SITZMARK HYDROPNEUMATIC PUMP STATION REPLACEMENT
ADDENDUM NO. 1

This document consists of 56 sheets (52 @ 8.5" x 11" and four @11" x 17"). It is the responsibility of the Bidder to assure and guarantee by acknowledging the receipt of this Addendum in the Bid Forms, that the Bidder has received the addendum in its entirety, and that the Bidder accepts all conditions contained herein.

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1. SECTION 00100 – INSTRUCTIONS TO BIDDERS

In Article 2, BID FORM, delete the text of the first bullet item in its entirety. Replace it with the following:

"All pages of the Bid Forms (Section 00300)"

2. SECTION 00310 – MEASUREMENT AND PAYMENT

In the last sentence of Article 2.12.A, delete the following text: "concrete generator pad,"

3. TECHINCAL SPECIFICATIONS TABLE OF CONTENTS

Delete the entry for Section 16920 – Motor Control Centers. There is not a Section 16920 for this project.

4. SECTION 11210 – PUMPS AND EQUIPMENT

Delete Section 11210 in its entirety. Replace it with the Section 11210-R1 included in this addendum.

5. SECTION 16120 – WIRE AND CABLE

Insert the Section 16120 included in this addendum after Section 16110.

6. SECTION 17150 – OUTSIDE PLANT CABLE SYSTEMS

Insert the Section 17150 included in this addendum after Section 17010.

7. SECTION 17200 – INSIDE PLANT CABLE SYSTEMS

Insert the Section 17200 included in this addendum after Section 17150.

8. SECTION 17300 – FIBER TESTING

Insert the Section 17300 included in this addendum after Section 17200.

9. DRAWING C5

Delete Drawing C5 in its entirety. Replace it with Drawing C5-R1 included in this addendum.

10. DRAWING C5-R1

In the EQUIPMENT LIST, delete the description for Item 16. Replace it with the following:

"EXHAUST FAN WITH LOUVER AND DAMPER. EXHAUST FAN SHALL BE 20-INCH DIRECT DRIVE, EXPLOSION PROOF FAN WITH A MINIMUM CAPACITY OF 3,000 CFM. CANARM P20-4 FAN, OR APPROVED EQUAL"

11. DRAWING S2

Delete Drawing S2 in its entirety. Replace it with Drawing S2-R1 included in this addendum.

12. DRAWING D1

Delete Drawing D1 in its entirety. Replace it with Drawing D1-R1 included in this addendum.

13. DRAWING E02

Delete Drawing E02 in its entirety. Replace it with Drawing E02-R1 included in this addendum.

14. DRAWING E05

Delete Note 6 in its entirety. There is no replacement.

15. DRAWING E08

Delete Detail 6 in its entirety. There is no replacement.

END OF ADDENDUM

SECTION 11210-R1
PUMPS AND EQUIPMENT

PART 1 – GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall perform all work required for installation of the pumping system, variable frequency drive, system controller and hydropneumatic pressure tank including but not limited to mounting pump and equipment to concrete pads, completing all pipe connections, completing all electrical and control wiring, and testing all equipment.

1.2 WORK INCLUDED

A. A variable speed packaged pumping system including five vertical turbine single-stage pumps with motors, variable speed pump controls, inlet and outlet manifolds, and 400 gallon hydropnuematic pressure tank with compressor.

1.3 REFERENCE STANDARDS

A. The work in this section is subject to the requirements of applicable portions of the following standards:

1. Hydraulic Institute

2. ANSI – American National Standards Institute

3. ASME – American Society of Mechanical Engineers

4. ASTM – American Society for Testing and Materials

5. IEEE – Institute of Electrical and Electronics Engineers

6. NEMA – National Electrical Manufacturers Association

7. NEC – National Electrical Code

8. ISO – International Standards Organization

9. UL – Underwriters Laboratories, Inc.

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 – Contractor Submittals.

PART 2 – PRODUCTS

2.1 VARIABLE SPEED PACKAGED PUMPING SYSTEM

A. Furnish and install a pre-fabricated and tested variable speed packaged pumping

system to maintain constant water delivery pressure.

B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer.

C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.

D. The complete packaged pumping system shall be NSF61 / NSF372 Listed for drinking water and low lead requirements.

E. The packaged pump system shall be ASHRAE 90.1 – 2010 compliant without the need of a remote mounted sensor. The control logic used to simulate a remote mounted sensor shall be proportional pressure control with squared or linear adaptation. An actual flow rate or calculated flow rate based on performance curves (5^{th} order polynomial) loaded into the controller; shall be used to adjust setpoint pressure in proportional pressure control.

2.2 PUMPS

A. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements. Pumps shall be certified for drinking water applications and shall contain a NSF nameplate upon completion of manufacturing. Pumps without the 3^{rd} party certification or self certified will not be acceptable.

B. The pumps shall be of the in-line vertical single-stage design.

C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

D. Vertical In-line pumps shall have the following features:

1. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.

2. The suction/discharge base shall have ANSI Class 150 flange connections as determined by the pump station manufacturer.

3. Pump Performance

a. The skid mounted pump system will contain five vertical turbine booster pumps. The pumps shall meet or exceed the following performance conditions:

Full Speed Performance Data	Requirements
Number of Pumps	5
Operating Point @ Full Speed, Each Pump	288 gpm @ 95 ft TDH

Total System Flowrate, 4 Pumps	1,150 gpm
Pump Speed, Rated/Maximum/Minimum, rpm	3274/3444/900
Motor Horsepower, HP	20
Voltage, volts/Phase	480/3
Min. Pump Efficiency	65%
Pump Discharge Size	4”
Number of Stages	1
Impeller Diameter, in	Per Manufacturer

b. Pump system shall be Grundfos Hydro MPC-EC (CUE) 5CR 64-1 3x460V 60Hz or approved equal.

4. Pump Construction.

a. Suction/discharge base, pump head	Ductile Iron (ASTM 65-45-12)
b. Shaft couplings, flange rings:	Ductile Iron (ASTM 65-45-12)
c. Shaft	431 Stainless Steel
d. Motor Stool	Cast Iron (ASTM Class 30)
e. Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
f. Impeller wear rings:	304 Stainless Steel
g. Intermediate Bearing Journals:	Silicon Carbide
h. Intermediate Chamber Bearings:	Leadless Tin Bronze
i. Chamber Bushings:	Graphite Filled PTFE
j. O-rings:	EPDM

5. The shaft seal shall be a balanced o-ring cartridge type with the following features:

a.	Collar, Drivers, Spring:	316 Stainless Steel
b.	Shaft Sleeve, Gland Plate:	316 Stainless Steel
c.	Stationary Ring:	Silicon Carbide
d.	Rotating Ring:	Silicon Carbide
e.	O-rings:	EPDM

The Silicon Carbide shall be imbedded with graphite.

6. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.3 VARIABLE FREQUENCY DRIVES (PANEL MOUNT)

A. The VFD shall convert incoming fixed-frequency single-phase or three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full-wave diode

bridge; VFDs utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.

B. The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.

C. The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.

D. The VFD shall utilize an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VFDs that utilize Sine-Coded PWM or look-up tables shall not be acceptable.

E. VFD shall automatically boost power factor at lower speeds.

F. The VFD shall be able to provide its full rated output current continuously at 110% of rated current for 60 seconds.

G. An empty pipe fill mode shall be available to fill an empty pipe in a short period of time, and then revert to the PID controller for stable operation.

H. Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.

I. Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

J. The VFD shall have temperature-controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

K. VFD shall provide full torque to the motor given input voltage fluctuations of up to +10% to -15% of the rated input voltage.

L. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. VFDs without a DC link reactor shall provide a 5% impedance line-side reactor.

M. Protective Features — the VFD shall be provided with the following:

- VFD shall have input surge protection utilizing MOVs, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.
- VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
- VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD shall identify which of the output phases is low or lost.
- VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning shall be exported during the event. Function shall reduce switching frequency before reducing motor speed.
- VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed may be reduced, but not stopped.
- The VFD shall have the option of an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.

N. Interface Features — the VFD shall be provided with the following:

- VFD shall provide an alphanumeric backlit display keypad, which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
- VFD shall display all faults in plain text; VFDs that can display only fault codes are not acceptable.
- All VFDs shall be of the same series, and shall utilize a common control card and

LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.

- VFD keypad shall be capable of storing drive parameter values in non-volatile RAM uploaded from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up programmed parameters.
- A red FAULT light, a yellow WARNING light, and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- A start guide menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning.
- VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLCs and other connected equipment from power surges and spikes.
- All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
- There shall be three programmable digital inputs for interfacing with the system's external control and safety interlock circuitry. An additional digital input is pre-programmed for start/stop.
- The VFD shall have two analog signal inputs: one dedicated for sensor input and one for external set-point input.
- One programmable analog output shall be provided for indication of a drive status.
- The VFD shall provide two user-programmable relays with selectable functions. Two Form C, 230 VAC/2A rated dry contact relay outputs shall be provided.
- The VFD shall store in memory the last five (5) faults with time stamp and recorded data.
- The VFD shall be equipped with a standard RS-485 serial communications port for communication to the multi-pump controller. The bus communication protocol for the VFD shall be the same as the controller protocol.

O. Service Conditions — the VFD shall be rated for the following:

- Ambient temperature operating range: -10°C to 45°C (14°F to 113°F) continuous; 50°C maximum intermittent.
- 0 to 95% relative humidity, non-condensing.
- Elevation to 1,000 meters (3,300 feet) without derating.
- Line voltage of 525 to 690 VAC, 380 to 480 VAC, or 200 to 240 VAC; with +10% to -15% variations. Line frequency variation of ±2% shall be acceptable.
- No side clearance shall be required for cooling of the units.

2.4 FIXED SPEED MOTORS

Fixed speed motors shall be provided with the following basic features:

1. Designed for continuous duty operation, NEMA Design B with a 1.15 service factor.
2. Totally Enclosed Fan Cooled or Open Drip Proof with Class F insulation.
3. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.
4. Motors shall have a NEMA C-Flange for vertical mounting.
5. Drive-end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

2.5 PUMP SYSTEM CONTROLLER

A. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

B. The controller shall be microprocessor-based with a Linux-based operating system. Software changes and updates shall be possible via USB, personal computer (notebook), and over-the-air via Wi-Fi. The controller user interface shall feature a color touch-enabled display with a minimum screen size of 10 inches (diagonal) for easy viewing of system status parameters and field programming. The display shall include a backlight with contrast adjustment. Password protection of system settings shall be standard.

C. Home Screen

The controller shall provide an enhanced home screen designed to give the user immediate visibility of system performance and operating status. The home screen shall display key operating information in a clear, intuitive format to allow quick assessment of pump operation and system condition. The home screen shall include, at a minimum:

- System illustration showing the overall pumping configuration
- System overview with measured values displayed in real time
- Operation mode menus providing direct access to primary operating states
- Warning, alarm, and information event indication
- Level 2 cards for pump details including pump speed, operation mode, run time, and pump alarms
- Adjustable display backlight
- Status LED indicating system condition
- Estimated flowrate (or actual flow if a flow sensor is used)
- Other user-defined measured parameters such as specific energy, control mode, and system setpoint

The home screen shall present key metrics and pump status in an easy-to-read layout, enabling the user to understand system performance at a glance. The design shall support intuitive navigation through zoom, move, and logical menu structures, allowing users to access advanced control features easily.

D. Cybersecurity

The pump system controller shall incorporate cybersecurity functions aligned with recognized international standards to ensure secure handling from production through operation, protect system data, and maintain operational integrity.

Applicable Standards:

- ISO/IEC 27001 for information security management of system data, configurations, credentials, and service information.
- IEC 62443-4-2 for secure industrial automation components, including requirements for identification and authentication control, use control, system integrity, data confidentiality, restricted data flow, timely response to events, and resource availability.
- RED-equivalent cybersecurity provisions for wireless-enabled equipment, including secure network access, protection against harmful interference, and prevention of unauthorized device communication.

1. Tamper Detection: The controller shall include tamper detection mechanisms that monitor unauthorized opening, configuration alteration, or manipulation of hardware or firmware. Tamper events shall generate a warning and be recorded in the controller's security log. Device identity and firmware integrity shall be validated on first startup to ensure secure

production-to-installation flow.

2. User Access Control: The controller shall support tiered user access levels including Operator, Service, and Administrator roles. Access to system parameters, network configurations, and firmware management shall require authenticated login per IEC 62443-4-2 identification and authentication control requirements. The controller shall log all user access attempts, including denied attempts, for audit purposes.
3. Secure Boot: The controller shall include secure boot functionality that validates firmware authenticity at startup using cryptographic checks. Modified, unauthorized, or corrupted firmware shall be prevented from loading, and the controller shall revert to a protected recovery mode. Configuration integrity (checksum validation) shall be monitored continuously.
4. Firmware Updates: All updates (USB, PC, or OTA) shall comply with IEC 62443-4-2 software integrity requirements. Updates shall be digitally signed by the manufacturer and verified before installation. The controller shall reject unsigned, altered, or expired update files and log these events.
5. Communication Security: All external communication interfaces (Ethernet, wireless, and service ports) shall meet IEC 62443-4-2 secure communication requirements. The controller shall support encrypted data exchange where applicable and enforce connection restrictions to known, trusted devices. Unauthorized network access, device spoofing, or foreign device association attempts shall be blocked and recorded as security events.
6. Device Identity: The controller shall contain a unique, non-modifiable device identifier used for secure pairing with system components, service tools, and wireless accessories. The controller shall communicate only with validated devices to prevent interference or cross-association with unknown equipment.
7. Cybersecurity Event Log:
   The controller shall maintain a log recording the following events, including timestamps and user access levels consistent with IEC 62443-4-2 event logging provisions:
   - User login attempts (successful and unsuccessful)
   - Parameter changes
   - Firmware updates
   - Communication interface modifications
   - Tamper events
   - Device association attempts
8. Operational Resilience: The controller shall maintain pump operation during cybersecurity-related interruptions by isolating affected communication channels, maintaining validated operating parameters, and reverting to a safe fallback state. Cybersecurity events shall not override pump protection, system safety functions, or core control logic.

E. Commissioning Wizard

The pump system controller shall include an integrated Commissioning Wizard to simplify and standardize system startup. The wizard shall provide a step-by-step guided workflow that verifies required parameters before advancing to ensure correct and consistent configuration.

1. The wizard shall offer Quick Setup for rapid initialization of standard applications and Full Setup for detailed configuration of advanced system requirements.
2. During commissioning, the controller shall automatically validate sensors, pump communication, and system inputs/outputs. Detected issues shall be displayed with corrective instructions prior to system activation.
3. Upon completion, the wizard shall present a summary of configured parameters and validation results.

4. The wizard shall prevent incomplete commissioning by requiring all essential parameters to be set before exiting. Context-based help shall be available at each step.

F. Galvanic Isolation: The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

G. Backup Battery: The controller shall have the ability to be connected to a backup battery to supply power to the controller during periods of loss of supply power.

H. Inputs / Outputs

The controller shall have, at a minimum, the following hardware inputs and outputs:

- Four (4) programmable Analog/Digital inputs
- Two (2) Digital inputs
- Two (2) Relay outputs
- Six (6) Analog inputs via BUS
- Support for up to sixteen (16) additional input/output modules for I/O expansion, including additional digital and analog outputs
- Ethernet connection (built-in web server)
- Field service connection via USB-A for firmware updates and default setting storage
- Field service connection to PC via USB-C for advanced programming, firmware upgrades, and data logging
- Field Bluetooth (BLE) connectivity for settings updates, troubleshooting, and system programming

I. Pump System Programming

As a minimum, the following parameters shall be available and/or field-adjustable:

- Water shortage protection (analog or digital)
- Sensor settings (suction, discharge, differential pressure — analog supply/range)
- PI controller (proportional gain and integral time) settings
- High system pressure indication and shutdown
- Low system pressure indication and shutdown
- Low suction pressure/level shutdown (via digital contact)
- Low suction pressure/level warning (via analog signal)
- Low suction pressure/level shutdown (via analog signal)
- Flow meter settings (if used, analog signal)

J. Pump Curve Data

The actual pump performance curves (5th-order polynomial) shall be loaded (software) into the pump system controller. Pump curve data shall be used for the following:

- Display and data logging of calculated flow rate
- Variable pressure control (quadratic or proportional)
- Pump outside-of-duty-range protection
- Sequencing pumps based on efficiency

K. Variable Pressure Control: The controller shall include variable pressure control to compensate for pipe friction loss by decreasing the pressure setpoint at lower flowrates and increasing the pressure setpoint at higher flowrates using actual or calculated flow rate. Variable pressure control that uses power consumption and speed only shall not be considered equal to variable pressure control that uses actual differential pressure measurement along with pump power and speed.

L. Multi-Sensor: The controller shall be capable of controlling using up to six (6) differential pressure (DP) sensors (zones). Each zone shall have programmable maximum and minimum DP ranges. The

controller shall be capable of an energy-optimal mode where pump speed/energy is reduced until any zone reaches the minimum DP setting.

M. Pulse Flow Meter: The system controller shall be able to receive pulse readings from a digital pulse meter and log/display accumulated flow.

N. DP Subtraction: The system controller shall be capable of controlling via subtraction of two pressure or temperature sensors for differential pressure or differential temperature control.

O. Programmable Setpoints: The system controller shall accept up to seven (7) programmable setpoints via digital input (additional input/output module may be required).

P. Setpoint Influence: The system pressure setpoint shall be capable of being automatically adjusted by an external setpoint influence. This function enables the user to adjust the control parameter (typically differential pressure) by measuring an additional parameter. Example: lower the system differential pressure setpoint based on a flow or outdoor temperature measurement.

Q. Remote Control: The controller shall be capable of receiving a remote analog setpoint (4–20 mA or 0–10 VDC) as well as a remote system on/off digital signal.

