3.6 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, perform a test on system.

B. While this test is proceeding, Engineer and Owner have full use of system. Only allow plant operating personnel to operate equipment associated with live plant processes. Plant operations remain the responsibility of Owner and decision of plant operators regarding plant operations are final.

C. During this test, PCSS personnel to be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS to provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, PCSS to perform repairs or replacement within 5 days.

E. Throughout duration of SAT, do not make software or hardware modifications to the system without prior approval from Owner or Engineer.

END OF SECTION 406121.20

APPENDIX **40 61 21-**A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX **40 61 21**-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

4-Jun-14

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config., and Wiring complete	Date	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding tank Tank Blower No. 2 Start Command	Start	17	DO	4	6	3								
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5								
PLC-SC	HSS-4105-1	Secondary Scum Pump No. 2 Start/Stop	Start	15	DO	4	6	6								
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7								
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9								
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11								
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12								
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13								
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15								

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4-Jun-14

[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Stategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

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SECTION 406126 - PROCESS CONTROL SYSTEM TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system training for provided devices and systems.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.4 ACTION SUBMITTALS

A. Preliminary Training Plan Submittal:

1. Prior to preparation of the Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

B. Final Training Plan Submittal:

1. Upon receipt of the Engineer's comments on the preliminary training plan, submit the specific proposed training plan with the following:

a. Definitions, objectives, and target audience of each course.
b. Schedule of training courses including proposed dates, duration and locations of each class.
c. Complete copy of all proposed handouts and training materials bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Directly relate training and instruction to system being supplied. Training program represents a comprehensive program covering all aspects of the operation and maintenance of the system.

B. Coordinate all training schedules with and at the convenience of Owner, including shift training required to correspond to Owner's working schedule.

C. Onsite instructors must be intimately familiar with operation and control of Owner's facilities.

D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. Provide manuals in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. Make use of teaching aids, manuals, or slide/video presentations as required. After the training services, deliver all training materials to Owner.

F. Owner reserves right to videotape all custom training sessions. All training tapes become the sole property of Owner.

G. Cost of Travel for Off-Site Training:

1. Cost of Travel for off-site training is paid directly by the entity employing the staff doing the traveling.

3.2 TRAINING SUMMARY

A. Provide the following training courses listed in the summary table below:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			
Installed Control System	2	2	1	Maintenance, Administrator

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
PLC Hardware/Software	2	2	1	Maintenance
Instruments – Magnetic Flowmeter	4	2	1	Maintenance
Instruments - Operator familiarity	2	8	1	Operations
Fiber Optics	4	2	1	Maintenance

B. Definitions of Audience Roles:

1. Administrator: Personnel responsible for maintaining the HMI / SCADA system.
2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations: Personnel responsible for daily plant operations.
4. Management: Non-daily operations personnel.

3.3 ONSITE TRAINING

A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training:

1. Provide training for Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. Conduct the training before the Functional Demonstrator Test (FDT), but not more than two months before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system.
4. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:

    a. System overview.
    b. System hardware components and specific equipment arrangements.
    c. Periodic maintenance.
    d. Troubleshooting and diagnosis.
    e. Network configuration, communications, and operation.
    f. TCP/IP addressing procedures for all Ethernet devices.

C. Programmable Logic Controller (PLC) Hardware and Software:

1. Provide training for Owner's personnel in the operation, maintenance, troubleshooting, etc. with the PLC hardware and software system. Conduct the training before the FDT, but not more than two months before.

2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the PLC system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the PLC system. Provide training covering the following subjects:

    a. PLC system overview.
    b. PLC system architecture.
    c. PLC system hardware components and specific equipment arrangements.
    d. PLC system startup, shut down, load, backup, and PLC failure recovery.
    e. Periodic maintenance.
    f. Troubleshooting and diagnosis down to the I/O card level.
    g. PLC configuration, communications, and operation.

D. Instrument Manufacturer Training:

1. Provide manufacturer instrument training for those instruments where specifically indicated in the Instruments section. This is on-site training provided by an authorized representative of the manufacturer. The manufacturer's representative is required to be fully knowledgeable in the operation and maintenance of the equipment.

E. Instrument Training:

1. Provide instruction on the maintenance of the field and panel instrumentation for Owner's instrumentation technicians. Conduct this training before the FDT, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Training program is required to include the following elements:

    a. Training in standard hardware maintenance for instruments provided.
    b. Specific training for actual instrumentation configuration to provide detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
    c. Testing, adjustment, and calibration procedures.
    d. Troubleshooting and diagnosis.
    e. Maintenance and frequency.

F. Instruments - Operator Familiarity:

1. Provide operator level instruction on the use of field and panel instrumentation for Owner's operations staff. Conduct training before the 30-day site acceptance test, but no more than one month before and at a time suitable to Owner. This training takes place at Owner's facility. Include hands on demonstration of the information each transmitter indicates, and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

G. Fiber Optic Training:

1. Provide instruction on maintenance of the fiber optic system for Owner's instrumentation technicians. Conduct training before the FDT, but no more than one month before and at

time suitable to Owner. This training takes place at Owner's facility. Provide training covering the following topics:

a. Fiber cable layout and basic of cable construction.
b. Termination procedures.
c. "Jumper" installation.
d. Testing procedures.
e. Troubleshooting and diagnosis.

END OF SECTION 406126

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SECTION 406193 - PROCESS CONTROL SYSTEM INPUT/OUTPUT LIST

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for I/O list submittal requirements.

1.3 DEFINITIONS

A. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by PLC.

B. Programmable Logic Controller (PLC): Ruggedized programmable computer used for industrial automation.

1.4 ACTION SUBMITTALS

A. Process Controller Input/Output (I/O) Schedule:

1. Submit complete I/O schedule as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 406193

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SECTION 406196 - PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Applications Engineer System Supplier (AESS) Programming Scope:

1. Develop the control system applications to implement process control descriptions for all new and existing systems. This Section is provided to define control strategies to be used for PLC programming of the system.
2. Contract Documents are a single integrated document, and as such, all Drawings and Specifications apply. It is the responsibility of Contractor and subcontractors to review all Sections to ensure complete and coordinated project.
3. PCSS is cautioned to read this Section and all related Sections and their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section with the specific requirement called out in the individual control strategy. Implement these general strategies throughout this Contract unless specifically directed otherwise in the individual loop process control descriptions.
4. Follow loop and device tagging criteria shown on Drawings without exception.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406866 “Configuration of Controller Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the SCADA system used for device level control and monitoring.

E. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.

F. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

H. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Control System Hierarchy:

1. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is shown in Figure 1.

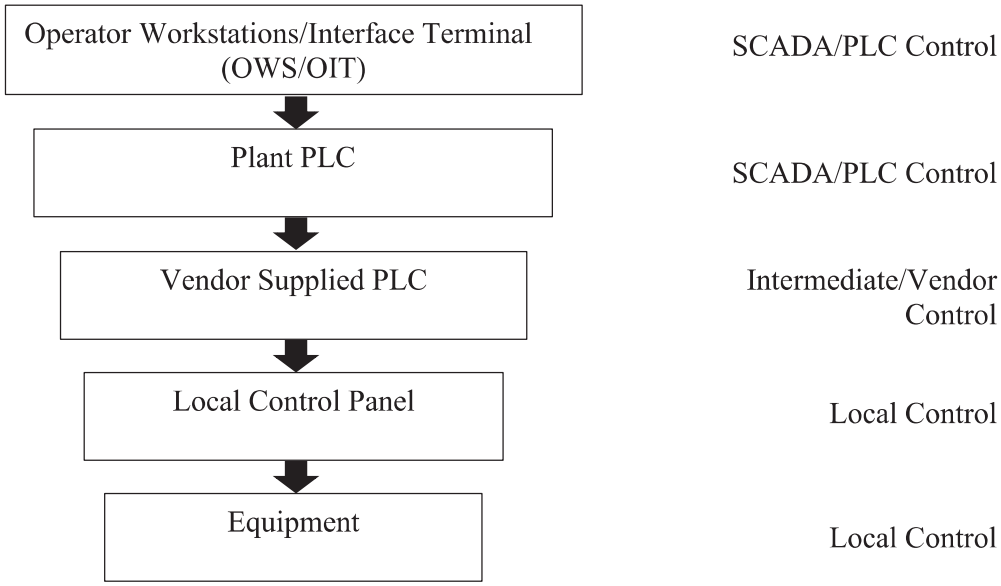

Figure 1. Control System Hierarchy

3.2 GENERAL CONTROLS AND MONITORING

A. Overview:

1. Hardware and/or software functions noted by this Paragraph reference are to be implemented in the PLC control system.

2. Setpoints, as defined by this section, refer to numerical values adjustable from the HMI.
3. PLC is responsible for resetting command bits sent from the HMI to the PLC. If the commanded state cannot be achieved for any reason, the PLC resets the bit to allow the operator to set the command bit again. For example, when pressing the AUTO button on the HMI, the PLC resets the AUTO command from the HMI after the device is in the AUTO Mode. If the AUTO Mode is not available for any reason, the PLC resets the bit, so the AUTO button can be selected at the HMI once AUTO control is available.

B. Interlocks:

1. Hardwired interlocks will interlock the controls locally, at the vendor PLC, and at the plant PLC. If the interlock occurs, the shutdown will cause the equipment to be inoperable at all levels of control.
2. Software interlocks are represented in a particular layer of the operation description and interlock the controls in that layer and the layers above it. However, the interlock does not interlock the commands in the layer before it. For example, a software interlock implemented at the SCADA/PLC level will not stop equipment from being controlled locally.
3. Interlocks that shutdown (stop a piece of equipment and prevent it from being restarted or moved) are displayed on the faceplate pop-up graphic for that piece of equipment.

C. Motors:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Motors can be started manually by the operator at the HMI, or automatically by the control strategy.
4. Automatic control strategies are defined in individual loop descriptions.
5. The SCADA system stops a motor or drive, if it does not receive the AUTO or REMOTE status or one of its software interlocks trips. If the drive or motor is in HAND or LOCAL, it will continue to run but the SCADA start/stop output will be open.
6. If a motor stops for any reason, it cannot be restarted automatically once the problem with the motor has been resolved. A manual reset from the OWS or OIT is required to resume operation.
7. Motors that have a HAND-OFF-AUTO (HOA) selector, indicate to the operator that the pump is being run in the HAND position. A motor is being run in HAND when the AUTO position is not true and the run confirm status is true. If not in AUTO, the SCADA PLC output contact will open and stop (shutdown) the pump.

D. Valves:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Valves with only full travel capability can be opened or closed manually by the operator at the HMI, or automatically by the control strategy.
4. Modulating valves with position feedback can be positioned between 0 percent and 100 percent open manually by the operator at the HMI, or automatically by the control strategy.
5. Automatic control strategies are defined in individual loop descriptions with their corresponding process variable used for control.

E. Analog Instruments:

1. Analog instruments refer to indicating devices capable of providing a continuous output relative to time.
2. Provide monitoring of the analog signals shown on the P&IDs.
3. Analog signals may be a continuous voltage (-10V to 10V, 0V to 5V, 0V to 10V) or current (0 mA to 20mA, 4mA to 20mA) as determined by the output of the field instrument. The output range corresponds to the minimum and maximum full-scale measurement.
4. The PLC will linearly scale the output range (voltage or current) to the equivalent values in engineering units.
5. Provide cutoff deadbands for when the analog signal is approaching the minimum or maximum full-scale measurement.

    a. An analog signal measuring less than or equal to 2 percent of full-scale will be forced to zero after an adjustable time delay.
    b. An analog signal measuring greater than 100 percent of full-scale will be clamped at 100 percent.

6. Provide CALIBRATION mode with an adjustable time setpoint (in hours).

    a. When entering CALIBRATION mode, the last good value is held prior to CALIBRATION mode being activated. The value is held until the calibration time setpoint expires.
    b. The Operator may enter calibration value, which will be the value held until the calibration time setpoint expires.
    c. When active, clearly indicate the instrument is in CALIBRATION mode on any local OITs and in the HMI system.

F. Discrete Instruments:

1. Discrete instruments refer to indicating devices with any number of non-continuous defined states (e.g., ON/OFF, 0 or 1).
2. Provide monitoring of the discrete signals shown on the P&IDs.

    a. When a contact or status from the instrument is true, the PLC will receive power to its input channel. The PLC registers this as a binary bit of 1.
    b. When a contact or status from the instrument is false, the PLC will receive no power (open circuit) to its input channel. The PLC registers this as a binary bit of 0.

G. PLC Hardware:

1. Monitor status and communication faults at the HMI.

    a. Implement watchdog timers to monitor CPU and I/O module health, and execution time for PLC routines.
    b. Generate an alarm at the HMI if any watchdog timer expires.

2. Program system time for all PLCs to synchronize with a Network Time Protocol (NTP) server once every 24 hours.

H. Input Validation:

1. Provide input validation for setpoints used in process control (e.g., chemical dosage setpoints, pump flow setpoints).
2. The PLC will verify that the HMI setpoint is within an acceptable predefined range.
3. Out of range values will be rejected by the PLC and the current value will be retained.

3.3 ACCUMULATORS AND TOTALIZERS

A. Accumulators:

1. Display accumulated run time for all equipment with a RUNNING status. Each run time accumulation is resettable from the HMI with a reset push button.
2. PLC will update the flow totals at 12:00 a.m. local time.

Runtime	Display Format
Current Day:	XX.XX Hrs.
Yesterday:	XX.XX Hrs.
Current Month:	XXX.X Hrs.
Previous Month:	XXX.X Hrs.
Accumulated Total:	XXXXXX Hrs.

B. Flow Totalizers:

1. Totalize all flow indications.

   a. If the flowmeter provided has a configurable pulse output for totalized flow, perform flow totalization using the pulse output. The PLC calculates totalized flow by multiplying the number of pulses by the volume per pulse.
   b. If the flowmeter provided does not have a configurable pulse output for totalized flow, perform flow totalization using the analog 4-20 mA signal.

      1) Do not totalize if the analog signal is outside the 4-20 mA range.
      2) Do not totalize if the value of the flow input is less than 2 percent of the full range of the input.
      3) Do not totalize if a discrete status exists that can be used to determine if flow is present (for example, no flow can be present unless a pump is running).

