged End Fittings: AWWA C110

2.04 PVC PIPE AND FITTINGS

- A. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket and spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
- B. PVC, AWWA Pipe: AWWA C905, Class 235, with bell end with gasket and spigot end.
 - 1. Comply with UL 1285 for fire service mains if indicated.
- C. PVC, Schedule 40 with bell end with gasket and spigot end (Drainage only)

2.05 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM 8 88, Type K, water tube, annealed temper.
 - 1. Copper Fittings: ASME 816.18, cast-copper-alloy or ASME 816.22, wrought-copper, solder-joint pressure type.
 - 2. All Type K copper tubing shall be continuous in length when possible. . If the length required on the plans is too long to be continuous, restrained joints approved by the City shall be used.

2.06 JOINING MATERIALS

- A. Transition Couplings: The Contractor shall provide any transition couplings as required.
 - 1. Underground Piping, NPS 2 and Larger: AWWA C219, metal, sleeve-type coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
 - 2. Aboveground Piping: Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Soldering Flux: ASTM B 813, water-flushable type.
- D. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.

2.07 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end. The Contractor shall provide these fittings as required.
 - 1. Manufacturers
 - a. Eslon Thermoplastics or equivalent.

2.08 PIPING SPECIALTIES

A. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.

1. Dielectric Unions: The Contractor shall supply and install dielectric unions on all connections between dissimilar metals. Should corrosion occur as a result of dissimilar metals, the Contractor will replace the corroded components. Factory-fabricated union assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar metals and ends with inside threads according to ASME B1.20.1.

B. All taps shall be made using a welded couplet or approved saddle. All pipe penetrations shall have an approved corp stop.

2.09 CORROSION-PROTECTION ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet. The Contractor shall provide and install Polywrap for all underground DIP in accordance with MAG. The color of all Polywrap that protects raw water piping shall be black.

2.10 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturer:
 - a. Pratt
 - b. Mueller
2. Resilient-Seated Gate Valves: AWWA C509, cast-iron or ductile-iron body and bonnet, outside screw and yoke; with bronze or gray-iron or ductile-iron gate, resilient seats, and low zinc stem.
 - a. Minimum Working Pressure: 150 psig.
 - b. End Connections: Flanged above grade and mechanical below grade.
 - c. Interior Coatings: AWWA C550.
 - d. OS&Y, rising-stem on above ground applications NRS of below ground applications

2.11 WATER-REGULATING VALVES

A. See Section 15500 "Miscellaneous Valves".

2.12 RELIEF VALVES

A. Well Pump

1. Product:
 - a. Val-Matic Corp. Model 102ST or equivalent.
2. Well Service Air Valves: Valve shall be suitable for pressures up to 400 psig, fully automatic float operated designed to exhaust air which is present in the pump column on pump startup and allow air to re-enter the column on pump shutdown or should negative pressure occur.

- a. The float shall be unconditionally guaranteed against failure including pressure surges. The float shall be protected against direct water impact by an internal baffle.

B. Discharge Piping

1. Product:

- a. Val-Matic Corp. Model 22.3 or equivalent.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems as outlined herein.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- C. Do not use flanges for underground piping. Flanges shall be used on aboveground piping.
- D. All ductile iron fittings shall be at least Class 350.
- E. All piping shall include restrained joints in accordance with the notes provided on the plans and these specifications.

3.03 VALVE APPLICATIONS

- A. General Application: Use flanged-end valves for above ground installation.

3.04 JOINT CONSTRUCTION

- A. Make pipe joints according to the following as amended by the requirements of MAG, the City of Buckeye, and the project plans and specifications:
 - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 2. Copper Tubing Soldered Joints: ASTM B 828. Use flushable flux and lead-free solder. Solder joints are allowed above ground only. Soldered joints require tru-union valves as well as additional unions within the piping.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.05 PIPING INSTALLATION

- A. Install ductile-iron, water-service piping according to MAG Specification Section 610, AWWA C600, and AWWA M41.
 - 1. Install Black PE corrosion-protection encasement according to MAG Section 610.5 and AWWA C105 for all underground DIP.
- B. Install copper tube and fittings according to the "Copper Tube Handbook."
- C. Bury piping with depth of cover over top at least 48 inches (lines 12" and smaller) and 60 inches (larger than 12") unless otherwise noted on the plans.
- D. Install all piping with restrained joints. A kicker system or an approved equivalent shall be submitted to the Engineer and City for approval prior to installation. Systems that do not include restrained joints may not be approved.
- E. Trenching, backfilling, and compaction shall be in accordance with Section "Earthwork" and modified by MAG Standard Specification 601 and related Details and City requirements. Should these standards conflict, the more stringent of the two as determined by the Engineer shall govern.

3.06 VALVE INSTALLATION

- A. Comply with AWWA C600 or AWWA 603 except as modified by MAG Specification Section 610.6.
- B. Water-Regulating Valves: Install aboveground between shutoff valves. C. Relief Valves: Install aboveground with shutoff valve on inlet.

3.07 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests in accordance with MAG Specification Section 611.

3.08 CLEANING

- A. Clean and disinfect water-distribution piping in accordance with MAG specifications and as follows. The Contractor shall be responsible flushing and disinfecting the downstream raw water transmission line between Wells 2 and 3 under the inspection of the City:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

END OF SECTION

SECTION 02711
DRYWELL

PART 1 GENERAL

1.01 WORK SPECIFIED HEREIN

A. All Labor, materials, equipment and services necessary to furnish and install the drainage system as indicated or specified. It is estimated that the required settling chamber depth of the proposed drywell will be 19' (14' effective settling depth and 5' of freeboard). This depth is an estimate and the actual requirements shall be determined in the field. Should a greater depth be required, the Owner shall pay the Contractor based on the unit costs provided in the bid schedule. Should the area's soils allow for a depth less than 19', the Owner will deduct an amount based on the unit costs provided in the bid schedule.

B. SUBSTITUTIONS

1. When a product (i.e., any material, process or equipment) is specifically identified by patent, proprietary name, trade name of manufacturer – and regardless of whether or not is followed by the words name or by "or equal", "or approved equal", or "or equivalent" – it is done to establish a standard of quality for the protection of the Owner, is intended to be descriptive, and is not intended to limit competition or to restrict the use of materials which may be equal to or better than the named product.
2. A bidder may substitute an alternative product for a product specifically identified, provided that approval of the alternative product has been obtained from the Engineer.
3. A bidder desiring to substitute an alternative product for a product specifically identified shall submit a written request for approval to the Engineer. Each such request shall include the name of the including (identification of the product, (b) any drawings, cut sheets or performance technical and test data for the product, and (c) any other information, reports, reviews relevant and necessary for the evaluation for the proposed alternative product.
4. The burden of proving the equality or superiority of the alternative product proposed for substitution is upon the Contractor. Any proposed alternative product must be compatible with, and have the capability of tying into, existing systems where they occur. Contractor shall pay for all modifications or alterations required in the use of any approved substituted products.
5. The Engineer shall consider and either approve or reject all alternative product proposals.

C. QUALITY ASSURANCE

1. The drywell installation shall be performed by Torrent or an approved A-General Engineering Contractor with not less than three (3) successfully completed contracts with similar soil conditions, depths and volumes of work contained in this project. Satisfactory evidence of compliance shall be submitted to the Owner prior to installation. Submittal of an equivalent by the Contractor does not guarantee its approval. The Contractor's bid must be able to accommodate a Torrent dry well if required by the City.

D. SITE INVESTIGATION

1. Bidders are expected to visit the site to formulate their own conclusions as to the character of the work under this section.

E. FINAL DRYWELL DEPTH

1. The total estimated depth for the proposed drywells is 120'. The final drywell depth shall be determined by the minimum penetration requirements, and may vary from this estimate and the base drywell bid depth. In accordance with applicable drainage ordinances and to insure proper drainage, a minimum penetration of ten (10) feet is required into clean permeable porous soils, contiguous to the terminus of the well. Should a greater depth be required, the Owner shall pay the Contractor based on the unit costs provided in the bid schedule. Should the area's soils allow for a depth less than 120', the Owner will costs provided deduct an amount based on the unit in the bid schedule.

PART 2 PRODUCTS

2.01 MATERIALS

Precast Liner:	Reinforced 4000 PSI concrete, 48" ID, 54" OD with eight 1.25" diameter holes per foot where indicated.
Manhole Cover:	Precast, conforming to ASTM C478, with modified flat bottom.
Overflow Pipe:	8-inch, ID Schedule 40 Poly Vinyl Chloride (PVC) solid wall.
Brackets:	Formed 12 gauge steel, fusion-bonded epoxy coated.
Drainage Pipe:	8-inch, 100-PSI minimum PVC pipe or ADS highway grade pipe, mated to the overflow pipe with suitable coupling.
Rings and Grates:	30" diameter nominal metal castings to conform to MDI#2024B specifications. The grates shall be bolted to the rings in two (2) locations and suitable for light traffic; "Storm Water Only" shall be cast into the grating surface.
Rock:	Clean washed rock uniformly graded between 3/8" and 1-1/2", sized to compliment soil conditions.
Drainage Fabric:	Mirafi 140 NL fabric, or approved equal.
Drainage Screen:	Minimum 8" ID, Schedule 40 PVC slotted screen, with 0.120 slots continuous, with a minimum of 160 slots per foot. 96" long overall, with a suitable coupling.
Debris Shield:	Rolled 16 gauge steel x 24" length, with rolled 16 gauge x. 265" maximum SWO flattened expanded steel internal screen x 12" length. Fusion bonded epoxy coated, quipped with internal screen and anti-siphon vent.
Moisture Membrane:	Polyethylene liner, 6 mil. Thick, conforming to ASTM D-2103.
Absorbent:	Hydrophobic petrochemical sponge with minimum four (4) quart capacity used in all well and interceptor chambers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units at locations indicated on the construction plans in strict accordance with manufacturer's printed instructions.

- B. The drilled holes shall be of the diameter shown on the plans. Reaming or piloting is only allowed for the settling chamber excavation, and the hole shall be drilled in a manner to maintain maximum permeability of the soils.
- C. The drainage pipe and drainage screen shall be suspended during backfill operations. The rock backfill shall be placed with care to prevent buckling or breakage of the drainage pipe and screen.
- D. The precast liner shall be centered in the drilled shaft. Sections are to be carefully aligned to maximize bearing surfaces.
- E. Filter fabric shall be placed at the bottom of the settling chamber. The filter fabric shall be placed tightly against the precast liner and overflow pipe.
- F. The ring and grate shall be set to the rim elevation shown on the plans, and shall be secured to the manhole cone with mortar. Slurry shall be placed around the circumference of the grate.
- G. Upon completion of each drywell, two (2) layers of UV stabilized Mirafi 100X fabric shall be placed beneath the grate. The fabric shall not be removed until after all site work is completed.
- H. Install polyethylene membrane over the top of the rock backfill.
- I. Clean up all debris and remove all excess excavated soil from the site, and legally dispose of same.

3.02 OBSTRUCTIONS

- A. If rock, boulders and other unforeseen obstructions are encountered which cannot be removed by standard drywell excavation methods, the drywell will be moved within the site to avoid the obstruction or the obstruction shall be drilled by an alternative method at no additional cost.

3.03 CLASSIFICATION OF ROCK

- A. Rock or rock-like soils are defined as material which cannot be drilled with conventional bucket auger equipped with standard teeth, and that require the use of carbide teeth, special rock core barrels, air tools, blasting and/or other methods of special excavation.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies cast-in-place concrete for structure foundations and slab, including
 - 1. Reinforcement.
 - 2. Concrete materials.
 - 3. Mix design.
 - 4. Placement procedures.
 - 5. Finishes.
 - 6. Coatings.

1.03 SUBMITTALS

- A. General: In addition to the following, comply with submittal requirements in ACI 301. Submittal checklist in ACI 301 includes 75 items. Many deal with Contractor-requested options; others do not apply for less complex projects.
- B. Design Mixes: For each concrete mix

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- D. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements for the contract Documents.
 - 1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
 - 2. Formwork and form accessories.
 - 3. Steel reinforcement and supports.
 - 4. Concrete mixtures.
 - 5. Handling, placing, and constructing concrete.

PART 2 - PRODUCTS

2.01 FORMWORK

- A. Furnish formwork and form accessories according to ACI 301.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.03 CONCRETE MATERIALS

- A. Portland cement: ASTM C 150, Type II.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1-1/2-inch nominal size.
- C. Water: Potable and complying with ASTM 94.

2.04 ADMIXTURES

- 1. Air-Entertaining Admixture: ASTM C260.
- 2. Water-Reducing Admixture: ASTM C494, Type A.
- 3. High-Range, Water-Reducing Admixtures: ASTM C 494, Type F

2.05 RELATED MATERIALS

- 1. Low luster clear finish interior floor slab sealers.

2.06 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Curing Compound: Curing Compound shall clear with out a fugitive die. Curing compound shall meet the moisture retention requirements of ASTM C-309, Type 1-D at coverage rate specified and that meets VOC Requirements as established by the Governing Authorities. Curing Compounds shall be compatible with future toppings, paints, waterproofing and finishes.
- D. Water: Potable

2.07 CONCRETE MIXES

- A. Comply with ACI 301 requirements for concrete mixtures.
- B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:
 - 1. Compressive Strength (28 Days): 3000 psi.
 - 2. Slump: 4 inches.
 - 3. Maximum water/cement ratio shall be 0.45"

2.08 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with ASTM C 94.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.09 JOINT SEALANTS

- A. One-part Polyurethane, Immersible. When sealants are required, use self-leveling for horizontal joints and non-sag for vertical joints.
 - 1. Polyurethane base, single-component, chemical curing; Federal Specification TT-S-00230, Type I or II, Class A.
 - 2. Capable of being continuously immersed in water, withstand movement up to 25% of joint width.
 - 3. Manufacturer of Nonsag: Sonneborn Sonolastic NP-1; Sika Chemical Corp., Sikaflex-1a No. 430; Mameco International Vulkem 116; or equal.
 - 4. Manufacturer for Self-Leveling: Sonneborn Sonolastic SL-1; Mameco International Vulkem 45; Sika Chemical Corp. Sikaflex 12SL; or equal.

2.10 Bond Breaker

- A. Pressure Sensitive Tape: When tape is required, use a tape recommended by sealant manufacturer to suit application.

2.11 Water Stops

- A. When stops are required, use either plastic or rubber water stops, as the Contractor may elect, manufactured to the dimensions called for on the plans.
 - 1. Plastic: Polyvinyl chloride water stop shall be manufactured from virgin polyvinyl chloride (PVC) compound. No reclaimed PVC will be allowed. The water stop shall have the following properties:

Test	ASTM Test Method	Specification
Tensile Strength, psi	D412	1800
Elongation, %	D412	350
100% Modulus, psi	D412	760
Low Brittle Temperature	D412	-50 °F
Cold Bend Test ¹	D746	No Failures

¹ Samples maintained at -70 F for 2 hours, then bent quickly around a 1/4 inch mandrel to 180°.

The supplier shall furnish test samples of the material from which water stop is to be manufactured. Samples shall be in sheet form having a uniform thickness of from 1/16 to 1/8 inch and having a total area of not less than 2 square feet. Each sample shall be comprised of pieces not smaller than 6 inches by 6 inches.

2. Rubber: When required, manufacture rubber water stop to the dimensions shown on the plans in such a manner that the finished project shall have an integral cross section which will be dense, homogeneous, and free from porosity and other imperfections. The water stop shall have the following properties.
 - a. Hardness: The Shore A Durometer hardness shall be 60 to 70 when testing according to ASTM D 2240.
 - b. Elongation: Minimum of 450%.
 - c. Tensile Strength: Minimum of 3000 psi.
 - d. Water Absorption: Maximum of 5% by mass after immersion in water for two days at 158 °F.
 - e. Tensile Strength After Aging: The test specimen, after accelerated aging of 7 days at 158 °F shall not retain less than 80% of the original tensile strength. The tensile strength of the test specimen, after accelerated aging 48 hours in oxygen at 158 °F and tensile stress of 300 psi shall be not less than 80% of the original tensile strength.
 - f. Compression Set: After 22 hours at 158 °F shall be not more than 30% when tested according to ASTM D 395, method B.
 - g. Specific Gravity: -1.17 ± 0.03 .
 - h. Defects: Minor surface defects such as surface peel covering less than 1 square inch, surface cavities or bumps less than 1/4 inch in longest lateral dimensions and less than 1/16 inch deep will be acceptable.

PART 3 - EXECUTION

3.02 FORMWORK

- A. Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.

3.03 STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.04 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Contraction (Control) Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. If joints are not indicated, submit proposed joint layout to the Engineer for approval. Construct contraction joints for a depth of 1/3 the slab thickness or 2-inches for reinforced concrete floor slabs that are not saw cut, at other slabs on grade provide a depth equal to at least one-third of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groove tool to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groove marks on concrete surfaces.
 2. 2-inch ZIP-STRIP type joint may used upon written approval by the Engineer, after an approved concrete placing plan showing both joint locations and types of joints that the Contractor plans to use.

3.05 CONCRETE PLACEMENT

- A. Comply with recommendation in ACI 304R for measuring, mixing, transporting, and placing concrete.
- B. Do not add water to concrete during deliver, at Project site, or during placement.
- C. Consolidate concrete with mechanical vibrating equipment.

3.06 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch (6 mm) in height rubbed down or chipped off.
 1. Apply to concrete surfaces not exposed to view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.
 1. Apply to concrete surfaces exposed to view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp proofing, veneer plaster, or painting.
 2. Do not apply rubbed finish to smooth-formed finish.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.07 FINISHING UNFORMED SURFACES

- A. General: comply with ACI 302.1R for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleed water appears on the surface.
 - 1. Do not further disturb surfaces before starting finishing operations.
- C. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
- E. Trowel and Fine-Broom Finish: Apply a partial trowel finish. Immediately after second trowel, and when concrete is still plastic, slightly scarify surface with a fine broom.
- F. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.08 TOLERANCES

- A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.09 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 305R for hot-weather protection during curing.
- B. If evaporation rate in paragraph below is exceeded, ACI 305R states that plastic shrinkage cracking is probable. See manufacturers' literature or ACI 305R for estimated moisture-loss chart relating relative humidity, air and concrete temperature, and wind velocity to rate of evaporation.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- E. Curing methods: Cure formed and unformed concrete for at least seven days by moisture curing, moisture-retaining-cover curing, curing com-pound (clean all nozzles after each USE), or a combination of these as follows. Note, see Contract Drawings General Structural Notes and City standards and specifications for additional requirements when using curing compounds.
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

- a. Water.
- b. Continuous water-fog spray.
- c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 1 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

3.11 REPAIRS

- A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION

SECTION 04065
MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes mortar and grout for masonry.
- B. Related Sections:
 - 1. Section 04820 – Reinforced Unit Masonry Assemblies: Installation of mortar and grout.

1.2 SUBMITTALS

- A. Section 01640 – Product Submittals
- B. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- C. Design Data: Submit design mix, required environmental conditions, and admixture limitations.
- D. Test Reports:
 - 1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, and compressive strength. Use Portland Cement-lime mortars or Mortar Cement that has been tested per ASTM 1329 that has maximum air content per ASTM C 185 at 12%. Masonry Cement shall not be used on this project.
 - 2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

PART 2 PRODUCTS

2.1 MORTAR AND MASONRY GROUT

- A. Premix Mortar: ASTM C387, Type S, using gray or white color cement as required to produce mortar color selected.
- B. Water: Clean and potable.
- C. Calcium chloride is not permitted.

2.2 MIXES

- A. Mortar Mixes:
 - 1. Mortar: ASTM C270, Type S. Use Portland cement-lime mortar or Mortar cement that has been tested per ASTM C1329 that has maximum air content per ASTM C 185 at 12%. Masonry Cement shall not be used on this project.
 - 2. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
 - a. Color: match existing wall mortar
- B. Grout Mixes:
 - 1. Grout for Structural Masonry: 2,000 psi strength at 28 days;

2. Application:
 - a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
 - b. Fine Grout: For grouting other spaces.
- C. Grout Mixing:
 1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install mortar and grout in accordance with Section "Reinforced Unit Masonry Assemblies."

3.2 FIELD QUALITY CONTROL

- A. Placement shall be witnessed by CITY if required by the CITY Inspector.
- B. Establishing Mortar Mix: In accordance with ASTM C270.
- C. Testing of Mortar Mix: In accordance with ASTM C780 for compressive strength.
- D. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength.

END OF SECTION

SECTION 04820
REINFORCED UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes concrete masonry units; reinforcement, and accessories. The Contractor shall modify the existing CMU site wall as required to install the proposed 20' gate and drainage openings shown on the plans.
- B. Related Sections:
 - A. Section 04065 - Masonry Mortar and Grout: Mortar and grout.

1.2 SUBMITTALS

- A. Product Data: Submit data for masonry units and other accessories.
- B. Shop Drawings: Submit complete layout of masonry modifications for review and approval by the Engineer. Include plan and elevation views that illustrate solid grout CMU, its reinforcement, and its connections to the existing wall and wall footing.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC 2012 as Amended by the Masonry Society: TMS MSJC - Building Code for Masonry Structures (ACI 530-11/ASCE 5-11/TMS 402-11), Specification for Masonry Structures (ACI 530.1-11/ASCE 6-11/TMS 602-11) and Commentaries.

1.4 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Product storage and handling requirements.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMUs)

- A. Hollow Concrete Masonry Units (CMU): ASTM C90, medium weight using Portland Cement ASTM C 150, Type II / V.
- B. Concrete Masonry Unit Size and Shape: Nominal modular size of 8"x 8" x 16" inches typical with special or custom units where required to match existing wall.

2.2 ACCESSORIES

- A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars, uncoated finish.

- B. Anchor Bolts: Headed, J-shaped or L-shaped
- C. Mortar and Grout: As specified in Section 04065.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other sections of work are properly sized and located.

3.2 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing of Concrete Masonry Units:
 - A. Bond: Running, except when using 8"x 8" x 8" inch units.
 - B. Coursing: One unit and one mortar joint to equal 8 inches.
 - C. Mortar Joints: Tooled concave joints at all head and bed joints.
- D. Masonry Control Joints (MCJ):
 - A. Install preformed masonry control joint device in continuous lengths. Seal butt and corner joints.
 - B. Size control joint in accordance with sealant manufacturer's recommendations for performance.

3.3 FIELD QUALITY CONTROL

- A. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.4 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

END OF SECTION

SECTION 04800
PRECAST CONCRETE EQUIPMENT SHELTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Specification Division 16, Electrical
- C. Refer to the Electrical Plans for additional information.

1.2 SUMMARY

- A. This Section includes requirements for the precast concrete equipment shelter corresponding shelter equipment.
- B. Corresponding shelter equipment includes, but is not limited to, the following:
 - 1. Door
 - 2. HVAC Unit(s)
 - 3. Lights
 - 4. Safety equipment

1.3 SUBMITTALS

- A. The Contractor shall submit shop drawings prepared by the shelter's manufacturer demonstrating conformance to all components of the project plans and specifications while satisfying the intent of the shelter.
- B. Foundation requirements and supporting calculations. Color sample for building finish, door finish, and floor tile.
- C. Color sample for building finish, door finish, and floor tile.
- D. HVAC and Fire Suppression System sizing calculations.

1.4 QUALITY ASSURANCE

- A. The shelter shall be designed and constructed in accordance with the 1997 Uniform Building Code and the ACI 318-95 Building Code.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE EQUIPMENT SHELTER

A. Manufacturer

1. Oldcastle Precast, Inc. -Model 1215-S or Approved Equal that can accommodate the interior dimensions provided below.
2. There shall be a 2" overhang at the top of the structure on all four walls.
3. The roof shall have a one-inch slope for runoff.

B. Interior (Finished Out) Dimensions: 18' Long x 11'-4" Wide x 9'-1" High

C. Design Loads

1. Roof Load: 65 psf
2. Floor Live Load: 250 psf
3. Wind Load: 110 MPH, Exp "C"
4. Seismic: Zone 4

D. Insulation

1. R11 Roof
2. R11 Walls
3. R4 Floor

E. Approximate Building Weight

1. 42,000 lbs

F. Concrete.

1. f'c = 5,000 psi @ 28 Days

G. Steel

1. ASTM A-615 Grade 60

H. Mesh

1. ASTM A-496 and A-497

2.2 LOCATION AND FOUNDATION REQUIREMENTS .

- A. The Building location shall comply with all applicable local codes and ordinances.

- B. The Building is to be located a minimum of one-third the height (40 feet maximum) away from downslopes greater than 3:1, and one-half the height (15 feet maximum) away from upslopes greater than 3:1.
- C. Do not locate the building over subsurface utilities, tanks, or similar objects.
- D. The Building floor slab is to bear on undisturbed non-expansive earth or compacted fill, free of organic material, with an allowable soil bearing pressure of 1,000 psf minimum. The Building is to be placed on well draining soil with drains as required so it is not affected by frost heave.
- E. Soil surface under the Building floor slab shall be flat and level. The soil around the Building shall be sloped away 1/8 inch per foot minimum for 5 feet minimum.
- F. The Building shall be placed on cast-in-place perimeter footing or slab sized, detailed by the manufacturer and sealed by an AZ PE.

2.3 EXTERIOR FINISH

A. Building Finish

- 1. Chamfer Strip Finish
- 2. Primer: Primer 1000 or Approved Equal
- 3. Paint Color: Desert Tan

B. Door Finish

- 1. Paint Color: Pallet Tan (System 4000 Sherwin Williams or Approved Equal)

C. Roof Finish

- 1. Elastomeric Coating (Solar Coat)

2.4 INTERIOR FINISH

A. Walls and Ceiling Finish

- 1. Paint Color: Norm White

B. Floor Finish

- 1. Tile
- 2. Manufacturer: Armstrong or Approved Equal-
- 3. Model: Imperial Texture Standard EXCELON Vinyl Composition Tile (12" x 12" x 1/8) or Approved Equal.
- 4. Color: 51925 Ash gray or Approved-Equal
- 5. Color-Integrated Vinyl Wall Base: V471018 Mid gray or Approved Equal
- 6. Adhesive: S-515

2.5 DOOR

- A. 3070 18 ga door with 16 ga frame
- B. Door shall include a removable one foot (1-foot) transom to allow for the removal of the electrical equipment.
- C. Door shall include panic bar on interior side that defeats the door strike
- D. Door drip cap-- 2 %"wide
- E. Lockset with changeable core

2.6 POWER

- A. 200 A, Single Phase, 120/240V
 - 1. Interior Duplex Receptacles and Exterior GFI Receptacles as shown on electrical plans.

2.7 HVAC

- A. Supply a minimum of two (2) 3 Ton, Single Phase HVAC units with 5 Kw Heat Strip and Lead Lag Controller. Building manufacturer shall verify sizing based on the heat load of proposed electrical equipment while maintaining an interior temperature of 70-80 degrees Fahrenheit.
- B. Submit HVAC sizing calculations for review and approval by engineer.

2.8 LIGHTS

- A. Interior fluorescent lights per luminaire schedule on Sheet E1.
- B. Emergency exit fixture with dual flood lights
- C. Exterior lights per luminaire schedule on Sheet E1.

2.9 OTHER EQUIPMENT

- A. Provide equipment as included in this section.
- B. Smoke detector
- C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and Class of fire exposure.
- D. Literature holder
- E. Tie-Down Kit
- F. FM-200 Fire Suppression System per specification section 15560.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Verify that foundations are within tolerances specified.
 - 2. Verify that reinforcing dowels are properly placed.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

- B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

- 1. Install Building in accordance with the project plans and these specifications.

END OF SECTION 04800

SECTION 09961
HIGH PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Coated surfaces to include:
 - a. Interior and exterior piping, regardless of type of factory-applied finish.
 - b. Exposed interior and exterior structural and non-structural steel surfaces.
 - c. Exterior and interior equipment, motors, and appurtenances.
 - d. Interior and exterior concrete and masonry.
 - e. Wood surface where noted in drawings.
 - f. Metallic and non-metallic wall, floor, ceiling or architectural surfaces where noted in drawings.
2. Labeling and directional arrows on piping, equipment with valves or electrical connections, valves, and ducts whether coated or not.
3. Do not coat the following unless specifically noted otherwise:
 - a. Factory-finished electrical motor control panels (MCC) and main instrument panels (MIP), flow indicators, and related equipment.
 - b. Underground equipment and piping.
 - c. Surfaces above suspended ceiling systems (unless color coded).
 - d. Existing surfaces.
 - e. Factory-finished trim.
 - f. Stainless steel.
 - g. Aluminum
 - h. Galvanized surfaces.
4. Do not coat over any code-required labels such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

B. CONTRACTOR shall be required to coordinate with the equipment manufacturer for surface preparation and coatings of equipment, motors, and appurtenances. Equipment to be coated and coating system are identified in equipment Specification section(s).

C. DEFINITIONS

1.02 Definitions:

1. Standard coating terms defined in ASTM D 16 apply to this Section.
2. Coatings: Heavy duty finishes for use on any surfaces, especially surfaces subject to submerged, high moisture, splash or chemical environment.
3. Ambient Conditions:
 - a. Interior: Surface subject to normal temperatures and humidity such as found in offices and corridors.
 - b. Exterior: Surface subject to weathering, sunlight or wet areas such as shower rooms and rooms with open tanks.

- c. Submerged: Surface submerged in a liquid as specified. Coat all surfaces in regular contact with the liquid plus 1 ft 0 in. above high liquid level.
 - d. Buried Below Grade: Footings, buried pipe or other materials buried below ground and in direct contact with the surrounding soil.
 - e. Surface Preparation: Any cleaning, sand-blasting or other preparation to be performed on the surface prior to the first coating application.
- 4. Primer Coat: Field prime, factory prime, or shop prime.
 - 5. Intermediate Coat: Any successive coats applied over primer coat before the finish coat.
 - 6. Finish Coat: Final coat applied to surface. When only one coat is required, it is listed as finish coat.
 - 7. Gloss ranges used in this Section include the following:
 - a. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - b. High gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.03 SUBMITTALS

A. Product Data

- 1. Submit manufacturer's literature stating application recommendations and generic makeup of each type of coating scheduled.
- 2. Substitutions: For coatings not specified, provide substitute manufacturer's literature with specified coating literature for ENGINEER to make proper evaluation.

B. Samples:

- 1. Actual color samples available for each type of coating scheduled.
- 2. Two 4 in. by 4 in. steel panels for each method of metal preparation specified. Panel shall be representative of steel used and prevented from deterioration of surface quality. Upon acceptance by ENGINEER, panel shall be preserved as reference source for inspection.

C. Miscellaneous:

- 1. Letter of Certification/Shop Painting:
 - a. CONTRACTOR has option of shop coating materials and equipment partially or totally.
 - b. If CONTRACTOR applies coatings in factory submit following:
 - i. Coatings used.
 - ii. Manufacturer's written certificate factory-applied coating system is identical to, or exceeds, specified requirements.
 - iii. Requirements for touch-up or coating.
 - iv. History of coating performance in same environment.
 - c. Submit following for factory-applied first coat.
 - i. First coat used.