R. Setpoint Ramp: The controller shall provide adjustable ramp time for setpoint changes (both increase and decrease).

S. Warnings and Alarms

The pump system controller shall store up to 500 warnings and alarms in memory. The time, date, and duration of each alarm shall be recorded. A free relay shall be provided for alarm notification to the building management system as needed. The controller shall display, at a minimum, the following alarm conditions:

Individual Pump Failure	Loss of Sensor Signal (4-20 mA)
VFD Trip/Failure	Limit 1 and Limit 2 Exceeded*
Pump Outside of Duty Range	External Fault
Loss of Remote Setpoint Signal (4-20 mA)	

*The controller shall be capable of monitoring two analog signals (e.g., suction pressure and discharge pressure) for additional pump or system protection.

T. Built-In Data Log

The controller shall have built-in data logging capability. Logged values shall be graphically displayed on the controller and downloadable to a notebook/PC as a delimited text file. A minimum of 7,200 samples per logged value shall be available for the following parameters:

- Estimated flowrate (or actual flow if flow sensor is connected)
- Speed of pumps
- Process value/sensor feedback (usually differential pressure)
- Power consumption
- Controlling parameter (process value)
- Inlet pressure (when remote differential pressure is the primary sensor)

U. Redundant Primary Sensor: The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor.

V. Secondary Sensor: Upon loss of signal from the remote sensor, the controller shall be capable of reverting control to the pump system-mounted sensors with a programmable setpoint. Pumps shall maintain constant, proportional, or quadratic pressure across the system until the remote

setpoint signal is restored.

A. Pump Test: The controller shall include a pump "Test Run" feature such that pumps are cycled on during periods of inactivity (system is in the "off" position but with electricity supply still connected). Inoperative pumps shall be switched on for a period of three to four seconds every 24 hours, 48 hours, or once per week at a programmable time of day.

B. Reduced Operation: During backup generator operation, the controller shall be capable of reducing power consumed by the pump system by either limiting the number of pumps in operation or limiting power consumption (kW). The controller shall receive a digital input indicating backup generator operation.

C. Power and Energy Consumption: The controller shall be capable of displaying instantaneous power consumption (watts or kilowatts) and cumulative energy consumption (kilowatt-hours).

D. Specific Energy: When a flow sensor is connected, the controller shall be capable of displaying instantaneous specific energy in watt-hours per gallon (Wh/gal) or watt-hours per 1,000 gallons (Wh/kgal).

E. Built-In Ethernet: The controller shall have an Ethernet connection with a built-in web server allowing connection to a building computer network with read/write access to the controller via a web browser.

F. Service Contact Information: The controller shall include a programmable Service Contact field that can be populated with service contact information including contact name, address, phone number(s), and website.

2.6 CONTROL PANEL

A. Short Circuit Current Rating (SCCR): The complete control panel assembly shall have a Short Circuit Current Rating of 100 kA.

B. BMS Integration: The system shall allow for streamlined BMS integration via a single point. The standard available protocol shall be BACnet MS/TP. Additional available protocols include: BACnet IP, EtherNet/IP, Modbus RTU, Modbus TCP, and LON. Integration to BMS protocols shall be made available via dedicated additional hardware or hardware already integrated into the system.

C. Enclosure and Listing: The pump system controller shall be mounted in a UL Type 12 rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire UL Type 12 control panel shall be UL 508 listed as an assembly.

D. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit, and control relays for alarm functions. The control panel shall include, at a minimum:

- 80 dB System Fault Audible Alarm with push button to silence
- Emergency/Normal Operation Switches (control bypass)
- Individual Service Disconnect Switches (accessible outside of panel)
- Pump Run Lights
- System Fault Light
- Surge Arrestor

E. Remote Monitoring and Cloud Connectivity: The controller shall be capable of secure cloud-based connectivity, allowing authorized users to remotely view system dashboards, operating status, trends, events, and alarms. The remote interface shall provide access to pump information, system performance data, device details, files, and configuration settings. The system shall support location-based visualization of the installation and provide full remote oversight of controller operations through an online platform.

F. Mobile App Integration: The controller shall support wireless connection to a mobile application for local setup, parameter adjustment, and system monitoring. The controller shall connect to

authorized mobile devices via Bluetooth, allowing users to access configuration menus, read operating data, and perform commissioning or service tasks directly from a handheld device. Bluetooth activation shall be required on both the controller and the mobile device to establish a secure pairing.

G. OSHPD/HCAI Seismic Compliance: The pump system controller and control panel assembly shall be OSHPD/HCAI compliant and supplied with a dedicated OSHPD Special Seismic Certification Preapproval (OSP) number. The certification shall meet the seismic performance requirements of the California Building Code for non-structural components used in healthcare facilities and shall comply with the HCAI Special Seismic Certification Program for pump control panels.

2.7 EFFICIENCY AND SEQUENCE OF OPERATION

A. The system controller shall operate equal-capacity variable speed pumps to maintain a constant pressure, constant differential pressure, or proportional pressure differential pressure setpoint depending on the application. The system controller shall receive an analog signal (4–20 mA) from the factory-installed pressure transducers on the discharge and suction manifolds, indicating actual system pressure and inlet pressure. The controller shall be capable of controlling the system based on subtracting discharge and suction transducer pressures for differential pressure across the manifolds.

B. Standard Cascade Control (Pumping Efficiency Based)

The pump system controller shall adjust pump speed as necessary to maintain system setpoint pressure as flow demand increases. Utilizing pump curve information (5th-order polynomial), the pump system controller shall stage on additional pumps when hydraulic efficiency will be higher with additional pumps in operation.

When pump curve information is unavailable and/or during regular system maintenance, the controller shall be able to learn or re-learn pump performance characteristics by analyzing differential pressure, pump speed, and individual pump power under controlled operating conditions. Once determined, the controller shall use the learned pump characteristics to select the most energy-efficient number of pumps in operation. The controller shall evaluate whether adding or removing a pump will reduce total power consumption while maintaining required system head and flow, and shall operate the system at the lowest determined power consumption that still meets system demand.

Exception: When flow and head are outside the allowable operating range of the operating pump(s), the controller shall stage on an additional pump to distribute flow and allow all pumps to operate within the allowable operating range. When system pressure equals the system setpoint, all pumps in operation shall reach equal operating speeds. The pump system controller shall have field-adjustable Proportional Gain and Integral Time (PI) settings for system optimization.

C. Proportional Pressure Control: The controller shall include a proportional pressure control mode that automatically reduces the system pressure setpoint at lower flow conditions and increases it at higher flow conditions based on actual system flow demand. The controller shall continuously adjust the setpoint along a programmable proportional curve to maintain stable operation, meet system demand, and reduce energy consumption.

D. Pilot Pump: The pump system shall be capable of operating with a dedicated pilot pump for improved efficiency during low-flow conditions. The pilot pump (when optioned) shall be sized at approximately one-quarter of the main pump capacity and shall operate as the primary pump when system demand is low. Use of a pilot pump shall reduce energy consumption in low-flow operation

and may allow the use of a smaller diaphragm tank or eliminate the need for a tank entirely. The pilot pump arrangement is recommended for installations with large variations between minimum and maximum system flow.

E. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors, or temperature measuring devices.

F. All pumps in the system shall alternate automatically based on demand, time, and fault. If flow demand is continuous (no-flow shutdown does not occur), the system controller shall have the capability to alternate pumps every 24 hours, every 48 hours, or once per week. The interval and actual time of pump changeover shall be field-adjustable.

G. The system controller shall be capable of controlling a pressure maintenance pump (jockey pump) in pressure boosting applications. The setpoint of the pressure maintenance pump shall be configurable to any value above or below the pump system's setpoint. The pressure maintenance pump shall be capable of being staged on as a backup pump when the capacity of the pump system is exceeded.

2.8 LOW FLOW STOP FUNCTION (CONSTANT PRESSURE APPLICATIONS)

A. The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature-based no-flow shutdown methods that have the potential to waste water or add unwanted temperature rise to the pumping fluid are not acceptable and shall not be used.

B. Standard Low Flow Stop and Energy Saving Mode

A bladder-type diaphragm tank shall be installed on the discharge manifold or downstream of the pump system with a pre-charge pressure of 70% of system setpoint.

When only one pump is in operation, the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system setpoint plus 50% of programmed on/off band, adjustable). The pump shall remain off until the discharge pressure reaches the start pressure (system setpoint minus 50% of programmed on/off band, adjustable).

Upon low flow shutdown, a pump shall be restarted in one of the following ways:

- Low Flow Restart: If the low flow condition still exists, the pump shall start and speed shall be increased until the stop pressure is reached, whereupon the pump shall again be switched off.
- Normal Flow Restart: If the pump system controller determines a low flow condition no longer exists, the pump shall start and speed shall be increased until the system pressure reaches the system setpoint.

2.9 SYSTEM CONSTRUCTION

A. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be

such that water stagnation cannot exist in manifold during operation to prevent bacteria growth inside manifold.

B. The suction and discharge manifolds material shall be 316 stainless steel. Manifold connection sizes shall be as follows:

10 inch and larger: ANSI Class 150 flanges

C. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

D. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2" and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2" and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

E. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

F. A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2/1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.

G. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

H. The base frame shall be constructed of corrosion resistant 304 stainless steel for systems with CR pump sizes up to CR64. The pump system base shall be powder coated white aluminum RAL9006, carbon steel ASTM A36 structural steel, for systems with CR95 and larger pumps.

I. Rubber vibration dampeners shall be fitted between each pumps and base frame to minimize vibration.

2.10 FACTORY TESTING

A. The tester used for testing the pump system shall be constructed and calibrated in accordance with the requirements of hydraulic test standard ISO 9906.

B. The entire pump station shall, as a minimum, be factory tested for functionality. Documented results of the functionality test shall be supplied with the pump station. Functionality testing shall include the following:

- Complete System Hydrostatic Test at 1.5 times the nameplate maximum pressure
- No-Flow Detection Shutoff Test
- Water Shortage Test
- Two-Point Setpoint Performance Test

C. Water used for testing shall be treated with three different filtration systems to ensure only clean water is used for testing the pump station:

- 25-micron mechanical filter — removes solid particulates from water
- Activated carbon filter — keeps water clear and eliminates odor
- Ultraviolet light system — eliminates bacteria growth

2.11 HYDROPNUEMATIC PRESSURE TANK

A. Tank shall be certified to NSF/ANSI 61 for drinking water use.

B. Tank shall be seismically restrained.

C. Designed and constructed per ASME Code Section VIII, Division 1.

D. Tank shall be horizontal with a 400 gallon volume and connections as shown on the project plans.

E. Tank construction shall be ASME approved steel shell.

F. Tank shall have a maximum operating temperature of 240ºF and 150 psig maximum working pressure.

G. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

2.12 AIR CHARGING SYSTEM

A. Pressure and water level in the hydropneumatic pressure tank shall be controlled by an electric air charging system. System shall include an oil-less air compressor, liquid level switch, and pressure switch. Air charging system shall be AIR RITE Model 610 or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. All mechanical equipment shall be installed in a neat, professional, workmanlike manner, according to manufacturers' instructions, applicable standards and these specifications. The finished appearance of installed mechanical equipment shall be first class.

B. **Manuals** CONTRACTOR shall furnish manufacturers' manuals (2 copies) for all installed mechanical equipment. The manuals need not be bound together.

C. **Testing** All pumps will be field tested by DISTRICT in accordance with applicable methods described in AWWA E 101, Appendix A. CONTRACTOR shall adjust or replace equipment not meeting specifications.

* * END OF SECTION * *

SECTION 16120

WIRE AND CABLE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install wire and cable for a complete operable electrical system as shown on Drawings.

B. Install approximately 300 feet of fiberoptic Cable on and off site in mostly existing conduit with testing per the DISTRICT's standards.

1.2 QUALITY ASSURANCE

A. All wire and cable shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Conductors, including insulation, cabling, jacket, filler, shielding, covering, and testing, shall meet applicable requirements of IPCEA and NEC.

C. The Fiber-optic cabling system shall meet the applicable requirements of the DISTRICT'S standards (attached with these Specifications, from a SCADA reliability improvement project):

1. Section 17150 – Outside Plant Cable Systems

2. Section 17200 – Inside Plant Cable Systems

3. Section 17300 – Fiber Testing

1.3 SUBMITTAL

A. Submit complete description of all power, signal, communication and instrumentation cables including name of the manufacturer, type of insulation, type of conductor, and size and catalog number of control, instrument signal cables.

B. The CONTRACTOR shall submit, in accordance with the requirements of Section 16010 the following materials and information:

1. A list of materials to be furnished, the name of the suppliers and the date of delivery of materials to the site.

2. Catalog data sheets and manufacturer's information all equipment described in this Specification Section.

3. Qualifications of technicians installing and testing Fiber Optic Cable and the testing equipment per the DISTRICT's standards, Specification Section 17150.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and CONTRACTOR's name. Store in a location as agreeable with DISTRICT, secure from weather or accidental damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS LABELING

A. Electrical conductors shall be delivered to the job site plainly marked or tagged on 24 inch centers as follows:

1. Underwriters Laboratories Label
2. Gauge
3. Voltage
4. Kind of Insulation
5. Name of Manufacturer
6. Trade Name

B. Conductor labels shall be white PVC tubing with machine printed black marking. Tubing shall be sized to fit conductor insulation. Adhesive strips are not acceptable.

C. Labels shall be manufactured by Panduit, Thomas & Betts, or equal.

2.2 POWER AND CONTROL CONDUCTORS

A. Insulation for all conductors shall be rated at 600 Volts.

B. All low voltage wiring shall be type THWN/THHN unless shown otherwise.

C. All conductors shall be sized for operation at 75 degrees C maximum operating temperature.

D. Unless specifically noted otherwise herein, all conductors for general wiring shall be a minimum of 98% conductivity, stranded, soft drawn copper. Aluminum or aluminum alloys are not acceptable.

E. 120 Volt control conductors may be #14 AWG, and shall be stranded.

2.3 SINGLE MODE FIBER OPTIC CABLE

A. Fiber Optic Cable shall be single mode 12 strand cable fused to an existing cable down the street in an existing pullbox per the DISTRICT's Standard Specifications, Section 17150.

2.4 SPECIALTY CABLES

A. Instrumentation signal cables shall be of the type used for process control with twisted shielded pairs (TSP) of triads with PVC jacket an overall shield over the multiple pairs or triads. Two conductor (pair) cable shall have black-clear insulation, three conductor cable shall have black-red-clear insulation. The instrumentation cable shall be rated 600 Volts at 60 degrees C or better. The size of the instrumentation cable shall be AWG No. 18 with seven strands minimum. All instrumentation cables shall be UL listed. Shield shall be an aluminum-backed synthetic material providing 100-percent shielding, with a copper drain wire. The cable shall be rated 90 degrees C minimum. Twisted shielded pair (TSP) cable shall be manufactured by Belden, Alpha or equal.

B. Telephone Cable (TIC) shall consist of 2 to12 pairs with 24 AWG conductors of soft bare copper. Conductors shall have thermoplastic compound insulation and shall be color coded per the telephone industry standards. The entire cable assembly shall have an outer jacket of black polyethylene that is resistant to abrasion, moisture, weather and environmental cracking. Cable shall be suitable for installation in conduit or direct burial and shall be manufactured by Alpha, Belden or equal.

C. Data cable (Cat 6) shall consist of 4 bonded pairs, each pair shielded, with 23 AWG conductors of soft bare copper and drain wire. Conductors shall have thermoplastic compound insulation and shall be color-coded per the telephone industry standards. The entire cable assembly shall contain a foil shield and have an outer jacket of black polyethylene that is resistant to abrasion, moisture, weather and environmental cracking. Cable shall meet the requirements for Category 6 data transmission cable, be suitable for installation in conduit or direct burial and shall be manufactured by Alpha, Belden or equal. Data outlets shall be rated Category 6 shielded. Termination methods shall be similarly rated.

D. Coaxial Cable (Coax) Cable shall be sized for length of run and application. Cable shall be suitable for installation in conduit and outside in free air, exposed to the elements: it shall be watertight. The cable shall be manufactured by Times Microwave, Series LMR-400 or equal.

E. Other specialty cables shall be provided by the manufacturer of the equipment or instrument they connect to.

2.5 PULLING LUBRICANT AND ROPES

A. Wire pulling lubricant shall be "Flax-soap", "minerallac" or equal.

B. Pullropes shall be 3/16" stranded nylon rated for 800 lbs.

2.6 CONNECTION

A. Motor connection and splice kits shall be 3M series DB or equal.

B. Wire nuts for joints, splices and taps for conductors #8 and smaller shall consist of a cone shaped expandable coil spring insert, insulated with a teflon or plastic shell. Threaded or crimp types will not be accepted. All wire nuts shall be taped. Use "Skotchlock", "Hydent", or equal.

C. Lugs and connectors for conductors #6 and larger shall be compression types of one piece tubular construction with flat rectangular tongues. Two hole lugs shall be used for sizes 4/0 and larger. Fittings for copper conductors shall be tin-plated copper.

D. Electrical tape shall be UL approved plastic.

E. Splices shall not be installed in raceway. Splice wires in approved boxes or condulets only.

2.7 EQUIPMENT GROUNDING WIRE

A. Ground wires, number 1/0 AWG or larger shall be tinned stranded bare copper cable. All smaller ground wires shall be insulated with green color insulation.

PART 3 EXECUTION

3.1 CLEANING

A. All debris and moisture shall be removed from both new and existing raceways, boxes, and cabinets before installing wire or cable.

3.2 PULLING

A. No oil, grease or similar substances shall be used to facilitate the pulling in of conductors. Use a specifically approved wire pulling compound.

B. No wire or cable shall be pulled in until all construction, which might damage insulation or fill conduit with foreign material is completed.

C. Wire shall be pulled into conduits with care to prevent damage to insulation, using basket pulling grips to avoid slipping of insulation on conductors. Nylon rope or other "soft" surfaced cable must be used for pulling in conduits other than steel.

3.3 CONNECTIONS

A. Use a kit for motors with #8 and larger feeder conductors. Kits shall consist of bolted crimped lugs with insulating boots.