2. Each flow totalization is resettable from the HMI/OIT with a reset push button.
3. Display totalized flow in million gallons (MG), thousands of gallons (kGal), or Gallons (Gal) in accordance with the following:

Totalizer	MG Format	kGal Format	Gal Format
Current Day:	X.XXX	XXX.XX	XXXX.X
Yesterday:	X.XXX	XXX.XX	XXXX.X
Current Month:	XXX.X	XXX.X	XXXX
Previous Month:	XXX.X	XXX.X	XXXX
Accumulated Total:	XXXX	XXXX	XXXX

4. Use appropriate flow totalizer units for the total volume anticipated for the time period. Unless requested by Owner, water process flows are totalized in million gallons (MG) and chemical flows are totalized in gallons (Gal). Auxiliary flow (e.g., backwash) units are determined based on the total flow for the day.
5. Chemical systems which do not have flowmeters will calculate usage based on the chemical tank volume. The PLC will calculate tank volume based on the measured level and the vessel geometry or the measured weight and the specific weight of the chemical.
6. PLC will update the flow totals at 12:00 a.m. local time.

3.4 ALARMING AND EQUIPMENT FAILURES

A. Analog Alarms:

1. Provide analog alarming capability for all analog signals monitored by the PLC.
2. Supervisor level users can set a common time setpoint (initially set to 5 seconds) that is used to generate alarms. The following alarms (setpoints to be Supervisor adjustable) are generated based on the analog feedback value. Each alarm includes the ability for individual enabling and disabling.

    a. High-High.
    b. High.
    c. Low.
    d. Low-Low.
    e. Loss of Signal.

3. LOSS OF SIGNAL alarm is generated when an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card. The following SCADA programming occurs:

    a. If the analog signal is used in a control loop or ratio control loop, that loop is placed into MANUAL.
    b. If the analog signal is used in a calculation, that calculation uses the last good analog signal. If the calculation is used in a control loop, that loop is placed into MANUAL.

4. SETPOINT REJECTED alarm is generated at the HMI when an analog setpoint is out of range and rejected by the PLC.

B. Discrete Alarms:

1. Program all discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms) to alarm after an HMI adjustable time delay expires.
2. The maximum alarm delay for Safety related alarms (e.g., E-stop) is 500 ms. Set each alarm timer during startup.

C. Motor Failure Alarms:

1. Supervisor level users can set a common elapsed time setpoint for each scenario below:

    a. Motors being remotely controlled generate a FAIL-TO-START alarm when the PLC sends the START command to the motor and it does not receive a RUNNING status from the motor after a supervisor adjustable time setpoint.

When a FAIL-TO-START alarm is generated, the START output command from the PLC is deenergized and the motor is prevented from starting until a reset is issued from the HMI.

b. Motors being remotely controlled generate a FAIL-TO-STOP alarm when the PLC sends the STOP command to the motor and it continues to run after a supervisor adjustable time setpoint.

c. Motors with adjustable speed control generate a SPEED DEVIATION alarm when the motor is running and the PLC sends a speed setpoint to the motor and it does not reach the correct speed (within a deadband, initially set to 10 percent) within a supervisor adjustable time setpoint. The motor remains running if the SPEED DEVIATION alarm is activated.

D. Valve Failures:

1. Supervisor level users can set a common time setpoint that is used to generate the following alarms. When a valve position alarm is active, the PLC output is maintained unless explicitly stated in the individual loop descriptions (e.g., a fail to open alarm does not trigger the PLC to close the valve).

a. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-OPEN alarm when the PLC sends the OPEN command to the valve and it does not reach the OPENED limit within a supervisor adjustable time setpoint.

b. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-CLOSE alarm when the PLC sends the CLOSE command to the valve and it does not reach the CLOSED limit within a supervisor adjustable time setpoint.

c. All modulating valves (POSITIONING) being remotely controlled generate a FAIL-TO-POSITION alarm when the valve feedback does not match the PLC commanded position within a supervisor adjustable time setpoint.

3.5 AUTOMATIC CONTROLS

A. Lead/Lag and Duty/Standby Strategy:

1. Pump Priority:

a. When pumps are called to operate by the automatic sequence, the order of their priority is determined by the following mode selection.

1) Operator Mode: The operator manually selects the priority of each pump (LEAD/LAG/STANDBY/OFFLINE) using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same priority. The pump cannot run in automatic mode or be used in any of the following automatic sequences if placed OFFLINE.

2) Alternation Mode: Used for pumps operating in a DUTY/STANDBY configuration. The pump priorities are rotated each time the DUTY pump is stopped by the control strategy.

3) Sequential Mode: Used for groups of three or more pumps (e.g., LEAD/LAG/STANDBY). The pumps are inserted into the sequence in ascending numerical order and the PLC rotates the pumps using a revolving queue. After an adjustable time setpoint expires, the LEAD pump becomes the STANDBY and the previous LAG pump becoming the new LEAD.

2. Automatic Operation:

   a. If the individual loop description requires that the pumps operate in the LEAD/LAG/STANDBY mode, the LAG is called to start when the following conditions are met after a time delay. If more than one LAG pump is included in the strategy (LEAD/LAG1/LAG2/STANDBY), the sequence repeats.

      1) LEAD pump is running at maximum speed for an adjustable length of time.
      2) The process variable being controlled is more than 5 percent from the target value. For example, in flow control, the flow must be 5 percent below the target.

   b. If multiple pumps are called to run by the automatic logic, pumps will run at the same speed.
   c. If the automatic strategy determines that a pump is needed and the pump for the required sequence position is unavailable, the pump with the next highest position immediately starts.
   d. If the individual loop description requires the pumps to operate in the DUTY/STANDBY mode, the STANDBY pump only starts if the DUTY pump is not available to run when called to start by the automatic strategy.

B. PID Control:

1. When individual control loops require PID control, use the PLC manufacturer's standard PID control functions. Provide PID faceplate with the following parameters:

   a. Setpoint (SP): Reference to the setpoint. This is the setpoint entered (either manually from the HMI or via program logic, as required by the individual loop description) and is maintained by the PID controller.
   b. Process Variable (PV): Reference to the process variable. The process variable is the feedback from a field device or instrument for comparison to the SP by the PID controller.
   c. Output (CV): Reference to the controlled variable. This is the signal varied by the PID controller in order to maintain the PV at the desired SP.

2. PID controller accepts inputs for proportional (P), integral (I), and derivative (D) setpoints used to tune the controller response. PID tuning parameters can be entered manually by the Operator at the HMI or calculated automatically if the PID controller supports autotuning functionality.
3. Operator can place PID controller in MANUAL or AUTOMATIC mode.

   a. In MANUAL, the Operator will enter the desired output (CV). The PID controller will use setpoint tracking to write the process variable (PV) to the controller setpoint (SP) to ensure bumpless transfer when the controller is switched from MANUAL to AUTO.
   b. In AUTO, the PID controller adjusts the output (CV) to hold the process variable (PV) at the setpoint (SP).

4. Configure PID controller to prevent reset windup when operating in MANUAL mode or when the output (CV) has reached maximum limit.

3.6 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

LOOP 120, 220 WELL DISCHARGE FLOW

A. General:

1. Continuous monitoring of raw water flow by means of a flow transmitter to SCADA.

B. Control:

1. Raw water flow indication used to control the Wells described in WELL MONITORING AND CONTROL.

C. Alarms/Monitoring:

1. Provide flow totalization, analog alarming, and monitoring as described in “Accumulators and Totalizers,” “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.
2. Generate a NO FLOW alarm if no flow is measured while any of the Wells are running.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

LOOP 115, 215 WELL DISCHARGE PRESSURE

A. General:

1. Continuous monitoring of Well Discharge Pressure by means of a pressure transmitter to SCADA.

B. Control:

1. Pressure indication used to control the Wells described in WELL MONITORING AND CONTROL.

C. Alarms/Monitoring:

1. Provide analog alarming and monitoring as described in “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

LOOP 100, 200 WELL MONITORING AND CONTROL

A. General:

1. Wells shall run locally via the Local Pump Control Panel. Wells shall be able to be controlled remotely via SCADA. When in Remote/Manual mode, operations shall start and stop a well pump and enter well pump speed. When in Remote/Auto mode, VFD shall modulate the well pump speed to maintain flow setpoint as entered by the operator via SCADA. In Remote/Auto mode, well pumps shall not start automatically, they must be started by the operator.

B. Interlocks:

1. The PLC shall monitor the status of utility power. Upon any change of this status, the well VFD shall be locked out from running or starting via the PLC logic. This interlock shall be reset upon operations depressing the reset pushbutton on the VFD panel or via a SCADA reset button on the appropriate graphic screen. This is to ensure an alternative power source is engaged or disengaged before running/starting a well pump.

C. Alarms/Monitoring:

1. Provide alarming and monitoring as described in “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

END OF SECTION 406196

SECTION 406733 - PANEL WIRING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for internal wiring of control panels and consoles.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 406763 “Control Panel Mounted UPS.”
4. Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”

1.3 DEFINITIONS

A. American Wire Gage (AWG): Measurement of the cross-sectional area of a conductor.

B. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

D. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Provide stranded, type MTW interconnecting wiring:

a. Use 600-volt insulation rated for not less than 90 degrees Celsius.
b. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring.

1) Locate either in a separate section of multi-section panel or behind removable Plexiglas or similar dielectric barrier.

c. Develop panel layout such that technicians have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. For power distribution wiring on the line side of fuses or breakers:

    a. Use 12 AWG minimum.
    b. For control wiring on the secondary side of fuses:

        1) Use 16 AWG minimum.
        2) Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.

3. Cover power distribution blocks with protective guards to meet “finger-safe” requirements of IP20.
4. Route power and low voltage DC wiring systems in separate wireways.

    a. Cross different system wires at right angles.
    b. Separate different system wires routed parallel to each other by at least 6-inches.
    c. Terminate different wiring systems on separate terminal blocks.
    d. Do not fill wiring troughs to more than 60 percent visible fill.

5. Terminations:

    a. Terminate wiring onto single tier terminal blocks:

        1) Uniquely and sequentially number each terminal block.
        2) Direct wiring between field equipment and panel components is not acceptable.
        3) Multi-level terminal blocks or strips are not acceptable.

    b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal).

        1) Provide each group of terminal blocks with a minimum of 25 percent spares.

    c. Use compression type, fused, unfused, or switched terminal blocks.

        1) Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments.
        2) Wire all active and spare PLC and controller points to terminal blocks.

    d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point.

        1) The third terminal is for shielded ground connection for cable pairs.

            a) Ground shielded signal cable at PLC cabinet.
            b) Wire all active and spare PLC and controller points to terminal blocks.

    e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
    f. Use only one side of a terminal block row for internal wiring.

        1) Field wiring side of terminal not to be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free-standing panels,

or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

g. Isolate circuit power from the SCADA cabinet to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse.

1) Use Phoenix Contact CLIPLINE series or equal.
2) One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator.

1) Use Phoenix Contact CLIPLINE series or equal.

6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
7. Clearly tag and color code wiring.

a. Tag numbers and color coding to correspond to panel wiring diagrams and loop drawings prepared by the PCSS.
b. Power wiring, control wiring, grounding, and DC wiring to utilize different color insulation for each wiring system used.
c. Color coding scheme to be in accordance with UL 508a, following the below criteria:

1) 120 VAC ➔Hot Black
2) 120 VAC Neutral ➔ White
3) 120 VAC Hot (Foreign) ➔ Yellow
4) 120 VAC Return (Foreign)➔ Yellow
5) Switched Hot ➔Red
6) 24 VDC + ➔Blue
7) 24 VDC - ➔White on Blue
8) 4-20 mA + ➔Red
9) 4-20 mA - ➔Black
10) Ground-Signal ➔Green
11) Ground-Panel ➔Yellow on Green

8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
9. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) to have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.

a. Power instruments requiring 120VAC power as shown on Drawings.

10. Wiring trough for supporting internal wiring:

    a. Plastic type with snap-on covers.
    b. Side walls to be open top type to permit wire changing without disconnecting.
    c. Trough to be supported to the subpanel by stainless steel screws.
    d. Do not bond trough to the panel with glue or adhesives.

11. Provide each panel with a single tube, LED light fixture, 20 Watt in size (minimum):

    a. Mounted internally to the ceiling of the panel.
    b. Light fixture to be switched and be complete with the lamp.

12. Each panel to have specification grade duplex convenience receptacle with ground fault interrupter:

    a. Mount internally within stamped steel device box with appropriate cover.
    b. Convenience receptacle is not to be powered from a UPS.
    c. Protect by a dedicated fuse or circuit breaker.

13. Each panel to be provided with an isolated copper grounding bus for all signal and shield ground connections.

    a. Shield grounding to be in accordance with instrumentation manufacturer's recommendations.

14. Provide each panel with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
15. Each panel to have control, signal, and communication line surge suppression in accordance with Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
16. Microprocessor-based electronic devices in the panel that are powered by 120VAC to be powered by the UPS.
17. Provide each panel with circuit breaker to interrupt incoming power.
18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. to be in compliance with the requirements of Division 26.

B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings to be provided under this Section.

C. Orientation of devices including PLC and I/O when installed to be per the manufacturer's recommendations.

    1. No vertical orientation of PLC racks are allowed unless specifically indicated by manufacturer as an acceptable mounting alternative and also approved by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

END OF SECTION 406733

SECTION 406866 - CONFIGURATION OF CONTROLLER SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.

B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control all equipment in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

1. Provide configuration of the PLC provided for all equipment shown on Drawings, except for controls equipment shown being provided as part of a vendor package system.

C. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submitted to Engineer and Owner in the form of a letter.

D. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406196 “Process Control Descriptions.”
3. Section 406343 “Programmable Logic Controllers.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to meetings specified in that section.

1.5 ACTION SUBMITTALS

A. Controller Program Submittal:

1. For each controller, submit the following using controller manufacturer's built-in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.

    a. PLC programs showing ladder logic, function block, high level language or another controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Clearly present each logic segment, describe the function of each timer, label and define the purpose of each subroutine call, etc. Ensure that program documentation is sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal demonstrates that all logic provided under this project follows the same structure and format and reflects a common programming approach.
    b. Submit memory usage report for the controller. Indicate total memory capacity and unused memory capacity.
    c. Submit cross reference index of I/O allocation and controller memory address. Include every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit HMI tag database showing all signals exchanged between the PLCs and HMI. Define any specific communication block memory addresses.