- ii. CONTRACTOR'S certification factory-applied first coat is compatible with field-applied finish coats.
- 2. Certification:
 - a. Certification by the manufacturer that products supplied, comply with local regulations controlling use of volatile organic compounds (VOCs).
- 3. Schedules:
 - a. Submit schedule of proposed coating systems.
 - b. Schedule of proposed coating systems shall identify same information as shown in coating schedule.
 - c. Schedule is not required if Tnemec coating materials are provided. Provide schedule for materials that are not Tnemec. Schedule will be used by ENGINEER to evaluate materials proposed.
- D. Submit in accordance with Section 01640.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications:

- 1. Engage an experienced applicator who has successfully completed coating system applications similar in material and extent to those indicated for Project.

B. Single-Source Responsibility:

- 1. Provide primers and coating material produced by same manufacturer for each system. Use only thinners recommended by manufacturer and only within recommended limits.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in original, sealed, unopened packages and containers bearing manufacturer's name. Each container shall have manufacturer's printed label stating type of coating, color of coating, instructions for reducing, and spreading rate.
- B. Protect and heat or cool material storage location to maintain temperature ranges recommended by coating manufacturer for most sensitive coating, but not less than 55 degrees F.
- C. Keep storage area neat and clean and replace or repair damage thereto or to its surroundings.
- D. Avoid danger of fire. Deposit cleaning rags and waste materials in metal containers having tight covers or remove from building each night. Provide fire extinguishers of type recommended by coating manufacturer in areas of storage and where finishing is occurring. Allow no smoking or open containers of solvents. Store solvents in safety cans.
- E. Empty containers shall have labels canceled and be clearly marked as to use.
- F. Upon Substantial Completion, remaining material will become property of OWNER. Seal material as required for storage, marked as to contents and shelf life, and store where required by ENGINEER. Provide OWNER with a minimum of 1 gallon of each color and sheen used on the project.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Do not apply exterior coating in cold, foggy, damp or rainy weather.
2. Do not apply finish in rooms where dust is being generated.
3. Do not apply exterior coating when temperature is lower than 50 degree F or as required by manufacturer.
4. Maintain interior temperature and relative humidity of space, as recommended by coating manufacturer, 24 hrs before applying and until coating is cured.

B. Protection:

1. Cover materials and surfaces, including floors, adjoining or below Work with clean drop cloths or canvas.
2. Remove hardware, accessories, plates, lighting fixtures, and similar items or provide protection by masking. Upon completion, replace above items or remove protection and clean.
3. Maintain manufacturer's environmental requirements while coating dries.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Coatings:

1. Tnemec (or as specially called out in the coating schedule).
2. Or approved equal.

2.02 MATERIALS

A. Coatings:

1. Color shall be formed of pigments free of lead, lead compounds or other materials which might be affected by presence of hydrogen sulfide or other gases likely to be present at Project.
2. Coatings shall meet surface burning characteristics as required by code and established by ASTM E84.
3. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.
5. VOC Classification: Provide high-performance coating materials, including primers, undercoats, and finish-coat materials, that have a VOC classification of 450 g/L or less.

2.03 COLORS

A. Colors shall be selected and approved by the CITY and ENGINEER. The CONTRACTOR will also submit any coatings applied on the exterior of the site to the community's HOA for approval.

B. A piping color schedule may be found at the end of this specification.

- C. Equipment Colors:
 - 1. Equipment includes equipment, motors, and structural supports, fasteners, and attached portions of electrical conduit.
- D. All exterior finish colors shall match Tnemec 04BR Desert Sands except as modified within the project specifications or on the plans or as selected by Owner from manufacturer's full range.

2.04 MIXING AND TINTING

- A. Each coat shall be slightly darker than preceding coat, unless otherwise approved.
- B. Tint undercoats similar to finish coats.

PART 3 EXECUTION

3.01 EXAMINATION

- A. If surfaces to be finished cannot be put into proper condition for finishing by customary cleaning, sanding, and puttying operations or if surfaces were improperly primed by others, report defects to ENGINEER, in writing, or assume responsibility and correct unsatisfactory finish resulting from improper surfaces. Commencement of Work indicates acceptance of surfaces.
- B. Materials removed and replaced to correct defects due to Work placed on unsuitable surfaces shall be at CONTRACTOR'S expense.
- C. Where surface dryness is questioned, test with dampness indicating instrument. Do not apply coatings over surfaces where moisture content exceeds that permitted in manufacturer's printed instructions.
- D. Provide coats compatible with the surface and prior coats.

3.02 SURFACE PREPARATION AND TOUCH-UP

- A. General:
 - 1. Surfaces, including floors shall be clean, dry, and free of loose dirt, dust, and foreign matter before applying coating.
 - 2. Comply with coating manufacturer's recommendations for surface preparation.
- B. Ungalvanized Ferrous Metal:
 - 1. General:
 - a. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
 - b. Prepare welds and adjacent areas to remove undercutting or reverse ridges on weld bead, weld spatter on or adjacent to weld or area to be coated, and sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
 - c. Coat surfaces same day prepared. Re-prepare surfaces starting to rust before coating.

2. Cleaning Methods:

a. Workmanship for metal surface preparation as specified shall conform with SSPC specifications as follows:

- i. SP-1: Solvent Cleaning
- ii. SP-2: Hand Tool Cleaning
- iii. SP-3: Power Tool Cleaning
- iv. SP-5: White Metal Blast Cleaning
- v. SP-6: Commercial Blast Cleaning
- vi. SP-7: Brush-off Blast Cleaning
- vii. SP-8: Pickling
- viii. SP-10: Near-White Blast Cleaning

b. Wherever "solvent cleaning," "hand tool cleaning," "wire brushing," "blast cleaning," or similar words of equal intent used in Specifications or coating manufacturer's specifications, they shall be understood to refer to applicable SSPC specifications listed above.

c. Use hand tools to clean areas that cannot be cleaned by power tools.

3. Shop Preparation: Equipment, structural steel, metal doors and frames, metal louvers, and similar items may be shop-prepared and first coat applied at CONTRACTOR'S option. Centrifugal wheel blast cleaning is acceptable alternate to shop blast cleaning. Clean and prime in accordance with this section.

4. Field Touch-Up: Sandblast items and equipment as specified to restore damaged surfaces previously shop or field blasted and first coat applied. Materials, equipment, procedures, and safety equipment for personnel shall conform to SSPC.

C. Galvanized Metal:

- 1. Touch-up damaged areas with zinc-rich primer.
- 2. Wash galvanized metal surfaces with mineral spirits or comparable manufactured products.

D. Masonry:

- 1. Remove loose grit and mortar.
- 2. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent or other suitable cleaning methods.

E. Concrete:

- 1. Do not begin surface preparation until 30 days after concrete has been placed.
- 2. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent or other suitable cleaning methods.
- 3. Brush-off blast to remove laitance, form release agents, and solid contaminants. Perform sufficiently close to surface to open up surface voids, bug holes, air pockets, and other subsurface irregularities, but so as not to expose underlying aggregate. Resulting surface should be clean and uniform as required by coating manufacturer. If brush-off blasting is impractical, acid etch with muriatic acid solution and wash with water or neutralizing agent as required by coating manufacturer.

F. Plastic:

- 1. Solvent clean pipe in accordance with manufacturer's recommendations.

2. Hand sand with medium grit sandpaper to provide tooth for coating system.
3. Large areas may be power sanded or brush-off blasted, provided sufficient controls employed so surface roughened without removing excessive material.

G. Existing Surface Preparation:

1. General:
 - a. Remove and replace or mask attachments if attachments are not to be coated.
 - b. Remove surface contamination such as oil, grease, loose or otherwise defective paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers to assure sound bonding to tightly adhering old paint. Glossy surfaces of old paint films shall be clean and dull before repainting.
 - c. Sand surfaces and feather edges where chipped surfaces occur.
 - d. Cut out and fill cracks or other defects in existing surface to match adjoining surfaces.
 - e. Exact nature of existing coatings are not known in all cases. While it is assumed they have oxidized sufficiently to prevent lifting or peeling when overcoated with coatings or paints specified, check compatibility by application to small area prior to starting coating. If lifting or other problems occur, notify ENGINEER for direction.
 - f. Comply with new coating manufacturer's recommendations for preparation of previously painted or coated surfaces.
2. Existing ferrous metal surfaces subject to chemical, submerged or splash conditions: As specified for ferrous metals.
3. Existing masonry surfaces subject to chemical, submerged, or splash conditions: As specified for masonry.
4. Existing concrete and precast concrete surfaces subject to chemical or splash conditions: As specified for concrete and precast.

3.03 APPLICATION

A. General Requirements:

1. Spread evenly and flows on smoothly without runs, lumps or sags.
2. Make edges of coating adjoining other materials or colors sharp and clean without overlapping.
3. Number of coats and film thickness required is same regardless of application method. Do not apply succeeding coats until previous coat has cured as required by manufacturer. Where sanding is required, according to manufacturer's direction, sand between applications to produce smooth, even surface.
4. Finish edges of doors as specified for faces. Apply one coat finish on tops and bottoms of doors after fitting.
5. Term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain system's integrity and provide desired protection.
 - a. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces.
 - b. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - c. Omit first coat on metal surfaces that have been shop-primed and touch-up painted.

6. Manufacturer-Applied Coating Systems:
 - a. Repair abraded areas on factory-finished items in accordance with manufacturer's directions.
 - b. Blend repaired areas into original finish.
7. Existing Surfaces:
 - a. If finish coat will not produce uniform coverage, provide first coat base over existing Work.
 - b. Where ceilings or walls scheduled for patching or remodeling, coat entire ceiling or wall in that area.
 - c. At altered rooms, wherever new Work adjoins existing Work, finish new Work to match existing. Apply first coats as specified for new Work on new Work and wash adjacent existing coated surfaces and apply finish coat(s) over entire area.
8. Application Procedures:
 - a. Apply coatings by brush, roller, spray, or other applicators according to manufacturer's instructions.

B. Priming and Sealing:

1. Refer to Coating Schedule for specific coating material.
2. Shop:
 - a. Shop first coat for ferrous metal shall comply with SSPC guidelines, and as specified in Coating Schedules of this Specification.
 - b. Hand or power sand chipped, peeled or abraded first coat and feather edges. Spot coat areas with specified first coat.
 - c. Prior to application of finish coats, clean shop-first coat surfaces free of dirt, oil, and grease.
 - d. Prepare and prime holdback areas as required for specified coating system.

3.04 FIELD QUALITY CONTROL

A. Sampling of Materials:

1. ENGINEER reserves right to select unopened containers of materials furnished for project and have materials tested at an independent testing laboratory. OWNER will pay for first tests.
2. Retests of rejected materials and tests of replacement materials shall be paid for by CONTRACTOR.
3. Remainder of contents of containers not required for testing will be returned to CONTRACTOR.

B. Coverage:

1. If coverage is not acceptable to ENGINEER, ENGINEER reserves right to require extra application of paint at no extra cost to OWNER.
2. Work at site where coat of material is applied will be inspected by ENGINEER before application of succeeding specified coat, otherwise no credit for coat applied will be given and CONTRACTOR automatically assumes responsibility to recoat Work in question.

Furnish ENGINEER report of particular coat applied and when completed for inspection to comply with above.

3.05 COATINGS SCHEDULE

A. General:

1. Unless otherwise noted, Tnemec products are identified in this schedule to establish quality and type desired only.
2. Scheduled thickness or coverage rate is as recommended by Tnemec. If other manufacturers are proposed and accepted, manufacturer's requirements shall be followed, but in no case may thickness or coverage rate be less.
3. DFT = dry film thickness (mils/coat). DFT shown is for spray application. Additional coats may be required if brushed and rolled.
4. sfpg = sq ft/gal (per coat).
5. Examples of surfaces to be coated are not all inclusive.

B. Coating Schedule:

C CONCRETE / MASONRY

C1 Interior

Surface Preparation	SSPC-SP13
Primer Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT
Finish Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT

C2 Exterior

Surface Preparation	Clean and Dry
Primer Coat	Series 180 or 181 W.B. Tneme-Crete; ≥ 6.0 DFT
Finish Coat	Series 180 or 181 W.B. Tneme-Crete; ≥ 6.0 DFT

C7 Buried Below Grade

Surface Preparation	SSPC-SP13
Finish Coat	Series 46-465 H.B. Tnemecol; ≥ 10.0 DFT

S STEEL

S1 Interior

Surface Preparation	SSPC-SP6
Primer Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 4.0 DFT
Finish Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT

S2 Exterior

Surface Preparation	SSPC-SP6
Primer Coat	Series 90-97 Tneme-Zinc; ≥ 3.0 DFT
Intermediate Coat	Series 27 Typoxy or Series 66 Epoxoline; ≥ 2.5 DFT
Finish Coat	Series 73, 1074 or 1075 Endura-Shield; ≥ 3.5 DFT

S3 Submerged Potable

Surface Preparation	SSPC-SP10
Primer Coat	Series 20 or N140 Pota-Pox; ≥ 4.0 DFT
Finish Coat	Series 20 or N140 Pota-Pox; ≥ 5.0 DFT

S4 Submerged Non-Potable

Surface Preparation	SSPC-SP10
Primer Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 4.0 DFT
Intermediate Coat	Series 104 H.S. Epoxy; ≥ 7.0 DFT
Finish Coat	Series 104 H.S. Epoxy; ≥ 7.0 DFT

S6 Buried Below Grade

Surface Preparation	SSPC-SP10
Primer Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 4.0 DFT
Finish Coat	Series 46H-413 Hi-Build Tneme-Tar; ≥ 17.0 DFT

I IRON**I1 Interior**

Surface Preparation	per manufacturer
Primer Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 4.0 DFT
Finish Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT

I2 Exterior

Surface Preparation	per manufacturer
Primer Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 4.0 DFT Series 27 F.C. Typoxy Polyamide Epoxy; 2.0 to 6.0 DFT
Intermediate Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT
Finish Coat	Series 73, 1074 or 1075 Endura Shield; ≥ 2.5 DFT

I3 Buried Below Grade

Surface Preparation per manufacturer
Primer Coat Series 46H-413 Hi-Build Theme-Tar
Finish Coat Series 46H-413 Hi-Build Theme-Tar; ≥ 17.0 DFT

I4 Submerged

Surface Preparation per manufacturer
Primer Coat Series 66 or N69 Hi-Build Epoxoline; ≥ 4.0 DFT
Finish Coat Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT

M NON-FERROUS METAL

M1 Interior

Surface Preparation per manufacturer
Primer Coat Series 66 or N69 Hi-Build Epoxoline; ≥ 2.5 DFT
Finish Coat Series 73, 1074 or 1075 Endura-Shield; ≥ 2.5 DFT

M2 Exterior

Surface Preparation per manufacturer
Primer Coat Series 66 or N69 Hi-Build Epoxoline; ≥ 2.5 DFT
Series 27 F.C. Typoxy Polyamide Epoxy; 2.0 to 6.0 DFT
Finish Coat Series 66 or N69 Hi-Build Epoxoline; ≥ 2.5 DFT

M3 Submerged

Surface Preparation SSPC SP-1 - Brush-Off Blast
Primer Coat Series 66 or N69 Hi-Build Epoxoline; ≥ 4.0 DFT
Finish Coat Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT

P PLASTIC

P1 Interior

Surface Preparation Tack Coat
Finish Coat Devoe Water Base Paint; ≥ 4.0 DFT

P2 Exterior

Surface Preparation Tack Coat
Primer Coat Devoe Water Base Paint; ≥ 1.5 DFT
Finish Coat Devoe Water Base Paint; ≥ 3.0 DFT

W WOOD

W1 Interior / Exterior

Surface Preparation	Clean and Dry
Primer Coat	Series 36 Undercoater; ≥ 3.0 DFT
Finish Coat	Series 6 Tneme-Cryl; ≥ 2.5 DFT

T STUCCO

T1 Exterior

Surface Preparation	Clean and Dry
Finish Coat	Series 607 Conformal Stain; per manufacturer

N INSULATION

N1 Vinyl-coated Pipe and Duct

Surface Preparation	<u>Hand sanded</u>
Primer Coat	Series 66 or N69 Hi-Build Epoxoline; ≥ 5.0 DFT
Finish Coat	

A Aluminum

A1 Interior / Exterior

Surface Preparation	per manufacturer
Finish Coat	Series 115 Uni-Bond DF; ≥ 3.0 DFT

3.06 ADDITIONAL COATING REQUIREMENTS

- A. Where noted in drawings, additional coating may be required on surfaces to protect against vandalism or graffiti.
1. Protective coating shall be ND Graffiti Shield as provided New Dimensions Solutions, LLC or approved equal.
 2. Apply coating per manufacturer's recommendations or as follows:
 - a. Apply four (4) separate coats. Allow each coat to dry completely before applying successive coats.
 - b. Porous materials (concrete/masonry, stucco): Use a coverage rate of approximately 250 square feet per gallon.
 - c. Semi-porous materials (wood): Use a coverage rate of approximately 500 square feet per gallon.
 - d. Non-porous materials (metal, plastic): Use a coverage rate of approximately 500 square feet per gallon.

3.07 SYSTEMS COLOR CODING AND LABELING SCHEDULE

- A. Colors for piping and equipment in piping systems are to be selected and approved by Engineer.
- B. Provide banding and labels.
- C. All exposed piping and equipment shall be finished coated with Tnemec Desert Sands - Color Code: 04BR.

3.08 FINAL TOUCH-UP

- A. Prior to Substantial Completion, examine coated surfaces and retouch or refinish to leave surfaces in condition acceptable to ENGINEER.
- B. After doors have been fitted and hung, refinish edges, tops, and bottoms.

3.09 CLEANING

- A. Before Substantial Completion, remove masking, coating, and other material from floors, glass, and other surfaces and remove rubbish and accumulated materials of whatever nature not caused by other trades from premises and leave in clean, orderly condition, with floors broom clean.

END OF SECTION

SECTION 11070
VERTICAL TURBINE PUMP

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. The installation of a deep well lineshaft turbine pump with above ground discharge, arranged for oil lubrication of the lineshaft bearing by an electric assembly and furnished with suitable drive and accessories as specified herein. The pumping units shall be designed and furnished in accordance with the latest hydraulic institute and AWWA specifications for lineshaft turbine pumps.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. The pump shall be designed and constructed to operate satisfactorily with a reasonable service life, when installed in atypical continuous turbine pump application. The pump shall be the product of, and manufactured by Goulds Pumps, Inc. or equivalent. Other manufacturers will be considered providing the unit offered as an approved equal in all respect to the brand and model preferred by the City and Engineer.

1.03 SUBMITTALS DURING CONSTRUCTION

A. Product Data:

1. Complete working detail and installation drawings and proposed equipment foundations based on certified prints. Drawings shall be sealed by an Arizona Professional Engineer.
2. Show all dimensions.
3. Parts list and descriptions including such items as manufacturer, make, model, style, type, weights, materials, coatings, finishes, and references to appropriate standards.
4. Pump manufacturer's curve showing principal characteristics of pump including:
 - a. Relation between delivery and head.
 - b. Relation between delivery and efficiency.
 - c. Relation between delivery and power.
5. Pump manufacturer's statement of overall efficiency guarantee for pumping unit under specified conditions.
6. Motors: Submit Product Data in accordance with these specifications.

D. Test Results:

1. Factory Test Data: Submit 3 certified copies of factory performance test data, including calculations showing losses not included in shop tests, field performance curves, and computations and curves showing power consumption by motor and bhp load on motor. Submit test data and calculation data.
2. Pump manufacturer's curve in triplicate, showing principal characteristics of proposed pump. Curve shall show:
 - a. Relation between delivery and head from no delivery to maximum delivery of pump.

- b. Relation between delivery and efficiency.
 - c. Shaft input power (hp) of pump between limits stated above.
 - d. Efficiency curve for bowl and motor.
- 3. Draw curves to scale with values that can be read accurately within 1%. Efficiency curves submitted shall constitute guarantee within 1% at rated capacity.
- 4. Field demonstration test results.
- D. Submit in accordance with Section 01640. Do not deliver pumping equipment unless approved by ENGINEER.
- E. Operation and Maintenance Data:
 - 1. Contractor shall furnish complete and detailed instructions for operation and maintenance of all equipment.
- 1.05 QUALITY ASSURANCE
 - A. Pump installer shall be a licensed contractor in State of Arizona.
- 1.06 DELIVERY, STORAGE, AND HANDLING
 - A. Prevent dirt, water, and chemicals from entering inside pipe and equipment.
 - B. Where possible, store materials and equipment inside and protect from weather. If it is necessary to store outside, elevate above grade and cover with waterproof covering.
- 1.07 PROJECT/SITE CONDITIONS
 - A. Pump equipment specified in this section are based on anticipated pumping conditions between the proposed Well 3 site and the existing Tartesso Unit 1 Water Supply Facility.

PART 2 PRODUCTS

2.01 GENERAL

- A. Working parts shall be readily accessible for inspection and repairs, easily duplicated, and easily replaced. Provide all necessary valves and appurtenances for the proper operation of the pumping system.
- B. Bearings shall be ample in size and lubricated. Bearings and similar parts shall have temperature rise not to exceed limit of safety and good practice for such parts.
- C. Apparatus shall be free from shock, vibration, and noise under conditions of load.
- D. Proportion pump parts for stresses that may occur during continuous operation, and for additional stresses that may occur during fabrication, erection, and intermittent or continuous operation.

2.02 PUMPING EQUIPMENT

- A. Manufacturers:
 - 1. Goulds Pumps, Inc. or equivalent
 - a. 13CHC (8 stage), 1800 RPM.

- B. Provide lubrication and pre-lubrication of all moving parts as needed.
- C. Pumping unit shall consist of intake strainer, bowl assemblies, column, anti-vortex and discharge head.

2.03 PUMP CONSTRUCTION

- A. Bowl assembly: The bowls shall be flanged type constructed of close grained cast iron conform to ASTM A48, class 30. They shall be free from sand holes, blowholes, or other faults and must be accurately machined and fitted to close tolerances. They shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times shut-off head, whichever is greater. The intermediate bowls shall have enamel or epoxy lined waterways for maximum efficiency and wear protection. All intermediate bowls shall be of identical design for interchangeability. An oil lubricated adapter with drain ports and adapter bearing shall be used to connect the intermediate bowl to the enclosed column assembly. An extra-long bronze throttle bushing shall be used in the top intermediate bowl and oil lube adapter to minimize the amounts of water leakage through the drain ports. Drain ports are to be provided with sufficient area and shape and angle to permit a non-horizontal escape of water that passes through the throttle bushing. All bowls shall be fitted with sleeve type bearing of bronze alloy C89835 or fluted rubber.
 - 1. A discharge adapter shall be used to connect bowls to the discharge column pipe. To ensure quality and consistency of product, cast iron components must be produced in a foundry owned by the pump manufacturer.
- B. Impellers: The impellers shall be constructed from ASTM B584 silicon bronze and shall be the enclosed (or semi-open) type. They shall be free from defects and must be accurately cast, machined for optimum performance and minimum vibration. Impellers are to be standard product of the pump manufacturer and not contain special workmanship to temporarily increase efficiency. They shall be securely fastened to the bowl shaft with taper locks of C1045 steel. The impellers shall be adjustable by means of a top shaft-adjusting nut.
- C. Suction: The suction bowl shall be provided with a non-soluble grease packed bronze bearing. A bronze sand collar shall be provided to protect this bearing from abrasives in the pumping fluids. The bearing housing shall have sufficient opening at the bottom for easy removal of the bearing.
- D. Wear rings: Pumps 6-inches and larger shall not be fitted with replaceable wear rings.
- E. Shaft: The bowl shaft shall be constructed from ASTM A582 type 416 stainless steel. It shall be precision ground and polished with surface finish better than 40 RMS.

2.04 COLUMN ASSEMBLY - OIL LUBRICATED

- A. Column pipe: The column pipe shall be furnished in sections not exceeding a nominal length of 20 ft. It shall be of ASTM A53 grade B steel pipe and weight shall be not less than schedule 30. The pipe ends shall be machined with 8 threads per inch with 3/16 taper and faced parallel to butt against subsequent column pipes. Inside diameter of the pipe shall be such that the head losses shall not be over 5 feet per 100 feet of pipe. The pipe shall be connected with threaded sleeve type steel couplings.
- B. The shaft enclosing tube shall be of sufficient diameter to provide adequate lubrication under any operating conditions. The enclosing tube shall be ASTM A120 extra heavy weight, continuous weld prime line pipe. Both ends of each tube length shall be bored, faced, and inside threaded with left hand threads. The ends of the tube shall be square with the axis and shall butt

to ensure accurate alignment. The lengths shall be interchangeable with the exception of the top section which shall be designed for applying proper tension to the tube. The tube shall be of such overall assembled length to properly match the length of the discharge column. The enclosing tube shall be stabilized in the column pipe by rubber centering spider spaced 10 feet from the top and bottom, and 40 feet intervals throughout the balance of the column length.

- C. Bearings: The lineshaft bearing which serves as a coupling for the shaft tubing shall be spaced at each tube length, to maintain alignment of pump shafting and to prevent excessive vibration. They shall be of bronze material and machined, threaded and grooved for proper lubrication. Bearings shall be placed every 5 feet.
- D. Lineshaft: The lineshaft shall be of ASTM A108 Grade C1045 steel, ground and polished with surface finish not to exceed 40 RMS. They shall be furnished in interchangeable section not over 20 feet in length, and shall be coupled with threaded steel couplings machined from solid steel bar. It shall have left-hand threads to tighten during pump operation. The diameter of the shaft and coupling shall be designed in according with AWWA E101 Standard.

2.05 DISCHARGE HEAD ASSEMBLY - OIL LUBRICATED

- A. Discharge Head: It shall be of the high profile type and be suitable base of high grade cast iron, ASTM A48-30. It shall be provided for mounting the motor with a discharge elbow having an above ground flanged discharge outlet for 10-inch standard pipe. The design shall have sufficient capacity to carry the combined weight of the column assembly. The design shall allow the top shaft to couple above the stuffing box tension plate assembly. The head shall have connections as required by the plans and standards for air lines, gauges, and sounding tube. If pump setting is deeper than 600-feet, a fabricated steel discharge head shall be used.
- B. A tension plate and tension nut assembly shall be installed in the discharge head to allow proper tension to be placed on the shaft enclosing tube. The tension plate nut shall be of cast iron with O-ring at the bottom end to provide the seal. The tension nut/bearing shall be made of silicon bronze to maintain tube tension and support for the head shaft. After proper tensioning, the tension nut shall be locked into position by a steel cap screw.
- C. The discharge head shall include two oil drippers. One dripper will be a manual dripper that will wet down the lineshaft at a constant rate, which may be adjusted. The second dripper will be an automatic dripper that starts at an adjustable time before the well pumps starts. The automatic dripper shall be controlled by a 120 volt solenoid valve. Both drippers will allow the wetting down of the lineshaft bearings before the pump is started, Both drippers will drain the same reservoir, which will have a 55-gallon volume and configuration approved by the City before installation.

2.06 SUCTION PIPE AND STRAINER

- A. A suitable cone strainer of galvanized steel shall be provided having a free area of at least five times the flow area of the suction pipe.

2.07 ELECTRIC MOTOR

- A. The motor shall be a heavy duty full voltage starting squirrel cage induction type, NEMA design B, 1800 RPM vertical hollow shaft motor, with a non-reverse ratchet to prevent reverse rotation of the rotating elements. A suitable thrust bearing shall be incorporated in the upper end of the motor adequate to receive the entire hydraulic thrust load of the pump unit plus the weight of the rotating parts under all conditions of operation with ample safety factor. This factor should be based on an average life expectancy of five years operating at 24 hours per day. The motor shall be premium efficiency with a TEFC enclosure, 1.15 service factor, and suitable for use on a 460 volt, three phase, 60-cycle electric service. Motor shall have winding thermal protection.

2.08 COATING

A. Coat in accordance with Section 09961, or as directed by ENGINEER.

1. Color: Match adjacent discharge piping.
2. Coating required on exposed discharge head.

2.09 SOURCE QUALITY CONTROL:

A. Factory test pump in accordance with AWWA E101.

B. Motor shall be factory tested prior to shipment to project site. Pump shall be factory tested using similar factory motor and all test results shall be submitted to ENGINEER prior to shipment to project site.

C. Test points shall include shut-off head, rated head, plus at least 3 other points as required for accurate curve plotting.

D. Test data and computations shall be made to provide field head-discharge curves, field wire to water efficiency curves, and field power consumption in kwh/1,000 gal at performance point.

E. Do not include velocity head or internal pump friction head in performance curves.

F. Correct test results to show field performance at speed at which unit will operate with 460v at motor terminals.

G. Do not ship pumping equipment until ENGINEER approves factory test data.

H. If, after installation, units do not operate smoothly, meet vibration limitations specified by Hydraulic Institute, and operate in substantial accordance with factory characteristic curves, they shall be removed and all money paid shall be refunded.

PART 3 EXECUTION

3.01 INSTALLATION

A. Remove and dispose of existing well pump, motor, column assembly, and piping. Install pumping equipment complete in accordance with manufacturer's recommendations and approved submittals. Cut or extend existing casing if required.

B. Make final alignment after process piping is completed and before startup, by manufacturer's representative.

C. Provide proper disinfection procedures per OWNER, State, Local Agency and County requirements.

D. Install pump column per manufacturer's recommendations.

E. On well pump, install PVC transducer line on top of first bowl complete with fittings mounted to pump base.

1. Drill and tap pump head for mounting.

- F. On well pump, install accessory equipment to provide for the proper operation of electrical and mechanical equipment.
- G. Grout pump base plate/discharge head on pump foundation.
- H. Install well casing vent including tapped opening in pump subbase and screened U-bend and vent piping terminating at least 24 in. above finish grade.
- I. Install discharge pressure gauge on process piping or on pump discharge head as indicated on Drawings.
- J. Shut down well pump for minimum of 12 hrs for disinfection. Chlorinate well with 50 ppm solution or as recommended by the manufacturer and per requirements by agency standards.
- K. Pump water to waste after shut-down period until chlorine residual disappears. Contain and de-chlorinate all waste streams.
 - 1. Obtain and comply with state and local permits, if required, for disposal of water pumped to waste.
 - 2. Provide temporary piping and accessories as necessary for disposal of water.
 - 3. Contractor must obtain NPDES permit before pumping to waste.
- L. Obtain 2 safe bacteriological samples in accordance with OWNER, MAG and ADEQ Specifications.
- M. Controls shall be per Electrical Plans and Specifications.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

- 1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site for mandays indicated, travel time excluded, for service during plant construction, plant startup, and training of OWNER'S personnel for operation and maintenance. Include minimum of:
 - a. 1 manday for Installation Services.
 - b. 1 manday for Instructional Services.
 - c. 1 manday for Post Startup Services.
- 2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, and troubleshooting and system related areas.