B. Joints, splices and taps in dry locations for feeder conductors #10 and smaller shall be made with twist-on connectors suitably sized for the number and gauge of the conductors.

C. Furnish and install proper lugs in all panelboards, pedestals and gutters as required to properly terminate every cable. Where paralleled conductors, or conductors of large size are to terminate on a breaker, a short length of copper cable (of capacity of the breaker) shall be connected to the breaker, and the proper compression type lug installed to connect this cable to the feeder cable. The cutting of cable strands to fit the breaker will not be permitted.

D. Only crimping tools approved by the manufacturer of the terminals or lugs shall be used.

E. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire. Wire in pedestals, panels, cabinets, pullboxes and wiring gutters shall be neatly grouped together with cable ties or other methods acceptable to the DISTRICT.

F. In underground location, joints, splices and taps shall be insulated by the "Skotchcast" epoxy-resin method. In-line splices may be insulated by approved waterproof "shrink tube" method. Splices shall be made if specifically approved by the DISTRICT (on a case by case basis).

G. In panels, pullboxes, gutter, etc. conductor shall be neatly fanned out and tagged with wire markers. Conductors installed as part of this project but for connection to equipment to be installed in the future shall be 50% longer than the estimated final connection length, neatly coiled and sealed for storage in the equipment's respective pullbox.

H. At outlets, junction boxes, pullboxes, fittings, etc., conductors shall be looped or pigtailed to extend at least six inches without splice beyond such wiring enclosures, and where used, pigtails added to loops for connection to fixtures or devices shall be at least six inches long.

I. Conduit shall be capped during construction by means of manufactured conduit seals or caps to prevent entrance of water or debris, and shall remain closed until ready for use

J Splices shall not be installed in raceway. Splice wires in approved boxes or condulets only.

3.4 COLOR CODING AND LABELING

A. Color Coding of Low-Voltage Building Wire: Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

Phase	120/208(or 240) Volts	277/480 Volts
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

1. AC control wire shall be red or pink.

2. DC control wire shall be light blue or violet.

3. DC power supply wires shall be red. DC analog signal wires shall be black if positive and white (or clear) if negative. DC system signal commons shall be white.

4. Equipment grounds shall be green.

B. In addition to color coding, all power, control, and alarm wiring shall be numbered and identified by means of wire markers at all pedestals, switchboards, MCCs, panelboards, gutters, junction boxes, pull boxes, receptacle outlets, light outlets, manholes, disconnect switches, and circuit breakers. These markers shall correspond to numbers on shop drawings and wiring diagrams. Wire markers shall consist of machine engraved numbers applied by an approved marking device. Provide Brady heat shrink labels or equal.

1. All individual conductors shall be labeled origin, destination and sequence number. The information shall be separated by slashes (/). The origin and designation shall be designated with the names shown on the Contract Documents. The sequence number shall be a unique sequential number for that particular cable run. At the PLC wire labels shall include the rack, slot and terminal number.

2. Multi-conductor cables shall be labeled origin, destination and sequence number. The information shall be separated by slashes (/). The origin and designation shall be designated with the names shown on the Contract Documents. The sequence number shall be a unique sequential number for that particular cable run. Twisted shielded cables shall be considered multiconductor cables.

3.5 SEALING CONDUCTORS IN CONDUITS

A. All conduits containing conductors shall be sealed as the conduit enters motor control centers, pull boxes and vaults. Power conductor, control conductors, and instrument-ation conductors shall be bundled and supported separately and independently in pullboxes.

B. All conduits entering chemical storage rooms shall be sealed.

3.6 FIBER OPTIC CABLE INSTALLATION

A. Some fiber optic cable and fittings are shown to be provided and installed as part of this project, but in an effort to minimize splices coordinate the work on site with the utility work in the street (off-site). Provide components and installation (of components provided or provided by others), as required to complete the fiber optic cable work and testing

3.7 FIBER OPTIC CABLE TESTING

A. All testing shall be performed according with District Standard specification section 17300, Fiber Testing.

3.8 OTHER TESTING

A. After installation has been completed, CONTRACTOR shall conduct tests required by Section 16010, General Requirements, Electrical. CONTRACTOR shall furnish necessary instruments and personnel required for testing.

END OF SECTION

SECTION 17150 – OUTSIDE PLANT CABLE SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. The CONTRACTOR shall furnish and install loose tube fiber optic cable (loose tube cable), fusion splices, labels, appurtenances and all other items necessary for a complete and functional installation in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Design, manufacture, install, and test in accordance with this Section and the following standards:

1. ANSI/TIA-455 (Entire 455 Series) - Fiber Optic Test Standards

2. ANSI/TIA-598-A - Optical Fiber Cable Color Coding

3. ANSI/ICEA S-87-640 - Standard for Optical Fiber Outside Plant Communications Cable

4. Telcordia GR-20 - Generic Requirements for Optical Fiber and Optical Fiber Cable

5. Telcordia GR-771 - Generic Requirements for Fiber Optic Splice Closures

6. ITU-T G.652.D - Characteristics of Single-Mode Optical Fiber and Cable

7. RUS 1753F-601a – Minimum Performance Specification for Fiber Optic Cables

8. NEC – National Electrical Code

1.3 SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 – CONTRACTOR Submittals.

B. The CONTRACTOR shall submit the following information:

1. Documentation from the fiber optic cable manufacturer demonstrating that the CONTRACTOR is trained and certified by the manufacturer to install, test, and maintain their products and is certified by the manufacturer to provide the manufacturer's warranty to the DISTRICT. Coordinate with Section 17150.1.4 – QUALITY ASSURANCE, Subpart A - CONTRACTOR Certification Requirements.

2. Copies of certifications for all personnel who will be installing and testing. Coordinate with Section 17150.1.4 – QUALITY ASSURANCE, Subpart A - CONTRACTOR Certification Requirements.

3. Product data, catalog information, cut sheets and specifications for loose tube fiber optic cable, fusion splice sleeves, labels, and appurtenances.

4. Loose tube fiber optic cable submittals shall include cable dimensions, fiber performance characteristics, glass strand manufacturer and composition of cable components.

5. Samples of cable design, minimum length 8 inches, stripped back to display major cable components. Samples of cable designs substantially similar in all respects to the proposed designs with the exception of fiber count are acceptable.

6. Recommended cable pulling lubricants.

7. Manufacturer's recommended installation and repair procedure.

1.4 WARRANTY

A. CONTRACTOR Warranty:

1. Provide a CONTRACTOR-endorsed two-year service warranty against defects in materials and workmanship. The warranty period shall commence upon DISTRICT acceptance of the Work.

2. Provide labor attributable to the fulfillment of this warranty at no cost to the DISTRICT.

B. Manufacturer Warranty:

1. Provide a Fiber Optic Cable Manufacturer extended product, performance, application, and labor warranty that shall warrant the fiber optic cable and all passive components installed by the CONTRACTOR. Additionally, this warranty shall cover components not manufactured by the Manufacturer, but approved by the Manufacturer for the Work.

2. Provide materials and labor attributable to the fulfillment of this warranty at no cost to the DISTRICT.

3. The Manufacturer warranty shall be a 25-year System Warranty.

a. Provide a copy of the warranty registration (application) document to the DISTRICT at the time of submittal to the manufacturer.

4. The Manufacturer Warranty period shall commence upon a Warranty Certificate being issued by the Manufacturer. The Warranty Certificate shall be issued no later than thirty (30) days after DISTRICT acceptance of the Work.

PART 2 – PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall verify existing site conditions such as actual distances between communication boxes, and/or poles, prior to purchase and delivery of the materials, including but not limited to: lengths of fiber optic cable required including required slack cable requirements and messenger strand lengths. Pre-cut materials or cable reels of insufficient length are the sole responsibility of the CONTRACTOR.

2.2 LOOSE TUBE CABLE

A. Loose tube fiber optic cable (loose tube cable) shall be rated for outdoor use, suitable for duct installations and lashed aerial installations. The following are the DISTRICT's minimum requirements for loose tube cable:

1. Optical Fiber: Single-mode, dispersion un-shifted glass fiber with 8.2/125 micron core/cladding construction with the following maximum attenuation characteristics:

   0.35 dB/km @ 1310 nm
   0.35 dB/km @ 1383 nm (water peak)
   0.25 dB/km @ 1550 nm

   a. Each cable shall have traceability of each fiber back to the original fiber manufacturer's fiber number and parameters of the fiber.

   b. Single-mode optical fibers shall be compliant with the ITU-T G.652.D specification for full-spectrum (low water peak) performance.

   c. Single-mode optical fibers shall be one of the following, no exceptions: Corning SMF-28e+®, CommScope LightScope® ZWP, CommScope TeraSPEED® OS2.

2. Cable Construction:

   a. The cable, including buffer tubes, shall be a completely gel-free or dry-type design.

   b. The cable shall have a single jacket with a single interlocking corrugated steel armor construction.

   c. The cable shall be all-dielectric, except for armor material, meeting or exceeding ANSI/ICEA, ANSI/TIA and Telcordia industry standards and specifications for outside plant fiber optic cable.

   d. Optical fibers and buffer tubes shall be color coded with distinct and recognizable colors in accordance with ANSI/TIA-598-A, “Color Coding of Fiber Optic Cables.”

   e. Cables shall be capable of a maximum pulling tension of 2700N (600 lb) during installation (short term limit) and 890N (200 lb) long-term installed.

B. Loose tube cables shall be one of the following, no exceptions: Corning ALTOS®, CommScope Systimax® Outside Plant.

2.3 LABELING

A. **Cable Tags and Markers**:

1. Cable tags, cable ties, and cable markers shall be manufactured from durable plastic/polymers and shall be suitable for use with on-site custom marking tools and shall be furnished according to the following:

   a. Tags: Fiber Optic Cable Marker Tags with Self-Laminating Flap, 2 inch by 3.50 inch, yellow/black, Panduit part number PST-FO or Fiber Optic Cable ID Tags with Self-Laminating Flap, 2 inch by 3.5 inch, yellow or orange, as

manufactured by Uticom Systems, Inc.

b. Wrap-Around Cable Markers: SnapAround Fiber Optic Cable Marker, 4 inch by 4 inch, orange, “CAUTION – FIBER OPTIC CABLE”, as manufactured by Uticom Systems, Inc.

B. **Splice Closure Labels**:

1. Splice shelf labels shall be Panduit Laser Component Labels or approved equivalent.

2. Buffer tube labels shall be Panduit Laser Non-Laminated Labels or approved equivalent

2.4 APPURTENANCES

A. **Tracing Wire**:

1. Tracing wire shall be No. 14 AWG solid copper with THWN/THHN rated insulation, orange in color.

B. **Cable Ties**:

1. Cable ties shall be heavy-duty, 0.3 inch width minimum, self-locking, weather resistant Nylon 12, black in color, with a minimum loop tensile strength of 90 pounds, length as required to completely encircle object with a single cable tie. Panduit part numbers PLT4H-120, PLT7H-120, PLT8LH-120 as required for cable size

2.5 FUSION SPLICE SLEEVES

1. Heat-shrinkable protective sleeves or housings as recommended by the fiber manufacturer. Coordinate with Section 17150.3.5.E.

PART 3 – EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall <u>not</u> install loose tube cable until all of the following requirements have been accomplished to the DISTRICT’s satisfaction and approval:

1. Factory test results for cable reels: reviewed and approved by the DISTRICT

2. Pre-Installation test results for cable reels: reviewed and approved by the DISTRICT

3. Installation Plans for lashed aerial and duct placement of loose tube cable: reviewed and approved by the DISTRICT

4. Fiber Optic Test Plan (Section 17300): reviewed and approved by the DISTRICT

3.2 INSTALLATION PHOTOGRAPHS

A. The CONTRACTOR shall thoroughly document the inside configuration of all splice closures (

B. and underground) and all underground structures including vaults, communication boxes and man-holes using a digital camera. Pictures shall be taken with a camera of 6 megapixel or greater resolution using electronic flash to provide the proper illumination as required. Digital pictures shall be saved in JPEG (.jpg) format using the highest quality setting (minimum compression). Saved files should range in size from 1.0 to 5.0 megabytes. Each picture file shall be assigned a unique name created by using the Work Location number of the splice closure and/or underground structure, a two-digit designation for multiple views at the same location (V01, V27, etc.), and the date (mmddyy). Provide digital pictures to the DISTRICT. The requirements for installation photographs are as follows:

1. Splice Closures: Depict the entire interior in a series of close-up pictures clearly showing plan (top) views of each and every splice tray (all labels clear and readable) showing slack fiber storage and the securing of buffer tubes, buffer tube slack storage with the enclosure, end plate construction (interior and exterior) including cable anchoring and securing of central strength member, cable seals, and cable grounding. Pictures shall be taken after Work is complete but before sealing and mounting the enclosure.

2. Underground Structures: Depict entire structure in a series of pictures clearly showing slack cable, labels, wall views of every wall, cable entrance and exit conduits, and the splice closure if installed at that location after Work is complete. Multiple pictures will be required at a single location, however at least one or two pictures shall be taken with a wide-angle view that depicts the entire cable/closure installation within the structure.

3.3 LOOSE TUBE CABLE - DUCT INSTALLATION

A. The CONTRACTOR shall take all necessary precautions to prevent damage to the cables in setting up the pulling apparatus or in placing tools or hardware.

B. Cable reels, which are delivered to the work location and are not set up immediately for placing operations shall be securely blocked or secured to a substantial support to prevent rolling.

C. Clean conduit free of all obstructions to DISTRICT’s satisfaction before installing cable in duct systems. Conduit cleaning shall be performed by pulling appropriately sized mandrels, followed with brushes as necessary, through the conduit to remove all obstructions, debris, and water. The CONTRACTOR shall also remove and dispose of all debris, sediment and other material, including water, from the bottom of all communication boxes as necessary to expose the end of conduits for cable installation purposes.

D. Install cable manufacturer's approved pulling tension measuring device at pulling end.

E. Monitor and record pulling tension continuously for each pulling operation. The CONTRACTOR shall not exceed the maximum pulling tension of the cable as specified by the cable manufacturer.

F. Have conversion data available to compute pulling tension from measuring device readout in the field.

G. Apply fiber-optic cable pulling grip or eye to reinforcing elements in cable and use a tension limiter device to limit tension to less than 600 Ibs.

H. Make cable attachment watertight to prevent penetration of water during installation. In addition, cable ends shall be protected at all times with acceptable end caps except during actual splicing. During splicing operations, protection shall be available for immediate use if necessary.

I. A cable feeder guide of suitable dimensions and strength shall be used between the cable reel and the face of the duct to protect the cable and guide it into the duct as it is pulled off the reel.

J. Lubricate cable continuously during the pulling-in operation with a lubricant compatible with the outer sheath of the cable and the conduit.

K. Do not subject cable to dynamic bending radius of less than 20 times the outside diameter of the cable.

L. Do not subject cable to minimum static bending radius in place to less than 15 times the diameter of the cable.

M. Vertical riser cables shall be secured with approved strain relief devices at the top of the riser conduit or at each floor level.

N. Slack Storage:

1. Provide 50 feet of slack cable for each cable that enters a splice closure at all splice closure locations, no exceptions. Coil cables in a neat and orderly fashion to facilitate splice closure removal and replacement, binding coils at a minimum of three (3) points around the coil with cable ties. Secure coil to box wall using cable ties and wall anchoring hardware as required.

2. Provide 50 feet of slack cable at all communication (fiber optic) boxes or as specified in the Contract Documents, no exceptions. Coil cables in a neat and orderly fashion to facilitate cable removal and replacement, binding coils at a minimum of three (3) points around the coil with cable ties. Secure coil to box wall using cable ties and wall anchoring hardware as required.

3. If 50 feet of slack cable cannot be accommodated in an underground structure, notify DISTRICT immediately.

O. Tracing Wire: The CONTRACTOR shall install a tracing wire in all conduits where non-armored loose tube cable is installed. Leave a 6 ft coil in each communication box or underground structure. Do not install tracing wire in innerduct. Do not install tracing wire with armored cables.

3.4 OPTICAL FIBER SPLICES AND SPLICE CLOSURES

A. Coordinate with Section 17300 - Fiber Testing.

B. Make fusion splices at all locations requiring splices, no exceptions.

C. All splicing equipment shall be cleaned and calibrated according to manufacturer's instruction prior to each splicing session at each location. Cable end preparation tools and procedures shall be consistent with the manufacturer's recommendations for the cable type being installed.

D. Splice fibers strictly in accordance with the Splicing Matrix Document. The DISTRICT shall provide the complete Splicing Matrix Document to the CONTRACTOR at the Pre-Construction conference. The Splicing Matrix Document consists of detailed Patch Panel and Splice Closure configuration diagrams which depict all fibers, buffer tubes, cables, patch panel modules, splice closures and splice closure trays to be installed in the Project. The DISTRICT may also issue a revised Splicing Matrix Document after splice closure and patch panel submittals have been reviewed and approved to incorporate any manufacturer specific variations of tray capacity, number of trays, etc. as required. The Splicing Matrix Document will also depict existing Patch Panels and Splice Closures which the CONTRACTOR shall access for the installation of additional cables, splices and other modifications including making temporary connections for testing purposes as part of the WORK. The following is a definition of splice closure terminology used in the Contract Documents including the Splicing Matrix Document:

Directional Splice (DS)	2 or more cables of varying fiber counts spliced partially or completely
	2 cables of the same fiber count spliced completely together in a straight-through configuration
Segment Splice (SS)	Tap cable spliced partially or completely to 1 or more cables of larger fiber counts without disturbing the continuity of other buffer tubes within the larger cable(s).

E. Each spliced fiber shall be packaged in a heat-shrinkable protective sleeve or housing as recommended by the fiber manufacturer. The CONTRACTOR shall use a heat shrink oven specifically made for fiber optic heat shrink applications. The use of hand-held heat guns is not acceptable. Bare fibers shall be completely re-coated with a protective coating prior to application of the sleeve or housing to protect the fiber from scoring, dirt, or micro-bending. Rack mounted organizer trays shall be used to hold the spliced fibers, with each fiber neatly secured to the tray.