B. Submit all electronic files associated with controller such that Owner and Engineer can open complete copy of controller program using controllers native programming package.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROLLER PROGRAMS

A. Develop application programs in a structured manner and follow an intuitive arrangement so that instrumentation technician with basic programming knowledge will be able to understand. Utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

B. Make changes to application programs and software configuration, based on comments during submittals, factory tests, field tests, and during commissioning process to meet design intent.

END OF SECTION 406866

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SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the general requirements to furnishing, installing, and servicing PCSS provided instruments.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 4071XX “Sections for flow measurement.”
3. Section 4073XX “Sections for pressure, strain, and force measurement.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Section 4071XX “Sections for flow measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Submit complete documentation for all field instruments in one comprehensive submittal. Use ISA-TR20.00.01-2007 data sheet format as a cover sheet for each instrument prior to data sheets. Submit complete Bill of Materials (BOM) or Index that lists all instrumentation equipment, sorted by Loop Number.

B. Submit separate data sheets for each instrument type:

1. Plant Equipment Number and ISA tag number per Drawings.
2. Product (item) name used herein and on Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.

C. Submit the following information for each instrument type:

1. Include construction details, material descriptions, dimensions of individual components and profiles.
2. Sizing calculations where applicable.
3. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.
4. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
5. Two-wire or four-wire device type as applicable.
6. Indicate which instruments will be provided with manufacturer's maintenance services if specified.

D. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes units being provided.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to individual instrument specifications for spare parts requirements.

B. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for PCSS requirements regarding submission of maintenance materials.

1.8 QUALITY ASSURANCE

A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.

B. Provide components compatible with functions required to form complete working system.

C. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for overall quality assurance requirements for PCSS scope of work.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 INSTRUMENT TAGS

A. Permanent stainless steel or other non-corrosive material tag firmly attached and indelibly marked with instrument tag number, as indicated in Drawings. Tag equipment before shipping to the site.

B. Provide 1/8-inch by 3/8-inch, Type 316 stainless steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements require a stainless steel identification tag.

1. Attach tag via stainless steel chain or stainless steel wire, 24-gauge minimum, to non-removable part of the device.
2. Stamp the ISA alphanumeric instrument number as indicated on the P&ID, loop, or detail drawings into the tag.
3. Minimum tag size is 1 inch H x 3 inches W with 3/16 inch thick alphanumeric characters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See installation requirements in individual specification sections.

B. Refer to Instrumentation Drawings.

END OF SECTION 407000

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SECTION 407113 - MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes magnetic flow meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.5 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.6 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Furnish sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, interconnecting cables, and unit conversions and algorithms as required for application.

2.2 MAGNETIC FLOW METERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Endress-Hauser Promag W500.
b. Substitutions: Not Permitted.

B. General:

1. Low-frequency, electromagnetic induction-type flow meter, producing linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.

C. Type:

1. Between-flange mounting.
2. Comply with AWWA M33.

D. Performance and Design Criteria:

1. Process Fluid: Refer to Device Schedule.
2. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 0.1 to 10 ft/sec (0.03 to 3.04 meters/sec).
3. Flow Tubes:

a. Body Material: Carbon Steel.

4. Liner: Polyurethane or hard rubber.

5. Flanges: ANSI 150 lb. or DIN PN 16.
6. Flange Material: Stainless steel.
7. Environment: For meters with remote mounted transmitters, meters below grade to be suitable for submergence for up to 48 hours to a depth of 30 feet (9 m). Meters above grade to be NEMA 4X (IP65).
8. Electrodes:

    a. Type 316L stainless steel.
    b. Bullet-nose, self-cleaning.

E. Accessories:

1. Rated for hazardous area, Class I, Division 2.
2. Provide manufacturer cable between transmitter and receiver.
3. Furnish stainless steel grounding rings, wires, and gaskets as recommended by manufacturer. All materials must be suitable for process and surrounding pipe.

2.3 TRANSMITTERS

A. Manufacturer: Same manufacturer as meter.

B. Transmitter Output:

1. 4- to 20-mA DC analog signal.

C. Housing: NEMA 4X (IP65), suitable for surface or pipe stand mounting.

D. Display:

1. Touch-screen programming, functioning through enclosure window without opening enclosure.
2. Size: Four lines by 16 characters.
3. Type: Backlit digital display.
4. User-selectable engineering units.
5. Readout of diagnostic error messages.

E. Control Power:

1. 120VAC, single phase, 60 Hz.
2. Provide local transformers as required.

F. Mounting:

1. Mounting: Remote, up to 30 feet from flow meter.

G. Required Accessories:

1. Fully configurable and locally viewable totalizer integral to transmitter.
2. Current signal output simulation.
3. Empty pipe detection.
4. Self-diagnostics.

5. Signal Cable: Provided by flow meter manufacturer.
6. Automatic zero adjust.
7. For outdoor installations, provide sunshield of sturdy, corrosion- and UV-resistant material.

2.4 DEVICE SCHEDULE

A. Well Discharge Flow, FE/FIT-120, FE/FIT-220.

1. Meter Size: 6 inch.
2. Flow Range: 0 – 600 gpm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

END OF SECTION 407113

SECTION 407326 - GAUGE-PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gauge-pressure transmitters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.7 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.8 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 GAUGE PRESSURE TRANSMITTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following or equal:

a. Rosemount 3051CG.
b. Substitutions: Not Permitted.

B. Type:

1. Microprocessor based, intelligent type.

C. Function/Performance:

1. Accuracy: 0.075 percent of span.
2. Operating Temperature: -4 to 176 degrees F (-20 to 80 degrees C).
3. Temperature Effect: Combined temperature effects less than 0.2 percent of maximum span per 82 degrees F (28 degrees C) temperature change.
4. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
5. Output: Zero adjustable over the range of the instrument calibrated span is greater than the minimum calibrated span.
6. Stability: 0.05 percent of upper range limit for one year.
7. Response Time: Less than 1 ms.
8. Display: Digital indicator displaying pressure in engineering units indicated on Drawings or in the instrument device schedule.
9. Diagnostics:

a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
b. Simulation capability for inputs and loop outputs.
c. Test terminals available to ease connection for test equipment without opening the loop.

d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to be available.

10. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of system being monitored.

D. Physical:

1. Power Supply: 24 VDC loop power.
2. Enclosure:

a. NEMA 4X (IP66), explosion proof.
b. Approved for Class I, Division 1, Groups C and D.
c. Instruments for hazardous locations have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified and as indicated on Drawings or in the instrument device schedule.

3. Process Wetted Parts (except for ozone/oxygen service):

a. Isolating diaphragm and other wetted metal parts: Type 316L stainless steel.
b. Gaskets and O-rings: Teflon.

4. Sensor Fill Fluid (except for ozone/oxygen service): Silicone.

E. Required Accessories:

1. Shutoff Cocks: Furnished by gauge manufacturer.
2. Provide diaphragm seals as shown on Drawings.

F. Device Schedule:

1. Well Discharge Pressure, PIT-115, PIT-215:

a. Range: 0-200 psig.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where gauge pressure transmitter will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

3.4 FIELD QUALITY CONTROL

A. Gauge-pressure transmitters will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit instrument calibration report in order to document the calibration procedure of the instruments.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up instruments, manufacturer shall provide training to Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain sensor and transmitter.

END OF SECTION 407326

SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surge suppressors.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Warranty: Manufacturer and Installer agree to repair or replace components of that fail(s) in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Phoenix Contact Series.
b. Substitutions: Not Permitted.

B. Function/Performance:

1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plan electrical systems.
2. Protection system lower than the instrument withstand level, while not interfering with normal operation.
3. Maintenance free and self-restoring.
4. Response time: Less than 50 nanoseconds.
5. Discharge surge current: At least 8kA (at an 8x20µs impulse waveform).

C. Required Surge Protection:

1. Analog Signal (4-20mA) Circuits:

a. Provide surge protection where any part of circuit is outside of building envelope.
b. Protect circuits at both the transmitter and control system end of the circuit.
c. Mount transmitter surge protectors in separate NEMA 4X enclosure or conduit mount.
d. Use of single device to protect both 120VAC and 4-20mA wires is acceptable.
e. Provide surge protector from the following:

1) Phoenix Contact PT Series.
2) Substitutions: Not Permitted.

2. Control Panel Power Feed (120VAC):

a. Provide protection of 120VAC power feed into control panels, instruments, and control room equipment.
b. Provide surge protector from the following:

1) Phoenix Contact “Mains-PlugTrab.”
2) Substitutions: Not Permitted.

3. Non-Fiber Based Data Highway or Communications Circuits:

a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
b. Provide circuit protection at both ends of the line.
c. Provide surge protector from the following:

1) Phoenix Contact PlugTrab Series.
2) Substitutions: Not Permitted.

4. Inductive Loads:

a. Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120VA or less that drive solenoid, coil, or motor loads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Engage qualified special inspector to perform the following special inspections:

B. Manufacturer's Field Service: Engage factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Isolators, intrinsically safe barriers and surge suppressors will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 MAINTENANCE SERVICE

A. Not Required.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407856

SECTION 432520 - SUBMERSIBLE TURBINE PUMPS (FOR WATER WELL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Submersible vertical turbine well pumps, including their respective column pipe, submersible motors, and variable frequency drives for two new production wells.

B. Contractor to be fully responsible for all elements of pump installation and setting, including:

1. Depth of setting.
2. Discharge column pipe.
3. Column check valve.
4. Surface discharge head assembly.
5. Supervisory services during installation and field testing of each unit and instructing regular operating personnel in the proper care, operation and maintenance of the equipment.
6. Include following paragraph to emphasize pump manufacturer unit responsibility.

C. Pump Manufacturer shall have unit responsibility for complete pumping system.

D. Related Requirements:

1. Section 260510 “Limited Electrical for Small Projects”.
2. Section 262505 “480V Control Panels”.
3. Section 406196 “Process Control Descriptions”.

1.3 DEFINITIONS AND ABBREVIATIONS

A. AESS: Applications Engineering System Supplier; refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for additional information.

B. AOR: Allowable Operating Region.

C. Failsafe: Normally closed contacts that open on alarm condition.

D. I/O: Input/Output (signals).

E. LCP: Local Control Panel.

F. PCSS: Process Control System Supplier.

G. POR: Preferred Operating Region.

H. P&ID: Process and Instrumentation Diagram.

I. Unit Responsibility: Sole responsibility for all components provided as part of pumping system.

1.4 ACTION SUBMITTALS

A. If manufacturing techniques differ, completely describe all aspects that do not conform to specifications.

B. Product Data: Submit manufacturer's literature, which may include drawings, describing the equipment including materials of construction, to indicate full conformance with specifications.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for submersible turbines and motors.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Total weight of pumping unit as well as weights of individual components.

C. Shop Drawings:

1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished including pump and motor, discharge head, column pipe, column check valve, power and signal cables, and water level monitoring system.
2. Schematic electrical wiring diagram and other data as required for complete pump installation.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Details of motor shroud/flow inducer for motor cooling.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's certified rating curves, to satisfy the specified design conditions including:

1. Operating speed specified.
2. Pump characteristics of head and flow showing full recommended range of performance including shut-off head for pump proposed. Curve for pump proposed not catalog sheets showing a family of curves.
3. Anticipated operating condition.
4. Brake horsepower.
5. Bowl efficiency.
6. Guaranteed net positive suction head required (NPSHR).
7. Identify POR and AOR (refer to ANSI/HI 9.6.3).
8. Plot curves on 8-1/2-inch by 11-inch sheets at as large a scale as practical specifically for proposed pump from no flow at shut-off head to pump capacity at minimum specified TDH.

9. Variable Speed Pumps: Include variable speed curves with five evenly spaced speeds plotted from maximum to minimum recommended speeds.
10. Curves shall be rising head capacity curve for stable pump operation.

B. Certification that velocity of flow past motor is adequate for motor cooling, based upon motor proposed and size of well casing. Submit details of enclosing flow inducer/suction sleeve/shroud required to provide cooling.

C. Tabulated data for drive motors including rated horsepower, full load rpm, power factor, efficiency curves at 1/2, 3/4 and full load, service factor, and kW input, including when pump operates at design point. Submit a certified statement from motor manufacturer that motors are capable of continuous operation on variable frequency drive power supply without affecting their design life for bearings or windings.

D. Test Reports:

1. Copies of all test data as described in Part 2 and 3.
2. A schedule of the date of shop testing and delivery of the equipment to the job site.
3. Description of pump factory test procedures and equipment.
4. Rotor balance report demonstrating compliance with balancing requirements of AWWA E102.

E. Welding certificates.

F. Material Test Reports: Certified analysis of impeller material: by a qualified testing agency.

G. Source quality-control reports.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's warranty.

J. Certify all product components suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61, Drinking Water System components – Health Effects, and NSF/ANSI 372, Drinking Water System Components – Lead Content.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manual:

1. Provide Operating and Maintenance Manual for equipment specified herein, specifically prepared for this installation and including all required drawings, equipment and materials information, descriptions, complete bill of materials, etc., as required to instruct operating and maintenance personnel unfamiliar with such equipment.

B. Warranty Documentation: submit warranty complying with requirements herein.

C. Project Record Documents:

1. Submit Project Record Documents recording actual locations and final orientation of all equipment and accessories.

1.7 QUALITY ASSURANCE

A. Furnish and coordinate all motors with the pump manufacturer.

B. Furnish units from a single manufacturer.

C. Install for satisfactory operation as shown on Drawings.

D. Manufacturer to be fully responsible for the design, arrangement and operation of all connected rotating equipment components.

E. Pumps to be in accordance with the Hydraulic Institute Standards, except when otherwise specified herein.

F. Equipment to be standard pumping equipment proven to have been manufactured by a manufacturer concerned and experienced in the production of such.

1. The pump manufacturer an authorized permanent service organization for servicing both pump and motor, within 100 miles of the installation site.

G. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer’s original packaging and inspect for damage. As necessary, provide inspection report to Manufacturer identifying any damage and rework necessary prior to installation.