B. Pump Test:

- 1. Conduct pumping test to demonstrate field performance of pumping equipment.
- 2. Duration of tests shall be as necessary to demonstrate equipment performance and obtain operating data, but shall not be less than 1 hr.
 - a. Measure water levels in well.
 - b. Measure flow rate and pumping water levels at intervals during test period.
 - c. Record water levels to nearest 0.10 ft.
 - d. Measure pressure in pump discharge piping.
 - e. Measure rate of electrical consumption.

- f. Compute pump operating characteristics and efficiency. Compare with manufacturer's performance curve data.
 - 3. Tests will not be considered complete, nor will pumping equipment be accepted if requirements of this Section are not met. All tests shall comply with recommendations of the Hydraulic Institute.
- C. Pump and motor shall operate without excessive vibration, and shall operate at pumping capacity and field efficiency which is consistent with field total dynamic head conditions and approved performance curve data for pumping equipment. Vibration shall be tested using a vibrometer acceptable to the ENGINEER. Vibrometer shall be provided by the CONTRACTOR. Vibrations shall be no more than 3 mils.

SCHEDULE 1 TO SECTION 11070	
PUMP AND ELECTRIC MOTOR CHARACTERISTICS	
<i>Pump Characteristics</i>	
Pump Designation	Tartesso Well No. 3
Pump Bowl Setting (ft)	445
Rated Capacity (gpm)	1,300
Total Dynamic Head at Rated Capacity (ft)	590
Minimum Efficiency of Pump at Rated Capacity (%)	83%
Maximum Allowable Pump Speed (rpm)	1800
Maximum Horsepower (bhp)	249
Pump Column Size (inches)	10
Pump Discharge Size (inches)	10
Pre-Approved Manufacturer and Model	Goulds 13 CHC / 8 Stage
<i>Electric Motor Characteristics</i>	
Horsepower (hp)	250
Voltage	460
Phase/Cycles (Hertz)	3/60
Nominal speed (rpm)	1800
Motor Frame	447

**SCHEDULE 2 TO SECTION 11070
PUMP PERFORMANCE TEST DATA**

TEST DATA PROJECT:								
PUMP NO.:	BOWLS:							
STAGES:	DATE:							
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8
Dynamometer Reading (lb)								
Dynamometer Constant								
(n_t) Test RPM								
Calculated Horsepower								
Shop Test Head (psi)								
Shop Test Head (ft)								
Gauge Height (ft)								
[h] Total Test Head (ft)								
Measured Flow Rate (gpm)								
Discharge Pipe Diameter (in)								
<i>TEST DATA ADJUSTED FOR FIELD RPM</i>								
[n] Estimated Field RPM								
[h₁] Adjusted Head (ft)								
[Q₁] Adjusted Flow Rate (gpm)								
[P₁] Adjusted Brake Horsepower								
Bowl Efficiency								
<i>TEST DATA ADJUSTED FOR THRUST BEARING hp LOSSES</i>								
[P_c] Line Shaft Losses in Field (hp)								
[P_t] Thrust Bearing Losses (hp)								
[P] $P_1 + P_c + P_t$ (hp)								
[h_c] Column Loss @ Pump Setting (ft)								
[h_e] Pump Discharge Head Loss (ft)								
[H] $h_1 - h_c - h_e$								
[E_p] Pump Efficiency								
$\frac{(Q_1)(H)}{(3,960)(P)}$								

* * * END OF SECTION * * *

SECTION 15500
MISCELLANEOUS VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The work discussed in this section pertains to the electronic remote control valve at the well pump to waste discharge assembly and the hydraulically controlled check valve on the well discharge.

1.02 QUALITY ASSURANCE

- A. Valves shall close drip tight when in the closed position.
- B. Valves and fittings shall have a minimum working pressure equal to or higher than the class of the pipe to which they are attached, or 150 psi, whichever is greater.
- C. Ends of valves shall match ends of adjacent pipe.
- D. Valves shall be marked to show name of manufacturer, year of manufacture, size of valve, maximum pipe to which working pressure, and arrow to indicate direction of flow.
- E. All necessary repairs shall be possible without removing the valve from the line.

1.03 SUBMITTALS

- A. Catalog data shall be submitted.
- B. Installation instructions shall be submitted.
- C. Operation and maintenance instructions shall be submitted.
- D. Manufacturer's statement of responsibility shall be submitted.

1.04 WARRANTY

- A. 3-Year warranty shall be required.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Electronic Remote Control Valve w/ Check Feature (Well Discharge)

- 1. Cla-Val Corp. Model 136-03 or equivalent.

- B. Electronic Remote Control Valve (Pump to Waste)

- 1. Cla-Val Corp. Model 61-29-KCX or equivalent.

2.02 EQUIPMENT

- A. General

- 1. The combination of two electrical remote control valves shall be installed at the well site as a pump to waste assembly. These valves will be configured to operate in accordance with Section 17550 of the Instrumentation Specifications.
 - 2. The electric control valves shall include the required piping and valves needed to allow the valves to be operated manually by bypassing the proposed solenoid

valve.

3. The electric control valves shall include limits switches rated for 120V to indicate fully opened and fully closed positions. The valves will also include solenoid valves rated for 120V.

B. Electronic Control Valve (Well Discharge)

1. This valve will use an independent pressure source from an off-site potable water distribution system. The Contractor shall provide small diameter lines with taps and a Solenoid valve from the independent source to the proposed valve.
2. The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. A resilient synthetic rubber disc shall have a rectangular cross-section and shall be retained on three and one-half sides to assure proper gripping under extreme hydraulic conditions.
3. The stainless steel valve stem shall be guided by two bearings located in the cover and the power unit body.
4. The main valve shall consist of two distinct operating chambers that are detachable and completely independent of the flow through the main valve body.
5. Refer to Specification Section 17550 for valve control and operation settings and for additional information.

C. Electronic Control Valve (Well Pump to Waste Assembly)

1. This valve will use an independent pressure source from an off-site potable water distribution system. The Contractor shall provide small diameter lines with taps and a Solenoid valve from the independent source to the proposed valve.
2. The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. A resilient synthetic rubber disc shall have a rectangular cross-section and shall be retained on three and one-half sides to assure proper gripping under extreme hydraulic conditions.
3. The stainless steel valve stem shall be guided by two bearings located in the cover and the power unit body.
4. The main valve shall consist of two distinct operating chambers that are detachable and completely independent of the flow through the main valve body.
5. Refer to Specification Section 17550 for valve control and operation settings and for additional information.

PART 3 EXECUTION

3.01 SCHEDULES

A. Electronic Control Valves

Size 6 and 10 inches

Pattern	Globe, Flanged
Pressure Class	Minimum working pressure equal to or higher than the class of the pipe to which they are attached, or 150 psi, whichever is greater.
Materials	
Valve Body and Cover	Ductile Iron
Disc Retainer & Diaphragm Washer	Cast Iron
Trim:Disc Guide, Seat, and Cover	Bronze
Bearing	
Disc	Buna-N Rubber
Diaphragm	Nylon Reinforced Buna-N Rubber
Stem, Nut, and Spring	Stainless Steel
Pilot System	
Temperature Range	to 180 F
Pilot Control	Bronze ASTM B62
Trim	Stainless Steel Type 303
Rubber	Buna-N Rubber
Solenoid Control Specifications	
Enclosure	General Purpose NEMA Type 3, Aluminum
Housing	
Body	Aluminum
Trim	Stainless Steel
Operating Pressure	300 psi AC or DC
Coil Insulation	Class A (molded)
AC Voltage	15.4 watts
DC Voltage	16.8 watts

END OF SECTION

SECTION 15560
FM-200 CLEAN AGENT FIRE SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1. SCOPE

- A. This Section includes Clean Agent fire-suppression, piping and equipment.
- B. Clean Agent in this specification is defined as FM-200 only. Inergen & NOVEC-1230 are NOT acceptable clean agents for this project.

1.2 GENERAL DESCRIPTION

- A. The work shall include the provision and installation and testing of a complete and operational Clean Agent suppression and alarm system in accordance with this specification and as indicated on the approved construction drawings. The detection system for the Clean Agent suppression system shall be primarily via ionization and/or photo-electric smoke detectors indicated on a deferred submittal prepared and permitted by the Contractor.
- B. The system shall include all standard accessories as are necessary for a complete and operable Clean Agent suppression system. Custom piping sizing and final nozzle layout shall be calculated and performed by the installing contractor and approved prior to installation. It shall be the responsibility of the installing contractor to coordinate with the General Contractor and all sub-contractors so as to provide a complete fully functional and operating system as specified.
- C. The Contractor shall furnish and install all apparatus, accessories, components and associated materials specified or necessary to furnish each system complete (including the initiation system detectors) and ready for operation. All equipment shall be the current product of their manufacturers.
- D. The Contractor shall furnish and install all detection and actuating control system(s) shall be complete, Class "A" electrically supervised combination automatic and manual. Automatic actuation shall be accomplished by smoke or heat detection in areas as indicated on the drawings. Electrical manual actuation stations shall accomplish manual actuation.
- E. The protected area shall have its own agent storage containers and piping as indicated on the approved construction documents. One common (Clean Agent) control panel may control all components. The equipment, materials, installation and workmanship shall be in strict accordance with the required and advisory provisions of NFPA-2001 (Current Edition), except as modified herein. Each system shall include all materials, accessories and equipment inside and outside the building necessary to provide each system complete and ready for use. Install each system to give full consideration to built-in spaces, piping, electrical equipment, ductwork and all other construction and equipment and to be free from operating and maintenance difficulties, all in accordance with detailed shop drawings to be submitted to Design Team and Owner for approval.
- F. Work also includes, but is not limited to the following:

1. Installation of required pressure gauges, signs to identify all valves, interconnection to the fire alarm control unit (releasing panel), hangers, audible and visible notification appliances. Any necessary core drilling through concrete or masonry floors or walls, with approval of structural engineer. General Contractor shall be responsible for fire stopping of all clean agent suppression system piping penetrations through fire rated walls, partitions, and floor-ceiling assemblies. Through-penetration fire-stop details, including Underwriter's Laboratories reference number, shall be shown on the shop drawings.

1.3 RELATED WORK

A. Related Sections and Division

1. It is the Contractor's responsibility to consult other specification sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete, fully integrated and operational installation.
2. Refer to these Division-16 specifications for related guidance:
 - a. Fire Alarm Control Panel will receive a signal from this control panel.

1.4 REFERENCES

- A. NFPA 70, 2008 Edition, National Electric Code
- B. NFPA 72, 2007 Edition, National Fire Alarm Code
- C. NFPA 2001, 2008 Edition, Standard on Clean Agent Fire Extinguishing Systems
- D. International Building Code – 2006
- E. International Fire Code – 2006

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications: The Contractor shall be an Arizona licensed Contractor in possession of a valid special hazards suppression system Contractor's license. A qualified Contractor whose business is located within a 75-mile radius of the project site must perform shop drawing design and installation. The Contractor shall have a minimum of three (3) years experience in the installation of special hazard suppression systems in similar facilities.
- B. All equipment shall be Listed or Approved by Underwriter's Laboratories or Factory Mutual.
- C. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing special hazards fire suppression systems and providing NICET III certified technician services needed to assume shop drawing design responsibility.
- D. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approved Guide" that comply with other requirements indicated.

- E. NICET III or IV Technical Responsibility: Preparation of shop drawings, calculations, and field test reports by a qualified NICET III or IV certified technician. Provide calculations in accordance with manufacturer's requirements and instructions.
- F. NICET Certified Technician Qualifications: A person who is certified to design special hazards fire suppression systems by the National Institute for Certification in Engineering Technologies and who is experienced in providing technician services of the kind indicated. Technician services are defined as those performed for installations of fire-suppression piping that are similar to those indicated for this project in material, design, and extent.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 SYSTEM DESIGN CRITERIA

- A. Design and installation of FM-200 clean agent fire extinguishing system shall conform to NFPA 70, NFPA 72 and NFPA 2001 and to the requirements as hereinafter specified as amended by this Section.
- B. Clean agent suppression system with reference points for design. In field wiring diagrams, show locations of devices and points of the system. Prepare working drawings in accordance with the requirements for "Plans" as specified in 2001. Include data essential to the proper installation of each system.
- C. The work shall meet IBC and IFC requirements, Owner requirements, Owner Insurance Underwriter requirements and includes all labor, materials, tools, equipment, transportation, and temporary construction necessary to design, fabricate, install and test complete a clean agent suppression system specified hereinafter.
- D. Submit clean agent discharge calculations verifying total storage requirements, flooding concentrations, discharge times, flow through the piping network, pipe sizes, and nozzle orifice sizes, in accordance with the Manufacturer's Listed design manual and NFPA 2001.
- E. The system shall totally flood the protected area indicated on the plans providing a volumetric concentration of clean extinguishing agent of not less than seven percent (7%) by volume at 70 (seventy) degrees Fahrenheit. Agent concentration shall be no more than the level of No Observable Averse Effect Level (NOAEL). Each protected area as shown on the drawings shall have its own dedicated storage cylinders as shown on the approved construction documents.
- F. The clean agent concentration shall be based upon shutting down the heating, ventilation and air conditioning (HVAC) systems at the time of agent discharge. The required clean agent concentration shall be maintained throughout the protected areas for a minimum of ten (10) minutes.
- G. The maximum clean agent discharge time shall be ten (10) seconds.
- H. Where required by Owner each system shall be provided with its own dedicated connected reserve supply of clean agent. Each reserve supply shall contain an amount

of clean agent equal to the primary supply of the system to which it is connected. Refer to approved construction documents for applicability.

1.7 PERMITS

- A. The Contractor shall obtain permits and pay any necessary fees. The Contractor shall carefully coordinate all work and testing subject to the requirements of Local and the Arizona State Fire Marshal's Office to ensure that all such work and testing is performed, witnessed and approved to the satisfaction of AHJ and Owner in accordance with all applicable rules, regulations, and permits. The Contractor shall submit a Request for Information (RFI) prior to performing any work that conflict with the requirements of the Contract Documents or which Contractor believes is outside the scope of work included in the Contract.

1.8 SUBMITTALS

- A. Product Data: For valves, alarm devices, tanks, hoses, piping, release panel, and suppression agent supply.
- B. Clean agent suppression system shop drawings: Working plans, prepared according to NFPA 2001, that have been approved by Owner. Include system calculations.
- C. Field quality-control test reports.
- D. Operation and maintenance data.
- E. Shop Drawings
 1. Within ten (10) days after the award of the contract, submit for approval of two (2) copies of manufacturer's literature for each piece of equipment used in the system. If the manufacturer's catalog sheets show more than one (1) item, the specific items proposed for use shall be clearly identified using arrows (highlights are not acceptable).
 2. Shop drawings, flow calculations, and material submittals used in this clean agent suppression system shall be in accordance with NFPA 2001 and shall be submitted to Architect, Engineer and Owner. Drawings shall be standard 24-inch by 36-inch drawings, 1/8-inch scale, and prepared on AutoCAD, Release 2000.
 3. Contractor shall prepare shop drawings, flow calculations, seismic load calculations (where applicable), provide complete materials cut sheets, and submit six (6) sets all package for approval before starting any work.
 4. Each submittal package shall be prepared and presented in a professional manner, be bound and shall include a title page and index. Each section of the submittal shall be numbered. Submittal packages shall be complete. Suppression system contractor shop drawings and calculations must be prepared and submitted for approval, by a NICET Level III or IV certified technician.
 5. The Contractor shall certify in writing that the submittal documentation is in conformance with all of the requirements of this specification and the applicable referenced Codes, Standards, and Regulations.
 6. The Contractor shall not order any equipment and shall not begin any work until the submittals have been approved in writing by all parties. The Contractor shall not perform any installation prior to the receipt of a written authority to proceed from Owner.
 7. Design Team, Owner and General Contractor shall review shop drawing documents for the limited purposes of checking for general conformance with the design and not to determine accuracy or completeness of other details such as dimensions and

- quantities. Design Team shall not approve means, methods or procedures of construction or installation; nor shall they review for safety precautions.
8. If submittals are found not to conform to all of the requirements of this specification and the applicable referenced Codes, Standards and Regulations, the Contractor shall be required to revise and re-submit the package with modifications.
 9. In the event that the Contractor's submittal package is required to be revised and resubmitted due to nonconformance with this specification, illegibility of the submittal, incomplete submittals, noncompliance with the referenced local, state and national Codes, Standards, and Regulations or nonconformance with pertinent documentation relative to the project, the Contractor shall pay all fees associated with the additional submittal review. Payment of the fees shall be solely the Contractor's responsibility.
- F. Prior to performing any work, the Contractor responsible for the clean agent suppression system installation shall include the following documentation in addition to those documents required elsewhere in this specification:
1. Sufficient information to describe their qualifications, the work efforts to be performed, and the materials to be provided, including the names and qualifications of the Contractors. Contractor's qualifications shall include years in business prior experience with installations that include this type of equipment that is to be supplied.
 2. A schedule indicating the delivery dates of the equipment to be supplied; installation sequence; time frame and the total amount of on-site technical assistance, time (in man hours) that the supplier of the equipment has included in their bid to comply with the requirements of this specification and demonstration test and final test/acceptance dates to meet Owner's scheduled project completion dates.
 3. A preliminary Equipment List identifying the type, quantity, make and model number of each piece of equipment to be provided under this submittal. The Equipment List shall include the type, quantity, make and model of spare equipment, as specified in this specification. Types and quantities of equipment submitted shall coincide with the types and quantities of equipment shown on the shop drawings. A final Equipment List shall be submitted with the Operating and Maintenance (O&M) manual, as specified in this Specification.
 4. A sequence of operation that describes how the system responds during an alarm, supervisory and trouble condition. The description shall include the releasing panel LED's, audible and visible indications; initiating devices, notification appliances, and auxiliary functions (such as HVAC fan unit shutdown and damper closure). The description shall provide sufficient information so that the exact function of each installed device and appliance is known.
 5. Manufacturer's original product datasheets, specifications, installation instruction sheets and descriptive information for all major components of the system. Copies shall not be acceptable. All equipment and devices to be furnished under this contract shall be clearly marked (with arrows) on the product datasheets.
 6. Detail sheets from the manufacturer of the U.L. Listed through-penetration fire stop assembly.
 7. Proof of insurance consistent with Owner's requirements.
- G. Equipment other than specified shall be considered for approval. It shall be the Contractor's obligation to submit data and information to allow Owner and Design Team time to consider the equality of the substituted items to that specified. It is the Contractor's responsibility to meet the entire intent of the specifications. Deviations from the specified items shall be at the risk of the Contractor until the date of substantial completion of the project and acceptance by Owner. Accepted submittals on substitute

equipment shall only allow the Contractor to proceed with proposing a substituted item and shall not be considered equal until such time as Owner and Design Team have completely accepted the substitute item. The Contractor shall provide the following in writing to Owner a minimum of ten (10) days before the submittal date:

1. Complete lists, descriptions, and drawings of materials to be used.
 2. All pertinent information regarding the reliability and operation of the equipment to be supplied.
 3. Manufacturer's original product datasheets, specifications, installation instruction sheets and descriptive information for all major components of the system.
- H. Owner may request a demonstration (without gas release) of the proposed equipment at no additional cost to Owner.
- I. The Contractor and the equipment supplier shall advise Owner of all anticipated projects that have the same approximate completion dates as this project and what impact they shall have on the timely completion of this project.
- J. Record Drawings
1. Maintain a current set of redlined drawings at the job site. Redline drawings shall show all changes made in the field.
 2. When installation is completed, prepare complete record (as-built) drawings that incorporate all changes to approved shop drawings. Coordinate with approved construction document engineering firm.
 3. Submit one (1) complete reproducible set of record drawings, and an electronic format set of drawings on AutoCAD, Release 2000, to Owner.
- K. Operating and Maintenance Information
1. Not less than seven (7) calendar days prior to the final acceptance testing of the entire system, and for use during the instruction period hereinafter specified, provide four (4) bound copies of an Operation and Maintenance Manual to Owner. The manual shall include an index, copies of all approved shop drawings and submittal materials (updated as-built), and a complete parts list of all components. The manual shall also include, for each item, the manufacturer's name, the serial number of the part, an ordering number, if appropriate, and a physical description of the part.
- L. Material and Test Certificates
1. When preliminary field tests have been completed and all necessary corrections made, submit to Owner a signed and dated letter attesting to the satisfactory completion of testing and stating that the system is in operating condition. The letter shall include a written request for a formal inspection and test.
- M. Schedule of Installation
1. Submit for approval a schedule of performance, showing all major milestones, within two (2) weeks after contract award.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products in accordance with manufacturers' instructions.
- B. Coordinate storage arrangement and location with General Contractor and Owner.

- C. Deliver and store products in shipping containers, with labeling in place.
- D. Provide temporary protective coating on cast iron and steel valves.
- E. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.10 ORDER OF PRECEDENCE

- A. Should conflicts arise out of discrepancies between documents referenced in this specification, the most stringent requirement shall apply; however, should a level of stringency be indeterminable, the discrepancies shall be resolved as follows:
 - 1. Owner's Insurance Underwriter's requirements shall take precedence over this specification.
 - 2. The IBC and IFC shall take precedence over this specification.
 - 3. The National Fire Protection Association Standards shall take precedence over this specification.
 - 4. This specification shall take precedence over the drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment furnished under this specification shall be new and listed for its intended application. Where two (2) or more pieces of equipment that perform the same function are required, they shall be the product of one (1) manufacturer and exact duplicates. Contractor shall ensure that all new equipment is completely compatible with existing on-site Fire Alarm Panels.
- B. Any material, equipment or product to be used, which is approved by Factory Mutual (FM) and not listed by Underwriter's Laboratories (UL), requires the approval of the Owner.

2.2 PIPING

- A. Conceal piping to the maximum extent possible. Piping shall be inspected, tested and approved before being concealed. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; the use of bushings is not permitted.
- B. ASTM A 53 or ASTM A 106, black or zinc-coated, threaded, Schedule 40.
- C. ASME B16.11 or ASME B16.3, Class 300, zinc-coated, threaded, except Class 150 or 300 for pipe $\frac{3}{4}$ -inch or smaller.
- D. Rods, hangers and supports shall be zinc plated. It is recommended that pipe hangers and supports be furnished and installed by the Contractor as follows:

Nominal Pipe Size (inches)	Maximum Spacing (feet)
1 and under	7
1.25	8
1.5	9
2	10
2.5	11
3	12
3.5	13
4	14
5	15
6	16

- E. Provide sleeves where piping passes through masonry or concrete walls, floors, roofs and partitions. Sleeves in outside walls below and above grade, in floor, and in roof slabs, shall be standard weight zinc coated steel pipe. Sleeves in partitions shall be zinc coated sheet steel having a normal weight of not less than 0.90 pounds per square foot. Space between piping and the sleeve, shall be not less than 0.5 inch. Sleeves shall be of sufficient length to pass through the entire thickness of the walls, partitions and slabs. Extend sleeves in floor slabs 2-inches above the finished floor. Pack space between the pipe and sleeve with a Listed through penetration fire stop system.
- F. Provide escutcheon plates for piping passing through floors, walls and ceilings with one piece or split type plates. Plates where pipe passes through finished ceilings shall be painted to match the ceiling color. Other plates shall be of steel or cast iron, with aluminum paint finish. Securely anchor plates in place.
- G. Discharge nozzles shall be custom-fabricated of corrosion resistant materials. All nozzles shall be designed so that the orifice piece is connected directly to the supply pipe. The size of pipe and nozzles shall be determined from the calculated flow and terminal pressures in accordance with established, recognized test data contained in the manufacturer's listed design manual.
- H. Storage cylinders shall be constructed of high strength alloy steel, conforming to all applicable specifications of the Department of Transportation. Container design shall permit on-site reconditioning and refilling when required. Safety valves, manifolds, pressure gauges, and pressure switches shall be furnished and installed.

2.3 IDENTIFICATION SIGNS

- A. Furnish and install a properly lettered and approved metal sign to each control valve and alarm device.
- B. Furnish and install a sign on the room containing the clean agent suppression system supply tanks stating: "Clean Agent Supply Tanks".
- C. Furnish and install required building exterior system safety signs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform clean agent suppression system flow calculations according to NFPA 2001 and Manufacturers Standards. Use results for system design calculations required in “Quality Assurance” Article in Part 1 of this Section.

3.2 INSTALLATION

- A. Contractor's Shop Drawings:
 - 1. Prior to installation, all shop drawings, calculations, and material submittals shall be reviewed and accepted by Architect, Engineer, Owner and General Contractor.
 - 2. Contractor shall coordinate work on this Section with other affected trades.
- B. Initial Material Inspection
 - 1. Ream pipe and remove burrs.
 - 2. Remove scale and foreign material from inside and outside before assembly.
 - 3. Contractor shall replace any damaged materials with new materials at no additional cost to the Owner.

3.3 APPLICATIONS

- A. Flanges, unions, transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in above-ground applications, unless otherwise indicated.

3.4 JOINT CONSTRUCTION

- A. Refer to NFPA 2001 and Division 15 Section “Basic Mechanical Materials and Methods” for basic piping joint construction.
- B. Refer to manufacturer's specification for joint construction.

3.5 PIPING INSTALLATIONS

- A. Refer to NFPA 2001 and Division 15 Section “Basic Mechanical Materials and Methods” for basic piping installation.
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Hangers, supports, and penetrations as detailed in Part 2 of these Specifications.
- D. All through penetrations fire stop systems as detailed in Part 2 of these Specifications shall be designed by Hilti or approved equivalent.
- E. Group piping at common elevations where practical. Identify all suppression system piping with a minimum 2-inch wide red band at 10-foot maximum intervals.
- F. Route piping in an orderly manner plumb and parallel to the building structure where practical.

3.6 CONNECTIONS

- A. Connect suppression system tanks to piping distribution network as indicated on the approved construction documents.

- B. Connect releasing valve to suppression system storage tanks.
- C. Electrical Connections: Power wiring is specified in Division 16.
- D. Connect alarm, supervisory, and trouble signal devices to the releasing panel.

3.7 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in Division 15 Section "Basic Mechanical Materials and Methods."

3.8 FIELD QUALITY CONTROL

- A. Scheduling of Work
 1. Coordinate the installation schedule for this portion of the work with the overall construction schedule for the project to ensure orderly progress of the work without delay.
 2. Coordinate the interface of the clean agent suppression system with the work of all other trades as well as new construction to ensure proper and adequate provision for the installation and connection of this system.
 3. The suppression system shall be installed under the supervision of a qualified, trained, NICET III or IV certified technician. The NICET III or IV technician is expected to be on site and during the installation of equipment, and testing of the system. The system shall be demonstrated to perform all of the functions as specified.

3.9 FINAL INSPECTION AND TESTING

- A. Demonstration Test
 1. The Contractor shall perform a demonstration testing in accordance with the requirements of NFPA 2001.
 2. Upon completion of the installation of the clean agent fire suppression system, the Contractor shall provide a minimum of one (1) week's notice to the Owner that the Contractor has satisfactorily tested the system and the system is ready for the Demonstration Test.
 3. At the time of notification, the Contractor shall submit one (1) copy of the approved Test Plan. The tests shall demonstrate that the operating and installation requirements of this specification have been met.
 4. When preliminary field tests have been completed and all necessary corrections made, submit to Owner a signed and dated letter attesting to the satisfactory completion of testing and stating that the system is in operating condition. The letter shall include a written request for a formal inspection and test. The following information shall be included in the letter:
 - a. Building information, including name, address, and city.
 - b. The Contractor's name, address, city and telephone number.
 - c. The control unit configuration, serial number, access passwords, extent of battery backup, locations of remote annunciators, a description of remote function, and type of fire department connection.
 - d. The total quantity of notification appliances, initiating devices, addressable modules, etc.

- e. The quantity of alarm signal units, fire alarm boxes, and each type of detector in each area. In addition, the connection position of each device shall be indicated, and further indicate the test results of each device and any subsequent action taken.
 - f. Pertinent comments regarding the installation, operation, testing, inspecting, or other aspects of the system.
 - g. The manufacturer's technical representative shall print his/her name and affiliation and sign and date the document.
5. The tests shall demonstrate the entire suppression system functions as intended. All circuits and devices shall be tested, including equipment shutdown, alarm signaling devices, horns, strobes and auxiliary functions (HVAC shut down, damper closures, and door closure). In addition, supervision of each circuit shall be tested.
 6. At a minimum, the Contractor shall perform the following:
 - a. Operate every detection and initiation device to ensure proper operation, correct annunciation at each releasing panel and the main fire alarm control unit (if applicable) and proper operation of all alarms and auxiliary functions. Where applying heat would destroy the detector, they may be manually operated.
 - b. The signaling line circuits and the notification appliance circuits shall be opened in at least two (2) locations to check for the presence of correct supervisory circuitry.
 - c. One-half (1/2) of all tests shall be performed on battery standby power.
 7. Upon satisfaction completion of the Demonstration Test, the Contractor shall leave the system operating for a minimum of one (1) week prior to the Acceptance Test.
 8. If unsatisfactory results occur during or after the Demonstration Test, the Contractor shall be responsible for any and all, additional charges incurred by the Owner with respect to corrective action including but not limited to test monitoring and engineering services during the time it takes to obtain Final Acceptance by the Owner. Final Acceptance by Owner means that the system is completely operational and in conformance with this specification and applicable codes and standards, all documentation has been submitted as required by this specification, and all training as required by this specification has been completed to the satisfaction of Owner.
 9. When the testing has been completed to the satisfaction of the Contractor's job foreman and the representative of the manufacturer, a notarized letter co-signed by each, attesting to the satisfactory completions of said testing, shall be forwarded to the Owner.

B. Room Test

1. A door fan room pressurization test shall be conducted to verify room integrity and that all protected areas are air tight to the maximum extent possible. This includes any false ceilings (ceilings shall have clips in place) or above space plenum and below raised floors. Contractor shall inspect and verify that all openings are sealed with caulking, weather proof door seals and include barriers for cable penetrations. Any retest shall be at the Contractor's expense. This Contractor shall thoroughly coordinate and ensure that the General Contractor is constantly aware of that area required to be pressurized and contained.

C. Acceptance Test [Without Agent Discharge]

1. The Contractor shall perform a demonstration testing in accordance with the requirements of NFPA 2001.
2. Before the installation shall be considered complete and acceptable by the awarding authority, the Final Acceptance Test shall be performed. This test shall be coordinated and performed by the Contractor's job foreman, in the presence of

Owner, and other interested parties identified by Owner. In order to assure attendance of the necessary representatives, prior to the final test, each representative scheduled to witness the test shall be provided reasonable notification of the test date by the Contractor (at least forty-eight (48) hours). The test shall not be conducted until all parties agree on the scheduled test date.