F. Perform fusion splicing, or any work within a splice closure, in a sheltered environment such as an enclosed trailer or van type vehicle. Work performed in the open air, under a canopy or tent, the back of a pickup truck or flatbed truck, or similar, is not acceptable.

G. Organize and train fibers and buffer tubes inside the splice closure in a neat fashion and strictly in accordance with the manufacturer's instructions.

H. Provide the maximum amount of buffer tube service slack in the splice closure and fiber strand service slack in splice trays according to the product manufacturer's specifications and instructions.

I. The DISTRICT will inspect and review the completed splice closure prior to sealing and closing the closure at all splice closure locations, no exceptions. The CONTRACTOR shall give the DISTRICT at least three (3) days notice for Work performed at all splice closure locations necessary to coordinate DISTRICT's inspection.

J. Assemble, secure cables, bond/ground cable armor and seal the splice closure case strictly in accordance with manufacturer's instructions. Ensure gasket is properly sealed before tightening bolts. Tighten bolts sequentially to evenly distribute the clamping forces.

K. Work Performed Inside Existing Splice Closures: Additional requirements are as follows:

1. The CONTRACTOR shall give the DISTRICT at least three (3) days notice for Work performed at all existing splice closure locations necessary to coordinate DISTRICT's inspection.

2. The CONTRACTOR shall perform re-entry and re-sealing strictly in accordance with the manufacturer's instructions.

3. The CONTRACTOR shall exercise extreme caution not to damage existing cables, buffer tubes, fibers, fiber splices, trays, etc. The CONTRACTOR shall notify the DISTRICT immediately if any existing fiber or other component is damaged.

4. Any damaged cables, buffer tubes, fibers, fiber splices, trays etc. shall be diagnosed, corrected and re-tested at CONTRACTOR expense.

Re-mount splice closure and re-coil slack cables in a neat and orderly fashion to facilitate splice closure replacement (and future removal), binding coils at a minimum of three (3) points around the coil with cable ties, and secure to box wall as shown on TDPUD Construction Drawing C-UG2, Splice Closure and Slack Coil Installation (Appendix C).

3.5 LABELING

A. Loose Tube Cable Sheath Labeling:

1. The loose tube cable sheath label shall consist of a plastic self-laminating tag attached with two (2) nylon tie wraps. The tags shall be permanently marked with the required information using machine-made label marking tools for a neat and orderly appearance of block-style text (UPPERCASE) and numbers. Freehand marking using UV-stabilized permanent ink pens is acceptable if a neat and orderly appearance of block-style text and numbers is achieved. Laminate tag after marking is complete.

2. Install at least three (3) labels in all underground structures through which a cable passes. Label each cable immediately as it enters an underground structure and again just prior to exiting the underground structure. Install a label on the cable slack storage coil, such that the label is visible from grade level. Where cabling is routed unexposed via innerduct through an underground structure, install labels on the exterior of the innerduct.

3. The loose tube cable sheath label shall contain the name of the DISTRICT (see below), cable number, total strand count of the cable, and distance to the next or from the previous box as depicted in the Contract Documents and Splicing Matrix documents. The distance between boxes shall be determined from installed cable lengths.

b. Example: A 144 count loose tube cable with cable number 'MN-C1-A' passes through box no.2. There are 1,500 feet of cable to the next box (no. 3) and 2,200 feet from the previous box (no. 1).

- Label for entrance (from box no. 1):

TRUCKEE DONNER PUD
MN-C1-A 144CT

2,200 FT

- Label for exit (to box no. 3):

  TRUCKEE DONNER PUD
  MN-C1-A 144CT
  1,500 FT

- Label for top of cable slack coil:

  TRUCKEE DONNER PUD
  MN-C1-A 144CT
  (530) 587-3896

4. Underground structures that contain a splice closure shall have an additional label attached to each cable within 12 inches of the splice closure such that the labels are visible from grade level.

5. Loose tube cables located inside buildings shall have their sheaths labeled within 12 inches of the fiber termination housing, and at the point at which the cable enters and/or exits the room.

6. Install wrap-around cable markers at intervals of five feet when the cable is installed in a cable tray or ladder, as a minimum.

7. Additional sheath labels shall be installed at the request of the DISTRICT.

B. Splice Closure Labeling:

1. Fiber optic splice shelves and drawers shall be labeled sequentially.

2. Identify the fiber splices using a single sheet, adhesive backed, labeling stock printed using a laser printer trimmed to fit the inside door of the splice shelf.

3. Identify in tabular form the splice tray, position number and the fiber strand spliced at that location.

4. Label all exposed buffer tubes with the cable number information such that the labels are easily visible when the splice closure is open and exposed for view.

5. Labeling shall consist of the numbers and/or other information as depicted in the Contract Documents and Splicing Matrix document.

3.6 FIBER TESTING

A. Installed loose tube fiber optic cable and fusion splices shall be tested in accordance with Section 17300 - Fiber Testing.

- END OF SECTION -

SECTION 17200 – INSIDE PLANT CABLE SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. The CONTRACTOR shall furnish and install termination equipment including patch panels, splice trays, connectors, patch cords, cabinets, enclosures, ladder racks, fusion splices, labels, appurtenances and all other items necessary for a complete and functional installation in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. Design, manufacture, install, and test in accordance with this Section and the following standards:

1. ANSI/TIA-455 (Entire 455 Series) - Fiber Optic Test Standards

2. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises

3. ANSI/TIA 569-B - Commercial Building Standard for Telecommunications Pathways and Spaces

4. ANSI/TIA 606-B – Administration Standard for Commercial Telecommunications Infrastructure

5. ANSI/TIA 607-B – Telecommunications Bonding and Grounding (Earthing) for Customer Premises

6. NECA/FOA 301 - Standard for Installing and Testing Fiber Optics

7. BICSI –Telecommunications Cabling Installation Manual

8. BICSI –Telecommunications Distribution Methods Manual (TDMM)

9. NEC – National Electrical Code

1.3 SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 – Contractor Submittals.

B. The CONTRACTOR shall submit the following information:

1. Copies of certifications from the fiber optic cable manufacturer demonstrating that the CONTRACTOR is trained and certified by the manufacturer to install, test, and maintain their products and is certified by the manufacturer to provide the manufacturer's warranty to the DISTRICT. Coordinate with Section 1.4 – QUALITY ASSURANCE, Part A - CONTRACTOR Certification Requirements.

2. Copies of certifications for all personnel who will be installing and splicing inside plant cable, including supervisory personnel. Coordinate with Section 1.4 – QUALITY ASSURANCE, Part A - CONTRACTOR Certification Requirements.

3. Product data, catalog information, cut sheets and specifications for all termination equipment including patch panels, splice trays, connectors, patch cords, cabinets, ladder racks, labels, and appurtenances.

4. Equipment rack elevation and plan views for all locations where fiber optic cable will be terminated. Views shall be to scale and shall depict the proposed arrangement of cabinets, enclosures, patch panels, splice trays, wire management, cable trays, and conduits relative to existing cabinets and enclosures. Locations include the following:

    a. Sitzmark **(STZ)**

5. Installation and recommended repair procedure manuals.

1.4 QUALITY ASSURANCE

A. CONTRACTOR Certification Requirements:

1. The CONTRACTOR shall have all Manufacturer certifications required to provide a Manufacturer extended product, performance, application, and labor warranty that shall warrant all passive components. Coordinate with Section 1.5 – WARRANTY and Section 17150 – Outside Plant Cable Systems, Part 2.2 Loose Tube Cable. Such certifications shall include, but be not limited to, Design Certifications and Installation Certifications.

2. The CONTRACTOR shall employ only trained personnel who have successfully completed appropriate training programs, passed exams, and obtained a certificate as proof thereof, to perform installation and testing work. These certificates shall have been issued by one or more of the following organizations:

    BICSI - Building Industry Consulting Service International, Inc.
    ETA – Electronics Technicians Association, International
    FOA – The Fiber Optic Association

3. The certifications required by job classification are as specified in Section 17150.1.4.A.3.
    a. Coordinate with Section 17150 – Outside Plant Cable Systems and Section 17300 – Fiber Testing.

B. Field Testing:

1. Coordinate with Section 17300 - Fiber Testing.

1.5 WARRANTY

A. Contractor Warranty:

1. Provide a CONTRACTOR-endorsed two-year service warranty against defects in materials and workmanship. The warranty period shall commence upon DISTRICT acceptance of the Work.

2. Provide labor attributable to the fulfillment of this warranty at no cost to the DISTRICT.

B. Manufacturer Warranty:

1. Provide a Fiber Optic Cable Manufacturer extended product, performance, application, and labor warranty as specified in Section 17150.1.5.B including sub-parts 1 through 4.

2. Provide materials and labor attributable to the fulfillment of this warranty at no cost to the DISTRICT.

3. The Manufacturer warranty shall be a 25-year System Warranty.

a. Provide a copy of the warranty registration (application) document to the DISTRICT at the time of submittal to the manufacturer.

4. The Manufacturer Warranty period shall commence upon a Warranty Certificate being issued by the Manufacturer. The Warranty Certificate shall be issued no later than thirty (30) days after DISTRICT acceptance of the Work.

5. Coordinate with Section 17150 – Outside Plant Cable Systems.

1.6 ACCEPTANCE AND PERFORMANCE REQUIREMENTS

A. Coordinate with Section 17300 - Fiber Testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store and protect patch panels, splice trays, connectors, patch cords, cabinets, enclosures, and all other products in accordance with the requirements in Section 01600.

PART 2 – PRODUCTS

2.1 GENERAL

A. Fiber optic components shall be manufactured by the manufacturers listed below. Components shall not be intermixed between different manufacturers unless the fiber optic cable manufacturer has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the Manufacturer Warranty (coordinate with Section 17200.1.5 - WARRANTY).

B. The CONTRACTOR shall physically verify existing site conditions prior to purchase and delivery of the materials, including but not limited to lengths of fiber optic cable, conduit and/or pathway to be used for routing cabling. Pre-cut materials of insufficient length are the sole responsibility of the CONTRACTOR.

C. Provide all incidental and/or miscellaneous hardware not explicitly specified or shown on the Contract Documents that is required for a fully operational, tested, certified and warranted system.

D. The fiber optic component manufacturer shall be one or more of the following manufacturers (coordinate with Section 17150.2.2 – Loose Tube Cable), no exceptions:

1. Corning Cable Systems
2. CommScope

2.2 PATCH PANELS, CONNECTORS, SPLICE TRAYS

A. Connectors shall be LC duplex type, factory terminated with single-mode fiber pigtails suitable for fusion splicing to outside plant fiber.

B. Enclosures with connector panels, blank connector panels (for unused connector panel slots), strain relief, cable management, fiber connectors and fiber optic receptacle adapters, splice housings, splice trays and with incidental materials necessary for mounting. Provide the following (all quantities are one (1) unless otherwise indicated) at each fiber termination location:

1. **Sitzmark (STZ)**:

a. Patch Panel: Corning CCH-01U, Closet Connector Housing

b. Splice Tray: Corning M67-110, Tray for 12 HSF splices

c. Grounding: Corning HDWR-GRND-KIT, Hardware Grounding Kit for Armored Cable

d. Cable Compression Fittings: Corning EDC-2WT-KIT, Watertight Compression Fitting Kit

e. Connectors: Corning CCH-RM12-A9-PO3RH, Closet Connector Housing Module, Pigtailed, 12 F, UPC, LC Connectors

f. Accessories: Cable Strain Relief, blank bezel plates, bonding conductors and Label Kits (Qty as required)

2.3 LABELING

A. Patch Panel Labels:

1. As recommended in ANSI/TIA 606-B. Permanent (i.e. not subject to fading or erasure), permanently affixed, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.

a. Labels: Panduit self-laminating laser/ink-jet labels or approved equivalent

b. Hand-Held Printer: Panduit LS8E or approved equivalent

B. Splice Tray Labels:

1. Splice shelf labels shall be Panduit Laser Component Labels or approved equivalent.

2. Buffer tube labels shall be Panduit Laser Non-Laminated Labels or approved equivalent.

2.4 GROUNDING AND BONDING

A. Bonding conductor:

1. No. 6 AWG CU, THHN or THWN insulation, green in color

2. Connectors, lugs, hardware shall be high copper alloy or silicon bronze, quantity as required.

PART 3 – EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall comply with the requirements of this Section and the requirements of the product manufacturers. Where there are conflicts between these Specifications and manufacturer requirements, the more stringent shall prevail.

B. The CONTRACTOR shall install terminal equipment in facilities critical to on-going DISTRICT operations including network, business systems, SCADA, pump and valve controls, telemetry and radio communications. The CONTRACTOR shall take the utmost care and every precaution to protect these systems from damage during the Work.

3.2 EQUIPMENT ENCLOSURES

A. Install enclosures and all associated hardware according to locations, elevations, and plan views as shown in the Contract Documents and as approved by the DISTRICT in CONTRACTOR submittals.

B. The CONTRACTOR shall install enclosures according to manufacturer requirements and recommendations. Enclosures shall be level and plumb to wall and floors.

C. The CONTRACTOR shall install enclosures using hardware of sufficient rating to carry the maximum weight capacity of the enclosure, according to the manufacturer's requirements:

1. Indoor enclosures (concrete block wall construction): Install enclosure on unistrut rails mounted to concrete block wall using appropriate fasteners.

3.3 GROUNDING AND BONDING

A. The CONTRACTOR shall be responsible for ensuring ground continuity by properly bonding all CONTRACTOR-installed equipment. Grounding and bonding shall be in accordance with this Specification, NEC, NFPA and local codes.

B. Bonding conductor shall be installed to bond all non-current carrying metal telecommunications equipment and materials to the nearest telecommunications or electrical service ground:

1. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic hardware.

2. Bond each section of ladder rack and bond ladder rack to enclosures/cabinets where ladder racks are connected.

3. Bonding conductor shall be continuous from protected equipment to ground connection. Splices of any type are not acceptable.

3.4 PATCH PANELS, CONNECTORS, SPLICE TRAYS

A. Install patch panels, connector assemblies, splice trays and all associated hardware according to locations, elevations, and plan views as shown in the Contract Documents and as approved by the DISTRICT in CONTRACTOR submittals.

B. The DISTRICT will inspect and review the Work at all patch panel locations, no exceptions. The CONTRACTOR shall give the DISTRICT at least three (3) days notice for Work performed at all patch panel locations necessary to coordinate DISTRICT's inspection.

C. The CONTRACTOR shall perform the installation in strict accordance to manufacturer requirements, instructions and recommendations.

D. Assemble, secure cables, bond/ground cable armor and mount the patch panel strictly in accordance with the manufacturer's instructions.

E. Organize and train fibers inside the splice tray in a neat and orderly fashion, and strictly according to the manufacturer's instructions.

F. Provide the maximum amount of buffer tube service slack and fiber strand service slack in patch panels, splice trays and/or splice housings, according to product manufacturer's specifications and instructions.

G. Install a service loop (slack) of loose tube fiber cable at all patch panel locations. Service loop shall be 15 feet minimum or as required to perform fusion splicing in a sheltered environment (coordinate with Section 3.5). Coil cables in a neat and orderly fashion to facilitate patch panel removal and replacement, and secure as required.

3.5 OPTICAL FIBER SPLICES

A. Coordinate with Section 17300 - Fiber Testing.

B. Make fusion splices at all locations requiring splices, no exceptions.

C. All splicing equipment shall be cleaned and calibrated according to manufacturer's instruction prior to each splicing session at each location. Cable end preparation tools and procedures shall be consistent with the manufacturer's recommendations for the cable type installed.

D. Splice fibers strictly in accordance with the Splicing Matrix Document (sample is included in Appendix C and complete document is available for review at District Offices). The DISTRICT shall provide the complete Splicing Matrix Document to the CONTRACTOR at the Pre-Construction conference. The Splicing Matrix Document consists of detailed Patch Panel configuration diagrams which depict all fibers, buffer tubes, cables, patch panel modules, splice closures and splice closure trays to be installed in the Project. The DISTRICT may also issue a revised Splicing Matrix Document after splice closure and patch panel submittals have been reviewed and approved to incorporate any

manufacturer specific variations of tray capacity, number of trays, etc. as required. The Splicing Matrix Document will also depict existing Patch Panels and Splice Closures which the CONTRACTOR shall access for the installation of additional cables, splices and other modifications including making temporary connections for testing purposes as part of the WORK.

E. Each spliced fiber shall be packaged in a heat-shrinkable protective sleeve or housing as recommended by the fiber manufacturer. The CONTRACTOR shall use a heat shrink oven specifically made for fiber optic heat shrink applications. The use of hand-held heat guns is not acceptable. Bare fibers shall be completely re-coated with a protective coating prior to application of the sleeve or housing to protect the fiber from scoring, dirt, or micro-bending. Rack mounted organizer trays shall be used to hold the spliced fibers, with each fiber neatly secured to the tray.

F. Perform fusion splicing in a sheltered environment such as an enclosed trailer or van type vehicle. Work performed in the open air, under a canopy or tent, the back of a pickup truck or flatbed truck, or similar, is not acceptable. If patch panel locations are inside buildings (such as water pump stations, water well stations, and other dusty and dirty environments) the CONTRACTOR shall take every precaution to protect the splicing work from contamination by use of a tent or similar protective device.

3.7 LABELING

A. Coordinate with Section 17150 – Outside Plant Cable Systems.

B. Labeling and administration shall comply with ANSI/TIA 606-B and standard industry practices.

C. Splice Tray Labeling:

1. Fiber optic splice shelves and drawers shall be labeled sequentially.

2. Identify the fiber splices using a single sheet, adhesive backed, labeling stock printed using a laser printer trimmed to fit the inside door of the splice shelf.

3. Identify in tabular form the splice tray, position number and the fiber strand spliced at that location.

4. Label all exposed buffer tubes with the cable number information such that the labels are easily visible when the splice housing is open and exposed for view.

5. Labeling shall consist of the numbers and/or other information as depicted in the Contract Documents and Splicing Matrix document.