B. Storage: Store pumps and all appurtenances according to Manufacturer’s instructions.

C. Do not disassemble factory assembled parts and components for shipment unless written permission received from Engineer.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to Manufacturer’s instructions.
3. Protect unpainted finished iron and steel surfaces to prevent rust and corrosion.
4. Protect finished surfaces of exposed flanges with wood or equivalent blank flanges.
5. Protect bearings against formation of rust in accordance with bearing manufacturer’s recommendations. Apply lubricant or corrosion inhibiting treatment during transportation, storage, handling, installation, and lapse of time prior to start-up.

Intermittently manually rotate equipment prior to start-up to ensure distribution of lubricant/protection.

1.9 SITE CONDITIONS

A. Ambient temperature range: 30 to 104 degrees F.

B. Field Measurements: as applicable confirm field measurements and interferences prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Provide manufacturer's warranty for pumping system.

B. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Pumps to conform to AWWA E-102, Submersible Vertical Turbine Pumps.

B. Furnish and coordinate motors with pump manufacturer.

C. Furnish units from a single manufacturer.

D. Install for satisfactory operation as shown on Drawings.

E. Manufacturer to be fully responsible for design, arrangement and operation of all connected rotating equipment components.

F. Pumps to be in accordance with the Hydraulic Institute Standards, except otherwise specified herein. Pump performance Acceptance Grade: 1U.

G. Equipment to be standard pumping equipment proven to have been manufactured by a manufacturer concerned and experienced in the production of such.

H. Pumps to have a continuously rising (from runout toward shutoff) head-flow rate performance curve for stable pump operation within the AOR.

I. Comply with NSF/ANSI 61, Drinking Water System Components – Health Effects, and/or NSF/ANSI 372, Drinking Water System Components – Lead Content.

J. Submersible pump to be set in a newly constructed water supply well. Work includes excavation and backfill necessary to install well head after cutting well casing to level shown on Drawings. Install all instrumentation to be fitted in the well as is specified in Division 40.

K. Pumping units:

1. Designed and built for 24-hour continuous service at all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain.
2. Designed and proportioned as to have liberal strength, stability and stiffness and to be especially constructed to meet the Specifications.

L. RO-118N Design criteria:

Item Description	Design Conditions
Service	Raw Water
Grundfos Product Number and Name	625S750-4AA
Number of Pumps	1
Maximum Motor Full Load Speed (FLS) (rpm)	3,600
Minimum Motor Speed as a Percentage to Full Load Speed (percent)	50
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	75
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	75
Minimum Pump and Column Discharge Size (inches)	6
Minimum Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	425/475
Flow Rate at Secondary Operation Point (gpm)	300
Minimum TH at Secondary Operation Point (feet)	415
Minimum Overall Efficiency at Secondary Operation Point (percent)*	55
Maximum NPSH3 at Secondary Operation Point (feet)	25
Intermediate (Design) Point Flow Rate (gpm)	500
Minimum TH at Intermediate (Design) Point Flow Rate (feet)	360
Minimum Overall Efficiency at Intermediate (Design) Point Flow Rate (percent)*	68
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	500/700
Minimum Overall Efficiency at BEP (percent)*	70
Primary Operation Point TH (feet)	175
Minimum Flow Rate at Primary Operation Point (gpm)	800
Minimum Overall Efficiency at Primary Operation Point (percent)*	50
Maximum NPSH3 at Primary Operation Point (feet)	40

* Note that minimum overall efficiencies listed are “wire-to-water” in accordance with ANSI/HI 11.6 – latest edition.

M. RO-118N Pump Setting Details:

1. Confirm elevations with final grading plans and data collected from well construction.

a. Existing Well Casing Diameter = 16 inches Nominal.
b. Elevation of Finished Ground Surface at Well Head: 15 feet.
c. Elevation of Discharge Centerline: 18 feet.
d. Elevation of Pump Intake: -135 feet.
e. Approximate range of static well water surface elevation: 0 to 26 feet.
f. Approximate minimum pumping water level elevation: -120 feet.

N. RO-120N Design criteria:

Item Description	Design Conditions
Service	Raw Water
Grundfos Product Number and Name	625S750-4AA
Number of Pumps	1
Maximum Motor Full Load Speed (FLS) (rpm)	3,600
Minimum Motor Speed as a Percentage to Full Load Speed (percent)	50
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	75
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	75
Minimum Pump and Column Discharge Size (inches)	6
Minimum Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	425/475
Flow Rate at Secondary Operation Point (gpm)	300
Minimum TH at Secondary Operation Point (feet)	415
Minimum Overall Efficiency at Secondary Operation Point (percent)*	55
Maximum NPSH3 at Secondary Operation Point (feet)	25
Intermediate (Design) Point Flow Rate (gpm)	500
Minimum TH at Intermediate (Design) Point Flow Rate (feet)	360
Minimum Overall Efficiency at Intermediate (Design) Point Flow Rate (percent)*	68
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	500/700
Minimum Overall Efficiency at BEP (percent)*	70
Primary Operation Point TH (feet)	175
Minimum Flow Rate at Primary Operation Point (gpm)	800
Minimum Overall Efficiency at Primary Operation Point (percent)*	50
Maximum NPSH3 at Primary Operation Point (feet)	40

* Note that minimum overall efficiencies listed are “wire-to-water” in accordance with ANSI/HI 11.6 – latest edition.

O. RO-120N Pump Setting Details:

1. Confirm elevations with final grading plans and data collected from well construction.

a. Existing Well Casing Diameter = 16 inches Nominal.
b. Elevation of Finished Ground Surface at Well Head: 15 feet.
c. Elevation of Discharge Centerline: 18 feet.
d. Elevation of Pump Intake: -135 feet.
e. Approximate range of static well water surface elevation: 0 to 33 feet.
f. Approximate minimum pumping water level elevation: -120 feet.

P. Capable of temporary operation at and near shut off head for 30 seconds maximum, during the ramping up and down process of the pump against a closed check valve when the pump is starting and stopping.

2.2 SUBMERSIBLE MOTOR PUMP DRIVE SYSTEM

A. Manufacturers:

1. Franklin.
2. Grundfos.

B. Hermetically sealed water-filled submersible motor.

C. Electric power supply: 480Volt, 3 Phase, 60 Hz.

D. Service factor: 1.0 (inverter duty).

E. Motor speed: To match pump speed.

F. Minimum full load efficiency: 85 percent.

G. Minimum full load power factor: 80 percent.

H. Maximum nominal motor diameter: 8-inches.

I. Motor capable of full load operation submerged in water up to 25 degrees C.

J. Nameplate rating on motor at 1.0 service factor not to be exceeded at any point on pump performance curve.

K. Enclose hermetically sealed stator and resin embedded windings in an all-welded epoxy coated steel or Type 316 stainless steel case, to dissipate heat quickly to the surrounding well water. Provide an elastomer expansion diaphragm with ample sized expansion chamber within motor case to equalize internal and external pressures at any depth of submergence. Motor to not require a breather plug or pressure relief valve for proper operation.

L. Motor windings: Solid copper conductor with class “Y” (waterproof) insulation rated for motor voltage.

M. Seals: Single mechanical type shaft seal with Silicon Carbide/Silicon Carbide seal faces to seal motor at shaft extension to pump coupling.

N. Wetted fasteners: Type 316 stainless steel with Monel nuts.

O. Rotor dynamically balanced and mounted on an amply sized Type 316 stainless steel shaft stabilized by water lubricated sleeve type carbon composite bearings.

P. Thrust bearing to carry weight of rotating assembly plus thrust of pump operating a shut-off head to be water lubricated self-aligning and self-equalizing Kingsbury Type assembly with multiple micro-finished stainless steel bearing shoes providing contact with a graphite or carbon composite rotating ring. Capability to run in either direction without damage.

Q. Motor factory filled with food-grade propylene glycol-potable water internal lubricating solution for maximum reliability and long life.

R. Provide a flow inducer (suction sleeve/shroud) of same material as well column pipe as required to provide adequate motor cooling. Submit details.

1. Size inducer in conformance with motor manufacturer's recommendations to maintain minimum head losses and velocity for adequate motor cooling, based upon well diameter.
2. Provide centralizers to position inducer uniformly around motor housing and within well casing. Provide guides to assist raising and lowering of motor past size transitions within well casing.
3. Design inducer to receive flow from well screen below elevation of motor to assure external cooling flow passes along entire length of motor.

S. Power Cable: Three-conductor plus ground power cable enclosed within a common jacket. Size conductors for voltage drop less than three percent at motor rated full load current and voltage measured at starter. Cable designed for submerged service, non-hygroscopic. Cable jacketing of neoprene or equal and insulation of Ethylene Propylene Rubber (EPR) or equal. Provide Type 316 stainless steel cable clamps to securely fasten cable at intervals of not more than 10-feet. Terminate cable at junction box at surface on discharge head. Furnish cable splicing kit for splicing of cable to motor leads.

T. Motor thermal protection: Motor to incorporate three thermal switches, one per stator winding, connected in series, to monitor motor temperature. Should any thermal switch open, motor to stop and activate an alarm. Coordinate selections of devices and settings with total distance from control cabinet to pump mounted in well.

U. Thermal protection cable: Provide thermal switch cable, single multi-conductor cable with sufficient individually insulated conductors sized for application, designed for submerged service, non-hygroscopic, the neoprene jacketing. Terminate cable at junction box at surface on discharge head. Furnish cable splicing kit for splicing of cable to monitoring leads on motor.

2.3 PUMP CONSTRUCTION

A. Manufacturers:

1. Grundfos.

B. Pump bowls: Type 316 Stainless steel, ASTM A744M.

1. Bowl bolting to be Type 316 stainless steel with Monel nuts (where nuts are used).
2. Pump bowl bearings: ASTM B505, Alloy C89835 bismuth tin bronze.

C. Impellers.

1. Closed type.
2. Material: CF8M Stainless Steel.
3. Dynamically balanced.
4. Enclosed type impeller design to include adequate material to provide for future machining for addition of wear ring to restore impeller efficiency.
5. Impellers fastened to shaft with lock collets or keys of stainless steel conforming.

D. Pump shaft: Type 316 Stainless steel, ASTM A276.

1. Shaft diameter in accordance with AWWA E102 of sufficient diameter to transmit motor torque with a liberal safety factor, minimize vibration, and rigidly support impellers between bowl bearings.

E. Shaft Coupling:

1. Size shaft coupling between motor and pump bowl shaft in accordance with AWWA E102, of sufficient size and strength to withstand maximum torque generated by motor plus safety factor.
2. Coupling of Type 316 Stainless steel, ASTM A276.
3. Coupling keyed to pump shaft.

F. Suction adapter:

1. One-piece casting of Type 316 Stainless steel, ASTM A744M to serve as suction inlet, lower bearing housing and motor adapter.
2. Suction inlet to include an ASTM A276, Type 316 stainless steel screen. Inlet area equal to at least five times impeller inlet area.
3. Bottom bearing: ASTM B505, Alloy C89835 bismuth tin bronze.
4. Design motor adaptor to prevent entrance of abrasive material into top end of motor. Provide a sand collar of rubber or bronze, ASTM B505, Alloy C89835 to protect suction adapter bearings from abrasives in liquid pumped.

G. 6-inch column pipe:

1. Column wall thickness in accordance with AWWA E102.
2. Type 316L stainless steel, ASTM A276 male NPT thread by male NPT thread between pump discharge and column check valve. Coordinate end connections with equipment vendors.
3. Certa-Lok Type 316 stainless steel drop pipe adapter with Certa-Lok male by male NPT thread between column check valve and Certa-Lok PVC drop pipe.
4. Certa-Lok Type 316 stainless steel drop pipe adapter will connect to Certa-Lok PVC drop pipe. Certa-Lok PVC drop pipe to use Certa-Lok drop pipe coupling with Certa-Lok female by Certa-Lok female, gaskets, splines, and screws.

5. Certa-Lok Type 316 stainless steel drop pipe adapter with Certa-Lok male by male NPT thread will connect to top section of Certa-Lok PVC drop pipe. Certa-Lok drop pipe adapter will connect to custom stainless steel wellhead as shown on Drawings.
6. Provide a minimum of four radially spaced guide vanes welded to discharge column pipe immediately above pump bowl assembly to assure that submersible pump and motor assembly is properly centered within well casing.

H. Discharge Head:

1. Provide a discharge head as shown on drawings to support pump and riser column within well and provide discharge connection to transmission piping.
2. Discharge head and integral baseplate of fabricated Type 316L stainless steel. Baseplate to be 150 lb. ASME B16.5 or B16.47 flange to engage flange at top of well casing.
3. Drill and tap discharge head baseplate for installation of well level monitor, vent, gravel port, manual level measurement port, and power cable penetration. Refer to Drawings for details.
4. Pump discharge head to provide waterproof connection to well casing.
5. Provide two or more lifting eyes on discharge head.
6. Outlet nozzle of discharge head to be flanged to ASME B16.5 or B16.47.
7. Provide tapped boss near discharge nozzle flange for connection of pressure gauge/pressure monitor.
8. Provide a steel well casing flange to match discharge head baseplate to be welded to the well casing. Flange bolts to be Type 316 stainless steel with Monel nuts.
9. Provide gasket between well casing flange and discharge head.

I. Column Check Valve:

1. Provide a spring loaded, positive-sealing column silent globe check valve located immediately above bowl assembly.
2. Check valve diameter same as column.
3. Check valve body constructed of cast stainless steel. Spring of Monel. Disc and shaft of Type 316 stainless steel with bronze bushings. Bolts of Type 316 stainless steel with Monel nuts.
4. Valve pressure rating to accommodate maximum total dynamic head of pump through entire performance range from shutoff to runout.

J. Name Plates: Stainless steel nameplate (with embossed data) securely mounted to body of equipment.

1. Pump nameplates include:

    a. Manufacturer’s name.
    b. Model number.
    c. Serial number.
    d. Rated flow capacity.
    e. Head.
    f. Speed.

2. Nameplate for motor:

a. Manufacturer's name.
b. Model number.
c. Serial number.
d. Horsepower.
e. Speed.
f. Input voltage.
g. Amps.
h. Number of cycles.
i. Power.
j. Service factors.

2.4 ACCESSORIES

A. Refer to details in the Drawings for wellhead accessories.

2.5 SHOP PAINTING

A. Shop prime and finish coat each component of pumping system including pump, motor, column, discharge head, and associated equipment. Prepare, shop-prime and finished-coat in accordance with Manufacturer's standard practice prior to shipment. Manufacturer’s standard colors. Provide adequate supply of touch-up paints.