3. The Contractor shall provide all the necessary personnel and equipment to conduct the tests.
4. At a minimum, the Contractor shall perform the following:
 - a. Operate every detection device to ensure proper operation, correct annunciation and the intelligent releasing panel and the main fire alarm control unit and the proper operation of all alarms and auxiliary functions. Where applying heat would destroy any detector, they may be manually operated.
5. If the Final Acceptance Test fails, the Contractor shall prepay all costs incurred to Owner for any and all reacceptance testing.
6. Upon satisfactory completion of the tests, the Contractor shall leave the system in proper working order and without additional expense to Owner, shall replace any defective materials or equipment provided by the Contractor under this Contract within one (1) year from the date of final acceptance by the awarding authority.

3.10 TRAINING REQUIREMENTS

- A. Security Personnel: Prior to final acceptance of the system, the Contractor and supplier shall provide operational training to Owner. Training session shall be a minimum of one (1) hour and shall be conducted at a time acceptable to the Owner. Each session shall include an overview of the system and the devices connected to it, emergency procedures (including alarm, trouble and supervisory condition procedures), control unit operation, and safety requirements. Each session shall include a complete demonstration of the system. Session shall be digitally recorded by video such that at the completion of the training, Owner may obtain and retain recording DVD's for future employee training. Dates and times of each training period shall be coordinated through Owner, not less than two (2) weeks prior to the training session.
- B. Maintenance Technicians: The Contractor shall arrange for manufacturer training representatives to provide the necessary factory training for operation and troubleshooting of the installed equipment to the buildings property management and maintenance technicians. This training shall include providing the Manager with all access codes and written certification that he/she is authorized to operate and troubleshoot the equipment supplied by the manufacturer. This training shall be digitally recorded by video such that at the completion of the training, Owner may obtain and retain recording DVD's for future employee training.

3.11 CLEAN-UP

- A. Maintain the jobsite clean and orderly each and every day. Upon completion of the work, the Contractor will completely remove all debris and excess materials from the job site.

3.12 GUARANTEE

- A. Except as otherwise expressly provided in the Contract Documents, and excepting only items of routine maintenance, ordinary wear and tear or unusual abuse or neglect, Contractor guarantees all work executed by Contractor and all supplies, materials and devices of whatsoever nature incorporated in, or attached with the work, or otherwise

delivered to the Owner as part of the work pursuant to the contract to be absolutely free of all defects of workmanship and materials for a period of one (1) year after final acceptance of the work by Owner's Representative.

- B. Include service directory with telephone numbers for 24-hour emergency service.

+ + END OF SECTION + +

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Electrical general provisions as indicated, specified and required for constructing a complete, ready for use electrical system as described in these Contract Documents.
- B. Labor, materials, apparatus, and appliances essential to the complete functioning of systems described and indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Documents or not, shall be furnished and installed by the Contractor. In case of doubt as to the work intended, or in the event of need for explanation thereof, Contractor shall refer to the Engineer for supplemental instructions.
- C. All items not specifically mentioned in these specifications or noted on the Drawings, or on shop drawings, but which are necessary to make a complete and satisfactory, working electrical/instrumentation installation, shall be deemed to be included herein.
- D. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of -20°C to 50°C , and specifically rated for an altitude of 1500 feet. Where these criteria cannot be met, ancillary equipment and/or special derating factors as approved by the Engineer shall be utilized.
- E. The Contractor shall perform all necessary saw cutting, core drilling, excavating, removal, shoring, backfilling, etc. as required for the proper installation of conduits whether inside or outside of the building(s) and structure(s). The Contractor shall repair and patch where demolition has taken place in a manner to match existing original structure.

1.02 SUBMITTALS

- A. Submit documentation for review as described in individual Specification Sections for products requiring submission.
- B. Submit Division 16 in one submittal, or at a maximum, the following may be submitted as separate submittals for this project.
 - 1. Commodities (Sections 16010-16195) and Grounding (Section 16450)
 - 2. Lighting (Section 16500)
- C. Documentation must be arranged in numerical sequence corresponding with each Specification Section and article of each Section. Soft copies shall be in “pdf” format with “character recognition” and shall include the following as a minimum:

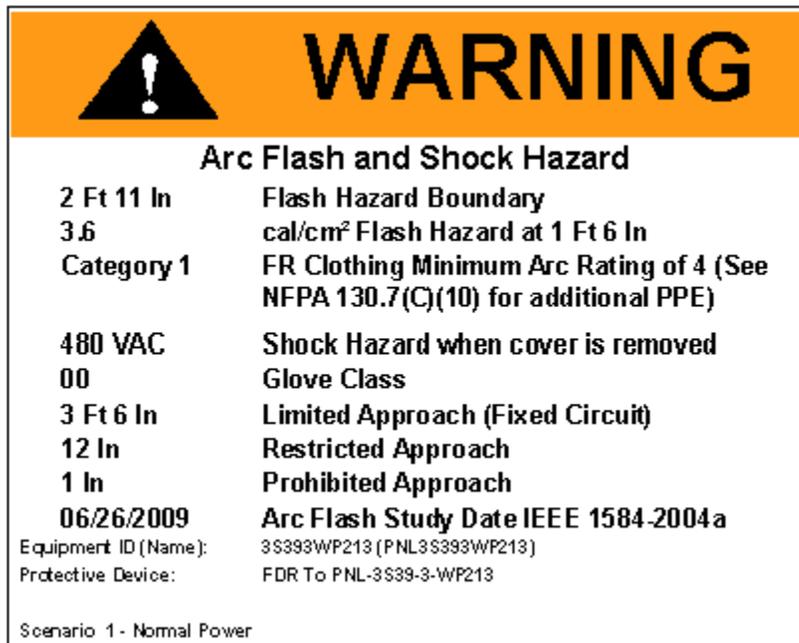
1. A cover sheet to identify the Contractor's name, name of the project, date and description, i.e. "Division 16 – Commodities".
 2. An index corresponding to each specification section with all addendum updates included. Each paragraph or bulleted item shall be check marked to signify compliance with each item and the information is included in the submittal package. If full compliance is not met for any reason, the non-compliance item shall be underlined and reference to a detailed written explanation of the deviation or non-compliance shall be provided in the margin to the right of the specification paragraph or bulleted item for consideration.
 3. Bookmarks within each section for each major component within.
 4. Complete manufacturer name and model number of each item. Listing items "as specified" without both make and model or type designation is not acceptable.
 5. Descriptive Data: complete description, information, and performance data covering materials and equipment that are being proposed. Each component shall be clearly identified on each sheet. Refer to individual specification sections for additional submittal requirements.
- D. Hard copies, if required, shall be bound in 3-ring binders (2" max) and include all information as described above for soft copies. The binders shall include tabs corresponding to a neatly typewritten index. The binder cover and edge shall clearly identify the Contractor's name, name of the project, date and submittal number.
- E. Important Notice:
1. **After material or equipment has been submitted and approved, no substitutions will be allowed. Any equipment installed that is different than the approved shop drawings and submittals will be removed and replaced at the Contractor's expense without exception!**
 2. If Contractor's submittal(s) depart from the Contract Documents, the Contractor shall make specific mention thereof in his letter(s) of transmittal, otherwise review of such submittals by the Engineer shall not constitute review of such departure(s).
 3. The Contractor may be charged for costs incurred by the Engineer for third and subsequent submittal reviews. Cost for Engineer's review time shall be billed at the Engineer's standard hourly rates.
 4. Where calculations, sealed by a registered professional engineer, are required to be submitted, they will be reviewed for content and format but will not be reviewed for accuracy.
- F. For control panels, motor starters and other equipment requiring multiple terminations of components and devices, the Contractor shall submit detailed shop drawings consisting of point-to-point wiring diagrams, bill of materials, interior and exterior elevations with dimensions prepared by the equipment manufacturer or a UL 508A recognized system integrator.

1.03 POWER STUDIES

A. An Arc Flash Hazard Study for the electrical distribution system equipment shall be prepared by the manufacturer of the overcurrent protective devices or one of the following independent, InterNational Electrical Testing Association (NETA) accredited testing organizations:

1. Southwest Energy Systems, LLC.
2. Hampton Tedder Technical Services
3. Western Electrical Services, Inc.
4. Electric Power Systems, Inc.
5. Electrical Reliability Services

The intent of the Arc Flash Hazard Study is to determine hazards that exist at each major piece of electrical equipment. The study shall indicate the total number of arc flash labels (locations with calculations) that will be supplied. Arc Flash Hazard Warning Labels listing all items as shown on the sample label below shall be provided and installed by the Contractor. Arc Flash Hazard Warning Labels shall be UV resistant where installed on equipment located outdoors. The study shall be submitted with the electrical equipment submittal.



Example Arc Flash Label

B. Short Circuit and Overcurrent Device Coordination Study: The manufacturer of the overcurrent protection devices or the selected NETA accredited testing organization shall prepare a coordination study to verify all 480-volt overcurrent devices will properly trip in a coordinated manner. When two or more overcurrent devices in series with each other experience a short circuit or overcurrent condition, the overcurrent device nearest to the fault shall trip (open) first to prevent any other device from tripping.

1. A report shall be prepared to summarize the coordination study, conclusions and recommendations. As a minimum it shall include the following:
 - a. The manufacturer's information used to prepare the study.
 - b. Assumptions made during the study.
 - c. Single line diagram showing all devices in the study with appropriate labels.
 - d. Device time-current curves on log-log paper showing:
 - 1) That the settings for each protective device will provide protection and selectivity.
 - 2) Each device and curve clearly identified.
 - 3) Recommended settings for each adjustable overcurrent device.
 - 4) Circuit interrupting device operating and interrupting times.
2. Short circuit amps available at each overcurrent device.
3. All overcurrent devices in series with each other indicated on one graph.
 - a. Time-current curves for each device shall be positioned to provide for maximum selectivity to minimize system disturbances during fault clearing.
 - b. Advise the Engineer of potential coordination problems discovered during the study and include recommendations to resolve the problem.
4. The report shall be submitted with the overcurrent device submittal. Equipment containing overcurrent devices will not be reviewed without the coordination study.

1.04 SPACE REQUIREMENTS

- A. Space Requirements: In the preparation of Drawings, a reasonable effort has been made to include equipment manufacturer's recommendations. Since space requirements and equipment arrangement vary according to manufacturer, the responsibility for initial access and proper fit rests with the Contractor. Final arrangement of equipment and service connections shall allow the unit to be serviced, including space to pull motors, change fuses, and operate switches. Minimum working clearances shall be as required by NEC and local codes.

1.05 COORDINATION

- A. Contractor shall coordinate with all other trades to avoid conflicts and interferences. No extra compensation will be allowed for changes made necessary due to interference between work of various trades.
- B. Any discrepancies noted in these contract documents or discrepancies between Drawings and actual field conditions shall be promptly brought to the Engineer

for a decision. No extra compensation will be allowed for changes made by the Contractor without Engineer's consent.

- C. Carefully check and coordinate each device location and elevation. Also check routing of all conduits for conflicts with structures, mechanical piping, etc. to avoid conflicts.

1.06 REGULATORY REQUIREMENTS

- A. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of the National Electrical Code (NEC), State and local codes, and according to the latest Institute of Electrical and Electronic Engineers (IEEE); American National Standards Institute (ANSI); American Society for Testing and Materials (ASTM); Insulated Cable Engineers Association (ICEA); National Electrical Manufacturers Association (NEMA) Standards; and the latest published regulations of the Federal Occupational Safety and Health Act (OSHA). When applicable, the material used in the performance of the electrical work shall be listed by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.
- B. The backpanel in the RTU/Control Section in the motor control center shall be assembled and wired by a UL 508A recognized panel shop. All control panel components shall be UL recognized or ground fault protected per UL 508A fabrication standards. Each control panel assembly shall be fabricated according to UL 508A Standards and shall bear a serialized UL 508A label.

1.07 RECORD DRAWINGS AND OPERATING AND MAINTENANCE MANUALS

- A. Record Drawings: On completion of work, Contractor shall furnish a complete set of Record Drawings and Shop Drawings which properly reflect final locations and sizes of conduit, equipment fixtures, controls, etc., as actually installed. Dimensions shall be included on the Contractor's as-built Drawings showing exact location of underground conduits.
- B. Operation and Maintenance (O&M) Manuals: Contractor shall provide O&M manuals for equipment and materials furnished under this contract. O&M manuals must be submitted and approved before final inspection of the project so that they may be used during startup. Soft copies shall be in "pdf" format with "character recognition" and shall include the following as a minimum:
 - 1. A cover sheet to identify the Contractor's name, name of the project, date and description, i.e. "Electrical Equipment O&M Manual".
 - 2. Bookmarks within each section for each major component within.
 - 3. Complete manufacturer name and model number of each item.
 - 4. Descriptive data, wiring diagrams, control panel drawings, etc from the approved submittals/shop drawings.
 - 5. Complete instructions regarding the installation, operation and maintenance of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. **O&M**

manuals must be individually tailored to the project and equipment as furnished.

6. Complete nomenclature of replaceable parts, part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or components not related to equipment furnished must be removed or crossed out. *O&M manuals must be individually tailored to the project and equipment as furnished.*
 7. Copy of warranties issued on the installation, showing dates of expiration.
- C. Hard copies, if required, shall be bound in 3-ring binders (2" max) and include all information as described above for soft copies. The binders shall include tabs corresponding to a neatly typewritten index. The binder cover and edge shall clearly identify the Contractor's name, name of the project, date and identified as "Electrical Equipment O&M Manual".

1.08 QUALITY ASSURANCE

- A. The Contractor performing the electrical construction and installation shall be a reputable Contractor licensed in the State of Arizona to do electrical **commercial** construction. As a minimum, an "L-11 Commercial" license is required. Where any electrical work indicated on the Drawings is over 600V, the Contractor must also be licensed do work on High Voltage Electrical and Transmission Lines.
- B. The Contractor must be located within a 100-mile radius of the project and have been in that vicinity for a minimum of five (5) years.
- C. The Contractor must have a minimum of five (5) years experience as a Contractor installing electrical and instrumentation systems for other projects of similar type, size and requirements. If requested, the Contractor must submit documentation and list of references of recent projects similar to this one.
- D. All equipment furnished shall be new and of current design. Like equipment shall be of the same manufacturer.
- E. Unless otherwise indicated, all equipment and components shall be rated for use in the environment installed. Outdoor equipment shall be weatherproof or rated for outdoor use.

1.09 WARRANTY

- A. In addition to specific warranties required by the Specifications, the Contractor shall leave the entire installation in complete working order and free from defects in materials, workmanship or finish. Contractor shall repair or replace at his own expense any part that may develop defects due to faulty material or workmanship during the tests and within a period of one year after the work is accepted by the Engineer and Owner. Contractor shall repair or replace existing equipment and work that is damaged during the repair of defective apparatus, materials or workmanship.

- B. All manufacturers' warranties shall be filled out in their entirety by the Contractor for the Owner using the Owner's name and address. Equipment warranty periods will commence on date of final acceptance.

1.10 DRAWINGS

- A. Clarity and Legibility: For purposes of clarity and legibility, the Drawings are diagrammatic only. Drawings are not intended to show every fitting, junction, gasket or component necessary, nor every difficulty that may be encountered during installation. Size and location of equipment are drawn to scale wherever possible. Contractor shall refer to related data in all Contract Documents and shall verify this information on site.
- B. Instrumentation and control drawings are diagrammatic only to indicate control strategy. Final circuitry shall be as determined by the I&C Contractor and reviewed by the Engineer for a fully functional system as intended.

1.11 REFERENCES

Reference in the specifications to known standards and codes. Each such standard referred to shall be considered a part of the Specifications to the same extent as if reproduced therein in full. The following is a representative list of such Associations, Institutes and Societies, together with the acronym by which each is identified.

AASHO	American Association of State Highway Officials
AIEE	American Institute of Electrical Engineers
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IES	Illumination Engineering Society
NEC	National Electrical Code (2005)
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
UL	Underwriter's Laboratories, Inc.

- A. Every reference in the Specifications shall mean the latest printed edition of each in effect at the Contract Date.

1.12 UTILITY SERVICE

- A. Contractor shall contact Arizona Public Service Company to provide electrical service(s) to the site. This includes the permanent as well as any temporary service requirements. The Contractor shall provide all necessary labor and material required to obtain this service(s) in accordance with utility requirements. Unless otherwise indicated in these documents, all fees and charges associated with providing, maintaining and usage of these services shall be included in the Contractor's bid.

- B. Submit copies of electrical service entrance equipment to APS for approval prior to releasing switchgear for fabrication. A copy of this approval letter shall be submitted to the Engineer.

1.13 ABBREVIATIONS

- A. References on the Drawings to various abbreviations have been made. The following is a representative list of such abbreviations together with the acronym by which each is identified.

AFF	Above finished floor
AFG	Above finished grade
AI	Analog input
AO	Analog output
APS	Arizona Public Service Company
ATS	Automatic transfer switch
C	Conduit
C/B	Circuit Breaker
CKT	Circuit
CPT	Control power transformer
Cu	Copper
DI	Digital input
DIST	Distribution
DO	Digital output
DWG	Drawing
GND	Ground
GFCI	Ground Fault Circuit Interrupter
GFI/GFP	Ground Fault Indication/Protection
GRS	Galvanized Rigid Steel Conduit
HPS	High Pressure Sodium
IMC	Intermediate Metal Conduit
INST	Instrument
MBJ	Main bonding jumper
MCB	Main Circuit breaker
MCC	Motor Control Center
MCP	Motor Circuit Protector
MFR	Manufacturer
MLO	Main Lug Only
NC	Normally Closed
NO	Normally Open
PC	Personal computer
PLC	Programmable logic controller
PR	Pair
REQ'TS	Requirements
RTU	Remote terminal unit
SES	Service entrance section
SSS	Solid State Soft Starter

SWBD	Switchboard
TTB	Telephone Terminal Board
TSP	Twisted Shielded Pair
TVSS	Transient Voltage Surge Suppressor
WP	Weatherproof

****END OF SECTION****

SECTION 16110

RACEWAYS

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Metallic and non-metallic wiring raceways.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data demonstrating compliance with this specification including couplings, fittings, bushings, and hangers.
- B. Submit on the proposed method for separating conduits in underground ductbanks.

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with NECA Standard of Installation and NFPA 70.

1.04 RELATED WORK

- A. Specification Section 16195, Electrical Identification

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Conduit:
 - 1. Rigid metal and intermediate:
 - a. Allied
 - b. Republic
 - c. Triangle Conduit and Cable Co.
 - d. Wheatland
 - 2. PVC coated rigid steel:
 - a. Ocal
 - b. Robroy
 - 3. Flexible and flexible water-tight:
 - a. Alflex Corp.
 - b. Carlon Products Corp.
 - c. Carol Cable Co., Inc.
 - d. Electri-Flex
 - e. Sealite
 - 4. Non-metallic PVC:
 - a. Can-Tex

- b. Carlon
 - c. Robroy Industries
 - d. Thomas & Betts Corp.
5. Conduit supports and hangers:
- a. Caddy
 - b. Thomas and Betts
 - c. Appleton
 - d. Crouse-Hinds
 - e. B-Line Systems
6. Supporting Channel:
- a. Ackermann-Johnson
 - b. Unistrut
 - c. B-Line

2.02 MATERIALS

- A. Metallic Conduit:
- 1. Rigid steel:
 - a. Hot dipped galvanized rigid steel; meet ANSI C80.1 and ASTM A153; UL labeled and meet UL Standard No. 6.
 - b. All fittings shall be threaded. Threadless couplings shall not be used unless specifically approved by the Engineer.
 - c. All conduit covers shall be secured with machine screws or threaded onto the conduit body. Covers secured by snaptight or wedge-nuts are unacceptable.
 - d. All galvanized rigid steel conduit in direct contact with the earth must be PVC coated to a thickness of 40-mils.
 - e. Where PVC coated rigid steel conduit is indicated on the Drawings, the conduit shall be galvanized steel with a factory installed PVC coating. All conduit fitting, boxes, connectors, etc. shall also be PVC coated by the factory.
 - f. No aluminum conduit shall be permitted unless approved by the Engineer.
 - 2. Intermediate: Shall be same as rigid above with thinner wall.
 - 3. Electrical metallic tubing (EMT or Thin-wall) shall not be used.
 - 4. Setscrew type fittings are not permitted under any circumstances.
 - 5. Flexible conduit:
 - a. Flexible rubber or plastic coated metallic type with watertight ferrule and sleeve type connectors. Standard steel type flexible conduit is unacceptable.
 - b. ANSI/NEMA FB1 steel connectors.

- B. Non-Metallic PVC Conduit:
1. Rigid non-metallic conduit Polyvinyl Chloride (PVC) type II PVC shall be schedule 40, suitable for use with 90 degree rated wire. Conduit shall bear UL labels for above and below ground use.
 2. All PVC conduit 1-1/4 inch and larger with bends greater than 45° shall utilize factory bends.
 3. Where the enclosure or raceway is subject to physical damage, conductors shall be installed in rigid metal conduit, intermediate metal conduit, Schedule 80 rigid nonmetallic conduit or equivalent.
 4. Meet UL standard #651.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. General:
1. Raceways shall be concealed, where possible, unless otherwise indicated on the Drawings. When exposed, confirm the exact routing with the Engineer prior to roughing in.
 2. Sizing: Minimum conduit sizes are indicated on the Drawings. The Contractor may choose to install larger conduit for ease of installation or wiring pulling at no additional cost to the Owner. If conduit or raceway size is not indicated on the Drawings, raceways shall be sized per NEC. Unless otherwise indicated, minimum conduit size shall be 3/4 - inches.
 3. Unless otherwise indicated, all exposed conduits to be galvanized rigid (GRC) or IMC. All direct buried or concrete encased conduits to be PVC Schedule 40.
- B. Conduit:
1. Conduit shall: Have openings temporarily plugged, using “pennies” or equal, to exclude plaster or other foreign materials; be reamed after cutting; have joints cut square, and butt solidly into fittings; have the ends terminated in a proper bushed fitting, be rigidly supported so as to prevent undue stress or strain on the couplings and connectors; be swabbed before conductors are pulled in.
 2. Concealed conduits shall be run in a direct line with long sweep bends and offsets. Horizontal runs shall be run with a slight incline, to prevent low spots or pockets (for drainage).
 3. Conduits shall be continuous from outlet to outlet, from outlets to cabinets, pull or junction boxes and shall be secured to boxes with lock nuts and bushings in such a manner that each system shall be electrically continuous throughout. “Erickson” couplings shall be used where required. No running threads shall be cut.
 4. Install conduit systems completely before conductors are pulled. Conduits shall be securely supported at proper intervals to structures with steel

clamps, or conduit hangers or by special supporting assemblies where indicated on the Drawings.

5. Conduit terminations shall contain insulated bushings. Provide grounding type bushings where steel conduit is stubbed into nonmetallic enclosures, stubbed up in the base of free-standing enclosures or where locknuts cannot assure proper ground continuity between metallic enclosures and the steel conduit. Provide service entrance and transformer connection conduits with grounding type bushings.
6. Exposed conduits shall be installed parallel to walls, floor and ceilings or at right angles to the building lines. Exposed bends shall be used only where approved. Covers shall be secured to bodies with machine screws.
7. IMC: May be used in lieu of heavy wall rigid, unless otherwise indicated.
8. Electrical metallic tubing (EMT) or "Thin-wall" may not be used on this project.
9. Hickey bends shall not be used for 1-inch and larger conduits. Either manufactured elbows or bends fabricated in a bending machine shall be used. The radius of the inner edge of bends shall be six times the internal diameter of the conduit for conduit sizes up to 2 ½-inches and 12 times internal diameter for 3-inches conduits and larger. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than 360° of total bends.
10. Conduit shall not be run above or adjacent to or below water piping, and must be individually supported.
11. In wet locations, and in locations where walls are frequently washed, the entire conduit system, including boxes and fittings used, shall be installed and equipped to prevent water from entering conduit. Conduit shall be so mounted so that there is at least ¼-inch air space between conduit and wall or similar supporting surface.
12. PVC may be used for buried conduit installations as permitted by NFPA 70 and local codes except where rigid steel is specified elsewhere in the Contract Documents. Boxes, fittings, couplings, transition fittings, adhesives and installation procedures recommended by the manufacturer and all applicable codes must be strictly followed.
13. Install liquid-tight flexible metal conduit at motors, transformers and equipment which are subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept ¾-inch size flexible conduit. Limit flexible conduit length to three feet maximum.

C. Conduit Supports and Hangers:

1. Conduits shall be individually fastened securely in place on maximum of 8-foot intervals for 1-inch conduit or less and 5-foot intervals for conduits over 1-inch and within 3-feet of each conduit run termination. Use only

supports, hangars and fasteners specifically designed for supporting electrical conduits.

2. Where two or more conduits 1-inch or larger run parallel, trapeze hangers may be used consisting of concrete inserts, threaded solid rods, washers, nuts and galvanized "L" angle iron, or P-1000 Unistrut cross members. Such conduits shall be individually fastened to the cross member of every other trapeze hangers with galvanized cast two hole straps, clamp backs, bolted with proper size cadmium machine bolts, washers and nuts. If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolt type clamps shall be used at the end of a conduit run and at each elbow. J-bolts, or approved clamps, shall be installed on each third intermediate trapeze hanger to fasten each conduit.
3. Hangers shall be made of durable materials suitable for the application involved and shall be painted with two coats of oil paint. Where excessive corrosive conditions are encountered, hanger assemblies shall be protected after fabrication by sherardizing or galvanizing, special paint or other suitable preservative methods.
4. For mounting on concrete or brick construction, insert anchors shall be installed with round head machine screws. In wood construction, round head wood screws shall be used. In brick, inserts shall be near center of brick, not near edge or in joint. Where steel members occur, drill and tap, and use round head machine screws.

D. Sleeves, Inserts, etc.: Lay out and install work in advance of the laying or pouring of floors and erection of walls. Furnish and install sleeves that may be required for openings through floors, wall, etc. Where plans call for conduit to be run exposed, furnish and install inserts and clamps for the supporting of conduit. If this Contractor does not properly install sleeves and inserts required, he will be required to do the necessary cutting and patching later, at his own expense, to the satisfaction of the Engineer.

E. Installation of Underground Conduits:

1. Install underground conduit as indicated on the Drawings. Backfill material around the conduits must be clean-fill (dirt with rocks no larger than 1/2-inch).
2. Conduit bends shall have long sweep radius curves instead of standard elbows where indicated on the Drawings. All PVC conduit bends greater than 45° shall be factory-made for conduits larger than 1-inch.
3. All underground PVC conduit shall be buried a minimum of 24-inches below finished grade, except when located below a concrete slab or freestanding electrical equipment. PVC conduits are permitted to be stubbed up into freestanding electrical enclosures. Where conduit stubs up out of the earth and is exposed, any portion of the conduit with less than 24-inches of cover shall be PVC coated galvanized rigid steel or rigid steel conduit with 20-mil rubber tape half-lapped to a thickness of 40-mils.

4. Conduit terminations shall contain insulated bushings. Provide grounding type bushings where steel conduit is stubbed into nonmetallic enclosures, stubbed up in the base of free-standing enclosures or where locknuts cannot assure proper ground continuity between metallic enclosures and the steel conduit. Provide service entrance and transformer connection conduits with grounding type bushings.
5. Underground conduits in ductbanks shall be separated and supported with pre-manufactured plastic chairs, unless submitted and approved otherwise, installed at 5-foot intervals in the trench.
6. Before pulling cables into underground conduits, pull a mandrel ¼-inch smaller than the conduit inside diameter and pulled through each conduit, and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduits. Underground conduits shall be swabbed before cables are pulled in.
7. Spare conduits shall be capped with an approved plug.
8. After duct runs are completed and set, backfill the trenches and tamp thoroughly to 90 percent compaction. Tamp to 95 percent compaction where conduits are located under a roadway. Compaction shall be witnessed by the Engineer.
9. Provide each PVC conduit with a bell at exit and entry points.
10. Duct runs shall be installed deeper than the minimum depth wherever required to avoid existing piping, tunnels, or other obstructions.
11. After duct is in place, notify the Engineer prior to backfill or concrete pour for inspection.
12. Provide plastic warning tape at 12-inches below finished grade over underground electrical installations which reads, "Caution - Buried Electrical Line Below".

3.02 CONDUIT MARKERS

- A. Every conduit shall be identified at each end. See Section 16195 - Electrical Identification.

****END OF SECTION****

SECTION 16120
WIRES AND CABLES
(600V OR LESS)

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Cables and wires rated 600 volts or less, as specified, including wiring of all devices.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data on all power, signal and communication cables demonstrating compliance with this Specification.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards:
1. NFPA 70 (NEC)
 2. UL listing for materials.
 3. ICEA S-66-524
 4. NEMA WC-7
 5. ASTM B-3 or B-8

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cable:
1. General Cable
 2. Rome
 3. Okonite
 4. Southwire
 5. Carol
- B. Connectors:
1. Ideal
 2. Burndy Corp.
 3. Thomas and Betts Co.
 4. O.Z. Gedney
 5. Minnesota Mining & Manufacturing (3M)

2.02 MATERIALS

- A. Conductors for wire and cable shall be stranded copper with 98% conductivity and shall be tinned or untinned in accordance with established standards for the type of insulation around the conductors. Solid conductors are not acceptable.

- B. Wire and cable shall be stamped approximately every two feet to indicate voltage, type, temperature rating, and other significant data or warnings.
- C. Conductors for general wiring, 600 volt or less shall meet the following requirements:
 1. Power: 600V, type THHN/THWN-2 for branch circuits No.8 AWG and smaller or XHHW-2 for branch circuits No.6 and larger, minimum size No. 12 AWG.
 2. Control: 600V type XHHW-2 (conductors run in conduit), 600V type MTW (control panel conductors), minimum size No.14 AWG.
 3. Analog Signal: Twisted shielded pair (TSP) or triad (TST) with #18 AWG drain wire and an overall PVC jacket rated 600V, minimum conductor size No.16 AWG.
 4. Ethernet: Category 5e plenum rated for outdoor/wet environments for cables installed in underground or underfloor conduits and Category 5e plenum rated cable installed elsewhere.
 5. Communications: 300V, size, type, materials, as required by the specific system specification and as required by the system equipment manufacturer.
- D. Wire Pulling Lubricant: Lubricant shall be UL listed and be of a consistency that will not leave an obstruction or tackiness that prevents pulling out wires in the future. No soap flakes or vegetable soaps will be permitted. Lubricant shall be Ideal Wire Lube or equal.
- E. Cable Ties: Wiring in panels, cabinets, etc. shall be neat and tied with “Ty-Rap” T&B “TY-5418” series, or Panduit Co. “Cable Wrap”.
- F. Terminations:
 1. 3-M Scotchlok lugs and connectors - copper.
 2. O-Z solderless connectors, grounding devices, power connectors, armored cable fittings, and cable terminations.
 3. Burndy - copper - all types as appropriate for cable size and configuration.
- G. Connector material shall be compatible with conductor material to prevent corroding, differences in coefficients of expansion or electrolysis.

PART 3 -- EXECUTION

3.01 INSTALLATION – WIRES AND CABLES

- A. Install wires and cables in NEC approved raceways (Section 16110).
- B. Branch circuit wiring shall be done with color coded conductors, using the same code throughout. Unless local codes indicate otherwise, the following color code shall be followed:
 1. Grounding conductor-Green.
 2. Neutral 240/120-White.
 3. Phase A 240/120-Black.