3.8 CABLE ASSEMBLIES

A. The CONTRACTOR shall deliver fiber patch cables to the District in the lengths and quantities as specified.

3.9 FIBER TESTING

A. Loose tube fiber optic cable, connectors and fusion splices shall be tested in accordance with Section 17300 - Fiber Testing.

- END OF SECTION -

SECTION 17300 – FIBER TESTING

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all labor, materials, tools, software, field-test instruments and equipment required for the complete testing, identification and administration of the Work.

B. The CONTRACTOR shall test every optical fiber link (terminated or un-terminated) in accordance with these specifications. Any failing fiber, cable, splice, or connector shall be diagnosed, corrected and re-tested at CONTRACTOR expense. The corrective action, up to and including cable replacement and installation, shall be followed with a new test to prove that the corrected fiber, cable, splice, or connector(s) meets the performance requirements. The final and passing test results for all fiber links shall be provided in the test result documentation as specified in this Section.

C. Post-Installation testing shall verify the installed condition of the cabling system and components with an optical time domain reflectometer (OTDR) and the attenuation of the installed cable plant with an optical loss test set (OLTS). The condition of the fiber end faces shall also be inspected and verified using a fiber microscope.

D. Test Results

The CONTRACTOR shall be responsible for all testing, performance verification activities and providing complete test documentation and other items as listed to the DISTRICT as follows:

1. Fiber End Face Inspections
2. Post-Installation Tests
3. Test Results Documentation (including manufacturer’s factory testing documents)
4. Test Results Software Program

1.2 REFERENCE STANDARDS

A. Test in accordance with this Section and the following standards:

1. ANSI Z136.2 - Standard For Safe Use Of Optical Fiber Communication Systems Utilizing Laser Diode And LED Sources

2. ANSI/TIA 455 (Entire 455 Series) - Fiber Optic Test Standards

3. ANSI/TIA 526-7 - Optical Power Loss Measurements of Installed Single-mode Fiber Cable Plant

4. ANSI/TIA 526-14A - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

5. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises

6. Telcordia GR-196-CORE - Generic Requirements for Optical Time Domain Reflectometer (OTDR) Type Equipment

7. Telcordia SR-4731 - Optical Time Domain Reflectometer (OTDR) Data Format

1.3 SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. The CONTRACTOR shall submit the following information:

1. Fiber Optic Test Plan as specified in this Section.

2. Manufacturer's catalog sheets and specifications for fiber optic field-test instruments including optical loss test sets (OLTS; power meter and source), optical time domain reflectometer (OTDR) and fiber inspection microscope.

3. Calibration certificates for OTDR and OLTS equipment.

4. Manufacturer's catalog sheets and specifications for test results software program.

5. Manufacturer's catalog sheets and specifications for launch cables required for use with OTDR testing.

6. Certificates for all testing personnel as specified in Section 17300.1.4.A.

7. Table of required submittals:

Material/Item	Specification Reference	Specifications	Certifications	Schedules	Plans	Reports	Other Documents	Samples
Testing Technician Certifications	17300.1.4.A		X					
Fiber Optic Test Documentation	17300.1.5					X		
Fiber Optic Test Plan	17300.1.4.B				X			
Optical Loss Test Set (Power Meter/ Source)	17300.2.1.A.1	X	X					
Optical Time Domain Reflectometer (OTDR)	17300.2.1.A.2	X	X					
Fiber Inspection Microscope	17300.2.1.A.3	X	X					
Test Results Software	17300.2.2	X					X	
Launch Cables	17300.2.3	X						

1.4 QUALITY ASSURANCE

A. The CONTRACTOR shall employ only trained personnel who have successfully completed appropriate training programs, passed exams, and obtained a certificate as proof thereof, to perform testing work. These certificates shall have been issued by one of the following organizations, no exceptions:

BICSI - Building Industry Consulting Service International, Inc.
ETA – Electronics Technicians Association, International
FOA – The Fiber Optic Association

1. Test Technicians: All (100%) personnel of this classification shall be trained and certified for installation and testing. Certification shall be one of following, no exceptions:
   BICSI – ITS Technician
   ETA – Fiber Optics Technician – Outside Plant (FOT-OSP)
   FOA – Certified Fiber Optic Specialist – Outside Plant (CFOS/O)
   FOA – Certified Fiber Optic Specialist – Testing (CFOS/T)

2. Submit copies of Test Technicians Certification documents

B. The CONTRACTOR shall develop and submit a Fiber Optic Test Plan (Test Plan) to the DISTRICT for review and approval. The Test Plan shall indicate the tests and procedures to be used at each test phase as specified in this Section. The CONTRACTOR shall resubmit the Test Plan if it is modified or changed after DISTRICT approval. This comprehensive Test Plan shall include a description of the proposed tests, methods (i.e. ANSI/TIA-568-C.0 Tier 2, ANSI/TIA 526-7, or ANSI/TIA-455-78-B, etc.) and forms to be used and the sequencing of these tests. Upon DISTRICT approval, the forms (paper and electronic) shall be used by the CONTRACTOR to record the results of the testing. All test results shall be submitted to the DISTRICT for review and approval upon the completion of each test activity.

1. The Test Plan shall include the following basic elements:
   a. Testing personnel/Subcontractor name and qualifications
   b. Test methods and procedures
   c. List of test equipment and calibration status
   d. Acceptance / failure criteria
   e. Sample test reports and data forms
   f. Sample test result database format
   g. Plan for resolution of problems and errors
   h. Any special test equipment and setup requirements
   i. Coordination with the DISTRICT's Splicing Matrix Document
   j. Schedule of Testing Activities (test sequence)

2. All tests shall be documented by the CONTRACTOR, require a sign-off by the CONTRACTOR's Project Manager, and shall be submitted to the DISTRICT for review and approval. Any and all fiber optic cable not passing the tests shall be repaired, replaced and/or corrected by the CONTRACTOR and rescheduled for testing at the CONTRACTOR's expense.

3. No tests shall be conducted until the Test Plan has been reviewed and approved by the DISTRICT. Any deviations to an approved Test Plan shall be submitted for review and approval of the DISTRICT five (5) days prior to any test activity.

4. The DISTRICT's approval of the Test Plan does not relieve the CONTRACTOR from meeting the requirements of this entire Specification.

C. A representative of the DISTRICT shall have the opportunity, and reserves the right to witness the testing. The DISTRICT shall be notified in writing of the start date of testing a minimum of three (3) working days before testing commences.

1.5 TEST RESULT DOCUMENTATION

A. The CONTRACTOR shall be responsible for preparing and organizing test result documentation for all test procedures required in this Section. This documentation shall be established on a segment-by-segment basis and shall describe all test results for each optical fiber in the segment. The result documentation shall be organized on a CD or DVD disk with a Table of Contents and indexes to differentiate the separate cable segments. Following the Table of Contents and before the individual cable segments section, a section shall be inserted for "Cable Records". The Cable Records sections shall contain, at a minimum, the following: the specification sheet and factory testing results provided by the cable manufacturer, and the results of Pre-Installation Testing.

B. The test result information for each fiber shall be recorded and saved in the memory of the field test equipment upon completion of the test. These test records shall be uploaded to software programs and external storage devices unaltered (i.e. as saved in the field test equipment).

C. The test result records saved in the field test equipment shall be transferred into a Windows™ -based software program that allows for the maintenance, inspection, printing, exporting and archiving of OTDR test records in "SOR" data format and OLTS test records in native data format.

D. The completed test results shall be stored electronically and delivered to the DISTRICT on CD or DVD disks, USB flash drive or Secure Digital (SD) card. Provide to the DISTRICT the software program required to view, inspect, export to other formats, and print any selection of test reports. Coordinate with Part 2.2.

E. A paper copy of the test results, printed directly from the test results software program, shall be provided in accordance with the approved Test Plan.

F. The detailed test results documentation data shall be provided in an electronic database for each tested optical fiber and shall contain the following information:

1. The date and time the test results were saved in the memory of the test equipment.

2. The manufacturer, model and serial number of the test equipment.

3. The revision of the test equipment software and the revision of the test standards database in the test equipment.

4. The name of the test selected to execute the stored test results.

5. The name of the personnel performing the test.

6. The identification of the fiber, cable and location in accordance with the naming convention defined in the Contract Documents and Splicing Matrix documents.

7. Fiber type and coefficients including Backscatter Coefficient and Index of Refraction.

8. Other information including Loss Threshold, Reflection Threshold, End Threshold, Pulse Width, launch cable length, Cursor A distance, and Cursor B distance.

9. The length, in kilometers (km), for each optical fiber as calculated by the OTDR.

10. Bi-directional OTDR trace analysis by test results software:
    - Averages end-to-end and event loss (including fusion splice loss) measurements using results from both directions
    - Bi-directional trace information in the event table
    - macrobend/microbend detection and analysis

11. The OLTS insertion loss (attenuation) measured at each wavelength, the link attenuation budget calculated for the corresponding wavelength and the margin or difference between the measured attenuation and the link budget value.

12. The overall Pass/Fail evaluation of the fiber-under-test for OTDR and OLTS measurements.

1.6 ACCEPTANCE AND PERFORMANCE REQUIREMENTS

A. The acceptance and performance requirements of this section shall apply to all installed fiber optic cable (terminated or unterminated), fusion splices, and connectors. Pre-Installation acceptance and performance requirements are listed in Section 17150 – Outside Plant Cable Systems. If a fiber optic cable, or individual fiber within a cable, splice, or connector fails to meet ANY of these requirements during Post-Installation testing (in one direction only, bi-directionally, or in the case of fusions splices the average of the two values), the cable, splice or component shall be replaced, re-installed and re-tested at CONTRACTOR expense. Acceptance and performance requirements are as follows:

1. Absolute maximum cabled attenuation at 1310 nm, each individual fiber link: 0.35 dB/km (see no. 8)

2. Absolute maximum cabled attenuation at 1550 nm, each individual fiber link: 0.24 dB/km (see no. 8)

3. Absolute maximum connector loss (pair): 0.40 dB

4. Absolute maximum fusion splice attenuation (bi-directionally averaged): 0.10 dB

5. Absolute maximum non-reflective event (microbends and macrobends) attenuation, each individual fiber link: 0.10 dB

6. Absolute maximum connector reflectance, each individual fiber link: - 48 dB (minus forty-eight decibels)

7. OLTS Attenuation Values: Acceptable readings (PASS) shall be less than the calculated budget value or no more than 0.10dB over the budget value.

8. Attenuation values that measure less than factory measurement values or Pre-Installation measurement values automatically FAIL this requirement and shall be re-tested to determine the discrepancy at CONTRACTOR expense. Cable that fails shall be replaced, re-installed and re-tested at CONTRACTOR expense.

B. Bi-Directional Analysis: The CONTRACTOR shall perform OTDR testing in such a way that the approved test results software performs automatic bi-directional analysis of individual fiber links. Fiber links for which automatic bi-directional analysis is not available, due to CONTRACTOR oversight or any other reason, are deemed to have FAILED. Fiber links shall be re-tested at CONTRACTOR expense until the software can perform automatic bi-directional analysis of individual fiber links.

C. The CONTRACTOR shall calculate the link attenuation budget value for each terminated fiber link using the following formulas as specified in ANSI/TIA-568-C.0 and with attenuation limits as defined in Part 1.6 A:

- Link Attenuation (dB) = Cable_Attn (dB) + Connector_Attn (dB) + Splice_Attn (dB)
- Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (km)

  Note: Length (km) = as measured by OTDR testing (bi-directional average)
- Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)

  Note: number_of_connector_pairs = 2
- Splice_Attn (dB) = number_of_splices * splice_loss (dB)

  Note: number_of_splices = per Splicing Matrix Document

D. The CONTRACTOR shall calculate, record and present to the DISTRICT the link attenuation budget value at each wavelength for each terminated fiber link, the actual reading taken during OLTS attenuation tests at each wavelength for each fiber link, and the margin or difference between the measured attenuation and the link attenuation budget value. Coordinate with Part 3.5 POST-INSTALLATION TESTS.

PART 2 – PRODUCTS

2.1 OPTICAL FIBER CABLE TEST EQUIPMENT

A. The field-test instruments shall be within the calibration period recommended by the manufacturer. Minimum requirements include:

1. Optical Loss Test Set (OLTS): Single-mode, optical fiber light source and power meter.

   a. Dual laser light sources with central wavelengths of 1310 nm (+-20 nm) and 1550 nm (+-30 nm)

   b. Accuracy: +-0.25 db

   c. Capable of storing and saving results in internal memory

2. Optical Time Domain Reflectometer (OTDR): High resolution unit capable of performing ANSI/TIA Tier 2 testing on single-mode fiber.

a. Dual laser light sources with central wavelengths of 1310 nm (+-20 nm) and 1550 nm (+-30 nm)

b. Dynamic Range: 34dB, single mode

c. Resolution: +-0.01 db

d. Capable of storing and saving results in internal memory

e. Capable of collecting data for bi-directional averaging by test results software

3. Fiber Microscope:

a. Magnification of 200X or 300X for end face inspection of fiber

B. Field-test instruments shall have the latest software and firmware installed.

C. OLTS and OTDR field-test instruments shall be of the same manufacturer and shall be capable of uploading test results to the same software program, no exceptions. OTDR test results shall be saved in "SOR" data format in compliance with the latest versions of Telcordia Bellcore GR-196-CORE and Telcordia SR-4731 standards, no exceptions.

D. The test result records saved within the field-test instruments shall be transferred into a Windows™-based test results software program that allows for the maintenance, inspection, printing and archiving of OTDR test records in "SOR" data format and OLTS test records in native data format.

2.2 TEST RESULTS SOFTWARE

A. Provide to the DISTRICT a complete, fully functional and licensed version of the test results software program for DISTRICT use. Software that is "trial-ware", "free-ware", "share-ware", "starter version", "lite", "reduced feature set version", basic version" or that in any way expires after a certain time period is not acceptable. Software shall be the latest full-featured commercial version available from the vendor as of the completion date of testing. The software shall be capable of reading, inspecting, printing, exporting and archiving of test results directly from OTDR and OLTS test equipment.

1. Bi-Directional Analysis: Software shall be capable of automatic bi-directional analysis and averaging, including automatic microbend/macrobend detection. The software shall average end-to-end and event loss measurements using results from OTDR measurements in both directions. Bidirectional trace information shall be shown in the event table.

2. Test Result Software shall be AFL Noyes® Test Results Manager (TRM) Advanced Version 2.01 (or latest release) or approved equivalent.

2.3 LAUNCH CABLES

A. The CONTRACTOR shall provide and use launch cables for all tests requiring the use of an OTDR, no exceptions. The type and length of Launch Cables shall be as recommended by the Test Equipment (OTDR) manufacturer and/or these Specifications necessary to reveal the insertion loss and reflectance of the near-end connections or the attenuation of unterminated (bare) fiber and shall be compatible with the Contract

specified fiber type(s). The minimum length of launch cables shall not be less than 150 meters. Coordinate launch cable fiber type with Section 17150 – Outside Plant Cable Systems and Section 17200 – Inside Plant Cable Systems.

PART 3 – EXECUTION

3.1 FIBER TESTING

A. The CONTRACTOR shall be responsible for satisfying all test requirements prior to submission for the DISTRICT's review and acceptance. The DISTRICT reserves the right to monitor all tests.

B. The CONTRACTOR shall perform all tests on optical fiber cabling that require the use of laser or LED light sources in strict compliance with the safety requirements of ANSI Z136.2.

C. The CONTRACTOR shall perform all tests according to the approved Test Plan as specified in this Section. All test procedures and data forms shall be submitted to the DISTRICT for review and approval before any tests are conducted as part of the Test Plan.

D. The CONTRACTOR shall compare the results of all tests with the requirements specified herein and submit results to the DISTRICT for review and approval. Failure to conform to the requirements of any test shall be counted as a defect and the fiber optic cable, splices, or connectors shall be subject to rejection by the DISTRICT. Rejected fiber optic cable, splices, or connectors shall be replaced with new materials, installed and re-tested at CONTRACTOR expense.

E. **Bi-Directional Analysis:** The CONTRACTOR shall perform OTDR testing in such a way that the approved test results software performs automatic bi-directional analysis of individual fiber links. This may include, but is not limited to, performing OTDR setup and using file naming conventions in a manner consistent with OTDR and test result software manufacturer’s requirements for bi-directional analysis.

F. The CONTRACTOR shall use launch cables for all tests requiring the use of an OTDR, no exceptions. Any testing (Pre-Installation or Post-Installation) performed without the use of Launch Cables shall result in the DISTRICT’s immediate rejection of such test results and shall require re-testing with Launch Cables at CONTRACTOR expense.

G. All factory-connectorized cable assemblies shall be tested for continuity prior to installation. The CONTRACTOR may use an OTDR to test this type of assembly.

H. Final inspection and acceptance of the installed fiber optic cable system shall be made after the completion of the installation, testing and approval by the DISTRICT of the documentation described above. Coordinate with Section 01700 – Project Closeout.

3.2 OTDR SETUP REQUIREMENTS

A. **Optical Fiber Parameters**:

1. Index of Refraction (IOR): Shall be set from the fiber manufacturer’s specification.
2. Backscatter Coefficient: Shall be set from the fiber manufacturer’s specification.

B. **Event Threshold Settings**:

1. Non-Reflective Events: Shall be set to lowest possible setting so all events are identified. Setting shall be 0.05dB minimum.

2. Reflectance: Shall be set suitably lower than the acceptance specification to capture reflectance results for each connector. Setting shall be -55dB minimum.

C. **Range (Resolution)**:

1. The Range setting shall be selected such that the Range value is approximately 1.25X to 1.5X the length of fiber under test plus the length of launch and receive cables. In no case shall the Range setting be more than 2X this length.

D. **Pulse Width**:

1. The goal shall be to use the shortest Pulse Width that will satisfy trace quality and allow for the end of the fiber to be seen clearly on the trace. Shorter pulse widths minimize event and attenuation dead zones in the trace. In general, set:

    - short Pulse Widths for shorter lengths of fiber
    - long Pulse Widths for longer lengths of fiber

2. If the trace quality exhibits excessive noise that cannot be removed by additional Averaging (time), select the next higher Pulse Width.