B. Clean all interior and exterior surfaces of pump column pipes and discharge heads and exterior of bowl assemblies of all rust and mill scale, grease, dirt, other foreign matter and apply Manufacturer’s standard epoxy coatings.

C. All coatings on wetted surfaces to be epoxy type in compliance with AWWA E-103, ANSI/NSF 61, ANSI/NSF 61 Annex G, and ANSI/NSF 372 for use with drinking water systems. Surface preparation to conform to coating manufacturer's recommendations.

D. Protect nameplates during painting.

2.6 SOURCE QUALITY CONTROL

A. Certified Factory Pump Tests:

1. Factory test each pump in accordance with ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests and AWWA E102.
2. Prior to conducting a pump test, notification of such test and list of test equipment and test procedures shall be forwarded to the Engineer at least ten (10) working days before the scheduled test date. All electronic transducers, meters, gauges, and other test instruments shall be calibrated in accordance with the frequency listed in the Hydraulic Institute Standards. Copies of calibration data shall be provided. Differential pressure type flow meters, such as venturis shall have been calibrated within 5 years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.

3. Visually inspect cast surfaces of all components per MSS SP-55.
4. Perform hydrostatic tests on each bowl assembly and discharge head in full compliance with ANSI/HI 14.6.
5. Perform certified pump performance tests of each pump including head, capacity, brake horsepower, wire to water pump efficiency, and NPSH3 in accordance with ANSI/HI 14.6.

    a. Testing to be performed at full rated pump speed of complete bowl assembly.
    b. Take at least seven operating points along pump curve plus shut-off head, with two points clustered close to specified design point.
    c. Test to demonstrate pump meets ANSI/HI 14.6, acceptance grade 1U at design point.
    d. If Manufacturer does not have historical test records for NPSH3 at specified design pump speed, test one pump to demonstrate NPSH3 versus flow rate.
    e. Submit complete report of test including description of procedure, test set-up arrangement, calibration data, raw and final test data, and certified pump performance curves.
    f. Test results submittal to be reviewed and approved by Engineer prior to release for shipment from factory.
    g. Calibrate all meters, gauges, and other test instruments within Manufacturer's established time period prior to scheduled test and include certified calibration data test submittal. If Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards to govern.
    h. Job motor or factory test motor may be used as pump driver during performance test.
    i. Testing will be non-witnessed.
    j. If any pump tested fails to meet specification requirements, modify until it meets all specification requirements. If any pump tested fails to meet efficiency requirements at any listed flow or head conditions and all reasonable attempts to correct the inefficiency are unsuccessful, replace pump(s) with unit(s) that meet specified requirements.

6. Factory test each motor and submit copies of test results. Tests to include the following:

    a. Perform routine tests on motors Report results as described on NEMA MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors." Test efficiency in accordance with IEEE Publication No. 112. Measure power factor on representative motors.
    b. Pressure check stators for leaks to ensure a guaranteed leak proof housing.
    c. Perform standard shop no load running current test, high potential test, and winding resistance test.

7. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 PREPARATION

A. Take all necessary field measurements to determine exact dimensions for all work and required sizes of all equipment under Contract. Verify all pertinent data and dimensions.

3.2 INSTALLATION

A. Installation to comply with AWWA E102 and applicable standards of Hydraulic Institute.

B. Install discharge head in accordance with manufacturer's requirements.

1. Ensure that protection of the well and sanitary seal is provided during excavation and subsequent backfilling of soil during the installation of the wellhead.
2. Cut well casing pipe in locations required for installation of discharge head. Cut well casing to proper elevation as shown or directed, and well on top flange for attachment of discharge head.
3. If damage is inflicted to any part of well or sanitary seal, repair all damaged materials to satisfaction of Engineer at no additional cost to Owner.
4. Clean all welded joints and restore protective coatings.

C. Pumping unit installation to comply with applicable State Health Department Requirements governing installation of pumps in Water Wells.

D. Provide tack welded strap restraints of same material as column pipe to positively lock to pump to discharge column to prevent unscrewing due to motor starting torque. Continue strap restraints up pump column to elevation recommended by Manufacturer.

E. Paint above grade portion of pump surface discharge with an approved paint, furnished in unopened manufacturer containers.

3.3 FIELD QUALITY CONTROL

A. Installation of discharge head, pump and motor and column piping to be inspected/monitored by a factory representative of pump manufacturer in presence of Engineer.

B. If Contractor does not provide qualified installation staff on the job during pump installation, Engineer may direct Contractor to provide services of Manufacturer's factory representative to provide necessary instructions to ensure a proper installation.

C. Submit a certificate from Manufacturer stating that installation of their equipment is satisfactory, equipment is ready for operation, and Owner's operating personnel have been suitably instructed in operation, lubrication and care of each unit.

3.4 STARTUP SERVICE

A. Provide services of factory representative to check completed pump installation and supervise start-up of pumping system.

B. After pump has been completely installed, conduct a test of equipment with factory representative of pump manufacturer in presence of Engineer to demonstrate compliance with pump design. Furnish all instruments, meters, gauges and incidentals which may be required for testing.

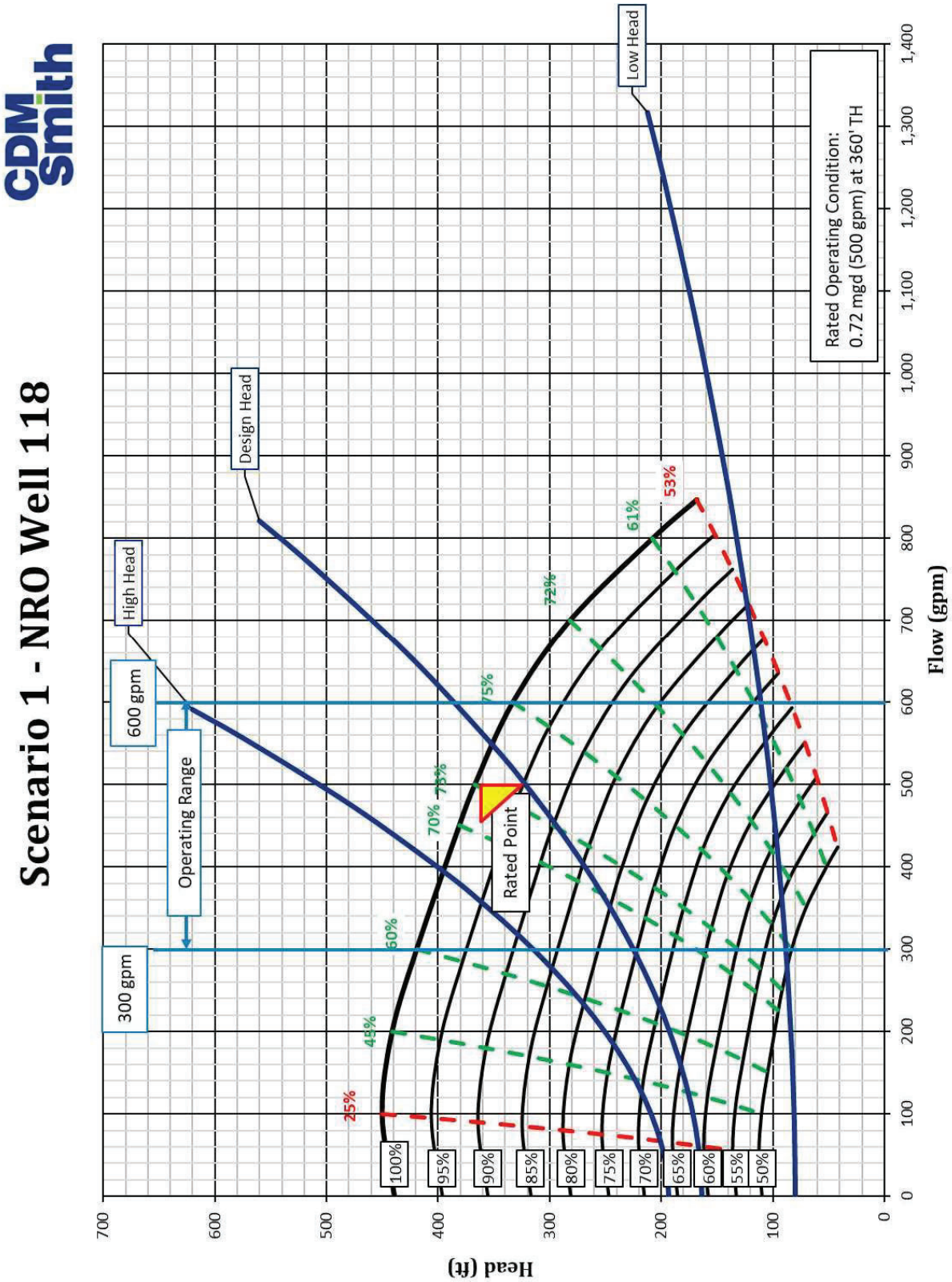
C. Upon recording pump discharge and pressure at five capacity points, shut-down and allow water level to recover within 1-inch of static levels. At this time, operate pump within plus or minus two percent of the design capacity for a period of one hour. Measure pump capacity, discharge head, horsepower input and motor speed shall be made. Water level drawdowns in observation wells shall be recorded at intervals approved by the Engineer.

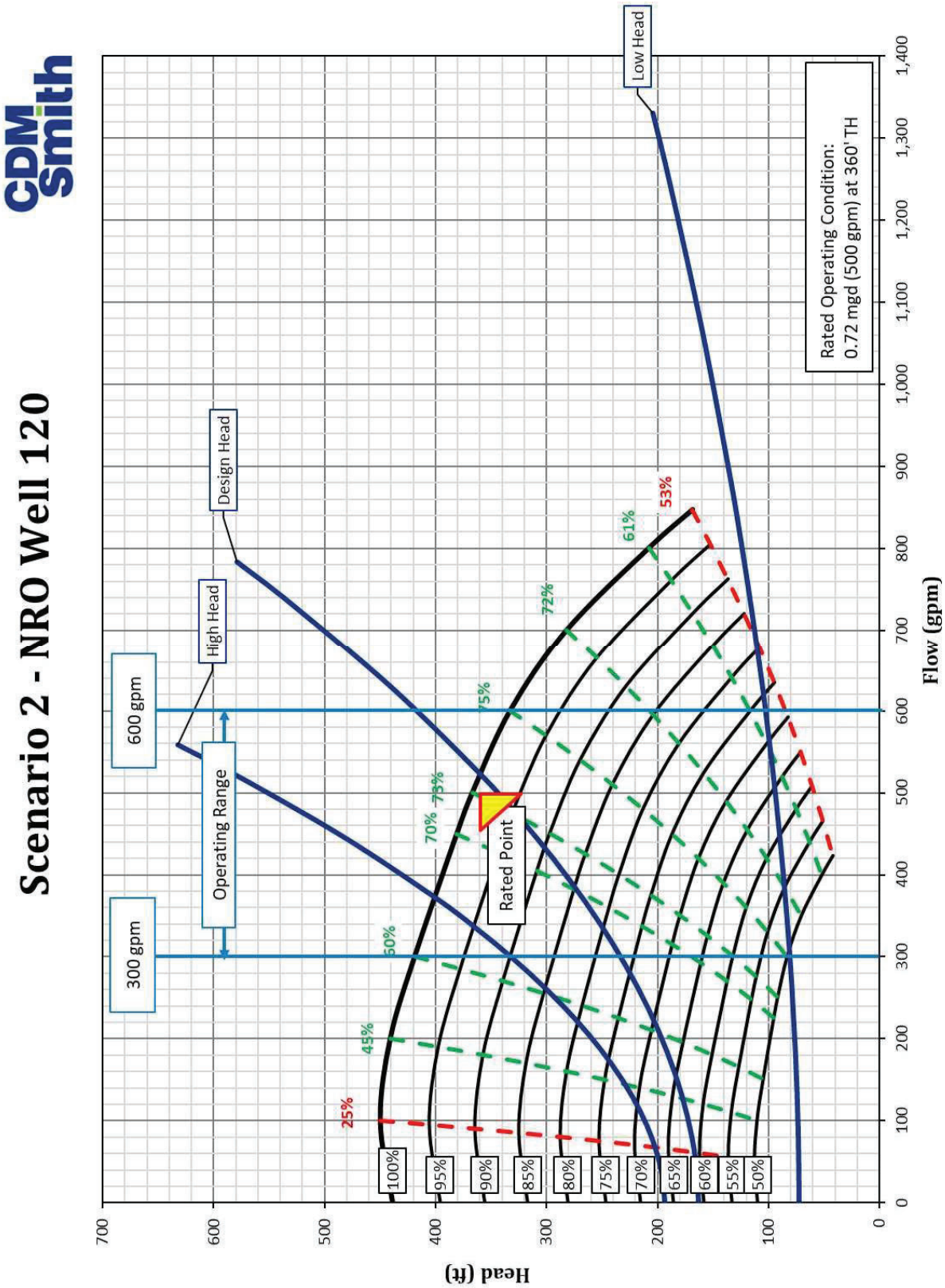
D. If compliance with above requirements are not met and corrections not effected within 30 days of mutually agreed date, then replace pump unit with one that will meet operating requirements. Such replacement shall be in full accordance with all requirements as specified herein. Rejection of pumping unit may not preclude its use after rejection if removal of pumping unit, prior to furnishing a replacement unit, will adversely affect Owner.

3.5 ATTACHMENTS

A. NRO Well 118 Pump and System Curves.

B. NRO Well 120 Pump and System Curves.





END OF SECTION 432520

SECTION 011000

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Work

B. CONTRACTOR's Use of Site

C. Work Sequence

D. COUNTY Occupancy

1.2 DESCRIPTION OF WORK

A. General: The Work to be done under this Contract is shown on the drawings and specified in Contract Documents.

B. The Work includes:

1. Furnishing of all labor, material, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary or proper for performing and completing the Work.

2. Sole responsibility for adequacy of plant and equipment.

3. Maintaining the Work area and site in a clean and acceptable manner.

4. Maintaining existing facilities in service at all times.

5. Protection of finished and unfinished Work.

6. Repair and restoration of Work or existing facilities damaged during construction.

7. Furnishing as necessary proper equipment and machinery, of a sufficient capacity, to facilitate the Work and to handle all emergencies normally encountered in Work of this character.