4. Phase B 240/120-Red.
 5. Phase A 480/277-Brown.
 6. Phase B 480/277-Orange.
 7. Phase C 480/277-Yellow.
 8. Neutral 480/277-Natural Gray.
- C. Wires No. 8 AWG and smaller shall have insulation with proper color. Wires No. 6 and larger shall have proper colored phase tape applied to the wire for a minimum of 3-inches at each termination.
- D. A minimum of 6-inch loops shall be provided at each outlet for installation of future devices or fixtures. Wires in outlet boxes not for the connection to fixtures at that outlet, shall be rolled up, connected together and taped or capped with wire nuts. Mark bundled, unused spare wires as “SPARE FROM [origination]”.
- E. Branch circuit sizing: Where wire size is not indicated on the Drawings, NEC and local codes shall govern. However, minimum branch circuit conductor size shall be No. 12 AWG.
- F. Pulling Cables: Wires and cables shall be carefully handled during installation. Lubricant used for pulling in wires and cables shall be used. Use a dynamometer when pulling conductors by mechanical means.
- G. Signal cables shall be run in separate raceways from power wiring. Keep separated from power wiring in control panels, wireways and junction boxes.
- H. Bending radius: Do not exceed the manufacturer’s maximum bending radius.

3.02 INSTALLATION – CONNECTORS AND TERMINATIONS

- A. Splices: Splices in conductors shall not be used unless otherwise indicated on the Drawings or approved by the Engineer. Where splices are allowed or necessary, they shall be mechanically strong and well made so that the electrical resistance of a joint shall not exceed that of two-feet of the conductor. Splices and terminations shall be made only in junction boxes and never in conduit. Do not splice in panelboards. For 600 volt wire No. 8 AWG and smaller, use wing nut solderless connectors, or crimped end-to-end connectors; No. 6 AWG and larger, use insulated parallel crimped connectors. Use tape to an equivalent insulation thickness on uninsulated splices. Follow manufacturer’s recommendations for sizing, stripping, twisting, etc.
- B. Motor terminations: Ring type, crimped connectors shall be installed on all conductors and bolted together back-to-back. For terminations with No. 6 and smaller wire, use 10-24 bolts. Use bolts that match the connector bolthole size for all other motor terminations. Apply one layer of cambric tape followed by three layers of rubber tape and finally, top with one layer of black vinyl tape.
- C. Non-motor terminations: Use ring or fork type, crimped connectors for all screw-on terminations. Wrapping wire around a binding post is unacceptable.
- D. Where special tools are required to properly install the particular connector the special tools must be used.

3.03 INSTALLATION – WIRE MARKERS

- A. Every wire shall be identified at each end. See Section 16195 - Electrical Identification.

****END OF SECTION****

SECTION 16130

BOXES

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Outlet boxes, pull and junction boxes and underground junction boxes.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data for standard outlet boxes up to six gang, including floor type demonstrating compliance with specification requirements and Drawings.
- B. Shop Drawings: Submit drawings for special pull, outlet, and junction boxes demonstrating compliance with NEC and specification requirements. Drawings shall indicate box dimensions and locations in building.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards:
 - 1. NEMA 250
 - 2. NFPA 70
 - 3. UL listing for materials.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Appleton Electric
- B. Crouse-Hinds
- C. Killark
- D. Raco
- E. Hoffman Engineering Co.
- F. O.Z. Gedney Co.
- G. Steel City
- H. Hubbell

2.02 MATERIALS

- A. Outlet boxes for exposed conduit systems and exterior locations shall be of the threaded-hub, cast-metal, conduit type fitting suitable for the wiring devices to be installed. Covers (blank, switch, receptacle, etc.) shall be the type specifically designed to fit the specified boxes.

- B. Exposed electrical junction boxes shall be sheet metal with an ANSI 61 gray color with size and type as indicated on the Drawings. NEMA rating shall be as indicated on the Drawings. Where a NEMA rating is not indicated, outdoor boxes shall be NEMA 3R and indoor boxes shall be NEMA 12. Junction boxes shall be sized as indicated on the Drawings. Where sizes are not indicated or larger size is required to meet code, the box size shall be as required by the National Electrical Code.
- C. Underground junction boxes:
 - 1. Construction: Electric underground junction boxes shall be precast concrete and size as indicated on the Drawings. Underground junction boxes shall have precast concrete extensions.
 - 2. Covers: Covers shall be rectangular, reinforced concrete and have the text "ELECTRIC" cast into the cover.
 - 3. Approved Manufacturer: Christy, or equal.
- D. Fittings, hangers, fastenings, etc., shall be of material that will prevent chemical reaction between itself and conduit or device it is fastening or supporting.

PART 3 -- EXECUTION

3.01 BOX LOCATIONS

- A. Location of Boxes: In order that boxes may be placed in proper locations, the Contractor shall familiarize himself with the details of these spaces and carefully lay out boxes so that the equipment or piping of other trades passing under, over, across or in close proximity to same, will not cause these boxes to be inaccessible for use or maintenance. Contractor shall consult with other Contractors and trades on the project and obtain details of the project to locate outlet boxes properly.
- B. Contractor shall be responsible for the exact and proper location of the various portions of his work. Consult the Drawing and details.
- C. Mounting Heights: The exact mounting height of each switch, receptacle, light fixture outlet, etc., shall be confirmed on the premises in conference with the Engineer. Unless otherwise indicated, receptacles to be mounted at 18-inches and light switches to be mounted at 42-inches above finished floor/grade.

3.02 INSTALLATION

- A. No thru-boxes shall be permitted.
- B. Boxes shall meet the following requirements:
 - 1. Proper size and shape for conduits entering them.
 - 2. Have unused openings closed with knock-out closures.
 - 3. Securely fastened to structure.
- C. Outlet boxes for surface-mounted fixtures shall meet the following requirements:

1. All outdoor boxes shall be cast steel or cast aluminum with threaded hubs. PVC coated boxes shall be used for installations with PVC coated rigid steel conduit. Bell boxes may be used for indoor applications with rigid steel conduit.
 2. Four inch octagonal or square.
 3. Minimum of 1 ½-inch lathers channel, attached to building construction for suspended ceilings.
 4. Four inch octagonal or square for exposed conduit work with the fixture extension pan or deep fixture canopy to enclose the box.
- D. Outlet Boxes for exposed conduit systems shall meet the following requirements:
1. Fastened with not less than two Paine, Phillips, Ackermann-Johnson, or equivalent, screw anchors and round head machine screws on brick and concrete walls or ceilings.
 2. Under no circumstances will drilling of cast boxes be allowed.
 3. Be provided with a vapor-proof gasket in wet locations or where indicated as “WP” (weatherproof) on the Drawings.
 4. Install weatherproof listed cover on boxes in exterior or wet locations.
- E. Pull boxes and junction boxes shall be:
1. Installed in runs of conduit more than 100-feet in length or the equivalent of four 90-degree bends.
 2. Entirely accessible.
 3. Securely mounted to building structure independent of the conduits connected to them.

****END OF SECTION****

SECTION 16140
WIRING DEVICES

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Wiring devices such as but not necessarily limited to power receptacles and light switches.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each wiring device including device covers demonstrating compliance with these Specifications and UL labeling.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and standards:
 - 1. NEMA
 - 2. UL listing
 - 3. NFPA 70

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Hubbell
- B. Leviton
- C. Bryant
- D. Crouse-Hinds

2.02 MATERIALS

- A. Light switches and receptacles shall meet NEMA WD1 and WD6 standards, be UL listed and be Heavy Duty, Industrial Specification grade. Commercial specification grade wiring devices are not acceptable.
- B. Amperage rating of each wiring device shall match the circuit's overcurrent device amperage rating to which it is connected.
- C. Wiring devices shall have an ivory finish unless otherwise specified.
- D. Power receptacles shall be the grounded type. Furnish ground fault circuit interrupter (GFCI) type where indicated on the Drawings or as required by the NEC.
- E. Light switches shall be the quiet type.
- F. Wiring Device Coverplates:

1. Coverplates: shall be specification grade brushed anodized aluminum finish. Plates covering a special device or remote switch whether single or ganged shall be labeled.
2. Weatherproof locations: Wiring devices installed outdoors or where identified on Drawings with “WP” shall contain a gasketed coverplate UL approved for wet locations.
3. Where weatherproof-while-in-use coverplates are indicated on the Drawings or required by NEC, power receptacles shall be provided with a cover that maintains UL approval for wet locations when a cord is plugged into the receptacle. Weatherproof-while-in-use coverplates shall be TayMac 10130 or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION/APPLICATION

- A. Devices and coverplates shall be plumb and parallel to adjacent surfaces or trim. Flush-mounted devices must be flush with finished wall surfaces and the coverplates must be tight to surfaces over which they are installed.
- B. Receptacles identified as GFCI or when required by the NEC shall have individual GFCI receptacles installed for each outlet. Installing a single GFCI receptacle and standard receptacles connected to the load side of the single GFCI receptacle is unacceptable.

3.02 FIELD QUALITY CONTROL

- A. Contractor shall verify that the openings have been properly patched around devices without damage to devices.
- B. Damaged or painted devices shall be replaced or cleaned as directed by the Engineer.

****END OF SECTION****

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 -- GENERAL

1.01 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers

1.02 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
 - 1. NEC 110-22 Identification of Disconnecting Means
 - 2. NEC 200-6 Means of Identifying Grounded Conductors
 - 3. NEC 200-10 Identification of Terminals
 - 4. NEC 210-5 Identification for Branch Circuits
 - 5. NEC 215-8 Means of Identifying Conductor with the Higher Voltage to Ground
 - 6. NEC 230-70, (B) Service Equipment, Marking
 - 7. NEC 310-11 Marking
 - 8. NEC 310-12 Conductor Identification
 - 9. NEC 400-22 Grounded-Conductor Identification
 - 10. NEC 400-23 Equipment Grounding Conductor Identification
 - 11. NEC 408-13 Panelboard circuit identification
- B. UL standard 224- Standard for Extruded Thermoplastic Insulating Tubing.

1.03 SUBMITTALS

- A. Product Data: Provide catalog data for wire and cable marking system to be utilized.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 -- PRODUCTS

2.01 NAMEPLATES AND LABELS

- A. Nameplates: Engraved laminated plastic with black letters on white background.
- B. Locations:
 - 1. Each electrical distribution and control equipment enclosure.

2. Disconnect switches.
 3. Each panel mounted device.
- C. Letter Size:
1. Use minimum 3/16-inch letters for identifying individual panel components and small panels. Use minimum 3/8-inch letters for identifying service section, electrical switchgear and other large equipment.

2.02 WIRE MARKERS

- A. Manufacturer: Raychem Corporation Model ShrinkMark or equal.
- B. Description: heat shrinkable radiation cross-linked, thermally stabilized, modified polyolefin sleeves with 3:1 shrink ratio. Markers shall be UL Standard 224 recognized.
- C. Sleeves shall be smear resistant prior to shrinking and achieve mark permanency when shrunk without the need for permatizing equipment. Sleeves should achieve mark permanency when standard ballpoint pens or high-carbon content fabric ribbons are used. The markers shall be flattened and mounted on a carrier suitable for use with commercially available print equipment. Markers shall be printable on both sides. Markers shall be resistant to common industrial fluids including Freon TF, Isopropyl alcohol, and Ethylene Glycol.
- D. Locations: Each conductor at each and every termination point.
- E. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on the Drawings.
 2. Control Circuits: Control wire number indicated on approved schematics, interconnection diagrams and shop drawings.
 3. Wire numbers shall be the same at both ends of the wire.

2.03 CONDUIT MARKERS

- A. Furnish and install conduit markers on ends of each conduit run and in intermediate locations such as junction boxes. Conduit markers shall be 19 gauge, 1½-inch diameter round brass with backfilled legend, Style #250-BL as manufactured by Seton Nameplate Corporation or equal. Marker shall identify conduit as indicated on the Drawings. If a conduit is not identified on the Drawings, the Contractor shall consult the Engineer for the proper identification.

PART 3 -- EXECUTION

3.01 WIRE MARKERS

- A. Wire markers shall be a minimum of 3/8-inches in length and placed as near as possible to the end of the wire. Orient wire marker such that the writing can be read without turning or twisting the wire.
- B. Wire numbers shall be the same at both ends of the wire.

3.02 NAMEPLATES

- A. Install nameplates parallel to equipment lines.
- B. Secure nameplates to equipment doors using stainless steel screws.

3.03 CONDUIT MARKERS

- A. Attach markers near the end of exposed conduits with stainless steel tie-wire.
- B. Epoxy conduit markers or clearly write conduit numbers on the floor where conduits terminate in bell ends flush with finished floor in freestanding equipment.

****END OF SECTION****

SECTION 16260

AUTOMATIC TRANSFER SWITCH

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Transfer switch with accessories as indicated herein.

1.02 REFERENCE:

A. STANDARDS:

1. National Electrical Manufacturers Association (NEMA):
 - a. ICS, General Standards for Industrial Control and Systems.
2. Institute of Electrical & Electronic Engineers (IEEE).
3. National Fire Protection Association (NFPA):
 - a. NFPA-110, Standard for Emergency and Standby Power Systems.

1.03 SUBMITTALS:

A. Submit the following:

1. Product Data: Provide catalog data on all components in accordance with this specification.
2. Drawings: Interconnection wiring diagrams for the generator control systems indicating control connections between the generator and automatic transfer switch. Power and control wiring conduit entrance locations.

1.04 OPERATING AND MAINTENANCE MANUALS

- A. Identify the size, model and features for each item.
- B. Furnish operating instruction manuals outlining step-by-step procedure required for system startup and operation, including manufacturer's name, model number, service manual parts list and brief description of all equipment and basic operating features. Instructions and documentation not related to the equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- C. Complete nomenclature of replaceable parts, part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or components not related to equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- D. Furnish maintenance instruction manuals outlining maintenance procedures, including a troubleshooting guide listing possible breakdown and repairs, and a simplified connection wiring diagram for the system.
- E. Copy of warranties issued on the installation, showing dates of expiration. Warranty period shall begin at date of substantial completion.

F. Refer to Specification Section 16010 for additional requirements.

1.05 QUALITY ASSURANCE

- A. Contractor to ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied.
- B. Comply with the following Codes and Standards:
 - 1. UL listing and labeling for materials.
 - 2. NFPA-70.

1.06 WARRANTY AND SERVICE

- A. A manufacturer's warranty shall be furnished on all components, parts, assemblies and performance of the generator against defects in materials and workmanship for a period of 2-years from the date of substantial completion. Warranty shall include parts, labor and travel expenses.
- B. The equipment manufacturer must have a local service center within a 250-mile radius of the project site with stocked spare parts and staffed with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ASCO 7000 Series
- B. Russ Electric RMT 2000 Plus series
- C. No equal

2.02 MATERIALS

- A. The transfer switch shall be provided with ratings, number of poles/wires and installed as indicated on the Drawings. The short circuit withstand ampacity shall meet or exceed the indicated AIC rating of the electrical equipment immediately connected to the load side of the transfer switch. The transfer switch shall be capable of switching all classes of loads while under full load.
- B. The transfer switch shall be mounted in an empty section of the motor control center as indicated on the Drawings.
- C. Load transfer shall be over-center, double-throw electrically and mechanically interlocked contactors. Interlocked circuit breakers are not acceptable.
- D. Provide main switch contacts with silver or silver alloy surfaces, arcing tips and arc extinguishing devices. Transfer switch shall be capable of closing on an inrush current 20 times its full load rating without contact damage and capable of withstanding a system short circuit fault until the overcurrent device trips. Total transfer time in either direction shall not exceed one-half second. Interlock *Normal* and *Emergency* contactors both mechanically and electrically so that both cannot be closed at any one time.

- E. Switching contactors and cable connections shall have a transparent protective cover to protect operating personnel from accidental contact and allow visual determination of the transfer switch position.
- F. The transfer switch shall be provided with a door mounted, 3-position selector switch or keypad with password for TEST, NORMAL and RETRANSFER manual transfer control which will activate the transfer switch with the same contact-to-contact speed as automatic operation.
- G. There shall be a separate adjustable time delay (0-2 min.) for transferring power from the *Normal* to *Emergency* and retransferring back.
- H. As a minimum, the transfer switch shall be provided with the following:
 - 1. Phase protection relay on each phase.
 - 2. Temperature compensated, solid-state voltage sensors shall simultaneously monitor all phases of both normal and standby power sources. Transfer from *Normal* to *Emergency* source shall occur when the *Normal* source voltage and frequency drops below an adjustable 85-95 percent nominal for a period of time as set by the time delay to transfer (0-2 minutes). Retransfer back to *Normal* shall occur when the *Normal* source has been restored to nominal an adjustable 85-95 percent for a period of time as set by the time delay to retransfer (0-30 minutes).
 - 3. An adjustable time delay (0-5 seconds) with a suitable contact for starting an engine generator upon loss of *Normal* power.
 - 4. Transfer of power to the standby source shall occur within 10 seconds of loss of *Normal* power.
 - 5. 250V, 10A, Form "C" auxiliary and control contacts as follows:
 - a. Two contacts that are closed when the transfer switch is in the *Normal* position.
 - b. Two contacts that are closed when the transfer switch is in the *Emergency* position.
 - 6. After retransfer of power from a standby generator source, the generator shall remain running for an adjustable time period as set by a timing relay (0-10 minutes).
 - 7. Separate pilot lights to indicate the presence of each source and transfer switch position.
 - 8. Separate status indicators to indicate the presence of each power source, signal to start engine generator, transfer/retransfer timing, transfer/retransfer complete and stop generator timing.
 - 9. Full rated lugs for *Normal*, *Emergency* and *Load* conductors as indicated on the Drawings.
 - 10. Terminal blocks for all control and monitoring field-wiring connections as indicated on the Drawings and as specified herein.

11. A 7-day, 24-hour adjustable exerciser clock or, if indicated on the Drawings, a remote start/stop input shall be capable of exercising the generator set under *No Load* condition.

PART 3 -- EXECUTION

3.01 COORDINATION

- A. The Contractor shall coordinate with the motor control center manufacturer to provide adequate space and mounting requirements for the automatic transfer switch. The connection from the load side of the automatic transfer switch to the switchgear bus shall be bussed with copper bus or cables as indicated on the Drawings. The switchgear manufacturer or a qualified UL-508A recognized panel shop shall do Bussing/cabling between the automatic transfer switch and switchgear bus.

3.02 INSTALLATION

- A. Install where indicated on plans. Mount unit such that it is level and plumb.
- B. Prior to installation, coordinate with other trades to verify conduits have adequate space to leave and enter the switch enclosure and for required code clearance. A minimum working clearance as defined by the NEC 110-26 shall be provided.
- C. Install in accordance with NFPA 70 and all applicable local codes and regulations.

3.03 TESTING

- A. Factory Tests:
 1. Provide factory production tests in accordance with NEMA standards and NFPA standard 110. Check and set all instruments and safety devices.
- B. On-site Tests:
 1. Simulate utility power failure to verify proper operation of the automatic transfer switch, automatic starting and stopping of the standby generator and retransfer back to utility when utility power is resumed. Record the time to achieve standby power after loss of the *Normal* power source. Record the time to retransfer back to the *Normal* power source.
 2. Verify all status and alarm signals being monitored remotely.

3.04 TRAINING

- A. The Contractor shall provide training by a manufacturer's factory-trained representative.
- B. The training shall be conducted at the project site.
- C. The training session shall include up to four Owner's representatives.
- D. The training session shall be a minimum of four (4) hours, conducted on a normal workday as decided upon by the Town.

- E. The training session shall include the proper maintenance and operation of the automatic transfer switch.

****END OF SECTION****

SECTION 16400

SERVICE AND DISTRIBUTION

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Furnish and install electrical service entrance and distribution equipment.

1.02 SUBMITTALS

- A. Product Data: Submit catalog cuts and manufacturer's descriptive literature for approval for:
 - 1. Service Entrance Sections
 - 2. Distribution sections.
- B. Shop Drawings:
 - 1. Submit drawings showing dimensions and dimensional clearances within the structure.
 - 2. Include metering, breaker/fusing, dimensioned bus locations.
 - 3. Submit single line diagram and any associated schematic and wiring diagrams for equipment in the service and distribution equipment.
 - 4. All electrical characteristics (voltage, phasing, amperage, bracing, interrupting capacity).
- C. Serving electric utility company coordination:
 - 1. The Contractor shall submit the above listed information to the serving utility company for approval of proposed service entrance equipment. The Contractor shall submit written approval from the serving utility company to the Engineer.

1.03 OPERATING AND MAINTENANCE MANUALS

- A. Identify the size, model and features for each item.
- B. Complete instructions regarding the operation and maintenance of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- C. Complete nomenclature of replaceable parts, part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or components not related to equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- D. Copy of warranties issued on the installation, showing dates of expiration.
- E. Refer to Specification Section 16010 for additional requirements.

1.04 QUALITY ASSURANCE

- A. Meet requirements of NEC (NFPA 70)
- B. Codes and Standards:
 - 1. NFPA 70-NEC
 - 2. NEMA
 - 3. U.L. listed
 - 4. ICEA
 - 5. IEEE
 - 6. ANSI
 - 7. Local utility company
- C. Service equipment shall bear markings “Suitable for Use as Service Equipment” or be UL listed as “Service Equipment.”
- D. The manufacturer of the service entrance equipment shall be the manufacturer of the circuit protective devices, and other accessories within.
- E. The manufacturer of the service entrance equipment shall be ISO 9000, 9001 or 9002 certified.
- F. The manufacturer of the service entrance equipment shall have produced similar electrical equipment for a minimum period of five (5) years. If requested by the Engineer, a list of installations with successful operation of similar equipment shall be provided demonstrating compliance with this requirement.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cutler-Hammer
- B. General Electric
- C. Siemens
- D. Square D Company
- E. No equal

2.02 GENERAL CONSTRUCTION

- A. The equipment specified herein shall have the following ratings:
 - 1. Voltage: As indicated on the Drawings
 - 2. Phasing: As indicated on the Drawings
 - 3. Alternating Current Frequency: 60 Hz
 - 4. Bus Bracing: As indicated on the Drawings
 - 5. Bus Amperage: As indicated on the Drawings
 - 6. Protective Device Mounting: Fixed
 - 7. Enclosure: Freestanding NEMA 3R

- B. The service equipment shall consist of the required number of vertical sections bolted together to form a rigid assembly. The internal components and bussing shall be completely enclosed (metal clad) with dead front construction. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure. The sides and rear of freestanding switchgear shall have removable bolt-on covers.
- C. All sections shall be rear aligned with depth as required. All overcurrent protective devices shall be group mounted. Devices shall be front accessible enabling assembly to be mounted against a wall.
- D. All bus bars shall be silver or tin plated copper. Main horizontal bus bars shall be mounted with all phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65°C over a 40°C ambient (outside of the enclosure).
- E. Provide a full capacity neutral bus.
- F. An appropriately sized copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the assembly. Ground conductors shall be attached to the bus by means of mechanical type lugs.
- G. All hardware used on conductors shall be high-tensile strength and zinc plated. All bus joints shall be provided with conical spring type washers.
- H. Small wiring, necessary fuse blocks and terminal blocks within the assembly shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- I. Mechanical type terminals shall be provided for all line and load terminations suitable for copper cable rated for 75°C.
- J. Assembly shall be furnished with an underground incoming line section and a separate barriered-off utility metering compartment complete with hinged sealable door(s). Bus work shall include provisions for mounting utility company current transformers and potential taps or transformers as required. Lugs shall be provided in the incoming line section for connection of the serving utility's cables.
- K. Provide stamped steel manufacturer's master nameplate(s) that identifies the assembly's designation, voltage, phasing, amperage, short circuit rating, manufacturer's name, general order number and item number.
- L. All exterior and interior steel surfaces of the assembly shall be properly cleaned and provided with a rust-inhibiting phosphatizing coating. Color and finish shall be ANSI 61, unless noted otherwise.

2.03 CIRCUIT BREAKER TYPE PROTECTIVE DEVICES

- A. Circuit breakers shall be of the molded case type and shall provide overcurrent protection with inverse time and instantaneous tripping characteristics.

- B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy, and arc extinction shall be accomplished by means of arc chutes.
- C. Circuit breakers shall have a minimum symmetrical interruption capacity as indicated on the Drawings.
- D. Circuit breakers with 225 Ampere frames and above shall have adjustable thermal and magnetic trip units. Solid-state circuit breakers shall be used if curve shaping is required for proper overcurrent device coordination.
- E. The Contractor shall be responsible for the setting of the adjustable protective parameters of the circuit breakers to ensure proper system protection and coordination.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The Contractor shall provide the services of a qualified and certified factory-trained manufacturer's representative as necessary for assistance in the installation and start-up of the equipment specified herein. The representative shall provide technical direction and assistance in making adjustments and testing of the equipment.
- B. Furnish and install service entrance equipment as indicated on the Drawings, in accordance with the serving utility's requirements, in accordance with the NEC and all applicable local codes and regulations.
- C. Install main bonding jumper and provide grounding of service entrance equipment as indicated on the Drawings and as required by the serving utility company.
- D. Install automatic transfer switch in blank section of the switchgear as indicated on the Drawings. The automatic transfer switch shall be provided by the generator manufacturer (Specification Section 16250).
- E. Before energizing, perform the following tasks:
 - 1. Remove all scraps of wire, dust, dirt and any other foreign material.
 - 2. Inspect the switchgear for proper installation as recommended in the manufacturer's installation instructions furnished with the gear. Inspect all bus bolts and cable connections to insure that they are tight and terminated properly. Inspect all overcurrent devices for damage and look for components that may have loosened during shipment.
 - 3. Meggar testing: Open all overcurrent devices and remove all instrumentation and control fuses. Use a megohmmeter developing 500 volts to test the switchgear. A minimum of 100-megaohms of resistance must be measured from each phase to ground. Any readings less than this

will require the manufacturer to inspect the switchgear and replace or make the necessary repairs.

****END OF SECTION****

SECTION 16440
DISCONNECT SWITCHES

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Separately enclosed fused and non-fused type safety switches for interrupting power to electrical loads.

1.02 SUBMITTALS

- A. Manufacturer's data for disconnect switches.
- B. Shop Drawings shall contain the following data:
 - 1. Name of motor(s) or load(s) being served.
 - 2. Horsepower and current rating.
 - 3. Voltage rating.
 - 4. Number of poles and wires.
 - 5. Fuse size and type, if applicable.
 - 6. Enclosure NEMA rating.
 - 7. Enclosure dimensions.
 - 8. Number and size of wires required between disconnect and load served.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards (refer to Section 16010):
 - 1. NFPA 70 (NEC).
 - 2. UL listing.
 - 3. NEMA

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cutler-Hammer
- B. General Electric Company
- C. Siemens – ITE
- D. Square D Company
- E. No equal

2.02 MATERIALS

- A. Disconnect switches shall be furnished with NEMA rated enclosures as indicated on the Drawings. If enclosure rating is not indicated on the Drawings, switches shall be furnished with NEMA rated enclosures as required by location being installed. All enclosures shall be constructed of sheet steel. NEMA 4X enclosures shall be constructed of stainless steel.

- B. Disconnect switches shall be:
1. Heavy-duty.
 2. Quick-make and quick-break type.
 3. Horsepower rated at 250 volts AC or DC, or 600 volt AC whichever is applicable.
 4. Capable of interrupting locked rotor current of the motor horsepower rating of the switch (assumed current of six times the rated full load current).
 5. Have switch blades that are fully visible in the OFF position when the door is open.
 6. Dead-front construction with permanently attached arc suppresser.
 7. UL listed removable lugs for copper and/or aluminum cable and front accessible.
 8. Furnish NEMA rated enclosures for locations as required.
 9. Unless otherwise indicated, fused disconnect switches shall be provided with Class R fuses and Class R rejecting kits.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Prior to installing disconnect switches, coordinate with other trades to verify conduits have adequate space to leave and enter the switch enclosure and for required code clearance. A minimum working clearance as defined by the NEC 110-26 shall be provided.
- B. Disconnect switches shall be securely mounted to a permanent structure and grounded per NFPA 70 (NEC). Where a permanent structure is not available for mounting switch, a supporting structure shall be fabricated and installed as approved by the Engineer. Disconnect switches shall be mounted in a location that is readily accessible and free from obstructions.
- C. Install a lamicoid nameplate on disconnect switch exterior that clearly identifies the load being served as specified elsewhere. Fasten nameplate with stainless steel screws.

****END OF SECTION****

SECTION 16450

GROUNDING

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Ground power system, electrical equipment and raceway grounding and bonding, and specialized systems, including testing.

1.02 SUBMITTALS

- A. Manufacturer's data for the following:
 1. Connection methods
 2. Ground Rods
 3. Ground rod wells

1.03 SYSTEM DESCRIPTION

- A. Ground electrical equipment, conduits, supports, cabinets, and switchgear in accordance with NFPA 70 (NEC) and as shown on the Drawings, the intent being a system ground and an equipment ground.

1.04 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards (refer to Section 16010):
 1. IEEE 81-1962--IEEE Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth.
 2. NFPA 70 (NEC)
 3. NEMA
 4. UL listing
 5. MIL Handbook 419

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Ground Rods:
 1. Anderson Electric Corp.
 2. Copperweld Corp.
 3. Harger

2.02 MATERIALS

- A. Ground rods shall be copperclad rods 3/4-inch in diameter and 10-feet long unless indicated otherwise on the Drawings.
- B. Ground rod wells shall be 8-inch diameter constructed of reinforced concrete with a reinforced concrete removable cover stamped "GROUND" as manufactured by Christy or equal.

- C. Connectors, mechanical lugs or wire terminals shall be used only to bond ground wires, junction and panel boxes.
- D. Grounding conductors shall be copper, size as indicated on the Drawings or as required by the NEC. Grounding conductors shall be bare or contain green insulation.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Where mechanical lugs are not welded or fastened with a threaded bolt, surfaces shall be thoroughly cleaned and paint scraped to bare metal before connections are made to insure good metal-to-metal contact.
- B. Grounding conductors shall be so installed as to permit shortest and most direct path from equipment to ground and be installed in metal conduit with both conductor and conduit bonded at each end; have connections accessible for inspection, and made with approved solderless connectors braced (or bolted) to the equipment or structure to be grounded. The grounding conductor shall in no case be a current carrying conductor; have a green jacket unless it is bare copper; be run in conduit with power conductors.
- C. Whether indicated or not, the Contractor shall bond the service entrance section equipment pad rebar to the service grounding electrode system.
- D. Exterior grade mounted equipment shall have their enclosures grounded directly to the system grounding electrode conductor.
- E. A main system ground, bare copper conductors, size as indicated, shall be run in PVC conduit from the main switchgear to a ground point beyond the footprint of the electrical equipment pad as indicated on the Drawings. This ground shall be extended to well pump casing and other ground rods as indicated on the Drawings.
- F. Connections to ground rods and steel water piping system shall be as noted on Drawings or be exothermically welded. Ground rod connections shall be done in a ground rod well for inspection purposes.
- G. All bonds between the grounding electrode conductors and the grounding electrodes must be accessible for inspection and routine maintenance. Any buried ground connections (except for rebar bonds) will not be accepted.
- H. All enclosure doors with 120V mounted devices shall be bonded to the enclosure ground bus.

3.02 TESTING

- A. Resistance between ground and absolute earth shall not exceed 25 ohms and shall be measured using the fall of potential method with a three or four terminal ground resistance tester accurate to the hundredths of an ohm. A minimum of ten (10) ground resistance tests shall be measured at 30' intervals from the farthest service grounding electrode. The test results shall be plotted on a curve and

submitted in the report. The ground resistance test shall be conducted in the presence of the Engineer before service is placed in operation. Use of salts, water or compounds to attain the specified ground resistance is not acceptable, unless consulted with the Engineer for approval.

- B. Test Report: Submit grounding test report including a drawing showing locations of ground tests, date the test was conducted, the weather conditions, and the measured resistance.

****END OF SECTION****

SECTION 16470
PANELBOARDS

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Panelboards

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data demonstrating compliance with this specification and the Drawings. Information shall include but not be limited to:
1. A panel schedule indicating branch circuit number, size and type of individual circuit breakers, interrupting capacity of the device and number of poles.
 2. Short circuit current bracing of the panel.
 3. Bus material and mounting type.
 4. Demonstrate means of identification of each circuit and of each panel by mark corresponding to the Drawings. Explain any deviations.
 5. Clearly indicate all dimensions and that it has been verified that the equipment will fit into place.
 6. Indicate ground bus kits.
- B. Test Data: Submit test reports on integrated panel.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards (refer to Section 16010):
1. NEMA
 2. UL listing
 3. NFPA 70 (NEC)
 4. W-P-115a Power Distribution, current edition

1.04 RELATED WORK

- A. Division 16, Electrical

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cutler-Hammer
- B. General Electric
- C. Square D Company
- D. No equal

2.02 MATERIALS

- A. Panelboards shall:
1. Have dead front construction.
 2. Be installed as indicated on the Drawings.
 3. Contain a ground bus kit.
 4. Have bus structure of size and ratings called for in accordance with UL 67, or as sized on the Drawings.
 5. Contain a main circuit breaker or solderless main lugs and solid neutral as indicated on the Drawings.
 6. Be mounted with the highest device handle not more than 6-feet above finished floor.
 7. Have neutrals grouped on a common bar.
 8. Have terminals rated UL for copper or aluminum.
 9. Be UL listed.
 10. Have copper bus bars of 98 percent conductivity and minimum cross sectional area based on UL 67 for heat rise.
 11. Have doors which are equipped with:
 - a. Door-in-door construction.
 - b. At least three hinges.
 - c. Spring lock or bar latch.
 - d. Framed directory on inside with 1/16-inch thick glass or plastic cover and typed written directory card.
 12. Be finished as noted on the Drawings, if not noted finished blue-gray lacquer.
 13. Designed so as to permit a combination of one, two or three pole breakers to be readily assembled.
 14. Have a manufacturer's stamped steel nameplate on the exterior indicating voltage, amperage, phases and short circuit bracing.
 15. Have bolt-on type branch circuit breakers.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Provide a means of keeping unauthorized hands out of live panels during construction when panelboard fronts have not been installed.
- B. Complete panelboard schedule by accurately typing in a brief load description for the appropriate circuit number. Place a copy of the panelboard schedule in the pocket of the panelboard door.
- C. Each circuit shall be clearly identified by color as to the phase connection. Wiring in panels shall be neat with rounded corners and tied in bundles with approved ties. See Section 16120.

- D. Where a common neutral is run for more than one branch circuit, the phase conductors shall be connected to separate, consecutive phases in order that the neutral will carry only the unbalanced current in each phase. Neutral conductors shall be same size as phase conductors unless specifically noted otherwise.
- E. Panelboards mounted in motor control center shall be installed by the motor control center manufacturer or UL-508A approved panel fabricator.

3.02 BALANCING

- A. Panelboard circuiting shall be as indicated on the Drawings whenever possible. Additional loads shall be placed to balance loads between phases as much as possible.

****END OF SECTION****

SECTION 16475

OVERCURRENT PROTECTIVE DEVICES

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Overcurrent Protective Devices such as fuses and circuit breakers.

1.02 SUBMITTALS

- A. Fuses: Submit catalog cuts which indicate the fuse symbol and ampere rating for each disconnect or device.
 - 1. Submit manufacturer's data showing fuse name, symbol, voltage rating, UL class, interrupting capacity or I-squared time (I^2t) characteristics and accessories.
 - 2. Fuse trip curves.
- B. Breakers: Submit catalog cutsheets that indicate type of breaker, size, trip, characteristics, interrupting capacity, and the specified features.

1.03 OPERATING AND MAINTENANCE MANUALS

- 1. Identify the size, model and features for each item.
- 2. Complete instructions regarding the operation and maintenance of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- 3. Refer to Specification Section 16010 for additional requirements.

1.04 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards (see Section 16010):
 - 1. NFPA 70 (NEC)
 - 2. UL listing
 - 3. ANSI
 - 4. NEMA

1.05 RELATED WORK

- A. Specification Section 16400, Service Entrance Section
- B. Specification Section 16440, Disconnect Switches
- C. Specification Section 16470, Panelboards
- D. Specification Section 16481, Motor Controllers
- E. Specification Section 16482, Motor Control Centers

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Fuses:
 - 1. Bussmann Mfg. Div.
 - 2. Gould-Shawmut
 - 3. Little-Fuse
- B. Circuit Breakers:
 - 1. Allen-Bradley
 - 2. Cutler-Hammer
 - 3. Siemens
 - 4. Square D Company
 - 5. No equal

2.02 MATERIALS

- A. Fuses:
 - 1. Fuses up to 600 volts shall meet the following:
 - a. Be of the same manufacturer.
 - b. Shall NOT be shipped in fused switches.
 - c. Shall be stored in a safe, moisture free area until needed.
 - d. All dual element fuses shall have separate overload and short circuit elements. The overload element shall include a spring-assisted thermal unit. The thermal unit shall open on a temperature rise above 280°F. Time delay for the overload element shall be at least 10 seconds at 500 percent of rated amperes.
 - e. When indicated on the Drawings or required by the local authority or serving utility, fuses shall be silver-sand UL Class R or Class L. current-limiting fuses (low-peak dual element).
 - f. Fuse ampere rating shall not exceed 175% of motor FLA. Abnormal motor conditions requiring increased ampere ratings shall be referred to the Engineer. Fuses shall be UL Class R current-limiting dual element with time delay.
- B. Circuit Breakers:
 - 1. Low voltage breakers up to 600 volts shall meet the following:
 - a. Be quick-make, quick-break type.
 - b. Have toggle mechanism insuring full contact pressure until time of opening whether manually or automatically operated.
 - c. Thermal magnetic type to have inverse time tripping characteristics with fixed thermal trip action to hold on harmless momentary overload.
 - d. Circuit breakers with 225-Ampere frames and above shall have adjustable thermal and magnetic trip units. Solid-state circuit

- e. A short circuit condition shall cause the magnetic trip element to instantly trip without damage or injury.
 - f. Have non-welding, non-corroding contacts.
 - g. Be full-size with mechanism enclosed in molded bake-lite case, sealed to prevent tampering or unauthorized changes in calibration.
 - h. Be UL listed and recognized.
 - i. Meet NEMA standards.
 - j. Be bolt-on type unless otherwise specified.
 - k. Have contacts that operate in a multiple plate arc-quenching chamber vented to load side of breaker - UL listed.
 - l. Be rated for AIC compatible with ratings of the panel or switchboard bus they are to be used in as indicated on the Drawings.
 - m. Be calibrated for operation in a minimum ambient temperature of 50°C.
 - n. All multi-pole breakers shall have common trip.
 - o. For multi-pole breakers shall require the same space as the equivalent number of single pole breakers. Wafer style breakers are unacceptable.
 - p. Have operating handle that visually indicates “on”, “off”, or “tripped”.
 - q. Clearly indicate ampacity and frame size.
 - r. Be labeled to indicate circuit number(s) and load served.
2. Refer to Specifications Section 16400 for service entrance section circuit breaker requirements.
 3. Circuit breakers with 225 Ampere frames and above shall have adjustable thermal and magnetic trip units. Solid-state circuit breakers shall be used if curve shaping is required for proper overcurrent device coordination.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Provide overcurrent protection for all wiring and equipment in accordance with NFPA 70, State or local codes, whichever is prevailing.
- B. Should nameplate data disagree with the size or application of an overcurrent protective device indicated on the Drawings, immediately bring it to the attention of the Engineer for a decision.
- C. Place a label inside each fused switch door. Label shall indicate fuse type, ampere rating and interrupting rating. Manufacturers’ labels are acceptable.

- D. Where blank spaces or spaces designated for future overcurrent devices are indicated on the Drawings, they shall be complete with bus links.

3.02 SPARE PARTS

- A. Furnish one spare set of three (3) of each size and type of fuse rated at more than 30 amperes, and 10 percent of each size and type of fuse rated 30 amperes or less, but in no case less than one set of three (3).

****END OF SECTION****

SECTION 16481
MOTOR CONTROLLERS

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Furnish and install motor controllers as indicated on the Drawings and as specified herein.
- B. Where motor controllers are installed in motor control centers, the overcurrent protective device, motor controller, and motor control center structure shall be of one manufacturer.

1.02 SUBMITTALS

- A. Shop Drawings: Submit drawings which include, but not limited to, the following applicable data:
 - 1. Motor designation and horsepower
 - 2. NEMA starter sizes and overload type/sizes
 - 3. Enclosure type with interior and exterior elevations with dimensions
 - 4. Control transformer ratings
 - 5. Circuit breaker (or fuse) sizes
 - 6. Auxiliary contacts
 - 7. Control devices being utilized
 - 8. Point-to-point wiring diagram by an approved system integrator
 - 9. Bill of material including spare parts being furnished
- B. Product Data: Submit manufacturer's data showing compliance with the Drawings and these specifications.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards (see Section 16010):
 - 1. NFPA 70 (NEC)
 - 2. UL listing
 - 3. NEMA
 - 4. Horsepower application rated
 - 5. IEEE

1.04 JOB CONDITIONS

- A. Coordinate with motor manufacturer for whom starters are being furnished to verify starter selected will properly start, run and protect the motor it serves.

1.05 RELATED WORK

- A. Specification Section 16120 – Wires and Cables (600V or less)
- B. Specification Section 16195 – Electrical Identification

- C. Specification Section 16475 – Overcurrent Protective Devices
- D. Specification Section 16482 – Motor Control Centers

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Allen-Bradley
- B. Cutler-Hammer
- C. General Electric Company
- D. Square D Company
- E. No equal

2.02 GENERAL

- A. Motor controllers shall be of the combination type complete with integral fused disconnect switch, magnetic-only type circuit breaker (MCP) or thermal magnetic circuit breaker as indicated on the Drawings with integral overload protection. Motor controllers shall be installed in separate enclosures as indicated on the Drawings. Enclosure rating shall be as indicated on the Drawings or as required by the NEC.
- B. Motor controllers specified herein shall be suitable for use with voltage and phasing as indicated on the Drawings.
- C. All motor starters and contactors shall be NEMA rated, minimum size 1.
- D. Motor controllers shall be equipped with individual, encapsulated, fused (primary and secondary) control power transformers, unless indicated otherwise on the drawings or herein. Control voltage shall be 120VAC unless indicated otherwise.
- E. Overload protection shall be of the electronic type. A pushbutton shall be provided to manually reset the overload protection with the controller enclosure door closed (automatic reset is not acceptable). The overload protection shall be equipped with a minimum of one normally open and one normally closed auxiliary contact.
- F. Motor controllers shall have an externally operated handle to open the disconnecting means. The handle shall have means to be locked in the open position with a minimum of three standard padlocks.
- G. All equipment furnished shall be new and of current design. Like equipment shall be of the same manufacturer.
- H. Access doors shall be mechanically interlocked with the overcurrent/disconnect device to prevent unintentional opening of the door while energized and unintentional application of power while door is open. Provisions shall be provided for releasing the interlock for intentional access and application of power.

2.03 SOLID STATE REDUCED VOLTAGE TYPE

- A. The solid-state reduced voltage motor controller shall consist of a power section, a one-piece printed circuit logic board and a field wiring interface terminal board.
- B. The power section shall be three-phase, 60 hertz, and rated for the horsepower and voltage as indicated on the Drawings. It shall consist of three sets of back-to-back phase controlled power semi-conductors. Resistor/capacitor snubber networks shall be used to prevent false firing of SCR's due to dv/dt characteristics of the electrical system.
- C. Thermostatically controlled cooling fans shall be provided. Fan shroud shall penetrate the NEMA 3R motor control center external housing for air intake and exhaust. Thermal sensors shall be provided on the heat sink to trip the control protective logic for an over-temperature condition. Thermal sensors shall be rated 90°F maximum.
- D. Three-phase current sensing via current transformers shall be provided for closed loop control to insure motor stability.
- E. The logic circuitry shall include as a minimum:
 - 1. Short circuit electronic trip overcurrent protection (time not to exceed 1/2 cycle).
 - 2. Inverse time running overcurrent protection.
 - 3. Auxiliary trip circuitry
 - 4. Gate firing circuit lockout protection of trip.
 - 5. Fault relay with on N.O. and one N.C. auxiliary contact.
 - 6. 250 percent - 450 percent current limit adjustment.
 - 7. Minimum and maximum voltage adjustments.
 - 8. Voltage stability adjustment.
 - 9. Phase sequence protection.
 - 10. Current and motor slip sensing to regulate motor voltage.
 - 11. External circuitry interface for start/stop control, run status, and common failure signals as indicated on the drawings.
 - 12. Adjustable control for controlled accelerating time (0-30 second minimum).
 - 13. Adjustable control for controlled stopping time (0-30 second minimum).
- F. Power terminations shall consist of pressure type terminals for top or bottom entrance.
- G. Provide NEMA rated bypass (shorting) and input contactors. Circuitry in the solid-state starter shall energize the bypass contactor when output voltage reaches 100%.
- H. Short circuit withstand rating shall meet or exceed the rating of the circuit breaker feeding the solid-state starter or as indicated on the Drawings. A current limiting circuit breaker may be used to reduce the short circuit amperes to the solid-state starter.

- I. Solid-state soft starter and bypass contactor combination must be capable of operating continuously in 122°F ambient temperature conditions without air conditioning. Derate components as necessary to achieve this requirement.
- J. The solid-state soft starter shall be equipped with a backlit LCD digital operator interface/keypad that can be remote mounted on the motor controller door. The display shall be two-line, 16-characters minimum. The operator interface/keypad shall include the following features as a minimum.
 - 1. Adjustments for the following operating parameters:
 - a. acceleration ramp time (soft start)
 - b. deceleration ramp time (soft stop)
 - c. initial torque
 - d. starting current limit
 - 2. Display of the following operating parameters:
 - a. voltage
 - b. motor current
 - c. KW
 - d. KWH
 - e. elapsed time meter
 - f. Power factor
 - 3. Display of the following alarms in descriptive text:
 - a. voltage unbalance
 - b. phase reversal
 - c. undervoltage
 - d. stall
 - e. jam
 - f. overload (overcurrent)
 - g. underload
 - h. excessive starts/hour
 - i. open gate (with phase indication)
 - j. controller overtemperature

2.04 NAMEPLATES

- A. Each motor controller shall be furnished with a nameplate identifying the load being served as indicated on the Single Line Diagram. Size shall be 1" x 3" minimum. Nameplates shall be fastened to the motor controller with stainless steel screws. See Section 16195 for additional requirements.

2.05 CONTROL DEVICES

- A. Provide control devices and components as necessary to meet the intent of design as indicated on the Drawings and described herein.

- B. Operator control devices and pilot lights shall be heavy-duty, oiltight, 30mm. Pilot lights shall be push-to-test, LED style with LED and lens color as indicated on the Drawings.
- C. Terminal blocks shall be furnished and installed for all field-wiring connections. Terminal blocks shall be rated 30A at 600VAC and mount on a standard 35mm din rail. Each terminal block shall be clearly marked with a terminal block designation per approved wiring diagram. Provide a minimum 25 percent spare.
- D. Control/timing relays shall be of the plug-in style with 120VAC, 10A contacts (DPDT minimum) with On-Off indicator. Standard DPDT control and timing relays shall be interchangeable without changing any wiring. Contacts for switching 4-20mA signal circuits shall contain gold or other noble metal coating. Intrinsically safe relays shall be furnished and installed where indicated on the Drawings or as required by code. Control relays shall have an LED that is illuminated when the control relay is energized. Timing relays shall have an LED that flashes when the relay is timing.

2.06 ELAPSED TIME METERS

- A. Elapsed time meters shall be non-resettable type, shall read to a maximum of 99999.9 hours, and shall operate when 120VAC is applied. Meters shall contain a bezel for panel mounting with a NEMA 4 rating.
- B. Acceptable manufacturers:
 - 1. Cramer Model 635G
 - 2. Yokogawa Model 240 611 AAAD
 - 3. Or equal

2.07 SPARE PARTS

- A. Provide the following spare parts in addition to those listed above:
 - 1. Two sets of fuses for each size and type used.
 - 2. Two spare pilot light lamps.
 - 3. 25 percent spare terminal blocks.
 - 4. One spare control and timing relay of each type utilized.
 - 5. One control power transformer of each size used.
 - 6. Five air intake filters.
- B. Package spare parts in suitable containers bearing labels that clearly indicate the contents.

PART 3 -- EXECUTION

3.01 CONTROLLER FABRICATION

- A. Motor controllers shall be assembled by the MCC manufacturer or by an approved UL 508A panel fabricator. The entire motor controller or motor control assembly shall be provided with a serialized UL 508A label.

- B. Motor control schematics indicated on the Drawings are schematic only. They are provided for bidding purposes to show the intent of control and operation. They are not intended to be actual wiring diagrams. It is the Contractor's responsibility to ensure that all motor controllers are designed and fabricated properly to meet the intent of the Contract Documents.
- C. Control wiring shall be type MTW with red insulation (#12 minimum for power, #14 minimum for control). All control wiring shall be contained in plastic wireways with removable covers. Wiring to door mounted devices shall be wrapped in a protective plastic flex. Control wiring installed on enclosure doors shall be secured to door with wire anchors cemented in place. Each control wire shall be clearly identified with a shrink-on wire marker and wire number designation per approved wiring diagrams.
- D. All field wiring shall be terminated on terminal blocks within the motor controller.
- E. All door mounted devices and internal control components shall be labeled to match the approved wiring diagrams.
- F. Enclosure doors shall be bonded to the enclosure ground bus.

3.02 INSTALLATION

- A. Furnish and install all motor controllers as indicated on the Drawings in accordance with the NEC and all applicable industry standards.
- B. Field-test all motor controllers to demonstrate proper operation. The motor controller fabricator shall be present during startup, testing and commissioning of each motor controller. The Engineer and/or Owner shall witness all motor controller field-testing.
- C. Set overload relays per motor manufacturer's recommendations.

****END OF SECTION****

SECTION 16482

MOTOR CONTROL CENTERS

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Furnish and install motor control centers (MCC) as indicated on the Drawings and as specified herein.

1.02 SUBMITTALS

- A. Shop Drawings: Submit drawings and information which include, but not limited to, the following applicable data:
 - 1. Manufacturer's technical information on equipment proposed for use.
 - 2. Complete single line diagrams that show all overcurrent devices (with ratings) and their connected loads. The single line diagram shall indicate each MCC compartment by compartment number and differentiate bussing from cabling.
 - 3. Enclosure type.
 - 4. Electrical ratings: Voltage, Amperage, Bracing, and Phasing.
 - 5. Detailed drawings that include arrangement and all elevation views (interior and exterior gear) with certified dimensions. MCC elevations shall indicate external disconnecting operating mechanisms as well as nameplate locations, size and data.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards (see Section 16010):
 - 1. NFPA 70 (NEC)
 - 2. UL 485
 - 3. NEMA ICS2-322
- B. Unless specified otherwise, the manufacturer of the motor control center shall be the same manufacturer of the enclosure and major components within.
- C. Completed assembly shall bear a serialized UL label.

1.04 RELATED WORK

- A. Specification Section 16120 – Wires and Cables (600V or less)
- B. Specification Section 16195 – Electrical Identification
- C. Specification Section 16475 – Overcurrent Protective Devices
- D. Specification Section 16481 – Motor Controllers

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Allen-Bradley (Centerline)
- B. Eaton (Freedom 2100 Series)
- C. General Electric Company (E9000 Series)
- D. Square D Company (Model 6)
- E. No equal

2.02 RATINGS

- A. Voltage: 480V (unless noted otherwise)
- B. Phasing: 3 phase, 3 wire (unless noted otherwise)
- C. Alternating Current Frequency: 60 Hz
- D. Bus Bracing: 65,000A (unless noted otherwise)
- E. Vertical Bus Amperage: 300A (unless noted otherwise)
- F. Horizontal Bus Amperage: As indicated on the Drawings
- G. Wiring/Terminations: NEMA Class II, Type B
- H. Enclosure: NEMA Type 1 (gasketed).

2.03 CONSTRUCTION

- A. Free standing, totally enclosed, dead front assembly consisting of nominal 90-inch high, 20-inch deep, minimum 20-inch wide vertical sections bolted and bussed together to form one continuous structure. All sections of the motor control center as indicated by the MCC elevation on the Drawings shall be supplied by one manufacturer.
- B. Isolated, readily accessible horizontal wireways at top and bottom.
- C. Isolated, vertical wireways with hinged doors for each vertical section. Wireways shall contain cable supports.
- D. Unit compartments shall be provided and sized to contain the equipment shown and specified. Each compartment shall be provided with a hinged access door complete with quick captive screws and provisions for padlocking in the ON or OFF position. Access doors shall be mechanically interlocked with the overcurrent/disconnect device to prevent unintentional opening of the door while energized and unintentional application of power while door is open. Provisions shall be provided for releasing the interlock for intentional access and application of power.
- E. All full-voltage starter units shall be of the drawout type. Drawout provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus. Drawout units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend into the bus compartment. Interior of all units shall be painted white. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal

blocks rated 600 VAC. Drawout units shall be secured by a spring-loaded quarter turn indicating type fastening device located at the top front of the unit.

- F. Sections or compartments identified as “space” shall be complete with hinged access doors and all accessories necessary for future use.
- G. Sections or compartments identified for special construction such as for soft starters or automatic transfer switch shall be complete with horizontal bussing, hinged access doors, backpanel for device mounting and shall be full height, full depth, with a width as required to house all electrical equipment as indicated on the Drawings.
- H. Unless otherwise indicated on the Drawings, specially constructed sections containing motor controllers shall contain an integrally mounted disconnect supplied and installed by the MCC manufacturer within the same section or compartment. The disconnect switch shall be interlocked with the MCC door so that it must be in the “OFF” position before the door can be opened.

2.04 BUS SYSTEM

- A. All bus bars shall be tin plated copper. The horizontal bus shall be rated at 65°C temperature rise over a 40°C ambient in compliance with UL standards. Vertical busses feeding unit compartments shall be securely bolted to the horizontal bus. All joints shall be front accessible for ease of maintenance.
- B. The main horizontal bus shall be glass polyester insulated and isolated from wireways and working areas. Horizontal bussing shall be located at the top and run the entire length of the MCC structure. Empty sections utilized for special construction by the System Integrator or MCC manufacturer such as soft starter or other controls shall be complete with horizontal bus.
- C. Vertical busses shall be completely isolated and insulated by means of a labyrinth design glass polyester barrier. Shutter mechanisms shall be provided to isolate the vertical bus when a unit has been drawn out. Sections or compartments identified as “space” shall be complete with vertical bus.
- D. The RTU/Control Section shall not be furnished with vertical bussing.
- E. The ground bus shall be located at the bottom and shall run the entire length of the structure. Furnish ground bus with compression type lugs of appropriate capacity as required for termination of main and branch circuit grounding conductors.
- F. Supply power cables shall terminate within the structure on a main overcurrent device or on main lugs, as indicated on the Drawings. Adequate dedicated space shall be provided for the type and size of cables used. If main lugs are utilized, they shall be compression type with anti-turn feature, sized for cables used.

2.05 FINISH

- A. The structure shall be given a phosphatizing pretreatment. The paint finish shall be an anionic, thermoset acrylic. Standard color of approved manufacturer shall be used, unless noted otherwise.

- B. The structure's finish shall pass 600 hours of corrosion resistance testing per ASTM B 117.

2.06 NAMEPLATES

- A. The entire MCC structure shall be furnished with a nameplate identifying the MCC designation, voltage, phases, wires, amperage and short circuit withstand rating. Size shall be 2" x 6" minimum constructed of stamped steel or engraved phenolic material (black on white) fastened to the MCC exterior structure with stainless steel screws.
- B. Each compartment shall be furnished with a nameplate identifying the load being served as indicated on the Single Line Diagram. Size shall be 1" x 3" minimum. Nameplates shall be fastened to each MCC bucket with two stainless steel screws.

2.07 CUSTOMER METERING

- A. Customer metering shall be a digital meter instrumentation package as manufactured by G.E. Multilin PQM, Square D (Powerlogic), Cutler-Hammer (IQ Analyzer), or equal.
- B. The unit shall have a front panel digital display consisting of LED's, Liquid Crystals, or vacuum-fluorescent display.
- C. The unit shall include integral fuses for each voltage phase input. The unit shall connect directly to the power supply voltage. Operating voltage for the unit shall be derived from the metered voltage input without the requirement of a separate power source.
- D. The unit shall include current transformers (CT's) shall be furnished and installed with ratings as indicated on the Drawings or per manufacturer's recommendation. A fourth CT shall be provided for the neutral bus to measure neutral current.
- E. The Digital Meter Instrumentation Package shall be capable of measuring real-time measured parameters for Power and Energy for the following:
 - 1. Voltage (line-neutral) V_a , V_b , V_c , V_{avg}
 - 2. Voltage (line-line) V_{ab} , V_{bc} , V_{ca} , V_{avg}
 - 3. Voltage Unbalance %
 - 4. Current I_a , I_b , I_c , I_{avg}
 - 5. Current Unbalance %
 - 6. Neutral Amps I_n
 - 7. Real Power KW_a , KW_b , KW_c , KW_{total}
 - 8. Reactive Power $KVAR_a$, $KVAR_b$, $KVAR_c$, $KVAR_{total}$
 - 9. Apparent Power KVA_a , KVA_b , KVA_c , KVA_{total}
 - 10. Real Energy KWH
 - 11. Reactive Energy $KVARH$
 - 12. Power Factor PF_a , PF_b , PF_c , PF_{total}
 - 13. Frequency Hz

- F. The unit shall be capable of storing in non-volatile memory a time stamped alarm and event log of up to 100 events including date, time (to 1 millisecond), event type, and value for all over/under limit conditions, all status input activity, and all relay operations.
- G. The unit shall have waveform capture capability allowing any of the voltage and current input channels to be digitally sampled at 64 samples per 60 Hz cycle (minimum). Waveform capture shall be stored in non-volatile memory. The unit shall also provide waveform recording capability for all voltage and current input channels. Waveform recording shall run continuously, sampling all inputs at 16 samples per cycle.
- H. The unit shall include a minimum of three independently programmable Form C dry contact control relay outputs for remote alarm monitoring. Output contacts shall be capable of being configured for a pulsed output proportional to KWH usage.
- I. The Digital Meter Instrumentation Package shall have a serial communications port (Modbus RTU protocol) with the following features:
 - 1. Switchable RS-232C and RS-485 capability.
 - 2. Addressable polling of multiple units.
 - 3. Selectable transmission at 300 to 19,200 baud.

2.08 SURGE PROTECTION DEVICE (SPD)

- A. The MCC shall be furnished with an SPD specifically designed for mounting in a 12” space MCC cubicle. The unit shall have the following features and functions:
 - 1. ANSI/UL 1449 Third Edition.
 - 2. UL 1283 listed for high frequency noise.
 - 3. UL 845 listed for motor control centers.
 - 4. All modes of protection: L-G & L-L
 - 5. The minimum Surge Current Rating shall be 250 kA per phase.
 - 6. The maximum UL 1449-Third Edition VPR for the protection of each mode shall not exceed the following:

<u>Mode</u>	<u>277/480</u>
Line-Neutral	<u>1200</u> VAC
Line-Ground	<u>1200</u> VAC
Neutral-Gnd	<u>1200</u> VAC
Line-Line	<u>2000</u> VAC
 - 7. Status pilot lights to indicate unit is powered and operating properly. Separate pilot light(s) shall indicate unit or individual phase protection module failure.
 - 8. Form C alarm contacts for remote monitoring unit failure.
 - 9. Minimum 5 year warranty.

2.09 TRANSFORMER

- A. KVA and voltage ratings shall be as indicated on the Drawings. Six voltage taps shall be provided; two above and four below nominal voltage in 2.5% increments.
- B. Transformers shall be designed for continuous operation at rated KVA, for 24 hours a day, 365 days a year operations, with normal life expectancy as defined in ANSI C57.96.
- C. Transformer sound levels shall not exceed 45dB.
- D. Insulation system: Transformers shall be insulated with a 220°C insulation system based upon 115°C rise. Required performance shall be obtained without exceeding the applicable temperature rise in a 40°C maximum ambient. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.
- E. Transformer core shall be constructed with high-grade, nonaging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10 percent above the highest tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction.
- F. External cable shall be rated 90°C for encapsulated type and 75°C for ventilated type designs. Connectors shall be provided for cable sizes as indicated on the Drawings. The core of the transformer shall be grounded to the enclosure.
- G. The center tap of the transformer secondary shall be bonded to the MCC ground bus.

2.10 ARC FLASH HAZARD WARNING LABEL

- A. Refer to Specification Section 16010.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Install at location as indicated on the Drawings. Furnish and install all support channels and adjust for a level and plumb standing.
- B. Install in accordance with the manufacturer's instructions and all applicable local codes.
- C. Field test all motor control center components. Damaged or inoperative equipment shall be replaced with new equipment at no cost to the Owner.
- D. Refinish marred or damaged areas of the structure to match the original integrity. If damaged areas cannot be restored to the satisfaction of the Owner, the damaged areas shall be replaced with new at no cost to the Owner.

- E. The Contractor shall provide the services of a certified factory trained manufacturer's representative to provide installation supervision, startup and field testing services as necessary.
- F. An empty section of the MCC shall be delivered to the I&C Contractor for fabrication of the RTU/control section and installation of the air conditioning unit.