3. Recommendations: Use a Pulse Width of 10ns or 30ns for fiber lengths up to 2 to 3km.

E. **Averaging (Time)**:

1. There are trade-offs between the Averaging and Pulse Width settings.

2. If by reducing the Averaging time the trace gets “bumpy”, then the Averaging time may need to be increased by itself or in conjunction with an increased Pulse Width setting.

3. If by increasing the Pulse Width there is excessive backscatter in the trace, then a longer Averaging time setting may be necessary by itself or in conjunction with a decreased Pulse Width setting.

4. In no case shall the Averaging time setting be less than 30 seconds for fiber lengths in excess of 1000 meters.

F. **Automatic Mode**:

1. If the OTDR has an “Auto” or “Automatic” mode, the use of this mode shall NOT be done in a blind or non-discerning manner. The trace produced shall be carefully reviewed and the settings shall be manually adjusted as necessary to conform to the requirements of this Specification and the OTDR manufacturer’s recommendations. A new trace shall be produced with any modified settings.

G. **Bi-Directional Testing**:

1. Insure that all settings, including event thresholds, range, pulse width and averaging

times, and circuit name or circuit ID are set exactly the same for both directions to ensure that bi-directional averaging is performed by the test results software.

2. Consult OTDR and/or test results software documentation for all requirements necessary to ensure that trace results can be bi-directionally processed by the test results software program. Implement any and all requirements.

H. **Launch Cable Length**:

1. If the length of fiber under test is 2,000 meters (6562 ft) or less, use a 150 meter launch cable.

2. If the length of fiber under test is greater than 2,000 meters, use a 1,000 meter launch cable.

I. **District Acceptance of OTDR Setup**:

1. Test results produced with OTDR settings or launch cable lengths that are not in conformity to the requirements of this Specification shall be deemed to have FAILED and shall be rejected.

2. Failed fiber links shall be re-tested at CONTRACTOR expense until the test result settings are shown to be in conformity to the requirements of this Specification.

3. The CONTRACTOR shall be responsible for resolving all DISTRICT concerns resulting from the OTDR tests including, but not limited to, settings that are not in conformance to the requirements of this Specification, the replacement of unacceptable cables, the replacement of pigtail connectors at termination panels, the re-splicing of cable, and re-testing as necessary at CONTRACTOR expense.

3.3 POST-INSTALLATION TESTS

A. The CONTRACTOR shall not conduct any Post-Installation tests until all cables, splice closures, patch panels, and terminations have been completely installed.

B. The CONTRACTOR shall perform two (2) phases of Post-Installation tests including (1) OTDR tests and (2) OLTS tests. Post-Installation testing shall consist of the following:

1. **First Phase (OTDR Tests)**: The CONTRACTOR shall conduct the first phase of Post-Installation tests with an OTDR to verify the overall fiber optic cable length in the segment, cable integrity, reflectance, fiber attenuation in dB/km after cable installation, splice attenuation and to reveal any events or point discontinuities. Measurements shall be made after splice closures are installed and mounted in underground structures and/or aerial locations. All testing shall be performed end to end in both directions (bi-directional) on every fiber link terminated or unterminated on one or both ends, no exceptions. Fiber links or fiber optic cable that is left un-terminated on one or both ends shall be tested using bare fiber adapters as necessary. OTDR testing shall comply with the methods stated in these Specifications, ANSI/TIA-568-C.0 Tier 2 and ANSI/TIA-455-78-B standards. The test results shall be compared to the Pre-Installation Tests to reveal events or point defects due to installation problems and to detect any un-terminated fibers. The CONTRACTOR shall be responsible for resolving all DISTRICT concerns resulting from the OTDR tests including, but not limited to, the replacement of unacceptable cables, the replacement of pigtail connectors at termination panels,

and the re-splicing of cable.

a. The CONTRACTOR shall use overall fiber length, as determined by OTDR testing, to calculate the link attenuation budget value for all terminated fiber links.

2. **Second Phase (OLTS Tests)**: The CONTRACTOR shall conduct the second phase of Post-Installation tests with an OLTS to measure link attenuation, verify fiber continuity, and verify that fibers have not crossed over in any splice closure or termination point. All testing shall be performed end to end in both directions (bi-directional) on every terminated fiber link (i.e., patch panel to patch panel), no exceptions. The CONTRACTOR shall perform bi-directional end-to-end attenuation testing at 1310 nm and 1550 nm wavelengths with the recorded loss being the average of the values in each direction. Bi-directional end-to-end attenuation testing shall be performed in accordance with ANSI/TIA-526-7, Method A.1, One Reference Jumper or equivalent method.

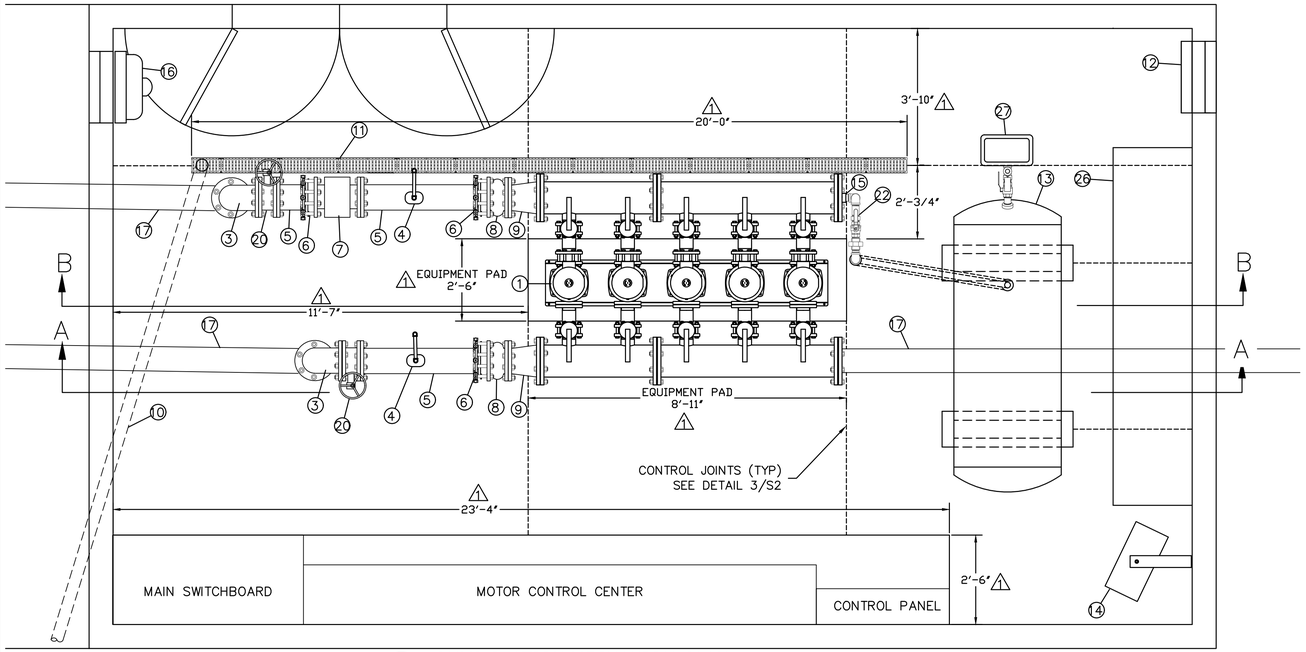
   a. The CONTRACTOR shall compare the OLTS attenuation reading to the attenuation budget value (see Part 1.6) for each fiber link. Acceptable readings (PASS) shall be less than the calculated budget value or no more than 0.10dB over the budget value. If the reading is higher than 0.10 dB over the budget value, the fiber link has failed the attenuation test (FAIL). The DISTRICT shall be notified of all fiber links which fail attenuation testing.

   b. The CONTRACTOR shall analyze OTDR traces and perform all other work as necessary to troubleshoot fiber links which fail OLTS testing. The CONTRACTOR shall re-terminate, re-splice, replace cables or components as necessary and re-test, at CONTRACTOR expense, to obtain acceptable test results.

C. Any fiber, cable, splice or component that fails to meet the Acceptance and Performance Requirements as listed in Part 1.6 as a result of Post-Installation testing shall be repaired and replaced at CONTRACTOR expense. The CONTRACTOR shall conduct the Post-Installation test(s) again, at CONTRACTOR expense, on any fiber, cable, splice or component that is repaired or replaced until it passes the test.

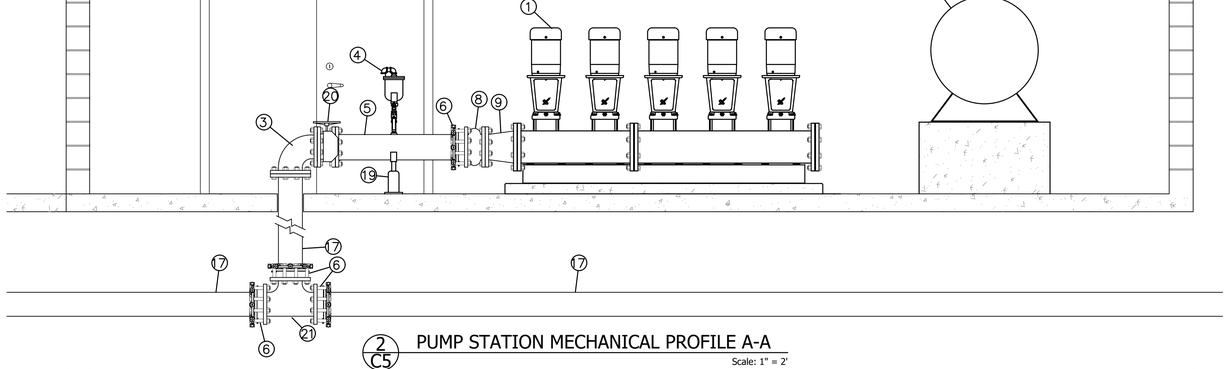
D. If, after Post-Installation testing, any cable, splice closure, or patch panel requires replacement and/or re-installation due to a manufacturing defect, physical damage or CONTRACTOR error (e.g. the incorrect size and/or type of cable, splice closure, or patch panel installed at a particular location) discovered subsequent to Post-Installation testing, then all Post-Installation tests shall be performed a second time at CONTRACTOR expense for affected fibers, cables, or other components subsequent to replacement and re-installation by the CONTRACTOR.

– END OF SECTION –



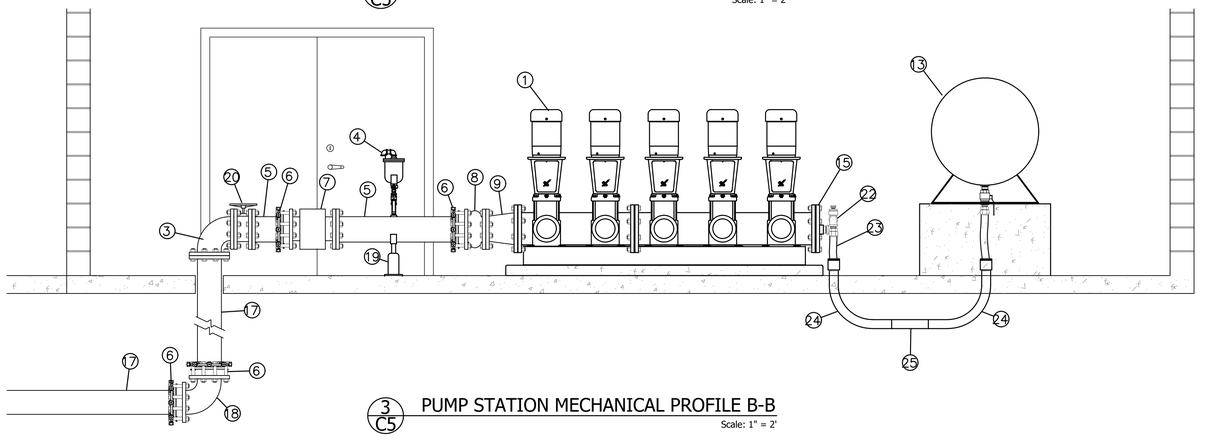
1/C5 PUMP STATION MECHANICAL PLAN

Scale: 1" = 2'



2/C5 PUMP STATION MECHANICAL PROFILE A-A

Scale: 1" = 2'



3/C5 PUMP STATION MECHANICAL PROFILE B-B

Scale: 1" = 2'

EQUIPMENT LIST:

1. GRUNDFOS HYDRO MPC-EC (CUE) 5CR 64-1 FIVE PUMP SKID MOUNTED SYSTEM
2. 8" DUCTILE IRON PIPELINE
3. 8" FLXFL WELDED STEEL 90° ELBOW, EPOXY COATED
4. AIR RELEASE ASSEMBLY
5. 8" WELDED STEEL FLXPE PIPE, EPOXY COATED
6. 8" RESTAINED FLANGE ADAPTER, EBBA IRON 2108 OR EQUAL
7. 8" MAGNETIC FLOW METER
8. 8" FLXFL MOLDED SPHERICAL JOINT, PROCO STYLE 240 SINGLE SPHERE OR EQUAL
9. 10"X8" FLXFL DUCTILE IRON REDUCER
10. 4" PVC DRAIN PIPE AND FITTINGS
11. FLOOR TRENCH DRAIN
12. INTAKE AIR VENT WITH LOUVER AND DAMPER
13. HYDROPNEUMATIC PRESSURE TANK, 400 GALLON, 36"ØX98", HANSEN WK-864-B OR EQUAL
14. ELECTRIC SPACE HEATER
15. 10" S.S. COMPANION FLANGE WITH 2" NPT TAP
16. EXHAUST FAN WITH LOUVER AND DAMPER
17. 8" FLXPE D.I. PIPE
18. 8" FLANGED D.I. 90° ELBOW
19. 8" PIPE STAND, STANDON S-92 SADDLE SUPPORT OR EQUAL
20. 8" BUTTERFLY VALVE
21. 8" FL D.I. TEE
22. HYDRO TANK CONNECTION DETAIL, SEE DETAIL 7/C5
23. 2" HDPE PIPE
24. 3" RIGID STEEL LONG RADIUS SWEEP
25. 3" RIGID STEEL CONDUIT
26. ROLLING DOOR HOOD
27. PRESSURE TANK COMPRESSOR ASSEMBLY, SEE DETAIL 6/C5

CONSTRUCTION NOTES

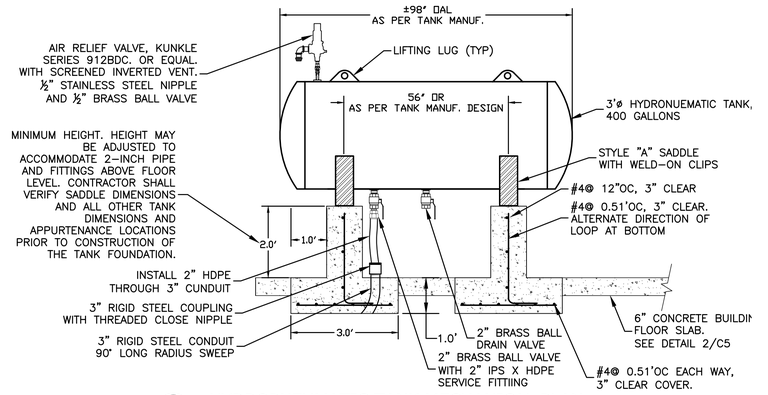
WRAP PIPES PASSING THROUGH CONCRETE FLOORS AND WALLS WITH ASPHALT SATURATED FELT PAPER OR OTHER WATERPROOF MATERIAL TO PREVENT BONDING TO CONCRETE.

DIMENSIONS OF PUMPS AND FITTINGS MAY VARY FROM THOSE SHOWN ON THE PLANS. CONTRACTOR SHALL BE RESPONSIBLE FOR CONFIRMING ACTUAL DIMENSIONS PRIOR TO INSTALLATION.

PIPING AND FITTINGS ARE SIMILAR FOR EACH SET OF PUMPS.

FLOOR SHALL BE SLOPED TOWARD FLOOR DRAINS.

DUCTILE IRON PIPE SHALL BE FLANGED OR OTHERWISE MECHANICALLY RESTRAINED TO PREVENT MOVEMENT. STEEL PIPE SHALL BE FLANGED OR WELDED. FLANGED ADAPTORS SHALL BE RESTRAINED.