8. Furnishing, installing, and protecting all necessary guides, track rails, bearing plates, anchor and attachment bolts, and all other appurtenances needed for the installation of the devices included in the equipment specified. Make anchor bolts of appropriate size, strength and material for the purpose intended. Furnish substantial templates and shop drawings for installation.

C. Implied and Normally Required Work: It is the intent of these Specifications to provide the COUNTY with complete operable systems, subsystems and other items of Work. Any part or item of Work, which is reasonably implied or normally required to make each installation satisfactorily and completely operable, is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.

D. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.

1.3 CONTRACTOR'S USE OF SITE

A. In addition to the requirements of the Supplemental Terms and Conditions, limit use of site and premises for work and storage to allow for the following:

1. Coordination of the Work under this CONTRACT with the work of the other contractors where Work under this CONTRACT encroaches on the Work of other contractors.

2. COUNTY occupancy and access to operate existing facilities.

3. Coordination of site use with ENGINEER.

4. Responsibility for protection and safekeeping of products under this CONTRACT.

5. Providing additional off site storage at no additional cost to the COUNTY as needed.

1.4 WORK SEQUENCE

A. Construct Work in stages to accommodate the COUNTY’s use of premises during construction period and in accordance with the limitations on the sequence of construction specified. Coordinate construction schedules and operations with ENGINEER.

B. Coordinate Work of all subcontractors.

1.5 COUNTY OCCUPANCY

A. The COUNTY will occupy premises during entire period of construction in order to maintain normal operations. Cooperate with the COUNTY's Manager or designee in all construction operations to minimize conflict, and to facilitate COUNTY usage.

B. Conduct operations with the least inconvenience to the general public.

1.6 PROTECTION OF EXISTING UTILITIES

A. In case of damage to existing utilities caused by construction activities, contact the owner of the utility or appropriate COUNTY department (Water or Wastewater) immediately. Repair any damage to existing utilities caused by construction activities in coordination with or as directed by the owner of the utility.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

A. Starting Work: Start Work within 10 days following the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of the project, and with such forces, material and equipment, as to complete the Work in the time established by the Contract. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 014200

REFERENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reference Abbreviations

B. Abbreviations

C. Reference Standards

D. Definitions

1.2 RELATED SECTIONS

A. Information provided in this section is used where applicable in individual Specification Sections.

1.3 REFERENCE ABBREVIATIONS

A. Reference to a technical society, trade association or standards setting organization, may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	Association of Home Appliance Manufacturers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers

ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders' Hardware Manufacturers Association
BIA	Brick Institute of American
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRD	U.S. Corps of Engineers Specifications
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation
Fed. Spec.	Federal Specifications
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
HMI	Hoist Manufacturing Institute
HPMA	See HPVA
HPVA	Hardwood Plywood Veneer Association
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
MIL	Military Specifications
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NBS	National Bureau of Standards, See NIST
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NFPA	National Fluid Power Association
NIST	National Institute of Standards and Technology
NLMA	National Lumber Manufacturers Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association

SPI	Society of the Plastics Industry
SSPC	Steel Structures Painting Council
STI	Steel Tank Institute
TCA	Tile Council of American
TIMA	Thermal Insulation Manufacturers' Association
UL	Underwriters' Laboratories, Inc.
USBR	U. S. Bureau of Reclamation
USBS	U. S. Bureau of Standards, See NIST

1.4 ABBREVIATIONS

A. Abbreviations which may be used in individual Specification Sections are as follows:

alternating current ..... ac
American wire gauge ..... AWG
ampere(s) ..... amp
ampere-hour(s) ..... AH
annual ..... ann
Ampere Interrupting Capacity ..... AIC
atmosphere(s) ..... atm
average ..... avg

biochemical oxygen demand ..... BOD
Board Foot ..... FBM
brake horsepower ..... bhp
Brinell Hardness ..... BH
British thermal unit(s) ..... Btu

calorie(s) ..... cal
carbonaceous biochemical oxygen demand ..... CBOD
Celsius (centigrade) C
Center to Center ..... C to C
centimeter(s) ..... cm
chemical oxygen demand ..... COD
coefficient, valve flow ..... C_v
condensate return ..... CR
cubic ..... cu
cubic centimeter(s) cc
cubic feet per day ..... cfd
cubic feet per hour ..... cfh
cubic feet per minute ..... cfm
cubic feet per minute, standard conditions ..... scfm
cubic feet per second ..... cfs
cubic foot (feet) ..... cu ft
cubic inch(es) ..... cu in
cubic yard(s) ..... cu yd

decibels ..... dB
decibels (A scale) ..... dBa
degree(s) ..... deg
dewpoint temperature ..... dpt
diameter ..... dia
direct current ..... dc
dissolved oxygen ..... DO
dissolved solids ..... DS
dry-bulb temperature ..... dbt

efficiency ..... eff
elevation ..... el
entering water temperature ..... ewt
entering air temperature ..... eat
equivalent direct radiation ..... edr

face area ..... fa
face to face ..... f to f
Fahrenheit ..... F
feet per day ..... fpd
feet per hour ..... fph
feet per minute ..... fpm
feet per second ..... fps
foot (feet) ..... ft
foot-candle ..... fc
foot-pound ..... ft-lb
foot-pounds per minute ..... ft-lb/min
foot-pounds per second ..... ft-lb/sec
formazin turbidity unit(s) ..... FTU

frequency ..... freq
fuel oil ..... FO
fuel oil supply ..... FOS
fuel oil return ..... FOR

gallon(s) ..... gal
gallons per day ..... gpd
gallons per day per cubic foot ..... gpd/cu ft
gallons per day per square foot ..... gpd/sq ft
gallons per hour ..... gph
gallons per minute ..... gpm
gallons per second ..... gps
gas chromatography and mass spectrometry ..... GC-MS
gauge ..... ga
grain(s) ..... gr
gram(s) ..... g
grams per cubic centimeter ..... gm/cc
Heat Transfer Coefficient ..... U
height ..... hgt
Hertz ..... Hz
horsepower ..... hp
horsepower-hour ..... hp-hr
hour(s) ..... hr
humidity, relative ..... rh
hydrogen ion concentration ..... pH

inch(es) ..... in
inches per second ..... ips
inside diameter ..... ID

Jackson turbidity unit(s) ..... JTU

kelvin ..... K
kiloamperes ..... kA
kilogram(s) ..... kg
kilometer(s) ..... km
kilovar (kilovolt-amperes reactive) ..... kvar
kilovolt(s) ..... kV
kilovolt-ampere(s) ..... kVA
kilowatt(s) ..... kW
kilowatt-hour(s) ..... kWh

linear foot (feet) ..... lin ft
liter(s) L

megavolt-ampere(s) ..... MVA
meter(s) ..... m
micrograms per liter ..... ug/L
miles per hour ..... mph
milliampere(s) ..... mA
milligram(s) ..... mg
milligrams per liter ..... mg/L
milliliter(s) ..... mL
millimeter(s) ..... mm
million gallons ..... MG
million gallons per day ..... mgd
millisecond(s) ..... ms
millivolt(s) ..... mV
minute(s) ..... min
mixed liquor suspended solids ..... MLSS
nephelometric turbidity unit ..... NTU
net positive suction head ..... NPSH
noise criteria ..... nc
noise reduction coefficient ..... NRC
number ..... no

ounce(s) ..... oz
outside air ..... oa
outside diameter ..... OD

parts per billion ..... ppb
parts per million ..... ppm
percent ..... pct
phase (electrical) .... ph
pound(s) ..... lb
pounds per cubic foot ..... pcf
pounds per cubic foot per hour ..... pcf/hr
pounds per day ..... lbs/day
pounds per day per cubic foot ..... lbs/day/cu ft
pounds per day per square foot ..... lbs/day/sq ft
pounds per square foot ..... psf
pounds per square foot per hour ..... psf/hr
pounds per square inch ..... psi

pounds per square inch absolute ..... psia

pounds per square inch gauge ..... psig
power factor ..... PF
pressure drop or difference ..... dp
pressure, dynamic (velocity) ..... vp
pressure, vapor ..... vap pr

quart(s) ..... qt

Rankine ..... R
relative humidity ..... rh
resistance ..... res
return air ..... ra
revolution(s) ..... rev
revolutions per minute ..... rpm
revolutions per second ..... rps
root mean squared ..... rms

safety factor ..... sf
second(s) ..... sec
shading coefficient ..... SC
sludge density index ..... SDI

Sound Transmission Coefficient ..... STC
specific gravity ..... sp gr
specific volume ..... Sp Vol
sp ht at constant pressure ..... Cp
square ..... sq
square centimeter(s) ..... sq cm
square foot (feet) ..... sq ft
square inch (es) ..... sq in
square meter(s) ..... sq m
square yard(s) ..... sq yd
standard ..... std
static pressure ..... st pr
supply air .... sa
suspended solids ..... SS

temperature ..... temp
temperature difference ..... TD
temperature entering ..... TE
temperature leaving ..... TL
thousand Btu per hour ..... Mbh
thousand circular mils ..... kcmil
thousand cubic feet ..... Mcf
threshold limit value ..... TLV
tons of refrigeration ..... tons
torque ..... TRQ
total dissolved solids ..... TDS
total dynamic head ..... TDH
total kjeldahl nitrogen ..... TKN
total oxygen demand ..... TOD
total pressure ..... TP
total solids ..... TS
total suspended solids ..... TSS
total volatile solids ..... TVS
vacuum ..... vac
viscosity ..... visc
volatile organic chemical ..... VOC
volatile solids ..... VS
volatile suspended solids ..... VSS
volt(s) V
volts-ampere(s) ..... VA
volume ..... vol
watt(s) ..... W
watthour(s) ..... Wh
watt-hour demand ..... WHD
watt-hour demand meter ..... WHDM
week(s) ..... wk
weight ..... wt
wet-bulb ..... WB
wet bulb temperature ..... WBT

yard(s) ..... yd
year(s) ..... yr

1.5 REFERENCE PUBLICATIONS

The following publications are incorporated into this Manual and are made a part of this Manual as is set out verbatim in this Manual. Violations of any provision of every such publication, as updated from time-to-time by Resolution(s) of the Board of County

Commissioners, shall be a violation of the Collier County Utilities Standards and Procedures Ordinance, as then amended.

A. Water Environment Federation, Manual of Practice No. 8, Wastewater Treatment Plant Design, W.E.F., 601 Wythe Street, Alexandria, VA, 22314-1994.

B. Water Environment Federation, Manual of Practice No. 9, Design and Construction of Sanitary and Storm Sewers, W.E.F., 601 Wythe Street, Alexandria, VA, 22314-1994.

C. Great Lakes/Upper Mississippi River Board of State Sanitary Engineers. Recommended Standards for Sewage Works, Health Education Service, Inc., P.O. Box 7283, Albany, New York, 12224.

D. Great Lakes/Upper Mississippi River Board of State Sanitary Engineers. Recommended Standards for Water Works, Health Education Service, Inc., P.O. Box 7283, Albany, New York, 12224.

E. Rules of the Florida Department of Environmental Protection for Water, Wastewater, and Reclaimed Water Systems, latest revisions of F.A.C. Chapters 62-550, 62-555, 62-600, 62-604, 62-610, 64E-6, and 64E-8, 3900 Commonwealth Boulevard M.S. 49, Tallahassee, Florida, 32399.

F. American Water Works Association, Inc., Water Treatment Plant Design, 6666 West Quincy Avenue, Denver, Colorado, 80235.

G. American Water Works Association, Inc., Water Treatment Plant Design, AWWA Standards and Applicable Manuals, 6666 West Quincy Avenue, Denver, Colorado, 80235.

H. Ductile Iron Pipe Research Association, Handbook, Ductile Iron Pipe/Cast Iron Pipe, Ductile Iron Pipe Research Association, 245 Riverchase Parkway East, Birmingham, Alabama, 35244.

I. Uni-Bell Plastic Pipe Association, Handbook of PVC Pipe, Uni-Bell Plastic Pipe Association, 2655 Villa Creek Drive, Suite 164, Dallas, Texas, 75234.

J. American National Standards Institute, latest revisions of applicable standards, 1819 L Street NW, Suite 600, Washington, D.C., 20036.

K. American Society for Testing and Materials, latest revisions of applicable standards, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, 19428-2959.

L. National Water Research Institute, Treatment Technologies for Removal of MTBE. NWRI, 10500 Ellis Ave., P.O. Box 20865, Fountain Valley, CA, 92728.

M. National Water Research Institute, Valuing Ground Water: Economic Concepts/Approaches. NWRI, 10500 Ellis Ave., P.O. Box 20865, Fountain Valley, CA, 92728.7.3.14.

N. U.S. Environmental Protection Agency, Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, Supplement to the Federal Guidelines for Design, Operation, and Maintenance of Wastewater Treatment Facilities, Technical Bulletin EPA-430-99-74-001, U.S. EPA, Office of Water Program Operations.

O. Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, Maps & Publications Sales, Mail Station 12, 605 Suwannee Street, Tallahassee, Florida 32399-0450.

P. Plastics Pipe Institute, Handbook of Polyethylene Pipe, 1825 Connecticut Ave., NW, Suite 680, Washington, DC 20009.

Q. National Fire Protection Association, 1995 Edition of NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 1 Batterymarch Park, Quincy, MA 02169.

R. Collier County Water-Sewer District Utilities Standards Manual.

S. National Electrical Code, latest revisions of applicable requirements.

T. Metcalf and Eddy, Wastewater Engineering Treatment and Reuse, 4th Edition, McGraw-Hill, 2002.

U. Water Environment Federation, Manual of Practice No. 11, Operation of Municipal Wastewater Treatment Plants, 601 Wythe Street, Alexandria, VA 22314-1994.

1.6 REFERENCE STANDARDS

A. Latest Edition: Construe references to furnishing materials or testing, which conform to the standards of a particular technical society, organization, or body, to mean the latest standard, code, or specification of that body, adopted and published as of the date of bidding this Contract. Standards referred to herein are made a part of these Specifications to the extent that is indicated or intended.