3.02 CUSTOMER METERING CONFIGURATION

- A. The customer meter shall be installed by the MCC manufacturer with an overcurrent protection/disconnecting device for each input phase conductor.
- B. The unit shall be flush mounted in the door of the motor control center as indicated on the Drawings.
- C. Install CT's, disconnect, wire and connect all electrical circuits to provide a fully operational customer metering package.
- D. Configure the digital metering package to display all measured values and parameters properly. Configure each alarm parameter for display with time and date stamp when the alarm threshold has been exceeded. Coordinate with the Engineer for initial alarm configuration setpoints.
- E. Configure the customer meter to provide dry contact closures and analog output signals as indicated on the Drawings. Provide an external terminal strip for termination of all field wiring used for remote monitoring. Field wiring shall not be terminated directly on the digital metering unit.
- F. At startup, the Contractor shall read and record all measured parameters as listed in above. Readings shall be done when the maximum amount of equipment is operating. The Contractor shall furnish this documentation to the Engineer and place a copy in the O&M manual.

3.03 TRANSFORMERS

- A. Install in accordance with manufacturer's instructions; verify that transformer is solidly grounded before energizing, and that all bending radii are within requirements.
- B. Adjusting: Adjust primary taps so that secondary voltage is within 2 percent of rated voltage.

3.04 CONTROL SECTION

- A. The MCC control section shall be considered a "Local Control Panel" and conform to all requirements as specified elsewhere in these Specifications (Division 17, Instrumentation).

****END OF SECTION****

SECTION 16500

LIGHTING

PART 1 -- GENERAL

1.01 SUMMARY

- A. Section Includes: Luminaires, ballasts, poles and lamps.

1.02 SUBMITTALS

- A. Submit manufacturer's data for the following:
1. Luminaires with designation as indicated on the Drawings, for each one proposed.
 2. Luminaire ballasts, for each one proposed.
 3. Lamps (type, color, wattage, etc.), for each one proposed.
 4. Light pole with accessories, including foundation details. Area light pole foundations must be designed for 80mph wind loading with 100mph wind gusts.
- B. Submit manufacturer's data demonstrating compliance with Specifications and the luminaires as indicated on the Drawings.

1.03 QUALITY ASSURANCE

- A. Comply with the following Codes and Standards (see Section 16010):
1. UL listed and labeled.
 2. NEMA
 3. NFPA 70 (NEC)
 4. IES

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Magnetic Ballasts:
1. Jefferson Electric (all types)
 2. Advance Transformer Co. (fluorescent)
 3. Universal Manufacturing Co. (fluorescent)
- B. Electronic Ballast
1. Motorola
 2. Advanced
 3. Magnetek
- C. Lamps:
1. Sylvania
 2. Philips

3. General Electric Co.

2.02 MATERIALS

- A. Luminaires shall be:
 1. Furnished with proper outlet boxes, hangers, hardware, supports, canopy extensions, etc. Wall mounted exterior luminaires shall be furnished with a flush-mounted box and be rated for outdoor use in wet locations.
 2. Furnished complete with lamps with wattage and voltage as indicated on the Drawings.
 3. Furnished complete with plaster frames and light tight gaskets when recessed in drywall or plaster ceilings or overhangs.
 4. Of the specified finishes and color.
- B. Ballasts for high-intensity discharge (HID) type luminaires shall be:
 1. Autoregulator, constant wattage type (CWA) 90% pf, 18 percent maximum loss, low starting current).
 2. LPA "Peak Lead" auto transformer type, 90 percent pf, 20 percent loss, for two lamp fixtures, metallic vapor.
 3. Series (isolated) constant wattage, 90 percent pf 10 percent loss.
 4. UL listed and labeled for application.
 5. Sound rated 20 to 24db.
 6. Free of magnetic hum.
 7. Isolated for vibration.
 8. Not exceed 90°C operating temperature.
 9. Meet NEMA standards and be labeled.
- C. Ballasts for fluorescent lighting luminaires shall be the electronic type and shall have the following minimum requirements:
 1. UL Listed Class P, Type 1
 2. Class A sound rating with no audible noise
 3. Operate at an input voltage of 108 to 132 (120 Volt Circuit) at an input frequency of 60 HZ. Light output shall remain constant for line voltage fluctuation of plus or minus 5 percent.
 4. Ballast shall be full rapid start and maintain full cathode heat during operation.
 5. Total harmonic distortion shall be less than 10 percent.
 6. Third harmonic distortion shall be less than 8 percent.
 7. Power factor shall be greater than 0.95.
 8. Lamp flicker shall be less than 2 percent.
 9. Lamp current frequency shall be greater than 25 KHZ.
 10. Ballast shall be rated for T-8 lamps.
- D. Lamps:

1. HID lamps shall be “pulse-start” metal-halide where indicated on the Drawings.
 2. Fluorescent lamps shall be as specified on the Drawings. Lamps shall be preheat, rapid start or instant start type unless otherwise specified on the Drawings. Lamp types shall be as follows:
 - a. 4-foot lamps shall be 32-Watt, bipin, cool white, 3150 lumens
 - b. Color Rendering Index (CRI): Lamps shall have a minimum CRI of 70 through the use of RE-70 or RE-80 rare earth phosphor coatings.
- E. Exterior Lighting:
1. Pole mounted area lights shall be furnished complete with pole, handhole, receptacle with WP while-in-use cover, light switch with WP cover, gaskets, welded ground lug opposite the handhole, luminaire labeled approved for wet location. Luminaires shall have lamp bases coated with an inhibitor to prevent base from corroding to the socket and be solidly grounded.
 2. Exterior luminaires shall be furnished complete with gaskets, cast aluminum weatherproof outlet boxes, labeled approved for outdoor locations, have lamp bases coated with an inhibitor to prevent base from corroding to the socket and be solidly grounded.

PART 3 -- EXECUTION

3.01 INTERFERENCES

- A. Contractor shall carefully examine the complete areas as well as each individual room where luminaires are to be installed, for interference with piping and other trades. Where such interferences occur, provide luminaires with proper type suspension to overcome such interferences.

3.02 INSTALLATION

- A. Luminaires shall be installed parallel with walls and ground for a neat appearance. Luminaires shall be installed parallel with walls and ground for a neat appearance. Where luminaires are indicated to be mounted on a perimeter wall, luminaires shall be installed on a surface mounted box at an elevation such that the top of luminaire is flush with the top of wall.
- B. Operate luminaires after installation and connection. Check for proper operation. Relamp luminaires that have failed lamps.

3.03 OPERATION

- A. Lighting shall be controlled as indicated on the Drawings.

****END OF SECTION****

SECTION 17500

GENERAL INSTRUMENTATION

PART 1 -- GENERAL

1.01 SYSTEM DESCRIPTION

- A. This section includes the general requirements for furnishing and installing the Instrumentation, Control and Monitoring equipment as indicated on the Drawings and specified in Division 17 of these specifications. Other instrumentation and control sections of this Division shall supplement this Section as necessary.
- B. The intent of the instrumentation and control sections of Division 17 is to require that all instrumentation as indicated, specified and/or required, shall be furnished by a single competent, qualified Instrumentation and Control Subcontractor (hereinafter referred to as the I&C Contractor) to assure system compatibility and coordination with all other subsystems.
- C. The Contractor with his I&C Contractor shall provide all labor, materials, and incidentals as indicated, specified and required to furnish, install, calibrate, adjust, test, document, program, start-up and train for a complete, integrated and functionally operational Instrumentation and Control System as is intended by these Contract Documents. The system includes but is not necessarily limited to the following major equipment:
 - 1. RTU/Control Section
 - 2. Lighting Control Cabinet
 - 3. PLC programming modifications, operator interface screen modifications and SCADA computer configuration modifications at the existing Tartesso Unit 1 Water Supply Facility (TU1WSF)
 - 4. Field Instruments
- D. Programming for this project includes work at the existing Tartesso Unit 1 Water Supply Facility. Modifications to the existing SCADA computer graphics (Wonderware) to monitor and control the well site are also included in this Contract. Refer to Specifications Section 17550 for additional information.
- E. Labor, materials, apparatus, and components essential to the complete functioning of systems described and indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Documents or not, shall be furnished and installed by the Contractor. In case of doubt as to the work intended, or in the event of need for explanation thereof, the Contractor shall refer to the Engineer for supplemental instructions.
- F. All items not specifically mentioned in these specifications or noted on the Drawings, or on shop drawings, but which are necessary to make a complete and satisfactory, working electrical/instrumentation installation, shall be deemed to be included herein. The Construction Documents are not intended to show every fitting, junction, or component nor every difficulty that may be encountered

during installation or coordination with different equipment manufacturers. The Contractor shall refer to related data in all Contract Documents and shall verify this information on site.

- G. Unless otherwise indicated, all equipment and components shall be rated for use in the environment installed. Outdoor equipment shall be weatherproof or rated for outdoor use. Equipment installed in corrosive areas shall be rated for that environment.

1.02 REFERENCES

- A. The specifications reference known standards and codes. Each such standard referenced shall be considered a part of the Specifications to the same extent as if reproduced therein in full. The following is a representative list of such Associations, Institutes and Societies, together with the acronym by which each is identified.

AIEE	American Institute of Electrical Engineers
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code (2005)
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
UL	Underwriter's Laboratories, Inc.

- B. Every reference in the Specifications shall mean the latest printed edition of each in effect at the Contract date or latest edition as adopted by the local governing authority.

1.03 SYSTEM RESPONSIBILITY

- A. The I&C Contractor shall have total responsibility for the work as specified in the instrumentation and control specifications of this Division. This includes but is not necessarily limited to furnishing system components, system integration and design, wiring diagrams, installation supervision, instrument calibration, PLC program modifications (at TU1WSF), operator interface screen modifications, SCADA computer Wonderware graphics modifications (at TU1WSF), RTU configuration, start-up, testing and operator training.
- B. The I&C Contractor shall obtain the services of a Programmer with a minimum of 10-years programming experience on projects of similar type. The Programmer must be Allen-Bradley certified.
- C. The I&C Contractor shall coordinate with the Engineer and Town of Buckeye for implementing and testing the control system at the well site and at the Tartesso Unit 1 Water Supply Facility (TU1WSF). *PLC programming and Wonderware*

configuration on the SCADA computer at Tartesso Unit 1 Water Supply Facility is included in this contract.

- D. The Programmer is a Subcontractor to the I&C Contractor and the I&C Contractor is a Subcontractor to the Contractor. Therefore, references made to the responsibilities and requirements of the Programmer or I&C Contractor shall only mean that the responsibilities and requirements pass through the Subcontractors and the final responsibility rests with the Contractor.

1.04 QUALITY ASSURANCE

- A. The I&C Contractor shall be a reputable system integrator and be an Underwriters Laboratory (UL) 508A recognized panel fabricator. The I&C Contractor must be located within a 100 mile radius of the project and have been in that vicinity for a minimum of five (5) years.
- B. The I&C Contractor must have a minimum of five (5) years experience as a system integrator, panel fabricator and instrumentation supplier for other projects of similar type, size and requirements. If requested, the Contractor must submit documentation from his selected I&C Contractor verifying the experience and UL 508A file number.
- C. All equipment furnished shall be new and of current design. Like equipment shall be of the same manufacturer.

1.05 SUBMITTALS

- A. Submit number of copies as specified elsewhere in these specifications. Submit systems as complete submittals, at one time, with items arranged in numerical sequence corresponding with each Specification Section and article of each Section. Submittals shall be bound in 3-ring binders (2" max) with tabs and a neatly typewritten index.
- B. Descriptive Data: Submit copies of complete descriptive literature, performance data, physical dimensions, power and signal connections for each component and equipment to be furnished. Provide name of manufacturer, style, and complete model number. Listing items "as specified" without both make and model or type designation is not acceptable.
- C. Component Data Sheets: Submit a component data sheet for each piece of instrumentation equipment similar to an ISA S20 form. Include equipment tag number, manufacturer's model number, location of service, materials of construction, size and scale range, calibrated range, setpoints, optional accessories and any other useful information.
- D. Important Notice:
 - 1. After material or equipment has been submitted and approved, no substitutions will be allowed.
 - 2. If Contractor's submittal(s) depart from the Contract Documents, the Contractor shall make specific mention thereof in his letter(s) of

transmittal, otherwise review of such submittals by the Engineer shall not constitute review of such departure(s).

3. The Contractor may be charged for costs incurred by the Engineer for third and subsequent submittal reviews. Cost for Engineer's review time shall be billed at the Engineer's standard hourly rates.
- E. Control System Drawings: Submit 11" X 17" detailed shop drawings indicating dimensions, component layout, mounting details, wiring diagrams, nameplate legends and bill of materials for each control panel.
1. Wiring diagrams shall include all interconnections, inter-wiring and terminals between all electrical and/or instrumentation units. Wire numbers shall be continuous from start to finish. Wire numbers shall not change when going from one unit, cabinet, enclosure, terminal or any device to another.
 2. Discrete control and power circuits: Submit ladder diagrams indicating all panel devices related to discrete functions mounted in or on control panel. Show unique rung numbers on left side of each rung. Label each wire, coil and terminal block. Show individual component terminal numbers.
 3. Analog signals: Indicate the entire analog loop on the wiring diagram including all devices connected in series and location of each device. Indicate loop power supplies and individual component terminal numbers. Indicate wire and terminal numbers of each device in the loop.
 4. Use different symbols for terminal blocks located in different pieces of equipment. Label each terminal block and wire termination point.
- F. If applicable, show each PLC I/O point rack, slot, terminal number and PLC configured address on each drawing.
- G. Submit a complete PLC I/O listing including instrument tag numbers and descriptions. The I/O list shall contain the PLC rack, slot, terminal number and PLC address. Submit a complete PLC program database cross-reference list linking each database and internal register with its associated I/O point(s).
- H. Refer to Specification Section 17550 for operator interface/SCADA computer configuration submittal requirements.

1.06 COORDINATION

- A. The Contractor shall coordinate with all other equipment manufacturers to avoid conflicts and interferences. No extra compensation will be allowed for changes made necessary due to conflicts between various equipment.
- B. The Contractor shall be responsible for coordination of control panel fabrication, testing and instrumentation installation and configuration of the wireless RTU at the well site and configuration of the PLC, wireless RTU, operator interface and SCADA computer at the TU1WSF. Project completion will not be granted to the Contractor until programming and configuration has been completed and complete automatic operation has been tested.

- C. Any discrepancies noted in these contract documents or discrepancies between Drawings and actual field conditions shall be promptly brought to the Engineer for a decision. No extra compensation will be allowed for changes made by the Contractor without Engineer's consent.

1.07 RECORD DRAWINGS AND OPERATING AND MAINTENANCE MANUALS

- A. Record Drawings: Upon completion of work, Contractor shall furnish a complete set of Record Drawings and Shop Drawings which properly reflect final tested system, loop diagrams, PLC programs, etc., as actually installed. Drawings shall accurately record the final constructed system and shall be labeled as "RECORD".
- B. Operating and Maintenance Manuals (O&M): The Contractor shall provide O&M manuals for equipment and materials furnished under this contract. Submit number of copies as specified elsewhere in these specifications. Assemble data in a single complete indexed volume and identify the size, model, and features indicated for each item. O&M manuals shall include the following information as a minimum:
 1. A neatly typewritten index near the front of the manual furnishing immediate information as to the location in the manual of emergency data regarding installation.
 2. Installation requirements and procedures.
 3. Equipment description and complete instructions regarding the installation, operation, shutdown, maintenance and trouble-shooting of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
 4. Bill of Materials, component data sheets, descriptive literature, product specification sheets, wiring diagrams and calibration procedures. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
 5. Complete listing of replaceable and expendable parts with part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or components not related to equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
 6. Copy of warranties issued for each piece of equipment.
 7. Provide a copy of all instrument calibration reports.
- B. Operator interface/PLC cross-reference table/interface list. The cross-reference list shall include all PLC registers linked to each operator interface display feature. The list shall include the operator interface tag, PLC address, I/O type and range of analog signals in engineering units.

- C. Four (4) copies of the final PLC program on 8-1/2" x 11" paper and two (2) copies on CDROM after final acceptance of the project. The programs shall be well documented with control descriptions.
- D. Two (2) copies of the final operator interface configuration files on CDROM after final acceptance of the project.

1.08 WARRANTY

- A. In addition to specific warranties required by the Specifications, the Contractor shall leave the entire installation in complete working order and free from defects in materials, workmanship or finish. Contractor shall repair or replace at his own expense any part that may develop defects due to faulty material or workmanship during the tests and within a period of one year (minimum, or as indicated elsewhere) after final acceptance. The Contractor shall repair or replace existing equipment and work that is damaged during the repair of defective apparatus, materials or workmanship at no cost to the Town of Buckeye.
- B. All manufacturer's warranties shall be filled out in their entirety by the I&C Contractor for the Town of Buckeye using the Town of Buckeye's name and address. Material warranty periods will commence on date of final acceptance.

PART 2 -- PRODUCTS

2.01 STANDARD EQUIPMENT

- A. Unless a specific product by manufacturer and model number has been called out, furnish and install equipment of the type specified which has been proven to operate successfully. Material or equipment that has been specified or called out by manufacturer and/or model number must be supplied with **no substitute**. All other equipment may be selected based on equal quality and performance.
- B. All control panel components shall be UL recognized or ground fault protected per UL 508A fabrication standards. Each control panel assembly shall bear a serialized UL 508A label.
- C. All instrumentation equipment and control panel components shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 50°C, and specifically rated for the altitude in which the equipment will be placed in service.

2.02 SPARE PARTS AND ACCESSORIES

- A. Furnish any special tool required for maintenance or routine calibration of equipment.
- B. Refer to individual Sections within this Division for required spare parts.

PART 3 -- EXECUTION

3.01 INSTALLATION SUPERVISION

- A. The I&C Contractor shall furnish the services of instrumentation technicians or control system engineers trained and experienced in the installation of the various instrument and control equipment being supplied. These services shall be utilized by the Contractor as he deems necessary to supervise installation, calibrate, troubleshoot and put equipment into service.

3.02 INSTRUMENT CALIBRATION

- A. The I&C Contractor shall provide the services of a factory representative with the proper tools and equipment to properly calibrate and adjust each instrument in the field. The Engineer shall be notified when the factory representative will be onsite to witness instrumentation calibration and setup. This site visit by the factory representative may also be utilized for the Town of Buckeye designated operator training as required below.
- B. Each instrument shall be tested with certified test instruments simulating inputs at 0, 25, 50, 75 and 100 percent of the calibrated range. Ten (10) data points shall be recorded by ascending to 100 percent then descending back to 0. Data shall be recorded on a prepared Instrument Calibration Report with the following information:
 - 1. Instrument description
 - 2. Type and location of service
 - 3. Manufacturer, model and serial number of instrument
 - 4. Scale range and engineering units
 - 5. Testing method and description
 - 6. Input values or settings
 - 7. Output values (recorded data)
 - 8. Calibrations notes or explanations
 - 9. Technician's name, date and signature
 - 10. Copy of the test instrument calibration report. Testing instrument must have been calibrated within one year prior to calibration date.

3.03 FINAL ACCEPTANCE

- A. Upon completion of instrument calibration and system validation, all systems to be retested under process conditions. The Town of Buckeye, Engineer and Contractor shall perform this test as a final acceptance test for each instrument or piece of equipment. The process variables will be pushed to their limit to verify accuracy, alarms and interlocks. Any defects or problems will be corrected immediately. Once all testing has been completed to the Town of Buckeye's satisfaction, the I&C Contractor shall submit a certified report with all substantiating data sheets indicating that the total instrumentation and control system meets the functional intent of the Contract Documents.

- B. The system integrator and Contractor should assume a minimum of 8-hours for field startup and testing on-site with the Engineer and Town of Buckeye.
- C. After installation of the system and checkout by the Town of Buckeye, Engineer and Contractor, a 30-day acceptance test shall be performed. The 30-day acceptance test shall include an operational demonstration of at least 30 days during which the system shall run continuously without loss of basic functions. The operational demonstration shall confirm that the status, alarm, and process variable signals are valid and are being updated appropriately. During the operational demonstration, the Town of Buckeye shall record all errors or abnormal occurrences. The Contractor shall investigate the problems and log his observations including a description of the problem, its apparent cause, and the action taken, if any, to recover from the occurrence. Repeated failure of any hardware component shall cause the acceptance test to be terminated and restarted.

3.04 OPERATOR TRAINING

- A. The I&C Contractor shall provide factory trained personnel for each field instrument and PLC/RTU control section components to perform Town of Buckeye designated operator training of each system. The training shall be done in a group session for a minimum of 8-hours. The training shall cover PLC control logic, operator interface monitoring and control functions, instrumentation operation, calibrations, adjustments, routine maintenance and repair.

****END OF SECTION****

SECTION 17510
FIELD INSTRUMENTS

PART 1 -- GENERAL

1.01 SYSTEM DESCRIPTION

- A. This section includes the general requirements for furnishing and installing the field instruments as indicated on the Drawings and specified in this Division of these specifications. Other instrumentation and control sections of this Division shall supplement this Section as necessary.
- B. The Contractor with the I&C Contractor shall provide all labor, materials, and incidentals as indicated, specified and required to furnish, install, calibrate, adjust, test, document, start-up and train for each field instrument furnished.
- C. Labor, materials, apparatus, and components essential to the complete functioning of field instruments described and indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Documents or not, shall be furnished and installed by the Contractor. In case of doubt as to the work intended, or in the event of need for explanation thereof, the Contractor shall refer to the Engineer for supplemental instructions.
- D. For purposes of clarity and legibility, the Drawings are diagrammatic only. Construction Documents are not intended to show every fitting, junction, or component nor every difficulty that may be encountered during installation or coordination with different equipment manufacturers. The Contractor shall refer to related data in all Contract Documents and shall verify this information on site.

1.02 SUBMITTALS

- A. Descriptive Data: Submit copies of complete descriptive literature, performance data, physical dimensions, power and signal connections for each field instrument to be furnished. Provide name of manufacturer, style, and complete model number. Listing items "as specified" without both make and model or type designation is not acceptable.
- B. Component Data Sheets: Submit a component data sheet for each piece of instrumentation equipment similar to an ISA S20 form. Include equipment tag number, manufacturer's model number, location of service, materials of construction, size and scale range, calibrated range, setpoints, optional accessories and any other useful information.
- C. Submit drawings and bill of materials for any sun shields that may be required. Drawings must clearly indicate how the sun shield will be fabricated and mounted.

1.03 OPERATING AND MAINTENANCE MANUALS

- A. Installation requirements and procedures.

- B. Complete instructions regarding the operation and maintenance of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. *O&M manuals must be individually tailored to the project and equipment as furnished.*
- C. Bill of Materials, component data sheets, descriptive literature, product specification sheets, wiring diagrams and calibration procedures. *O&M manuals must be individually tailored to the project and equipment as furnished.*
- D. Complete nomenclature of replaceable parts, part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or components not related to equipment furnished must be removed or crossed out. *O&M manuals must be individually tailored to the project and equipment as furnished.*
- E. Provide a copy of all instrument calibration reports.
- F. Refer to Specification Section 17500 for additional requirements.

1.04 COORDINATION

- A. The Contractor shall coordinate with all other equipment manufacturers and trades to avoid conflicts and interferences. No extra compensation will be allowed for changes made necessary due to conflicts between various equipment.
- B. Any discrepancies noted in these contract documents or discrepancies between Drawings and actual field conditions shall be promptly brought to the Engineer for a decision. No extra compensation will be allowed for changes made by the Contractor without Engineers consent.

1.05 IDENTIFICATION TAGS

- A. All field instruments and devices shall have an identification tag meeting the following requirements:
 - 1. Device designation or field instrument number on tag shall be as indicated on the Drawings.
 - 2. Device designation shall be permanently etched or embossed onto a stainless steel tag which shall be fastened to the device housing with stainless steel rivets or self tapping screws of appropriate size.
 - 3. Where neither of the above type of tag fastening can be accomplished, permanently attach the tag to the device or instrument by a circlet of 1/16-inch diameter stainless steel wire rope.
 - 4. Panel mounted devices and field instruments shall be identified with nameplates as described in Specifications Section 16195.

PART 2 -- PRODUCTS

2.01 MAGNETIC FLOWMETERS

- A. General

1. Magnetic flowmeters systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flowmeter system shall include a metering tube, signal cable, transmitter and flowmeter grounding rings.
 2. Magnetic flowmeters and electronics shall be manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.
- B. Metering Tube:
1. Constructed of 304 or 316 stainless steel with 150 lb. carbon or stainless steel AWWA Class D flanged connection.
 2. Utilize a minimum of 2 bullet-nosed, self-cleaning electrodes.
 3. The liner shall be non-conductive and in conformance with the Manufacturer's recommended service.
 4. Electrodes constructed of materials that are in conformance with the Manufacturer's recommendation for the meter's intended service.
 5. Meter housing rated for accidental submergence.
 6. Two stainless steel grounding rings shall be furnished and installed in accordance with the manufacturer's bore and material recommendation for the meter's intended service. Installation shall be per flowmeter manufacturer's recommendations. Unless otherwise indicated, flowmeter grounding shall consist of a 3/4" x 10-foot copperclad ground rod bonded to the grounding rings with a No.6 bare copper conductor.
- C. Transmitter: The transmitter shall be mounted on the flowtube or remotely where indicated on the Drawings. The interconnecting cable shall be furnished by the flowmeter manufacturer of sufficient length to avoid splicing. Transmitters shall be housed in NEMA 4 enclosures suitable for mounting outdoors. The transmitter shall produce an electrically isolated 4-20mA DC output into a minimum load of 800 ohms linear to flow and a dry-contact, field adjustable, pulsed output for remote totalization.
- D. Calibration can be accomplished from a HART Communicator or PC software with a modem connected anywhere in the 2-wire loop.
- E. Performance Requirements:
1. Time Constant: 0.5 to 1000 seconds.
 2. Accuracy: 0.50 percent of flow rate from 10 to 100 percent of full range over 1 ft. per second.
 3. Repeatability: 0.25 percent of full scale.
 4. Isolation: either galvanic or optic
 5. Empty pipe detection: The flow transmitter shall display "Empty Pipe" when the metering tube is not completely full.

6. Power consumption: 30 watts max
 7. Power supply: 24VDC nominal
- F. Factory Testing
1. Each flowmeter shall be hydraulically calibrated at a facility that is traceable to the National Institute of Testing Standards using a 3-point (minimum) test. The calibrations procedures shall conform to the requirements of MIL-STD-45662A. A real-time computer generated printout of the actual calibration data indicated apparent and actual flows for each flow test shall be submitted to the Engineer within thirty (30) days prior to shipment of the meters to the project site.
- G. Acceptable Manufactures:
1. Water Specialties UltraMag UM-06
 2. Or equal

2.02 PROPELLER FLOWMETERS

- A. The flowmeter tube shall be fabricated steel with straightening vanes and flanged ends having a diameter and drilling conforming to the Mechanical Drawings. The meter head shall be cast iron or fabricated steel with a bolted saddle to allow easy removal. All ferrous surfaces shall be coated, inside and outside, with a 6 mil thickness of an epoxy or other material that conforms to the requirements of AWWA C550, and to the prevailing requirements of NSF 61, the Food and Drug Administration and of the Environmental Protection Agency.
- B. The propeller shall be injection molded thermoplastic supported in ceramic sleeve type bearing system. The drive mechanism shall be stainless steel or tungsten carbide magnetically coupled with the propeller through a mineral oil filled gearbox. Cable driven flowmeters are unacceptable.
- C. The flowmeter shall have a local register with a six-digit totalizer and a rate of flow indicator registered in GPM.
- D. The flowmeter shall be provided with a two-wire type analog transmitter that converts the rotor rotational speed to a 4-20mA DC output proportional to the calibrated flow range. Where indicated on the Drawings, a dry-contact, pulsed output shall be provided that can be field adjustable to pulse each time a predetermined flow quantity has passed through the flowmeter.
- E. The transmitter circuitry, indicator and totalizer shall be enclosed in a NEMA Type 4X housing that is attached directly to the meter head or remotely mounted as indicated on the Drawings.
- F. The flowmeter accuracy shall be +/-2.0% of the actual flowrate over its operating range. The flow tube pressure rating shall be as required for the application (150 psi minimum). The transmitter temperature rating shall be 120°F minimum suitable for installation in direct sunlight.
- G. Acceptable manufacturers:

1. Water Specialties ML-04
2. Or equal

2.03 SUBMERSIBLE LEVEL TRANSDUCER

- A. Submersible level transducers shall be a 2-wire device consisting of an all-titanium housing and removable polyurethane nose specifically designed for liquid level measurement. The transducer shall contain a silicon piezo-resistive pressure sensor that converts the applied pressure, performs linearization, temperature correction, atmospheric pressure correction, damping, and other transfer functions to determine the correct value of the applied pressure. The applied pressure shall be converted to a 4-20mA DC signal. The level transducer shall have the following functions and features as a minimum:
1. Range: as required for the maximum process liquid level
 2. Over Range: 4X rated psi minimum
 3. Accuracy: 0.25% full scale
 4. Operating Temperature Range: -5°F to +140°F
 5. Compensated Temperature Range: +30°F to +86°F
 6. Temperature Effect: less than 1.5% full scale
 7. Dimensions: 8" long x 0.75" diameter maximum
 8. Temp: -20°C to 80°C
- B. A NEMA 4X termination enclosure with desiccant and lightning arrestor shall be furnished. The transducer cable and analog signal cable shall terminate in this enclosure. The enclosure shall also include a desiccant moisture status indicator that will let the operator know when the desiccant must be restored.
- C. A polyurethane cable molded to the transducer shall be furnished with sufficient length to reach the sensor termination enclosure without splicing. The cable shall include a vent tube that allows for pressure adjustments due to atmospheric pressure.
- D. The enclosure shall be mounted to a 2" pipe support with U-bolts as indicated on the Drawings. The 2" pipe shall be installed in the ground a minimum of 30" and extend above grade 18". Apply 20-mil rubber tape on the portion of pipe that is in direct contact with the Earth. Install a 2" rain cap on top to prevent water from entering the pipe.
- E. Acceptable Manufacturers:
1. Druck PTX-1230 with an STE 110 termination enclosure
 2. Or equal

2.04 GAUGE PRESSURE TRANSMITTERS

- A. The pressure sensor shall utilize oil filled sensing diaphragms with capacitor plates that convert the applied pressure to an electronic signal to the transmitter logic unit. The transmitter logic unit shall be solid state, programmable micro-processor based electronic unit that receives the capacitor signals and performs

linearization, temperature correction, rangedown, damping, and other transfer functions to determine the correct value of the applied pressure. The transmitter shall be 2-wire and provide a proportional 4-20mA dc signal and shall provide an integral digital display. The pressure transmitter assembly shall be suitable for sensing gauge, absolute, or differential type pressures as specified herein and/or as indicated of the Drawings. The pressure transmitter assembly shall have the following functions and features as a minimum:

1. Microprocessor based software that can perform self-diagnostics and provide a communications port utilizing a recognized industry standard type protocol.
 2. Integral indicator to display process pressure in engineering units.
 3. Integral pushbuttons for local programming, including digital trimming of sensor and output electronics with zero and span adjustments.
 4. Range: 0 - 300 PSI, unless noted otherwise.
 5. Rangeability: 15:1
 6. Service: liquid, gas, or vapors.
 7. Analog output: 2-wire, 4-20mA(selectable for linear or square root)
 8. Operating temperature of logic unit: -40 to 85 deg C.
 9. Operating temperature of sensor (silicone fill): -40 to 104 deg C.
 10. Humidity limits: 0 to 100% relative
 11. Damping: 0 to 16 sec (adjustable in 0.1 sec steps)
 12. Accuracy: +/- 0.1% of calibrated spans from 1:1 to 10:1 with a repeatability of 0.1%
 13. Stability: +/- 0.25%
 14. Temperature effect at max span: zero error: +/- 0.2% per 56 deg C, total effect +/- 0.38% of span per 56 deg C.
 15. Temperature effect at min span: zero error: +/- 3% per 56 deg C, total effect +/- 3.18% of span per 56 deg C.
 16. Wetted materials: Isolating diaphragm: 316L SS; Drain/vent valves: 316 SS; Process flange and adapters: 316 SS; O-rings: Viton.
 17. Non-wetted materials: Fill fluid: Silicone oil; Bolts: Cadmium-plated carbon steel; Electronics housing: Low-copper aluminum - NEMA 4X; Cover O-rings: Buna-N; Paint: Epoxy-polyester.
 18. Process connections: 1/4"-18, unless indicated otherwise on Mechanical Plans.
 19. Electrical connections: 1/2"-14 NPT conduit with screw terminals and integral test jack plugs compatible with miniature banana plugs.
- B. A stainless steel block and bleed valve shall be furnished and installed on each pressure transmitter for ease of calibration and service. The block and bleed valve shall be sized as required for the process connection.
- C. Acceptable Manufacturers:

1. ABB 2600T Series
2. Foxboro, Model IGP10
3. Or equal

2.05 PRESSURE SWITCHES

- A. Pressure switches shall be of the snap-action switch actuated, Bourdon tube type with a visible calibrated dial and pointer(s) indicating switch setting(s). Function shall be for gauge pressure, external field adjustable with a trip point repeatability of 1% of actual pressure. Pressure switches shall have the following features and functions as a minimum:
 1. Housing: NEMA 4
 2. Range: 0-150 psi or as appropriate for the application
 3. Proof pressure: 150 percent of range psi minimum
 4. Actuating element: Single point (fixed deadband) service - 316 SS Bourdon tube
 5. Electrical switch: Snap-action switch, SPDT, 120VAC, 10A min
 6. Service: liquid, gas, or vapors
 7. Process connection: 1/4" N.P.T. male
- B. An isolation ball valve shall be furnished and installed on each pressure switch for ease of removal without disruption of service. The ball valve shall be sized as required for the process connection.
- C. Where indicated on Drawings or as required for dual control, pressure switches shall have an adjustable deadband for setting separate open and close operating pressures. Minimum adjustable deadband setting shall be no greater than 20 psi.
- D. Acceptable Manufacturers:
 1. Mercoïd DSW Series
 2. Or equal

2.06 PRESSURE GAUGES

- A. Pressure gages shall have the following features as a minimum:
 1. Housing: 4-1/2", aluminum case with plastic lens, white dial and black numbers/graduations/pointer
 2. Silicone oil filled
 3. Range: 0 – 100 psi
 4. Proof pressure: 150 percent of range psi minimum
 5. Accuracy: one percent of full scale
 6. Wetted material: 316 stainless steel
 7. Dial/pointer: stainless steel or aluminum
 8. Service: liquid, gas, or vapors as indicated on the Drawings
 9. Process connection: 1/4" NPT male

10. Calibration: micro-adjustment screw
 11. Accessories: test cock, female outlets and an isolation ball valve
- B. An isolation ball valve shall be furnished and installed on each pressure gauge for ease of removal without disruption of service. The valve shall be sized as required for the process connection.
- C. The Contractor shall furnish and install all mounting hardware and support structures necessary for proper operation in accordance with the manufacturer's recommendations and the Contract Documents. Materials used for support structures shall be suitable for the environment in which it is installed (corrosive - stainless steel, non corrosive - galvanized steel; unless indicated otherwise).
- D. Acceptable Manufacturers:
1. US Gauge (Ametek)
 2. Ashcroft
 3. Winters
 4. Or equal

2.07 SURFACE MOUNTED DOOR/GATE INTRUSION ALARM SWITCHES

- A. Intrusion alarm switches for gates and doors shall be a heavy-duty industrial, adjustable magnetic wide gap type. Switch and magnet housing shall be constructed of anodized aluminum.
- B. Each intrusion alarm switch shall be provided with an armored flexible cable and wiring assembly of sufficient length to reach junction/termination box indicated on the Drawings without splicing.
- C. Acceptable Manufacturers:
1. Sentrol Model 2507AH
 2. Or equal

2.08 MOTION SENSORS (INDOOR)

- A. Motion detection alarm switches installed inside the electrical enclosure shall be DSC model BV-302D, or approved equal.

2.09 MOTION SENSORS (OUTDOOR)

- A. Motion detection alarm switches installed outside the electrical enclosure shall be Protech model Pyramid XL2, or approved equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Inspect each instrument and piece of equipment for defects, damage and correct operation before installation. Inspect work area and work involving other trades to verify readiness for installation.

- B. Field instruments shall be installed per manufacturer's requirements. Verify that all mounting, process and electrical connections are secure and tight before operating instrument.
- C. Install field instrument identification tag as described above.
- D. The Contractor shall coordinate with the Mechanical Contractor to verify process connection type and location.
- E. Furnish and install sun shields for all analog instruments installed outdoors in direct sunlight where recommended by the instrument manufacturer.
- F. Refer to Section 17500 for additional installation supervision, calibration, testing and start-up requirements.

****END OF SECTION****

SECTION 17520
LOCAL CONTROL PANELS

PART 1 -- GENERAL

1.01 SUMMARY

- A. The I&C Contractor shall furnish all tools, equipment, materials, and supplies, and shall perform all labor as required for furnishing and installing complete and fully functional Local Control Panel (LCP's) as indicated on the Drawings and as specified herein or in other Sections of the Specifications. LCP's shall be designed to provide the sequence of operation specified elsewhere and/or as indicated on the Drawings.
- B. The following is a list of LCP's to be furnished under this Contract:
 - 1. RTU/Control Section
 - 2. Lighting Control Cabinet

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the requirements specified elsewhere.
- B. Product Data: Submit manufacturer's data demonstrating compliance with specification requirements. Including enclosure, finish, control devices, relays, terminal blocks, wireway and accessories.
- C. Submit LCP wiring diagrams showing each and every wire in the panel and field wiring to the panel including each wire number and wire size. The wiring diagrams must indicate the terminal number at each device or terminal block where the wire is terminated, including field devices.
- D. Submit interior component layout drawings of LCP's with component labels and bill of materials.
- E. Submit exterior elevation drawings of LCP's with dimensions and device labels.

1.03 OPERATING AND MAINTENANCE MANUALS

- A. Installation requirements and procedures.
- B. Complete instructions regarding the operation and maintenance of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- C. Bill of Materials, component data sheets, descriptive literature, product specification sheets, wiring diagrams and calibration procedures. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- D. Complete nomenclature of replaceable parts, part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or

components not related to equipment furnished must be removed or crossed out.
O&M manuals must be individually tailored to the project and equipment as furnished.

E. Refer to Specification Section 17500 for additional requirements.

1.04 QUALITY ASSURANCE

A. Design, construct and test according to the following Codes and Standards:

1. NEMA ICS-1, 2 & 3
2. NEMA (Testing Standards BU 1.3.03 or 1.304)
3. UL listing and labeling for materials.
4. NFPA-70
5. UL 508A

1.05 CONSTRUCTION STANDARDS

A. The local control panels (LCP's) shall be assembled and wired by a UL 508A recognized panel assembler. All control panel components shall be UL Listed or UL Recognized under the category "Industrial Control Equipment".

1.06 RELATED WORK

A. Division 17, Instrumentation

PART 2 -- PRODUCTS

2.01 GENERAL

- A. The I&C Contractor shall furnish LCP's to satisfy the functional requirements specified in the relevant mechanical equipment, and Instrumentation & Control specification sections and as indicated on the Drawings. All components shall be UL labeled or provided with proper ground fault protection as required by UL 508A.
- B. All internal wiring shall be contained in plastic raceways or troughs having removable covers. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental contact with energized terminals.
- C. Install heat shrinkable radiation cross-linked, thermally stabilized, modified polyolefin sleeves with 3:1 shrink ratio wire markers on each wire in the control panel. Markers shall be UL Standard 224 recognized.
- D. Identification of panel-mounted devices, conductors, and electrical components shall meet the requirements specified elsewhere.

2.02 TERMINAL BLOCKS

- A. Each LCP shall be provided with identified terminal strips for the connection of all external conductors. There shall be sufficient terminal blocks for all external connections plus an additional 25 percent spare for future use. Terminal blocks shall be identified in accordance with approved shop drawings. Terminal blocks shall be individual, stacking, compression type, 600VAC, 30A minimum, suitable for wire sizes No. 10 - No. 18. A printed terminal block label shall be affixed to each terminal block for identification.
- B. Each field-mounted device deriving power from the LCP shall be individually fused with a knife-blade or plug-in fused terminal block and blown fuse indicator.
- C. Terminal blocks shall be mounted on high-rise DIN rails for ease of access to wire terminations.
- D. Terminal blocks for analog signals shall be tiered style with built-in 3-stage surge protection for connection of a twisted shielded pair conductor including a separate ground connection. Analog signal terminal blocks shall be Phoenix Contact model TT-2PE-24DC or equal.

2.03 CONTROL RELAYS

- A. Relays shall be plug-in type utilizing rectangular blades with an indicating LED, and sockets with screw-type terminals and hold-down clips. Timing relays shall be provided with an indicating light that flashes when the relay is timing. Operating coil voltage shall be as required or indicated on the Drawings.
- B. Contacts shall be rated 10 Amps at 120 VAC. Contact material shall be silver-cadmium oxide except for signal switching circuits that shall be gold plated or other noble metal.
- C. Acceptable manufacturers:
 - 1. Control relays: IDEC RH2B-UL
 - 2. Timing relays: Square D type JCK
 - 3. No equal.

2.04 LCP TVSS UNIT

- A. A 120VAC transient voltage surge suppressor (TVSS) shall be installed on the 120V panel power supply as indicated on the Drawings.
- B. The TVSS shall utilize bipolar Silicon Avalanche Diode (SAD) technology and a two-stage surge suppression design. The TVSS shall be designed to protect against an ANSI/IEEE C62.41 Category A surge.

2.05 POWER SUPPLIES

- A. Power supplies shall be of the solid-state circuitry type UL-1950 and CSA-1402C certified. Input power shall be 120VAC, +/- percent 10, output power shall be as indicated on the Drawings or as required for proper operation of connected loads.
- B. Line regulation shall be within +/- 0.05 percent with a 10 percent line change. Load regulation shall be within +/- 0.05 percent with a 50 percent load change.

Output ripple shall not exceed 0.2 percent peak-to-peak. Transient response shall be less than 50 microseconds for a 50 percent load change.

- C. Power supplies shall be fully rated with an efficiency of at least 60 percent for a temperature range of 0 - 60°C or be oversized appropriately. Power supplies shall produce EMI/RFI noise levels within the requirements of FCC Docket 20780.
- D. Power supplies shall contain internal short circuit and overload protection. Output fusing shall be supplied on the positive terminal.
- E. Power supplies shall have provisions for parallel connection and have an auxiliary fault contact for remote monitoring.
- F. Acceptable manufacturers:
 - 1. Omron S82K series
 - 2. Or equal.

2.06 LIGHTING CONTACTOR

- A. Lighting contactors shall be heavy-duty type with a single, 120 VAC operating coil.
- B. Unless otherwise indicated, the lighting contactor shall have a minimum of two 600V contacts with an amperage rating no less than the maximum lighting circuit passing through the contactor.

2.07 PHOTOCELL

- A. Photocells shall operate on 120VAC unless otherwise indicated and housed in a heavy-duty, weatherproof housing.
- B. Normally open contacts shall close at approximately three-footcandles and open at approximately 12-footcandles.

2.08 SPARE PARTS

- A. Provide one control relay of each type utilized.
- B. Provide (3) spare fuses of each size and type utilized.
- C. Refer to related specification sections for additional spare parts required.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. LCP's shall contain components as indicated on the Drawings.
- B. All front accessible panel-mounted devices shall be mounted a minimum of 42-inches above finished floor elevation.
- C. Each PLC I/O point connected to an external device shall be terminated at terminal blocks. Where AC and DC signals must intercept each other, cross wires at 90° angles. Route AC and DC signals in separate wireways. Provide blank wireways for field wiring by the Contractor.

- D. All internal wiring shall be contained in plastic raceways or troughs having removable covers. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental contact with energized terminals.
- E. Wire markers shall be a minimum of 3/8-inches in length and placed as near as possible to the end of the wire. Orient wire marker such that the writing can be read without turning or twisting the wire.
- F. Wire numbers shall be the same at both ends of the wire.
- G. Minimum control panel conductor size for power shall be No.12 AWG. Minimum conductor size for control wiring shall be No. 14 unless protected by a 10A overcurrent protective device or smaller, in which case it can be No.16 AWG. Analog signal cables shall be 600V, No.16 AWG twisted shielded pair.
- H. Wire markers shall be installed on the end of each wire. Orient wire marker such that the writing can be read without turning or twisting the wire.
- I. All control panel components shall be properly labeled with an engraved nameplate.
- J. All analog signals shall include a DIN rail mounted TVSS designed for 20mA and 24VDC protection.
- K. RTU Cabinet enclosure doors that contain 120VAC devices shall be bonded to the enclosure grounding lug.

3.02 INSTALLATION

- A. LCP's shall be installed as indicated on the drawings.
- B. LCP's shall be stored in an indoor, dry location at the jobsite to protect from condensation, damage, and the effects of weather.
- C. Interior and exterior of LCP's shall be cleaned, and coatings shall be touched up to match original finish upon completion of the work.
- D. All wireless RTU discrete outputs shall activate individual interposing DPDT control relays. At least one of the contacts on the interposing relay shall be wired to terminal blocks for connection to field wiring.
- E. See Section 17500 for additional installation requirements.

3.03 TESTING, STARTUP & TRAINING

- A. LCP's shall be factory assembled, and tested at the control panel shop for sequence of operation prior to jobsite delivery. An additional test shall be performed on site after all field devices have been installed and connected.
- B. See additional testing, start-up and training requirements as specified elsewhere in these specifications.

****END OF SECTION****

SECTION 17531

REMOTE TERMINAL UNIT (RTU)

PART 1 -- GENERAL

1.01 SUMMARY

- A. This section includes the furnishing and installation of a wireless Remote Terminal Unit (RTU) with antenna, power supplies, interconnecting cables and all associated components for control and monitoring of equipment as indicated on the Drawings and as specified herein.
- B. The RTU configuration shall be provided by the I&C Contractor as defined in Specifications Section 17500. The I&C Contractor shall coordinate the installation and wiring of the RTU with the Engineer, and make provisions for on-site start-up and testing of the RTU.

1.02 SUBMITTALS

- A. Manufacturer's catalog cut sheets indicating electrical characteristics, capabilities and physical attributes for each RTU component including , power supplies, I/O modules, antenna, antenna feedline and connectors, surge suppressors, antenna feedline grounding kit and waterproof kit, special interface modules or devices, interconnecting cables and any other equipment related to the RTU.
- B. Manufacturer's catalog cut sheets indicating electrical characteristics, capabilities and physical attributes for each PLC component including discrete input module, antenna, antenna feedline and connectors, surge suppressors, antenna feedline grounding kit and waterproof kit, special interface modules or devices, module racks, operator interface, interconnecting cables and any other equipment related to the PLC at the Tartesso Unit 1 Water Supply Facility (TU1WSF).

1.03 OPERATING AND MAINTENANCE MANUALS

- 1. Installation requirements and procedures.
- 2. Complete instructions regarding the operation and maintenance of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- 3. Bill of Materials, component data sheets, descriptive literature, product specification sheets, wiring diagrams and calibration procedures. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
- 4. Complete nomenclature of replaceable parts, part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or components not related to equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***

5. Refer to Specification Section 17500 for additional requirements.

1.04 SYSTEM OVERVIEW

- A. The well site contains a wireless remote terminal unit (RTU) and associated appurtenances to transmit and receive signals to and from the existing Tartesso Unit 1 Water Supply Facility RTU. The well pump will be controlled from the Tartesso Unit 1 Water Supply Facility based on the storage reservoir level (programming at the water supply facility is included in this contract).
- B. The existing SCADA computer at the Tartesso Unit 1 Water Supply Facility utilizes Wonderware to monitor and control this well site and other offsite wells. The SCADA computer also contains SCADAAlarm software to alert operators by telephone when a critical alarm occurs at the well site. Programming and configuration of the existing Wonderware and SCADAAlarm software on the SCADA computer is included in this contract.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. General
 1. Wireless RTU's shall be din rail mounted, and contain I/O extension modules as required to transmit and receive the signals indicated on the Drawings. The wireless RTU's shall be bi-directional transceivers capable of point to multipoint operation utilizing integrated 900MHz, license free, frequency hopping, spread spectrum radios. I/O extension modules shall transmit and receive signals and power via DIN rail connector(s). I/O mapping of each extension module and addressing of each transceiver shall be accomplished using a thumbwheel on the front of each unit. Wireless RTU's shall have an operating temperature rating of -40 to 158°F and operate on 24VDC. The required I/O channels shall be as indicated on the plans
 2. Each wireless RTU shall be furnished with hardware, cables, software, operation and maintenance manuals necessary to monitor and control equipment, as listed in the Specifications and as indicated on the Drawings. Each wireless RTU input and output shall be connected as per the manufacturer's requirements and recommendations.
 3. Wireless RTU transceivers shall be configured using a USB cable and pre-configured memory "stick".
 4. Acceptable wireless RTU manufacturers
 - a. Phoenix Contact RAD-900-IFS Wireless Module with I/O Expansion Modules as necessary
 - b. Or equal
- B. PLC Discrete Input Module (in the PLC Cabinet at TU1WSF)

1. Discrete input module shall be plug-in, rack style modules, which sense voltage input and shall have LED indicators for each point displaying the status of the field contact. Maximum 16 points. Provide 10 percent spare points wired to terminal blocks (four minimum). Discrete input modules shall be Allen-Bradley 1756-IB16D.
- C. Telemetry Components
1. 900MHz Yagi directional antenna with 8dBi gain minimum
 2. Antenna mounting hardware for mast mounting as indicated on the Drawings
 3. Andrew LDF4-50A or equal ½” heliax antenna feedline cables
 4. Andrew 241088-1 or equal ground strap kits
 5. Andrew 221213 or equal weatherproofing kit
 6. Antenna feedline surge arrestor (Polyphaser model IS-50NX-C2 or equal)

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Each field input and output indicated on the Drawings shall be connected as per the manufacturer’s requirements and recommendations. Each RTU/PLC I/O point shall be terminated at terminal blocks (no direct wiring to the PLC is acceptable).
- B. Install a 3/4” x 10’ copperclad ground rod at the base of the radio antenna for grounding the antenna and cable. Install a #2 copper grounding conductor with green insulation between ground rod and antenna grounding kit. Provide exothermic weld for the ground rod connection.
- C. Upon completion of installation and all field wires terminated at each site, the Contractor shall thoroughly test the RTU system for proper operation with all field wiring terminated. Each input and output signal shall be tested for correct indication and control function. When the Contractor is satisfied that the system performs as intended by these Contract Documents, the Contractor shall call for an official start-up. System start-up shall be performed by the Contractor with the I&C Contractor, Programmer, Engineer and Town of Buckeye present.
- D. See additional testing requirements in Section 17500 of these specifications.

****END OF SECTION****

SECTION 17550

CONTROL DESCRIPTIONS

PART 1 GENERAL

1.01 GENERAL SCOPE OF WORK

- A. This section includes the general system overview and description of logic for each piece of equipment being controlled by the RTU. Other sections of Division 17 shall supplement this Section as necessary.
- B. The intent of this section is to provide guidance to the Contractor and Programmer in the programmable logic function for various I/O signals indicated on the Drawings. The control and monitoring functions described herein cover the basic logic to be performed with each I/O signal. The primary function of these control descriptions is to provide information that cannot be indicated in electrical schematic diagrams such as logic performed by the PLC located at the Tartesso Unit 1 Water Supply Facility, operator interface and/or Wonderware software from the SCADA Computer located at the Tartesso Unit 1 Water Supply Facility. ***PLC programming and Wonderware configuration on the SCADA computer at Tartesso Unit 1 Water Supply Facility is included in this Contract***
- C. These control descriptions are not intended to cover every possible scenario or describe every possible timer, interlock, safety shutdown, etc. that may be necessary for a complete operational system.
- D. An attempt has been made on the Drawings and in these Specifications to describe system logic and functionality as well as show all signals, interlocks, and devices necessary for proper operation of the control and monitoring systems. However, if a particular signal, device, sensor, interposing control relay, signal converter, control logic, interlock (hardware or software), etc., is required to meet the intent or operational requirements and is not indicated, the I&C Contractor shall furnish and install this piece of equipment with no extra compensation.
- E. The I&C Contractor shall coordinate the fabrication, installation and testing of the entire control system, including telemetry to Tartesso Unit 1 Water Supply Facility.
- F. The control system shall be programmed and configured to perform monitoring and control of the water system as indicated in these Contract Documents and as intended for a fully operational system.
- G. The Programmer shall include a minimum of sixteen (8) hours of programming time for modifications or changes in the system logic or Wonderware graphics as requested by the City of Buckeye or Engineer. This additional programming time will take place only after the system has been programmed and tested for proper operation as described herein.

1.02 SUBMITTALS

- A. Submit revised operator interface graphic displays with a brief description of the control and monitoring schemes for each screen. Describe each feature being monitored or controlled and how the information will be displayed (change color, pop-up text, flashing, etc.). Displays shall be similar in nature to the existing well site displays currently on the operator interface. Submit an 8-1/2" X 11" copy of each proposed graphic screen in normal state and in alarm state.
- B. Submit revised Wonderware graphic displays with a brief description of the control and monitoring schemes for each screen. Describe each feature being monitored or controlled and how the information will be displayed (change color, pop-up text, flashing, etc.). Displays shall be similar in nature to the existing well site displays currently on the SCADA computer. Submit an 8-1/2" X 11" copy of each proposed graphic screen in normal state and in alarm state.
- C. Operator interface screens shall be reviewed by the Engineer and City of Buckeye during the submittal phase and again during startup testing. If minor modifications are deemed necessary by the Engineer or the City, modifications shall be made at no cost to the Owner.

1.03 DELIVERABLES

- A. Two (2) copies of the revised PLC program on CDROM after final acceptance of the project. The PLC logic shall be well documented with control descriptions to the satisfaction of the Owner and Engineer.
- B. Two (2) copies of the revised operator interface configuration files on CDROM after final acceptance of the project.
- C. Two (2) copies of the revised Wonderware configuration files on CDROM after final acceptance of the project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SYSTEM OVERVIEW

The well site shall be monitored and controlled by an RTU located in the RTU/control section of the motor control center. A supervisory control and data acquisition (SCADA) system using radio telemetry will monitor and control the entire Tartesso water system from the Tartesso Unit 1 Water Supply Facility.

The existing SCADA computer located at the water supply facility contains an HMI software package (Wonderware) to monitor and control the Tartesso water system. The Wonderware software on the SCADA computer enables the operator to monitor signals from the well site such as flowrates, pressure, on-off status, alarms, etc.

Communication between the Unit 1 Water Supply Facility and this well site shall be done using non-licensed (spread spectrum) radio remote telemetry units (RTU).

3.02 OPERATOR INTERFACE AND WONDERWARE CONFIGURATION (AT TU1WSF)

- A. The existing operator interface screens located at the TU1WSF shall be modified to depict the graphical displays as indicated herein.
- B. Each process display shall have symbols and indicators necessary to show all the information associated with that piece of equipment. The way in which information is displayed shall match existing as much as possible.
- C. Equipment RUN (active), OFF (not active), and ALARM indications and functions shall match existing.
- D. Control features such as Start, Stop or Reset shall have the appearance of an actual pushbutton control station to match existing.

3.03 WELL PUMP CONTROL

The well pump delivers water to the storage reservoir located at the Tartesso Unit 1 Water Supply Facility. The well pump shall be controlled by the PLC at the Unit 1 Water Supply Facility via radio telemetry to keep the storage reservoir full. This well pump shall be sequenced with four other well pumps for operation as described below.

This well pump's start and stop level setpoints shall be operator adjustable and indicated on the operator interface and SCADA computer.

This well pump is supplied with a Hand-Off-Auto (HOA) selector switch and a bypass/solid state soft starter (B/S) selector switch.

Manual operation: When placed in Hand mode, the well pump shall start and run continuously until the HOA is placed in the Off or Automatic mode. Well pump running status shall be sent to the RTU and displayed on the operator interface and SCADA computer. Manual starting and stopping the well pump will still properly operate the waste valve since this operation is hard-wired relay logic.

Automatic operation: In Automatic mode, an In-Auto status signal shall be sent to the RTU and displayed on the operator interface and SCADA computer. When in Automatic mode, the well pump shall be controlled by logic in the TU1WSF PLC via radio RTU. The existing PLC logic at the water supply facility shall be modified to start this well pump in a lead/lag-1 sequence with two other well pumps. An additional operator adjustable Lag-2 pump start setpoint shall be provided on the SCADA computer and automatic alternation of well pumps shall be provided for three well pumps each time all well pumps have stopped. The start and stop levels for this well pump shall be displayed on the operator interface and SCADA computer.

If desired, the well pump can be commanded to start directly from the operator interface or SCADA computer. Well pump running status shall be displayed on the operator interface and SCADA computer. When the well pump is called to start, a "called to start" indication shall be displayed on the operator interface and SCADA computer.

The well pump contains a solenoid operated waste valve and discharge valve. When the well pump is off, the solenoids are de-energized and the waste valve is fully open and the discharge valve is fully closed. The waste valve must be fully open and the discharge

valve must be fully closed (as sensed by a limit switch on each valve) in order for the pump to start (PLC logic and hardwired function). When the well pump is started, a waste duration timer will start timing (hard-wired timer in the well pump controller). After the waste duration timer times out, the valves' solenoid will be energized (hard-wired relay logic) causing the waste valve to slowly close and the discharge valve to slowly open. When the waste valve is closed and the discharge valve is open, flow from the well pump will flow to the storage reservoir. Fully open and fully closed signals from the waste valve and discharge valve (monitored by individual limit switches on each valve) shall be sent to the RTU and displayed on the operator interface and SCADA computer.

Interlocks/alarms:

A hardwired timer in the well pump controller shall be started when the waste duration timer has timed out and the waste valve solenoid has been energized to close the waste. If the waste valve does not fully close (as sensed by a limit switch on the waste valve), a "waste valve failed" alarm shall be sent to the RTU for display on the operator interface and SCADA computer and the well pump shall be stopped until the alarm has been manually reset at the well pump controller.

The well pump starter contains hardwired controls for monitoring soft starter failure, bypass starter overload, motor high motor temperature and high discharge pressure. If any of these alarm conditions occur, the appropriate alarm shall be sent to the RTU and displayed on the operator interface and SCADA computer. Solid state soft starter failure and bypass starter overload have been combined as "well pump failure". Control logic shall not attempt to start the well pump if any of these alarm conditions exist.

If the well pump is called to start and the water supply facility PLC has not received a RUN signal from the well pump within 15 minutes, logic in the PLC shall activate the well pump failure alarm on the SCADA computer. This alarm must be reset at the SCADA computer before the well pump can be called to start again. *F.Y.I.: a hard-wired, 0-10 minute backspin timer in the well pump controller prevents the well pump from starting immediately after stopping or power failure. This must be taken into account after a power failure or if restarting is attempted within 10-minutes after the well pump has been running.*

The well pump controller contains an across-the-line bypass starter. A selector switch shall be provided on the well pump controller cabinet that determines whether the solid state soft starter or bypass starter will be used to operate the well pump. If the soft starter fails, the selector switch must be switched to "backup" mode before the well pump can be operated on the backup starter. A signal shall be sent to the RTU when the selector switch has been switched to the "backup" mode and displayed on the operator interface and SCADA computer.

3.04 WELL WATER LEVEL MONITORING

A submersible type level transmitter monitors water level in the well.

The level transmitter provides a 4-20mA analog pressure signal to the RTU and shall be displayed on the operator interface and SCADA computer.

3.05 WELL WASTE FLOWMETER

A propeller type flowmeter measures the water being delivered by the well pump. The flowmeter shall provide a 4-20mA analog output signal proportional to flowrate and a pulsed discrete signal to the RTU/Control Section for future monitoring.

3.06 WELL DISCHARGE FLOWMETER

A magnetic type flowmeter measures the water being delivered by the well pump. The flowmeter shall provide a 4-20mA analog output signal proportional to flowrate and a pulsed discrete signal to the RTU and shall be displayed on the operator interface and SCADA computer. A password protected reset function shall be configured on the operator interface and SCADA computer to allow the operator to reset the flow totalizer on the operator interface.

If the well pump is running and no flow signal is present for 2-minutes, the well pump shall be stopped and a “flow failure” alarm shall be displayed on the operator interface and SCADA computer. Control logic shall not attempt to start the well pump again until the flow failure alarm has been reset on the operator interface.

If the well pump is running, the discharge valve is fully open and a low flow alarm condition (operator adjustable setpoint) occurs, the well pump shall be stopped and a low flow failure alarm shall be displayed on the operator interface and SCADA computer. Control logic shall not attempt to start the well pump again until the flow failure alarm has been reset on the operator interface.

3.07 PRESSURE MONITORING

A pressure transmitter monitors well pump discharge pressure.

The pressure transmitter provides a 4-20mA analog pressure signal to the RTU and shall be displayed on the operator interface and SCADA computer.

3.08 SURGE PROTECTIVE DEVICE (SPD)

An SPD in the electrical switchgear has been provided to protect electrical and instrumentation equipment from utility voltage transients and lightning. The SPD contains a dry contact that closes when a phase protection module has failed and needs replacement. The SPD failure alarm shall be sent to the RTU and displayed on the operator interface and SCADA computer.

3.09 POWER FAILURE

A power failure relay shall be provided in the RTU/control section to send a signal to the RTU for display on the operator interface and SCADA computer.

3.10 INTRUSION ALARMS

Intrusion alarm switches shall monitor the entrance gates, service entrance section doors and electrical building door. Also, two motion sensors (one inside the electrical enclosure and one outside the electrical enclosure) have been provided. When a gate or door is

opened and/or motion is detected, an alarm shall be sent to the RTU and displayed on the operator interface and SCADA computer and SCADAAlarm shall be activated.

****END OF SECTION****