4/C5 HYDROPNEUMATIC TANK MECHANICAL PLAN

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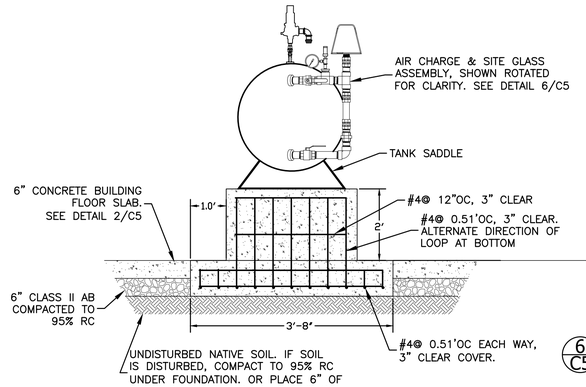
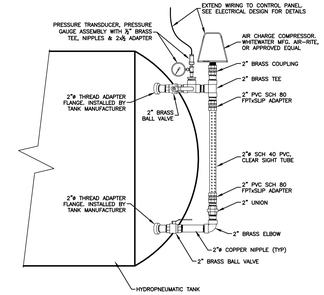


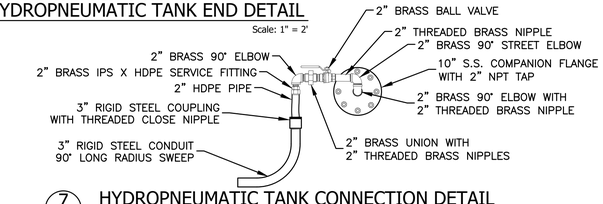
5/C5 HYDROPNEUMATIC TANK END DETAIL

Scale: 1" = 2'



6/C5 SIGHT GLASS AND COMPRESSOR DETAIL

Scale: 1" = 2'



7/C5 HYDROPNEUMATIC TANK CONNECTION DETAIL

Scale: NTS

REV	DATE	REVISIONS	INITIAL
1	8-12-26	ADDENDUM 1	KSK

SITZMARK HYDROPNEUMATIC BOOSTER PUMP STATION REPLACEMENT

MECHANICAL DETAILS

TRUCKEE DONNER Public Utility District
11570 DONNER PASS ROAD
TRUCKEE, CA 96161
PHONE: 530-587-3896
NEVADA COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Road, Suite 202, Nevada City, CA 95959
Phone: (530) 265-6021 Website: sauerseng.com

BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

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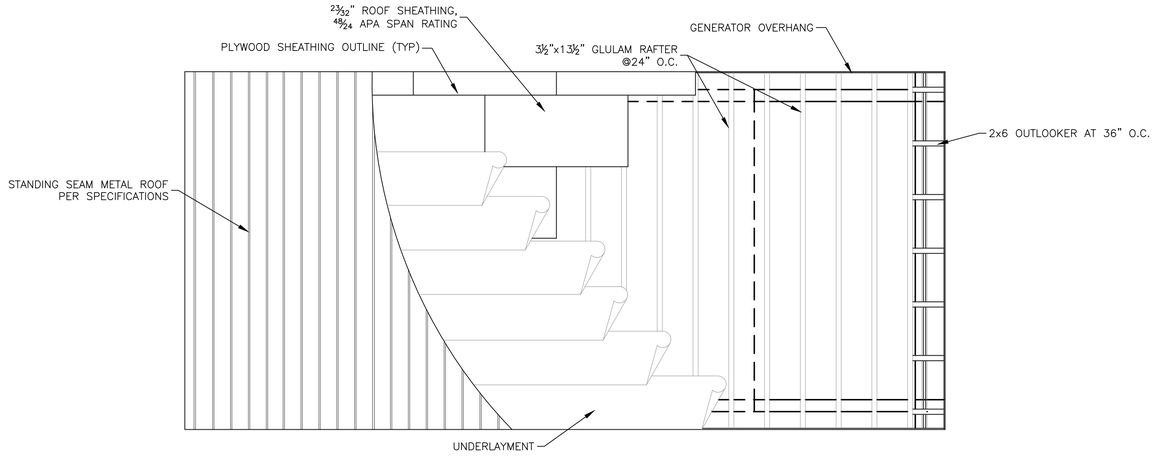
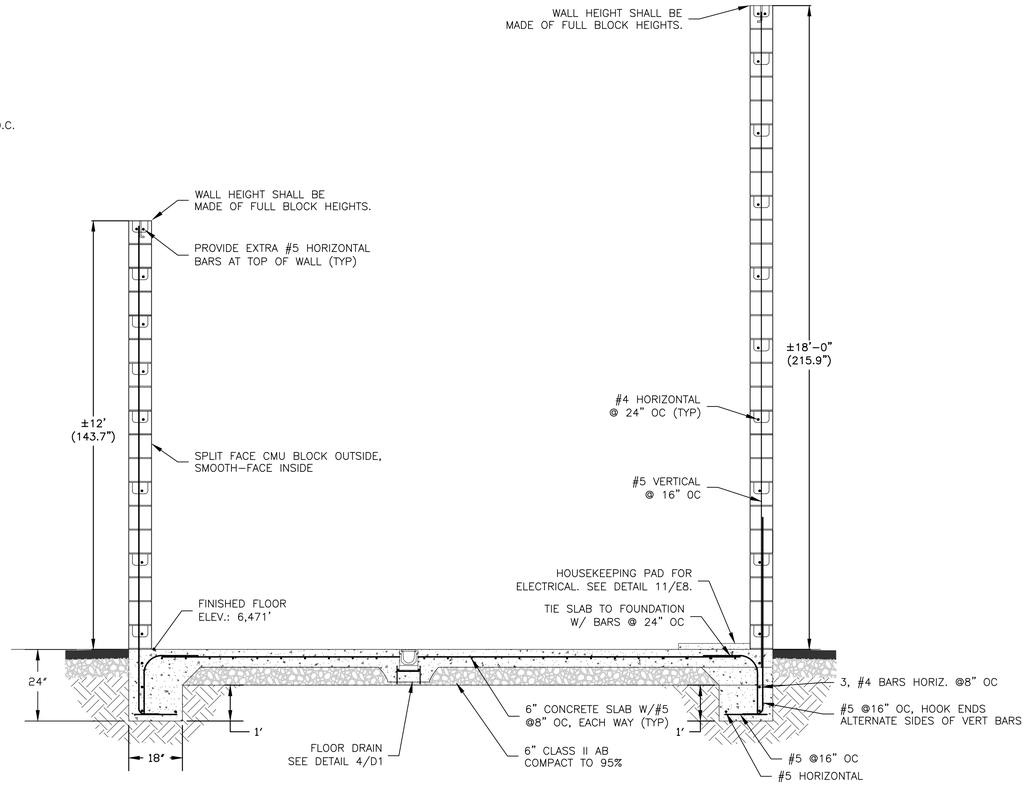
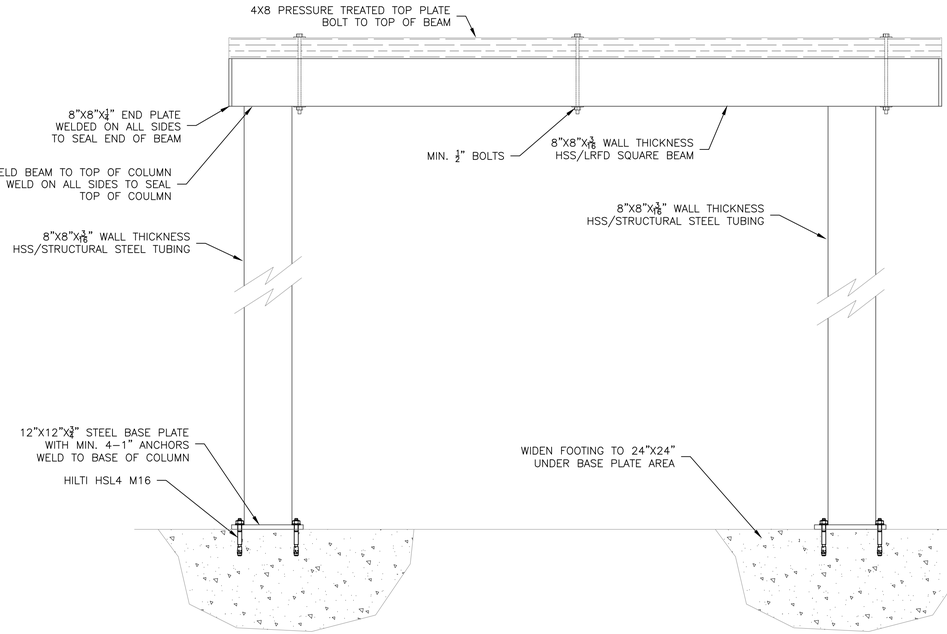
C5-R1



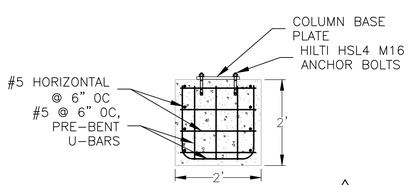
1/S2 ROOF PLAN - RAFTER LAYOUT DETAIL
Scale: 1/4" = 1'



2/S2 BUILDING AND OVERHANG FOUNDATION AND REINFORCEMENT DETAIL
Scale: 1/2" = 1'



3/S2 GENERATOR ROOF EXTENSION BEAM AND COLUMN DETAIL
Scale: 1" = 1'



5/S2 COLUMN FOOTING DETAIL
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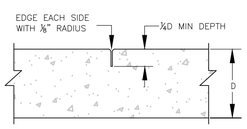
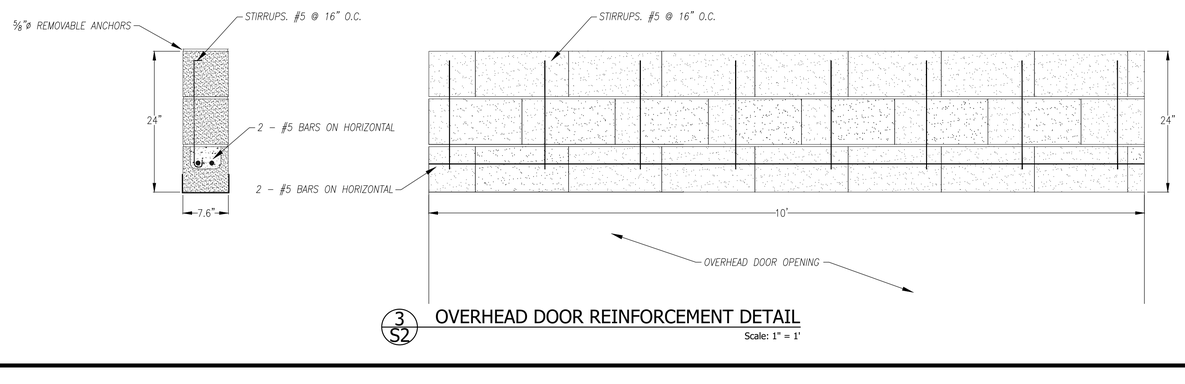
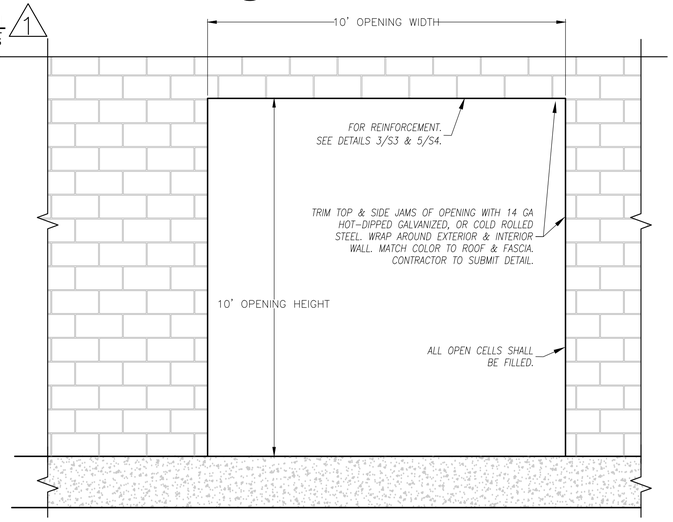


3/S2 TOOLED CONTROL JOINT
Scale: NTS



3/S2 OVERHEAD DOOR REINFORCEMENT DETAIL
Scale: 1" = 1'



4/S2 OVERHEAD DOOR OPENING DETAIL
Scale: 1/2" = 1'

REV	DATE	REVISIONS	INITIAL
1	8-12-26	ADDENDUM 1	KSK

SITZMARK HYDROPNEUMATIC BOOSTER PUMP STATION REPLACEMENT

ROOF DETAILS & WALL OPENING REINFORCMENT DETAILS

TRUCKEE DONNER Public Utility District
11570 DONNER PASS ROAD
TRUCKEE, CA 96161
PHONE: 530-587-3896
NEVADA COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Road, Suite 202, Nevada City, CA 95959
Phone: (530) 265-8021 Website: sauerseng.com

0 1
BAR IS ONE INCH ON ORIG. DRAWING
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PROJECT NUMBER:
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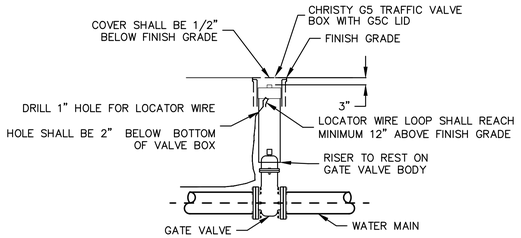
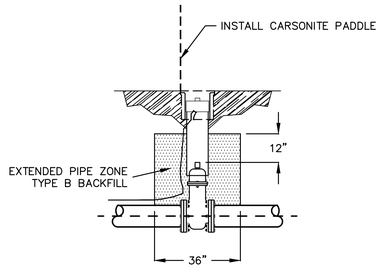
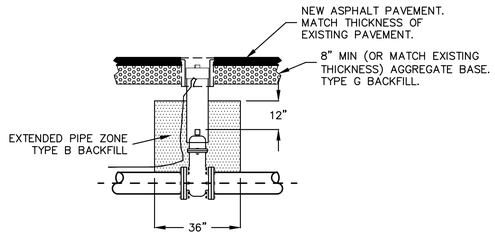


DIMENSIONAL LAYOUT



OUTSIDE PAVED AREAS



WITHIN PAVED AREAS

1 D1 GATE VALVE DETAIL
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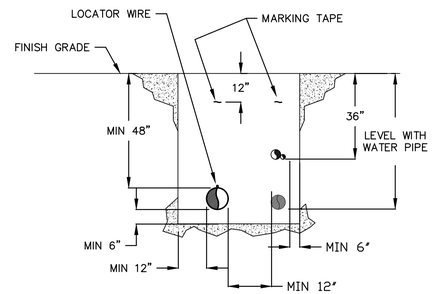
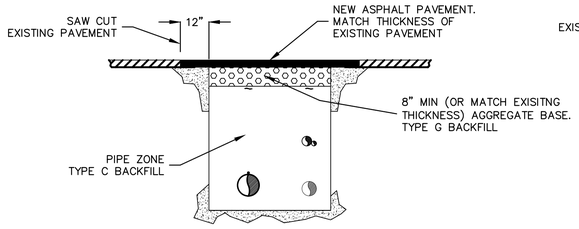
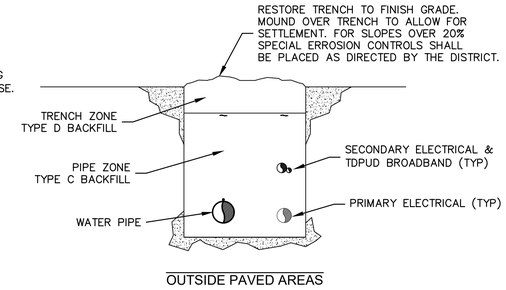


TRENCH DIMENSIONAL LAYOUT



WITHIN PAVED AREAS



OUTSIDE PAVED AREAS

3 D1 JOINT TRENCH DETAIL
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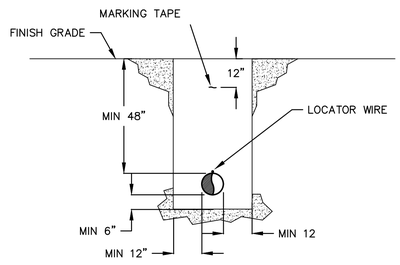
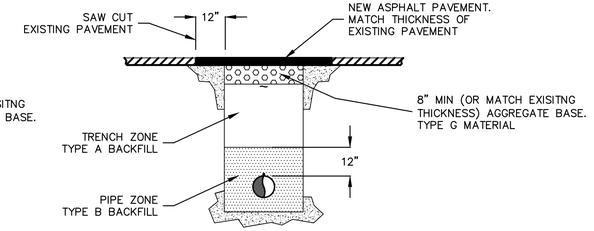
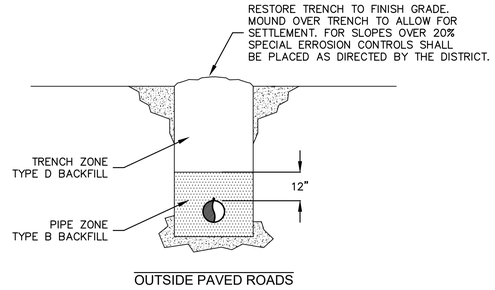


TRENCH DIMENSIONAL LAYOUT



WITHIN PAVED AREAS



OUTSIDE PAVED ROADS

4 D1 WATER MAIN TRENCH DETAIL
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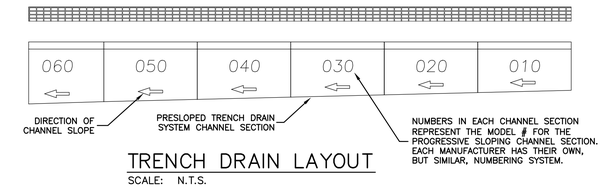
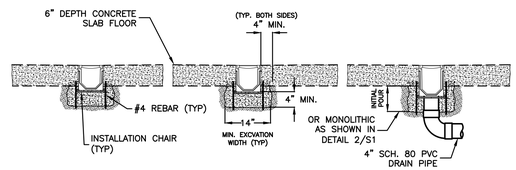
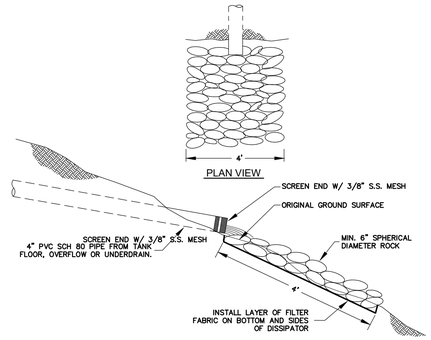


TRENCH DRAIN LAYOUT
SCALE: N.T.S.

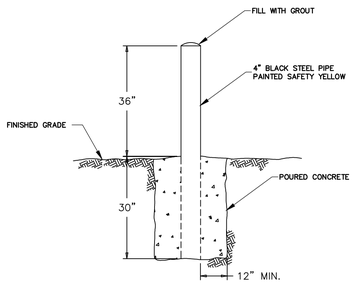


TRENCH DRAIN X-SECTION
SCALE: N.T.S.

4 D1 TRENCH DRAIN DETAIL
Scale: N.T.S.



5 D1 DRAINAGE DISSIPATOR DETAIL
Scale: N.T.S.



6 D1 BOLLARD DETAIL
Scale: N.T.S.

NOTES:

1. CONTACT ALL AGENCIES AND/OR UTILITIES TO CONFIRM CONSTRUCTION REQUIREMENTS.
2. THE SIDE OF THE TRENCH AT THE WATER PIPE OPPOSITE FROM THE OTHER UTILITIES MUST REMAIN FREE OF ANY OBSTRUCTIONS.

MINIMUM TRENCH WIDTH	
PIPE DIAMETER	WIDTH
4"	30"
6"	30"
8"	32"
10"	34"
12"	36"
14"	38"
FOR PIPE >14", DISTANCE FROM PIPE EDGE TO TRENCH WALL SHALL BE MIN. OF 12"	

REV	DATE	REVISIONS	INITIAL

SITZMARK HYDROPNEUMATIC BOOSTER PUMP STATION REPLACEMENT

PIPING DETAILS

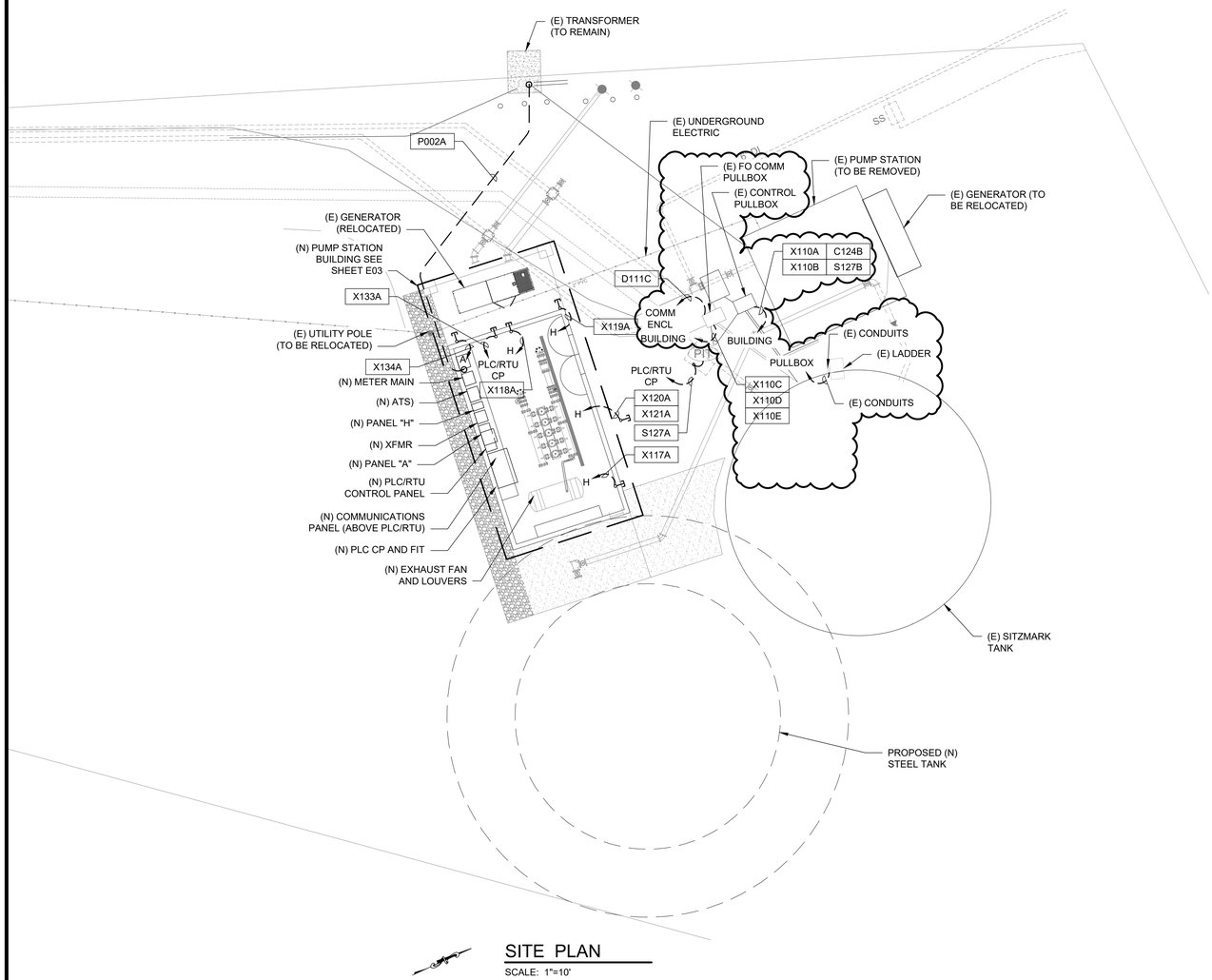
TRUCKEE DONNER Public Utility District
11570 DONNER PASS ROAD
TRUCKEE, CA 96161
PHONE: 530-587-3896
NEVADA COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Road, Suite 202, Nevada City, CA 95959
Phone: (530) 265-8021 Website: sauerseng.com

BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:
DESIGN BY:
DRAFTING BY:
CHECKED BY:
FILE PATH:
DATE:
SCALES:
AS SHOWN
HORIZONTAL
NA
VERTICAL

D1-R1



SITE PLAN

SCALE: 1"=10'

NOTES

1. COORDINATE NEW ELECTRIC SECONDARY SERVICE CONDUIT AND INSTALLATION OF METER/MAIN ENCLOSURE WITH DISTRICT. IT IS EXPECTED THE EXISTING TRANSFORMER AND PAD WILL BE RE-USED.
2. REUSE AND RELOCATE EXISTING GENERATOR. PROVIDE NEW PAD. PROVIDE RE-START-UP SERVICES AND CHECK-OUT DURING FACILITY START-UP.
3. IN THE EXISTING PUMP STATION BUILDING AND AROUND THE PERIMETER, AS PART OF THE DEMOLITION WORK, SAFELY REMOVE ALL ELECTRICAL EQUIPMENT ABOVE GRADE AND IN THE BUILDING AND PROPERLY DISPOSE OF IT. LEAVE EVERYTHING NOT DEMO'D IN A SAFE CONDITION.
4. COORDINATE THE INSTALLATION OF NEW CONDUIT ON THE EXISTING TANK WITH THE DISTRICT. THE EXISTING CONDUIT SHALL REMAIN IN PLACE (AND IN SERVICE UNTIL SWITCHOVER). MEET WITH ENGINEER ON SITE TO DISCUSS MINIMIZING THE SAW CUTTING OF THE APRON AROUND THE TANK. REPAIR THE APRON. PAINT NEW CONDUIT AND MOUNTING HARDWARE TO MATCH THE TANK.
5. THE CONTRACTOR SHALL PROVIDE AND INSTALL A 2" DIAMETER COMM CONDUIT (PVC 40 BELOW GRADE AND RIGID STEEL AT ELBOW BELOW FOUNDATION AND IN BUILDING WHERE EXPOSED WITH PULLROPE) BETWEEN THE EXISTING FO PULLBOX AND THE NEW COMM ENCLOSURE.
6. THE CONTRACTOR SHALL REMOVE AND DISPOSE OF 360 FEET OF EXISTING 12 STRAND FIBER-OPTIC CABLE BETWEEN THE FO COMM BOX ON SITE AND A SIMILAR PULLBOX DOWN THE STREET. THE CONTRACTORS SHALL PROVIDE AND INSTALL NEW 12 STRAND SINGLE MODE FIBEROPTIC CABLE BETWEEN THE EXISTING COMM BOX DOWN THE STREET (USING NEW AND EXISTING CONDUIT) AND THE NEW COMM ENCLOSURE (USING NEW CONDUIT) IN THE NEW BUILDING ON SITE. THE CONTRACTOR SHALL SPLICE THE NEW CABLE STRANDS TO EXISTING STRANDS IN THE COMM PULLBOX DOWN THE STREET. THE CONTRACTOR SHALL TERMINATE THE NEW STRANDS IN THE NEW FIBER ENCLOSURE IN THE BUILDING. THE CONTRACTOR SHALL TEST THE FIBER.

CONDUIT SCHEDULE

CONDUIT NUMBER	SIZE	RUN FROM	RUN TO	LOCATION SERVED	CKT TYPE	CKT VOLTS	NO CKT WIRES	CKT TYPE WIRE	CKT WIRE SIZE	GND TYPE WIRE	GND WIRE SIZE	NOTES
P002A	3"	TDPUD	METER/MAIN/PS	BPS	P		1	Pullrope				PROVIDE PER TDPUD
P003A	2-1/2"	ATS	METER/MAIN/PS	BPS	P	480	4	THWN	4/0	THWN	1	
P004A	2"	ATS	GENERATOR	BPS	P	480	4	THWN	2/0	THWN	2	
C004C	1"	ATS	GENERATOR	BPS	C	120	4	THWN	14	THWN	14	
P004D	2-1/2"	ATS	PANEL H	BPS	P	480	4	THWN	4/0	THWN	1	
P004E	3/4"	PANEL A	GEN HEAT	BPS	P	120	2	THWN	10	THWN	12	
P004F	3/4"	PANEL A	BATTERY CHR	BPS	P	120	4	THWN	12	THWN	12	
C004G	3/4"	ATS	CONTROL PANEL	BPS	C	120	6	THWN	14	THWN	14	ATS AND POWER STATUS
C004H	3/4"	GENERATOR	CONTROL PANEL	BPS	C	120	10	THWN	14	THWN	14	GENERATOR STATUS
P100A	2"	PUMP CP	PANEL H	BPS	P	480	3	THWN	2/0	THWN	4	PUMP CP POWER FEEDR
S100B	1-1/4"	PUMP CP	PLC/RTU CP	BPS	S	24	2	TSP	18	THWN	14	FLOW STATUS
D100C	1-1/4"	PUMP CP	PLC/RTU CP	BPS	D		1	CAT 5				NETWORK CONNECTION
P100D	3/4"	PANEL A	PLC/RTU CP	BPS	P	120	2	THWN	12	THWN	12	PLC/RTU CP POWER FEEDER
C100E	1"	PUMP CP	PLC/RTU CP	FUTURE	C	120	20	THWN	14	THWN	14	PUMP CP STATUS (20 SPARES)
P101A	1"	PUMP CP	PUMP NO. 1	BPS	P	480	3	THWN	8	THWN	10	MOTOR POWER FEEDER
C101B	3/4"	PUMP CP	PUMP NO. 1	BPS	C	120	4	THWN	14	THWN	14	TEMP SWITCH AND LOS
P102A	1"	PUMP CP	PUMP NO. 2	BPS	P	480	3	THWN	8	THWN	10	MOTOR POWER FEEDER
C102B	3/4"	PUMP CP	PUMP NO. 2	BPS	C	120	4	THWN	14	THWN	14	TEMP SWITCH AND LOS
P103A	1"	PUMP CP	PUMP NO. 3	BPS	P	480	3	THWN	8	THWN	10	MOTOR POWER FEEDER
C103B	3/4"	PUMP CP	PUMP NO. 3	BPS	C	120	4	THWN	14	THWN	14	TEMP SWITCH AND LOS
P104A	1"	PUMP CP	PUMP NO. 4	BPS	P	480	3	THWN	8	THWN	10	MOTOR POWER FEEDER
C104B	3/4"	PUMP CP	PUMP NO. 4	BPS	C	120	4	THWN	14	THWN	14	TEMP SWITCH AND LOS
P105A	1"	PUMP CP	PUMP NO. 5	BPS	P	480	3	THWN	8	THWN	10	MOTOR POWER FEEDER
C105B	3/4"	PUMP CP	PUMP NO. 5	BPS	C	120	4	THWN	14	THWN	14	TEMP SWITCH AND LOS
P106A	3/4"	PANEL H	TRANSFORMER	BPS	P	480	2	THWN	12	THWN	12	TRANSFORMER FEEDER
P106B	1"	PANEL A	TRANSFORMER	BPS	P	240	3	THWN	8	THWN	10	PANELBOARD FEEDER
X110A	1"	POWER WIREWAY	(E) CONTROL PULLBOX	EXISTING TANK			1	Pullrope				SPARE - CAP FOR FUTURE
X110B	1"	POWER WIREWAY	(E) CONTROL PULLBOX	EXISTING TANK			1	Pullrope				SPARE - CAP FOR FUTURE
X110C	2"	PLC/RTU CP	(E) CONTROL PULLBOX	EXISTING TANK			1	Pullrope				SPARE - CAP FOR FUTURE
X110D	2"	PLC/RTU CP	(E) CONTROL PULLBOX	EXISTING TANK			1	Pullrope				SPARE - CAP FOR FUTURE
X110E	2"	COMM ENCL	(E) CONTROL PULLBOX	EXISTING TANK			1	Pullrope				SPARE - CAP FOR FUTURE
P111A	3/4"	COMM ENCL	PANEL A	BPS	P	120	2	THWN	12	THWN	12	COMM ENCL RECPT. FEEDER
D111B	2"	COMM ENCL	PLC/RTU CP	BPS	D		1	CAT 6				
D111C	2"	COMM ENCL	(E) COMM PULLBOX		D		1	12 S	FO			
P115A	3/4"	PANEL H	HEATER CON	BPS	P	480	3	THWN	10	THWN	8	HEATER POWER FEED
C115B	3/4"	T-STAT	HEATER CON	BPS	C	120	4	THWN	14	THWN	14	THERMOSTAT
P116A	3/4"	PANEL H	FAN	BPS	P	120	3	THWN	12	THWN	12	FAN
C116B	3/4"	T-STAT	FAN	BPS	C	120	4	THWN	14	THWN	14	THERMOSTAT
X117A	1"	PANEL H	STUB-UP	FUTURE			1	Pullrope				SPARE - CAP FOR FUTURE
X118A	1"	PANEL H	STUB-UP	FUTURE			1	Pullrope				SPARE - CAP FOR FUTURE
X119A	1"	PANEL H	STUB-UP	FUTURE			1	Pullrope				SPARE - CAP FOR FUTURE
X120A	1"	PANEL H	STUB-OUT	FUTURE			1	Pullrope				SPARE - CAP FOR FUTURE
X121A	1"	PANEL H	STUB-OUT	FUTURE			1	Pullrope				SPARE - CAP FOR FUTURE
P122A	1"	PANEL H	AIR COMPRESSOR	BPS	P	480	3	THWN	10	THWN	10	AIR COMPRESSOR FEEDER
C122B	1"	PLC/RTU CP	COMP CP	BPS	C	120	4	THWN	14	THWN	14	COMPRESSOR STATUS
C122C	1"	PLC/RTU CP	HYDROTANK	BPS	C	120	4	THWN	14	THWN	14	SPARES
C122D	1"	AIR COMPRESSOR	HYDROTANK	BPS	C	120	4	THWN	14	THWN	14	TANK STATUS
P123A	3/4"	PANEL A	SMOKE DETECTOR	BPS	P	120	2	THWN	12	THWN	12	SMOKE DETECTOR POWER
C123B	3/4"	PLC/RTU CP	SMOKE DETECTOR	BPS	C	120	2	THWN	14	THWN	14	SMOKE DETECTOR STATUS
C124A	3/4"	PLC/RTU CP	STAT INTRUSION SW	BPS	C	120	2	THWN	14	THWN	14	INTRUSION SWITCH STATUS
C124B	3/4"	PLC/RTU CP	(E) CONTROL PULLBOX	BPS	C	120	2	THWN	14	THWN	14	INTRUSION SWITCH STATUS
S127A	1"	PLC/RTU CP	EXISTING PIT-90	BPS	S	24	1	TSP	16	THWN	14	SYSTEM SUCTION PRESSURE
S127B	1"	PLC/RTU CP	(E) CONTROL PULLBOX	BPS	S	24	1	TSP	16	THWN	14	TANK PRESSURE/LEVEL
S128A	1"	PUMP CP	PIT-100	BPS	S	24	1	TSP	16	THWN	14	SKID SYSTEM PRESSURE
S129A	1"	PUMP CP	PIT-110	BPS	S	24	1	TSP	16	THWN	14	SYSTEM PRESSURE
X133A	1"	PLC/RTU CP	STUB-UP	FUTURE			1	Pullrope				SPARE - CAP FOR FUTURE
X134A	1"	PANEL A	STUB-UP	FUTURE			1	Pullrope				SPARE - CAP FOR FUTURE
P135A	3/4"	PANEL A	BUILDING RECPTS	BPS	P	120	2	THWN	12	THWN	12	RECEPTACLE POWER
P135B	3/4"	PANEL A	BUILDING RECPTS	BPS	P	120	2	THWN	12	THWN	12	RECEPTACLE POWER
P135C	3/4"	PANEL A	BUILDING LIGHTS	BPS	P	120	6	THWN	12	THWN	3X12	BUILDING LIGHTING POWER
P154A	3/4"	PANEL A	FIT-111	BPS	P	120	2	THWN	12	THWN	12	FLOWMETER POWER
S154B	1-1/4"	FE-111	FIT-111	BPS	S		2	PER	MFG			FLOW SIGNAL
S154C	1"	PLC/RTU CP	FIT-111	BPS	S	24	1	TSP	18	THWN	14	FLOW SIGNAL

IDENTIFIES THE TYPE OF CIRCUIT BEING SERVICED			
C=	CONTROL	P=	POWER
S=	INSTRUMENT SIGNAL	T=	TELEPHONE
D=	DATA	X=	SPARE

USA NORTH 811 Call 811 Before You Dig

ECS
ECS Engineering, Inc.
916-718-3686
samterry@earthlink.net

REV	DATE	REVISIONS	INITIAL

SITZMARK HYDROPNEUMATIC BOOSTER PUMP STATION REPLACEMENT

ELECTRICAL SITE PLAN

TRUCKEE DONNER Public Utility District
11570 DONNER PASS ROAD
TRUCKEE, CA 96161
PHONE: 530-587-3896
NEVADA COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Road, Suite 201, Nevada City, CA 95959
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0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH,
ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	
DESIGN BY:	CCE
DRAFTING BY:	SWT
CHECKED BY:	SWT
FILE PATH:	
DATE:	
SCALES:	
HORIZONTAL	E02-R1
VERTICAL	
SHEET:	17 of 24

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