B. Precedence: The duties and responsibilities of the COUNTY, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees are set forth in the Contract Documents, and are not changed or altered by any provision of any referenced standard specifications, manuals or code, whether such standard manual or code is or is not specifically incorporated by reference in the Contract Documents. Any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority, to undertake responsibility contrary to the powers of the ENGINEER as set forth in the Contract Documents cannot be assigned to the ENGINEER or any of the ENGINEER's consultants, agents or employees.

1.7 DEFINITIONS

A. In these Contract Documents the words furnish, install and provide are defined as follows:

1. Furnish (Materials): to supply and deliver to the project ready for installation and in operable condition.

2. Install (services or labor): to place in final position, complete, anchored, connected in operable condition.

3. Provide: to furnish and install complete. Includes the supply of specified services. When neither furnish, install or provide is stated, provided is implied.

4. COUNTY: Collier County Board of Commissioners, County Government Center, 3301 East Tamiami Trail, Naples, Florida 34112, or authorized staff or representatives.

5. ENGINEER: The terms Design Professional, Design Engineer, and Engineer are interchangeably used throughout the Contract Documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 014500

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals

B. Inspection Services

C. Inspection of Materials

D. Quality Control

E. Costs of Inspection

F. Acceptance Tests

G. Failure to Comply with Contract

1.2 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in the individual material sections.

B. Certificate Submittals: Furnish the ENGINEER authoritative evidence in the form of Certificates of Manufacture that the materials and equipment to be used in the Work have been manufactured and tested in conformity with the Contract Documents. Include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

1.3 INSPECTION SERVICES

A. COUNTY's Access: At all times during the progress of the Work, and until the date of final completion, afford the County Manager or designee and ENGINEER every reasonable, safe, and proper facility for inspecting the Work at the site. The observation and inspection of any work will not relieve the CONTRACTOR of any obligations to perform proper and satisfactory work as specified. Replace work rejected due to faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, with satisfactory work at no additional cost to the COUNTY. Replace as directed, finished or unfinished work found not

to be in strict accordance with the Contract, even though such work may have been previously approved and payment made therefor.

B. Rejection: The County's Manager or designee has the right to reject materials and workmanship which are defective or require correction. Promptly remove rejected work and materials from the site.

C. Inferior Work Discoveries: Failure or neglect on the part of the County Manager or designee to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring the County Manager or designee at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the Work in which inferior work or improper materials were used.

D. Removal for Examination: Should it be considered necessary or advisable by the County Manager or designee, at any time before final acceptance of the Work, to make examinations of portions of the Work already completed, by removing or tearing out such portions, promptly furnish all necessary facilities, labor, and material, to make such an examination. If such Work is found to be defective in any respect, defray all expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the Work will be considered a change in the Work to be paid for in accordance with applicable provisions of the Contract.

E. Operation Responsibility: Assume full responsibility for the proper operation of equipment during tests and instruction periods. Make no claim, other than provided in the Contract Documents, for damage that may occur to equipment prior to the time when the County Manager or designee accepts the Work.

F. Rejection Prior to Warranty Expiration: If at anytime prior to the expiration of any applicable warranties or guarantees, defective equipment is rejected by the County Manager or designee, repay to the COUNTY all sums of money received for the rejected equipment on progress certificates or otherwise on account of the Contract lump sum prices, and upon the receipt of the sum of money, County Manager or designee will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. Do not remove the equipment from the premises of the COUNTY until the County Manager or designee obtains from other sources, equipment to take the place of that rejected. The County Manager or designee hereby agrees to obtain other equipment within a reasonable time and the CONTRACTOR agrees that the COUNTY may use the equipment furnished by the CONTRACTOR without rental or other charge until the other new equipment is obtained.

1.4 INSPECTION OF MATERIALS

A. Premanufacture Notification: Give notice in writing to the ENGINEER sufficiently in advance of the commencement of manufacture or preparation of materials

especially manufactured or prepared for use in or as part of the permanent construction. When required, notice to include a request for inspection, the date of commencement, and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, ENGINEER will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, or will notify CONTRACTOR that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. Comply with these provisions before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

B. Testing Standards: Conduct tests of electrical and mechanical equipment and appliances in accordance with recognized, applicable test codes.

1.5 QUALITY CONTROL

A. Testing

1. Field and Laboratory

a. Provide personnel to assist the ENGINEER in performing the following periodic observation and associated services.

(1) Soils: Observe and test excavations, placement and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.

(2) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by ENGINEER.

(3) Masonry: Sample and test mortar, bricks, blocks and grout; inspect brick and block samples and sample panels; inspect placement of reinforcement and grouting.

(4) Structural Steel: Verify that all welders are certified; visually inspect all structural steel welds; mechanically test high-tensile bolted connections.

b. When specified in the Contract Documents, provide an independent laboratory testing facility to perform required testing. Qualify the laboratory as having performed previous satisfactory work. Prior to use, submit to the ENGINEER for approval.

c. Cooperate with the ENGINEER and laboratory testing representatives. Provide at least 24 hours notice prior to when specified testing is

required. Provide labor and materials, and necessary facilities at the site as required by the ENGINEER and the testing laboratory.

d. When an independent electrical testing agency is specified in the Contract Documents, provide a member of the National Electrical Testing Association to perform inspections and tests.

2. Equipment: Coordinate and demonstrate test procedures as specified in the Contract Documents and as required during the formal tests.

3. Pipeline and Other Testing: Conform to test procedures and requirements specified in the appropriate Specification Section.

4. Testing of Gravity Sanitary Sewer Lines

a. Watertight Construction: It is imperative that all sewers and force mains, manholes, and service connections be built watertight and that the CONTRACTOR adhere rigidly to the specifications for material and workmanship. Since all of the water and sewage in the lines will be treated at the treatment plant, special care and attention must be given to securing watertight construction. After completion, the sewers or sections thereof will be tested and gauged. If infiltration or exfiltration is above the limits specified, the sewer construction work will be rejected.

b. Cleaning: Exercise care during construction of the manhole to see that materials do not enter the sewer line. Keep the invert and shelf of the manhole clean of all mortar, broken brick, sand, or any other materials falling into the manhole. Immediately remove such material. Maintain this condition until final acceptance of the work. Prior to testing of gravity sanitary sewer lines, clean the lines using appropriate tools.

c. Gravity Sewers - Visual Inspections: On completion of each block or section of sewer, or at such other times as the County Manger or designee may direct, the block or section of sewer is to be cleaned, tested and inspected. Each section of the sewer is to show, on examination from either end, a full circle of light between manholes. Each manhole, or other appurtenance to the system, shall be of the specified size and form, be watertight, neatly and substantially constructed, with the rim set permanently to design position and grade. All repairs shown necessary by the inspection are to be made; broken or cracked pipe replaced, all deposits removed and the sewers left true to line and grade, entirely clean and ready for use.

d. Infiltration Limits: Provide the equipment necessary to check the lines for infiltration or exfiltration as directed by the County Manager or designee, before they are put in service. Infiltration in excess of fifty (50) gallons per day inch-mile of sewer will result in having the CONTRACTOR go over the lines, ascertain where the leakage exists, and repair the lines to the extent necessary to bring the infiltration down within acceptable limits. Observable inflow is not permitted.

e. Exfiltration Limits: The length of sewer subject to an exfiltration test shall be the distance between two (2) adjacent manholes. Close the inlets of the upstream and downstream manholes with watertight plugs and the test section filled with water until the elevation of the water in the upstream manhole is two (2) feet above the crown of the pipe in the line being tested, or two (2) feet above the existing groundwater in the trench, whichever is higher. A standpipe may be used instead of the upstream manhole for providing the pressure head when approved by the County Manager or designee. Measure exfiltration by determining the amount of water required to maintain the initial water elevation for one (1) hour period from the start of the test. The maximum allowable leakage, including manholes, shall be 50 gallon per inch for diameter per mile of pipe per day.

f. Air Testing: Air testing shall be required if, in the opinion of the County Manager or designee, conditions are such that infiltration measurements may be inconclusive. Conduct the test in the presence of the County Manager or designee and conform to the following requirements:

   (a) Test pressure shall be 3.5 psi increased by the groundwater pressure above the top of the sewer.

   (b) Pressure loss from shall not exceed 0.5 psi during the required testing time.

   (c) Testing time in minutes shall be calculated as 0.625 x nominal pipe size (inches).

g. Deformation Test

   (a) Deformation tests shall be performed on all gravity sewer lines. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system.

   (b) No pipe shall exceed a deformation of five percent (5%). If deformation exceeds 5%, mechanical methods to correct deformation may be used. If mechanical methods are unsuccessful, the pipe shall be excavated. Replacement

or correction shall be accomplished in accordance with requirements in the approved specifications.

(c) The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM Specification, including the appendix, to which the pipe is manufactured. The test shall be performed without mechanical pulling devices.

B. Reports

1. Certified Test Reports: Where transcripts or certified test reports are required by the Contract Documents, meet the following requirements:

a. Before delivery of materials or equipment submit and obtain approval of the ENGINEER for all required transcripts, certified test reports, certified copies of the reports of all tests required in referenced specifications or specified in the Contract Documents. Perform all testing in an approved independent laboratory or the manufacturer's laboratory. Submit for approval reports of shop equipment tests within thirty days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type, quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.

2. Certificate of Compliance: At the option of the ENGINEER, submit for approval a notarized Certificate of Compliance. The Certificates may be in the form of a letter stating the following:

a. Manufacturer has performed all required tests

b. Materials to be supplied meet all test requirements

c. Tests were performed not more than one year prior to submittal of the certificate

d. Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified

e. Identification of the materials

1.6 COSTS OF INSPECTION

A. COUNTY's Obligation: Initial inspection and testing of materials furnished under this Contract will be performed by the County Manager or designee, or inspection bureaus without cost to the CONTRACTOR, unless otherwise expressly specified. If subsequent testing is necessary due to failure of the initial tests or because of rejection for noncompliance, reimburse the COUNTY for expenditures incurred in making such tests.

B. CONTRACTOR's Obligation: Include in the Contract Price, the cost of all shop and field tests of equipment and other tests specifically called for in the Contract Documents, except those tests described above under “COUNTY’s Obligation”. The County Manager or designee may perform tests on any material or equipment furnished under this Contract at any time during the Contract. If tests performed by the County Manager or designee result in failure or rejection for noncompliance, reimburse the COUNTY for expenditures incurred in making such tests. Tests performed by the County Manager or designee shall prevail in determining compliance with Contract requirements.

C. Reimbursements to the COUNTY:

1. Materials and equipment submitted by the CONTRACTOR as the equivalent to those specifically named in the Contract may be tested by the County Manager or designee for compliance. Reimburse the COUNTY for expenditures incurred in making such tests on materials and equipment that are rejected for noncompliance.

2. Reimburse the COUNTY for all costs associated with Witness Tests that exceed 5 Calendar Days per kind of equipment.

1.7 ACCEPTANCE TESTS

A. Preliminary Field Tests: As soon as conditions permit, furnish all labor and materials and services to perform preliminary field tests of all equipment provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, make all changes, adjustments and replacements required prior to the acceptance tests.

B. Final Field Tests: Upon completion of the Work and prior to final payment, subject all equipment, piping and appliances installed under this Contract to specified acceptance tests to demonstrate compliance with the Contract Documents.

1. Furnish all labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests.

2. Conduct field tests in the presence of the ENGINEER. Perform the field tests to demonstrate that under all conditions of operation each equipment item:

   a. Has not been damaged by transportation or installation

   b. Has been properly installed

   c. Has been properly lubricated

   d. Has no electrical or mechanical defects

   e. Is in proper alignment

   f. Has been properly connected

   g. Is free of overheating of any parts

   h. Is free of all objectionable vibration

   i. Is free of overloading of any parts

   j. Operates as intended

3. Operate work or portions of work for a minimum of 100 hours or 14 days continuous service, whichever comes first. For those items of equipment that would normally operate on wastewater or sludge, plant effluent may be used if available when authorized by ENGINEER. If water cannot properly exercise equipment, conduct 100-hour test after plant startup. Conduct test on those systems that require load produced by weather (heating or cooling) exercise only when weather will produce proper load.

C. Failure of Tests: If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, then promptly correct such deficiencies. Failure or refusal to correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the County Manager or designee, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the CONTRACTOR to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

1.8 FAILURE TO COMPLY WITH CONTRACT

A. Unacceptable Materials: If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, do not deliver said material or equipment, or if delivered remove it promptly from the site or from the

Work and replace it with acceptable material without additional cost to the COUNTY. Fulfill all obligations under the terms and conditions of the Contract even though the County Manager or designee fail to ascertain noncompliance or notify the CONTRACTOR of noncompliance.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 015000

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General Requirements

B. Related Sections

C. Temporary Utilities

D. Temporary Construction

E. Barricades and Enclosures

F. Fences

G. Security

H. Temporary Controls

I. Traffic Regulation

J. Field Offices and Sheds

1.2 RELATED SECTIONS

A. Section 011000 - Summary of Work

B. Section 015526 – Traffic Regulations and Public Safety

C. Section 020500 – Connection to Existing Systems

D. Section 312319 – Groundwater Control for Open Cut Excavation

E. Section 320117 - Pavement Repair and Restoration

F. Section 330518 –Laying and Jointing Buried Pipelines

1.3 GENERAL REQUIREMENTS

A. Plant and Facilities: Furnish, install, maintain and remove all false work, scaffolding, ladders, hoistways, braces, pumping plants, shields, trestles,

roadways, sheeting, centering forms, barricades, drains, flumes, and the like, any of which may be needed in the construction of any part of the Work and which are not herein described or specified in detail. Accept responsibility for the safety and efficiency of such works and for any damage that may result from their failure or from their improper construction, maintenance or operation.

B. First Aid: Maintain a readily accessible, completely equipped first aid kit at each location where work is in progress.

C. Safety Responsibility: Accept sole responsibility for safety and security at the site. Indemnify and hold harmless the COUNTY and the County's Manager or designee, including the ENGINEER, for any safety violation, or noncompliance with governing bodies and their regulations, and for accidents, deaths, injuries, or damage at the site during occupancy or partial occupancy of the site by CONTRACTOR's forces while performing any part of the Work.

D. Hazard Communication: Furnish two copies of the CONTRACTOR's Hazard Communication Program required under OSHA regulations before beginning on site activities. Furnish two copies of amendments to Hazard Communications Program as they are prepared.

1.4 TEMPORARY UTILITIES

A. Water: Provide all necessary and required water without additional cost, unless otherwise specified. If necessary, provide and lay water lines to the place of use; secure all necessary permits; pay for all taps to water mains and hydrants and for all water used at the established rates.

B. Light and Power: Provide without additional cost to the COUNTY temporary lighting and power facilities required for the proper construction and inspection of the Work. If, in the ENGINEER's opinion, these facilities are inadequate, do NOT proceed with any portion of the Work affected thereby. Maintain temporary lighting and power until the Work is accepted.

C. Heat: Provide temporary heat, whenever required, for work being performed during cold weather to prevent freezing of concrete, water pipes, and other damage to the Work or existing facilities.

D. Sanitary Facilities: Provide sufficient sanitary facilities for construction personnel. Prohibit and prevent nuisances on the site of the Work or on adjoining property. Discharge any employee who violates this rule. Abide by all environmental regulations or laws applicable to the Work.

1.5 TEMPORARY CONSTRUCTION

A. Bridges: Design and place suitable temporary bridges where necessary for the maintenance of vehicular and pedestrian traffic. Assume responsibility for the

sufficiency and safety of all such temporary work or bridges and for any damage that may result from their failure or their improper construction, maintenance, or operation. Indemnify and save harmless the COUNTY and the COUNTY's representatives from all claims, suits or actions, and damages or costs of every description arising by reason of failure to comply with the above provisions.

1.6 BARRICADES, LIGHTS AND ENCLOSURES

A. Protection of Workmen and Public: Effect and maintain at all times during the prosecution of the Work, barriers, lights and enclosures necessary for the protection of workmen and the public. Perform all work within the County right-of-way in strict accordance with the COUNTY Maintenance of Traffic Policy and other applicable statutory requirements.

B. Provide suitable barricades, lights, signs and watchmen at excavation sites and all other places where the Work causes obstructions to normal traffic or constitutes in any way a hazard to the public.

1.7 FENCES

A. Existing Fences: Obtain written permission from property owner(s) prior to relocating or dismantling fences that interfere with construction operations. Reach agreements with the fence owner as to the period the fence may be left relocated or dismantled. Install adequate gates where fencing must be maintained. Keep gates closed and locked at all times when not in use.

B. Restoration: Restore all fences to their original or better condition and to their original location on completion of the Work.

1.8 SECURITY

A. Preservation of Property:

1. Preserve from damage, all property along the line of the Work, in the vicinity of or in any way affected by the Work, the removal or destruction of which is not called for by the Drawings. Preserve from damage, public utilities, trees, lawn areas, building monuments, fences, pipe and underground structures, and public streets. Note: Normal wear and tear of streets resulting from legitimate use by the CONTRACTOR are not considered as damage. Whenever damages occur to such property, immediately restore to its original condition. Costs for such repairs are incidental to the Contract.

2. In case of failure on the part of the CONTRACTOR to restore property or make good on damage or injury, the County Manager or designee may, upon 24 hours written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due or which may become due the

CONTRACTOR under this Contract. If removal, repair or replacement of public or private property is made necessary by alteration of grade or alignment authorized by the County Manager or designee and not contemplated by the Contract Documents, the CONTRACTOR will be compensated, in accordance with the General Conditions, provided that such property has not been damaged through fault of the CONTRACTOR or the CONTRACTOR's employees.

B. Public Utility Installations and Structures:

1. Public utility installations and structures include all poles, tracks, pipes, wires, conduits, vaults, valves, hydrants, manholes, and other appurtenances and facilities, whether owned or controlled by public bodies or privately owned individuals, firms or corporations, used to serve the public with transportation, gas, electricity, telephone, storm and sanitary sewers, water, or other public or private utility services. Facilities appurtenant to public or private property that may be affected by the Work are deemed included hereunder.

2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. Existing public utility installations and structures are indicated on the Drawings only to the extent such information was made available to, or found by, the ENGINEER in preparing the Drawings. These data are not guaranteed for completeness or accuracy, and the CONTRACTOR is responsible for making necessary investigations to become fully informed as to the character, condition, and extent of all public utility installations and structures that may be encountered and that may affect the construction operations.

3. Before starting construction, identify and mark all existing valves and maintain access to the valves at all times during construction.

4. Contact utility locating service sufficiently in advance of the start of construction to avoid damage to the utilities and delays to the completion date.

5. If existing utilities are damaged during the Work, immediately notify the owner of the affected utility. In coordination with or as directed by the owner, remove, replace, relocate, repair, rebuild, and secure any public utility installations and structures damaged as a direct or indirect result of the Work under this Contract. Costs for such work are incidental to the Contract. Be responsible and liable for any consequential damages done to or suffered by any public utility installations or structures. Assume and accept responsibility for any injury, damage, or loss that may result from or be consequent to interference with, or interruption or discontinuance of, any public utility service.

6. At all times in the performance of Work, employ proven methods and exercise reasonable care and skill to avoid unnecessary delay, injury, damage, or destruction to public utility installations and structures. Avoid unnecessary interference with, or interruption of, public utility services. Cooperate fully with the owners thereof to that end.

7. Provide notice to the County Manager or designee of any proposed connections to existing utilities, interruptions of service or shutdowns in accordance with Section 020500. Give written notice to the owners of all public utility installations and structures affected by proposed construction operations sufficiently in advance of breaking ground in any area or on any unit of the Work, to obtain their permission before disrupting the lines and to allow them to take measures necessary to protect their interests. Advise the Transportation Operations Department, Fire and Rescue Services of any excavation in public streets or the temporary shut-off of any water main. Provide at least 48 hours notice to all affected property owners whenever service connections are taken out of service.

C. Work on Private Property: Work on this project will require operations on private property, rights of way or easements. The County Manager or designee has secured the appropriate easements or rights of entry from the affected property owners. Comply with all easement or rights of entry provisions. Conduct operations along rights-of-way and easements through private property to avoid damage to the property and to minimize interference with its ordinary use. Upon completion of the Work through such property, restore the surface and all fences or other structures disturbed by the construction as nearly as possible to the preconstruction conditions. Do not remove any material from private property without the consent of the property owner or responsible party in charge of such property. Hold the COUNTY harmless from any claim or damage arising out of or in connection with the performance of work across and through private property.

D. Miscellaneous Structures: Assume and accept responsibility for all injuries or damage to culverts, building foundations and walls, retaining walls, or other structures of any kind met with during the prosecution of the Work. Assume and accept liability for damages to public or private property resulting therefrom. Adequately protect against freezing all pipes carrying liquid.

E. Protection of Trees and Lawn Areas:

1. Protect with boxes, trees and shrubs, except those ordered to be removed. Do not place excavated material so as to cause injury to such trees or shrubs. Replace trees or shrubs destroyed by accident or negligence of the CONTRACTOR or CONTRACTOR's employees with new stock of similar size and age, at the proper season, at no additional cost to the COUNTY. If required by Contract Documents, provide preconstruction audio-video recording of project in accordance with the Technical Specifications.

2. Leave lawn areas in as good condition as before the start of the Work. Restore areas where sod has been removed by seeding or sodding.

1.9 TEMPORARY CONTROLS

A. During Construction:

1. Keep the site of the Work and adjacent premises free from construction materials, debris, and rubbish. Remove this material from any portion of the site if such material, debris, or rubbish constitutes a nuisance or is objectionable.

2. Remove from the site all surplus materials and temporary structures when they are no longer needed.

3. Neatly stack construction materials such as concrete forms and scaffolding when not in use. Store pipe to be incorporated into the Work in accordance with AWWA standards. Promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

4. Properly store volatile wastes in covered metal containers and remove from the site daily.

5. Do not bury or burn on the site or dispose of into storm drains, sanitary sewers, streams, or waterways, any waste material. Remove all wastes from the site and dispose of in a manner complying with applicable ordinances and laws.

B. Smoke Prevention:

1. Strictly observe all air pollution control regulations.

2. Open fires will be allowed only if permitted under current ordinances.

C. Noises:

1. In accordance with the COUNTY's Noise Ordinance, maintain acceptable noise levels in the vicinity of the Work. Limit noise production to acceptable levels by using special mufflers, barriers, enclosures, equipment positioning, and other approved methods.

2. Supply written notification to the County Manager or designee sufficiently in advance of the start of any work that violates this provision. Proceed only when all applicable authorizations and variances have been obtained in writing.

D. Hours of Operation:

1. Operation of construction equipment is only permitted Monday through Saturday, 7:00 AM to 7:00 PM. Obtain written consent from the County Manager or designee for operation of construction equipment during any other period.

2. Do not carry out non-emergency work, including equipment moves, on Sundays without prior written authorization by the County Manager or designee.

E. Dust Control:

1. Take measures to prevent unnecessary dust. Keep earth surfaces exposed to dusting moist with water or a chemical dust suppressant. Cover materials in piles or while in transit to prevent blowing or spreading dust.

2. Adequately protect buildings or operating facilities that may be affected adversely by dust. Protect machinery, motors, instrument panels, or similar equipment by suitable dust screens. Include proper ventilation with dust screens.

F. Temporary Drainage Provisions:

1. Provide for the drainage of stormwater and any water applied or discharged on the site in performance of the Work. Provide adequate drainage facilities to prevent damage to the Work, the site, and adjacent property.

2. Supplement existing drainage channels and conduits as necessary to carry all increased runoff from construction operations. Construct dikes as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect the COUNTY's facilities and the Work, and to direct water to drainage channels or conduits. Provide ponding as necessary to prevent downstream flooding.

3. Maintain excavations free of water. Provide, operate, and maintain pumping equipment. Dewater trenches in accordance with Sections 312319 and 330518.

G. Pollution: Prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. Do not permit sanitary wastes to enter any drain or watercourse other than sanitary sewers. Do not permit sediment, debris, or other substances to enter sanitary sewers. Take reasonable measures to prevent such materials from entering any drain or watercourse.

1.10 TRAFFIC REGULATION

A. Parking: Provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Contract, to avoid any need for parking personal vehicles where they may interfere with public traffic or construction activities.

B. Access: Conduct Work to interfere as little as possible with public travel, whether vehicular or pedestrian. Provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when the CONTRACTOR has obtained permission from the owner or tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at the designated point.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 015526

TRAFFIC REGULATION AND PUBLIC SAFETY

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. General Requirements

B. Traffic Control

C. Public Safety

1.2 RELATED SECTIONS

A. Section 015000 – Construction Facilities and Temporary Controls

B. Section 320117 – Pavement Repair and Restoration

C. Section 330201 – Roadway Crossings by Open Cut

1.3 GENERAL REQUIREMENTS

A. Perform all work within COUNTY rights-of-way in strict accordance with the County's Maintenance of Traffic Policy and other applicable statutory requirements to protect the public safety.

B. Be responsible for providing safe and expeditious movement of traffic through construction zones. A construction zone is defined as the immediate areas of actual construction and all abutting areas which are used by the CONTRACTOR and which interfere with the driving or walking public.

C. Remove temporary equipment and facilities when no longer required. Restore grounds to original or specified conditions.

D. The requirements specified herein are in addition to the plan for Maintenance of Traffic as specified in Section 330201.

1.4 TRAFFIC CONTROL

A. Include as necessary precautions, not to be limited to, such items as proper construction warning signs, signals, lighting devices, marking, barricades, channelization, and hand signaling devices. Be responsible for installation and maintenance of all devices and requirements for the duration of the Construction period.

B. Provide notice, at least five (5) working days prior to construction, to the State or County Department of Transportation of the necessity to close any portion of a roadway carrying vehicles or pedestrians so that the final approval of such closings can be obtained at least 48 hours in advance. At no time will more than one (1) lane of roadway be closed to vehicles and pedestrians. With any such closings make adequate provision for the safe expeditious movement of each.

C. Be responsible for notifying Transportation Operations Department, Police, Fire, and other Emergency Departments whenever construction is within roadways and of the alternate routes.

D. Be responsible for removal, relocation, or replacement of any traffic control device in the construction area that exists as part of the normal pre-construction traffic control scheme.

E. Immediately notify the County Manager or designee of any vehicular or pedestrian safety or efficiency problems incurred as a result of the construction of the project.

F. Be responsible for notifying all residents of any road construction and limited access at least 72 hours in advance.

1.5 PUBLIC SAFETY (DURING CONSTRUCTION, ALTERATION OR REPAIR)

A. In areas of high vehicular traffic, provide a safe walkway around the work area.

B. Use barricades or other barriers to prevent any possibility of injury to the public caused by the CONTRACTOR's work.

C. Keep walk areas around the work areas clean of sand, stones, and any other material that could cause a pedestrian accident.

D. Barricade work areas left overnight. Install flashing warning lights in areas required by the COUNTY.

E. Unless an approved detour is provided at any open cut crossings, a minimum of one-way traffic will be maintained during the daylight hours and two-way traffic at night. All traffic detours will be restricted to limits of the Right-of-Way with necessary flagmen and/or marking devices. These detours shall be approved by the COUNTY. Detour of traffic outside of the Right-of-Way will be considered with the approval of local governmental agencies and private concerns involved.

F. Crossing and Intersections: Do not isolate residences and places of business. Provide access to all residences and places of business whenever construction interferes with existing means of access. Maintain access at all times. If pavement is disturbed, a cold mix must be applied at the end of the day.

G. Detours

1. Construct and maintain detour facilities wherever it becomes necessary to divert traffic from any existing roadway or bridge, or wherever construction operations block the flow of traffic. The location of all detours will require prior approval of the COUNTY.

2. Furnishing of Devices and Barriers: Furnish all traffic control devices (including signs), warning devices and barriers. Costs of such devices shall be incidental to construction and included in unit prices bid.

3. Maintenance of Devices and Barriers: Keep traffic control devices, warning devices and barriers in the correct position, properly directed, clearly visible and clean, at all times. Immediately repair replace or clean damaged, defaced or dirty devices or barriers as necessary.

H. Flagmen: Provide certified flagmen (flaggers) to direct traffic where one-way operation in a single lane is in effect and in other situations as may be required. Radios may be required if flagmen cannot maintain contact with each other.

I. Utilize all necessary signs, flagmen, and other safety devices during construction.

J. Perform all work with the requirements set forth by the Occupational Safety Health Administration.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION