PRINCE WILLIAM WATER
Your Water • Your Environment • Our Mission

SCADA DESIGN & CONFIGURATION STANDARDS

July 2025

Version 3.03

Document History and Version Control

Document history and version control are used to record detail of minor and major amendments (reviews) to this document over time. It allows anyone accessing the document to know if it is the most current version; when it was last amended; what was changed from the previous version; and who made the change(s).

Version Number	Section	Date	By	Description
0.01	All	May 22, 2015	CDM Smith	Draft Version
0.02	All	June 19, 2015	CDM Smith	Pre-Final Version (Incorporates Draft Comments)
1.00	All	July 14, 2015	CDM Smith	Final Version (Incorporates Pre-Final Comments) – Issued for Use
2.00	All	March 2018	IT/SCADA	Document renamed. Overall document review and updates.
2.01	All	April 2018	IT/SCADA	Product updates. Overall document review and updates.
2.02	All	November 2018	IT/SCADA	Product Updates and adding new product for Generator Fuel Level. Edited requirements for PMR. Fixed Appendix J.
2.03	All	November 2020	IT/SCADA	Product part number updates, general updates.
2.04	All	July 2021	IT/SCADA	Product part number updates, general updates.
2.05	All	January 2022	IT/SCADA	Product part number updates, PCSS requirements, general updates.
3.00	All	July 2022	IT/SCADA	Product part number updates, addition of AESS language such that AESS may be provided by SA or GC, decision to be made prior to conformed/final specifications.
3.01	All	January 2023	IT/SCADA	Product part number updates, additional markup of AESS language, modification of Backup Controller type for complex stations.
3.02	All	July 2024	IT/SCADA	Product part number updates, language regarding remote access and wireless technologies. Updated PWCSA to PWW and changed logo. Updates/changes highlighted in YELLOW.
3.03	All	July 2025	IT/SCADA	Updated Service Authority with Prince William Water. Product part number updates highlighted.

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101 Standards Overview

101.01 Introduction

The Supervisory Control and Data Acquisition (SCADA) Design and Configuration Standards (Standards) is Prince William Water's (PWW) design and configuration technical requirements for automation, instrumentation, and process control design and configuration throughout the distribution and collection (D&C) system.

These Standards apply to all new construction. PWW reserves the right to modify any of the requirements for existing facilities that are being upgraded.

101.02 Purpose

The purpose of this document is to establish uniformity and consistency by any party providing design and configuration services and/or providing SCADA related equipment for PWW. These standards provide a minimum baseline for all projects involving new construction or the upgrading of existing D&C facilities. Consult PWW before deviating from these Standards, or if the Project Design Engineer (PDE) determines that the Standards do not cover a unique situation.

The PDE must obtain approval in writing to deviate from the standards and requirements presented in this manual. Unless written approval of a deviation is provided by PWW, no deviations are permitted. It is not acceptable to assume Prince William Water design reviewers will pick up on deviations included in the detailed design or electrical schematics. Contact PWW for clarifications, if needed.

The Standards describe acceptable implementation practices and standards that are in accordance with Prince William Water required practices. All users are expected to exercise good professional judgment and apply appropriate industry standards for all projects.

Although the SCADA Standards Design and Configuration Standards dictate much of the automation design for projects, the manual does not contain actual specifications which can be used directly within contract specifications. It is the PDE's responsibility to develop specifications and drawings that incorporate PWW's standards and are acceptable to PWW.

101.03 System Description

The top-end system at PWW's Operations Control Center is comprised of a fault-tolerant, open architecture SCADA network consisting of servers hosting various applications including a real-time data historian. Prince William Water operations staff interact with the SCADA system using workstations residing in the control room or remotely through a secure connection to the SCADA system. Programmable Logic Controllers (PLCs) provide all monitoring and control functions at each remote site and interface with the existing and input/output (I/O) data points. All site automatic control logic exists within the remote site. For local monitoring and back-up control at each remote site, a backup touch screen operator interface terminal (OIT) panel and I/O for critical controls is located at the control panel. In more complex process control situations, a second PLC with minimal I/O may be used rather than a backup OIT. In this situation, the Main OIT would be the display for that backup process. This PLC shall be comprised of parts from Appendix A.

101.04 Compatibility of Products

Throughout this document, equipment may be described by function, features, or other characteristic. All equipment that has received prior approval by PWW is listed in Appendix A – Standard Components. For purposes of compatibility with the system architecture or key system components, some items are shown as **No "or equal" or substitutions.** Where this constraint is not shown, PWW's preferred manufacturer and model is provided. If a substitution is proposed for any of this equipment, the substitute product must have identical features, capabilities, warranties, and MTBF characteristics, and must be manufactured of equal or better materials.

Refer to Appendix A – Standard Components for information on submitting proposed substitute products for consideration by PWW.

101.05 Compliance

PWW's Infrastructure SCADA System is planned around standardized equipment, configuration, and programming in order to minimize maintenance and maximize the efficient operation of the Distribution and Collection system. Any variation from the Standards described in this document and the SCADA Programming Standards document can be expected to extend the time needed for review and acceptance of designs or constructed systems, and may result in the rejection of the design or constructed system.

In order to assist in understanding the requirements of the Standards, the steps typically necessary to complete the process of submitting designs for review all the way through testing and acceptance are summarized below:

Sequence of Control System Submittals, Reviews, and Testing:

1. Panel Layout Drawings and Preliminary Test Plan Submittal
2. Panel Layout Drawings Submittal Review and Approval Period
    a. Panel Layout Drawings Re-Submittal Review and Approval Period if Required
3. Submittal Review Coordination Meeting
4. PCSS Test Plan & Programming Submittal Review and Approval Period
    a. PCSS Test Plan & Programming Re-Submittal Review and Approval Period if Required
5. AESS Programming Submittal
6. PCSS Unwitnessed Factory Test (UFT) w/Recorded Results
7. PCSS Witnessed Factory Test (WFT) w/Recorded Results
    a. PWW may, at its discretion, waive the WFT
8. Joint on-site AESS / PCSS Operational Readiness Test (AESS/PCSS-ORT)
    a. This shall include PWW SCADA Personnel to program and test various devices (e.g. Cameras, Badge Readers, etc.) as well as the GeoSCADA integration.
    b. Separate AESS Operational Readiness Test (AESS-ORT) - Only if needed
9. Site Acceptance Test (SAT) for SCADA

Each project may be unique, and different design and submittal steps may be necessary to achieve an approved design. Contact PWW as needed to understand and comply with the applicable requirements.

101.06 Document Organization

The Standards are divided into 14 sections (plus appendices). Each section has its own numbering sequence and is divided into sub-sections as necessary. The 14 sections and appendices are defined as follows:

Section 101: Standards Overview

Section 110: Tagging Conventions

Section 120: Required Design Documents

Section 130: Contracting

Section 140: Control Hierarchy

Section 150: Site Specific Design Requirement

Section 160: Programmable Logic Controllers

Section 170: Operator Interface Terminals

Section 180: Control Panels

Section 190: System Testing

Section 200: Backup Power and Miscellaneous Monitoring

Section 210: Field Instrumentation

Section 220: Access Control, Operational Video, and Lighting Controls

Section 230: Telemetry, Networking, and Cyber Security

Appendix A: Standard Components

Appendix B: Sample P&IDs

Appendix C: Example General and Design Drawings

Appendix D: Example Equipment & Instrument and I/O Lists

Appendix E: Alarms, Alerts, and Logging Configuration

Appendix F: PCSS Qualification Requirements

Appendix G: Acceptance Testing

Appendix H: Remote Site Network Configuration Requirements

Appendix I: Sample Schedule

101.07 List of Acronyms and Abbreviations

The following acronyms and abbreviations are used throughout the SCADA Design Standards Manual:

AE	Applications Engineering
AESS	Applications Engineering System Supplier
AI	analog input
ANSI	American National Standards Institute
AO	analog output

ATS	automatic transfer switch
AWG	American Wire Gauge
CPU	central processing unit
CSI	Construction Standards Institute
FRP	fiber-reinforced plastic
D&C	distribution and collection
DI	digital input
DNP3	Distributed Network Protocol 3
DO	digital output
GC	General Contractor
HMI	Human Machine Interface
HOR	Hand-Off-Remote
I&C	instrumentation and controls
I/O	input/output
ISA	International Society of Automation
LAN	local area network
MCC	motor control center
MTW	machine tool wire
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
OIT	operator interface terminal
ORT	operational readiness test
P&ID	process and instrumentation drawing
PCSS	Process Control System Supplier
PDE	Project Design Engineer
PLC	Programmable Logic Controller
PoE	Power over Ethernet
PQM	power quality meter
PWW	Prince William Water
REX	Request to Exit
RTU	remote telemetry unit
RVSS	reduced voltage soft starter
SAT	site acceptance test
SCADA	Supervisory Control and Data Acquisition
Service Authority	Prince William County Service Authority

SIT	system integration test
Standards	SCADA Design and Configuration Standards
SNMP	Simple Network Management Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
UFT	unwitnessed factory test
UL	Underwriters Laboratories
UPS	uninterruptible power supply
USB	universal serial bus
VAC	voltage alternating current
VDC	voltage direct current
VFD	variable frequency drive
VLAN	virtual local area network
WAN	wide area network
WFT	witnessed factory test

110 Tagging Conventions

110.01 Introduction

This section includes the requirements for instrument and equipment tagging including loop assignment on all design projects.

110.02 Instrument and Equipment Tagging

Equipment tagging shall be used to identify drawing objects such as instruments, valves, pumps, tanks, and other devices. Pieces of equipment and instrumentation through the plant will be given a tag that can be referenced between mechanical and electrical equipment. No piece of equipment or instrument shall have an identical tag to any other piece of equipment at the same site. Submit the tagging plan to PWW for approval before developing design documents.

The format for all equipment tags shall be as follows: XXXX-LLLS

Where:

XXXX	1 to 4 letter identifier; International Society of Automation (ISA) instrumentation tag identifiers code (for instruments) or, mechanical equipment abbreviation
LLL	3-digit loop number
S	1-digit letter optional suffix (A, B, C…)

110.02.01. XXXX – Mechanical Equipment Abbreviations

All equipment, motors, pumps, mixers, etc. abbreviations shall consist of up to 4 letters to describe the type of equipment. Some mechanical equipment abbreviations are shown as follows.

- AC Air Compressor
- ATS Automatic Transfer Switch
- G Grinder
- GEN Generator
- HPU Hydraulic Power Unit
- P Pump
- VFD Variable Frequency Drive

Additional device codes and abbreviations will be jointly developed and approved by PWW.

110.02.02. XXXX – ISA Instrumentation Tag Identifiers

Instrument tagging will follow ISA standards as established in the ISA Standards Book, Library for Measurement and Control: Volume I.

TABLE 110-1. ISA INSTRUMENT TAG IDENTIFIERS

First Letter(s)			Succeeding Letters		
Letter	**Measured or Initiating Variable**	**Variable Modifier**	**Readout or Passive Function**	**Output or Active Function**	**Function Modifier**
A	Analysis		Alarm		
B	Burner, Combustion		Users Choice	Users Choice	Users Choice
C	Conductivity			Control	Closed
D	Density	Differential			Deviation
E	Voltage		Primary Element		
F	Flow, Flow Rate	Ratio			
G	Gauge		Glass		
H	Hand (Manual)				High
I	Current		Indicate		
J	Power		Scan		
K	Time, Schedule	Rate of Change		Control Station	
L	Level		Light (Pilot)		Low
M	Moisture				Middle
N	Users Choice		Users Choice	Users Choice	Users Choice
O	Users Choice		Orifice		Open
P	Pressure		Point (Test Connection)		
Q	Quantity		Integrate, Totalize		
R	Radiation		Record or Print		Run
S	Speed, Frequency	Safety		Switch	Stop
T	Temperature			Transmit	
U	Multivariable		Multifunction	Multifunction	Multifunction
V	Vibration			Valve or Damper	
W	Weight, Force		Well		
X	Unclassified		Unclassified	Unclassified	Unclassified
Y	Event, State, Presence			Relay or Compute	
Z	Position			Drive, Actuate, or Unclassified Final Control Element	

110.02.03. LLL – Loop Numbers

On every design project, identification numbers for equipment and instruments must be assigned. Project loop numbering shall follow the ISA loop numbering format defined by the ISA standard ISA-5.1, paragraph 4.3.

There are no specific ISA guidelines for assigning loop numbers; however, PWW has standardized on loop number ranges based on the relative location of the process or area grouping. The following are the loop number ranges, by site type, that shall be adhered to on all design projects:

TABLE 110-2. LOOP NUMBERING BY SITE TYPE

Loop Number Range	Process / Area
	PUMP STATIONS
100-199	Station Influent / Suction
200-299	Pumping
300-399	Station Effluent / Discharge
400-499	Station Power / Electrical Systems
500-599	Supplemental Systems / Miscellaneous
600-699	Water Quality Monitoring / Chemical Addition
700-799	Building Management
800-899	Security / Access Control
900-999	Backup Control
	ELEVATED STORAGE TANKS
100-199	Primary Piping including Level Measurement
200-299	Pumping (If Present at Site)
300-399	Station Outlet / Discharge (If Present at Site)
400-499	Station Power / Electrical Systems
500-599	Supplemental Systems / Miscellaneous
600-699	Water Quality Monitoring / Chemical Addition
700-799	Building Management
800-899	Security / Access Control
900-999	Backup Control
	METERING / PRESSURE REDUCING STATIONS
100-199	Pre-Metering / Pre-Pressure Reducing
200-299	Metering / Pressure Reducing
300-399	Post-Metering / Post-Pressure Reducing
400-499	Station Power / Electrical Systems
500-599	Supplemental Systems / Miscellaneous
600-699	Water Quality Monitoring / Chemical Addition
700-799	Building Management

TABLE 110-2. LOOP NUMBERING BY SITE TYPE

Loop Number Range	Process / Area
800-899	Security / Access Control
900-999	Backup Control

110.02.04. S – Optional Suffix

Only used when a given loop has more than one instrument with the same functional identification.

110.03 Process Pipe Tagging

Included on process and instrumentation drawings (P&IDs), identification of process piping is an important activity for improved process understanding. All major or minor process piping shall be tagged as follows:

"Size – Service – Spec"

Where:

Size	Pipe diameter in inches
Service	Process service abbreviation
Spec	Pipe material abbreviation

120 Required Design Documents

120.01 Introduction

The Designer shall submit two types of deliverables for SCADA design projects: drawings (plans) and specifications. This section provides an overview of the referenced industry standards, different types of drawings that can be developed as well as an overview of each specification section and when to use it.

This section is presented in general terms to guide the PDE in developing documents that meet PWW's requirements, while allowing some latitude in meeting specific project requirements. The Designer shall submit an outline of the proposed design documents to PWW for approval prior to beginning development of a detailed design.

120.02 References and Applicable Standards

The following automation codes and standards shall apply to the D&C SCADA control systems in addition to the Standards. The current revision shall be the standard upheld to.

International Society of Automation (ISA)

- ISA S5.2, Binary Logic Diagrams for Process Operations.
- ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
- ISA S5.4, Instrument Loop Diagrams.
- ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
- ISA RP60.3, Human Engineering for Control Centers.
- ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.
- ISA-99, Industrial Automation and Control Systems Security.

National Electrical Manufacturers Association (NEMA)

National Fire Protection Agency (NFPA)

- NFPA 70, National Electrical Code (NEC).
- NFPA 79, Industrial Control Equipment.

Area Classification

- PDE to establish classification per codes, Prince William Water, and AHJ.

Project Specifications

- PDE shall use the reference specifications, modified as required for the project and Approved by PWW, for the project construction documents.
- The reference specifications are available from PWW in electronic format upon request.

Underwriters Laboratories, Inc. (UL)

- UL 508 - Industrial Control Equipment - for custom fabricated equipment.

- A nationally recognized testing laboratory, as approved by both the Authority having jurisdiction and PWW (when PWW is not the AHJ), may substitute for UL listing on commercial off the shelf products.

120.03 Drawings

The PDE shall present instrumentation and controls (I&C) design drawings in a logical manner using the following sequence for types of drawings:

- Legend Sheets
- Control System/Network Architecture Drawings
- Facility Plan and Equipment/Device Location Drawings
- P&IDs
- Panel Layouts
- Installation Details
- Demolition Details
- Other drawings as necessary to clearly describe the project

Refer to Appendix B – Example P&IDs and Appendix C – Example General and Design Drawings. These examples are for general arrangement and content only, and are not to be copied or reused for design or submittal purposes. Appendix B and C both include a **REQUIRED BORDER STYLE** for the Panel Drawings and the P&I Drawings.

120.03.01. Drawing Coordination

The physical location of instruments shall be shown on all relevant drawings. With Prince William Water approval of the PDE's Design Document Outline, drawings for different disciplines may be combined for small projects as appropriate. Locate equipment as indicated below:

- Mechanical
  - Locate all field instruments, show interface to mechanical piping (pipe taps, insertion meters, etc.).
- Electrical
  - Locate all equipment that requires electrical power supply connection.
  - Locate all equipment requiring signal or communications interconnection.
- Architectural
  - Locate control panels and enclosures on floor plan layouts.
- Structural
  - Locate instruments on: flumes, weirs, stilling wells
  - Special equipment access railings, bases, and pads
  - Antennas including antenna base considering wind-loading factor

Care must be taken to specify or detail the field mounting location of all instruments, remote- mounted controls and indicators or displays so that equipment can be easily maintained and operated. Details or coded notes shall be used to clearly define the location and orientation of controls and indicators so

that they can be safely accessed and read. Indicators or displays should face the operator and be horizontally and vertically located so that they can be easily read.

Controls, switches, and keypads must be readily accessible to and appropriately illuminated for the operator.

120.03.02. Legend Sheets

Legend sheets shall be provided to clearly define all of the symbology, nomenclature, equipment and line types shown on the design drawings. Each discipline shall have their own legend sheets for their drawings. Where appropriate, ensure that, on black and white prints and copies, symbology and line types clearly delineate between new and existing equipment, construction and demolition, and other changes to an existing facility.

120.03.03. Control System/Network Architecture Drawings

For all D&C projects, a control system/network architecture drawing(s) shall be provided that quantifies and locates all of the major equipment in the system. The drawings shall show the major components of the network (e.g., communication medium, communication panels and components, and UPS systems), connecting cables and types, all control panels that have controllers connected to the network, and the operator interface devices such as OITs. Any of these components powered by the UPS shall be noted on this drawing.

120.03.04. Facility Plan and Equipment/Device Location Drawings

The Facility Plan Drawings shall show the overall site with the location of all planned or visible structures, facilities, driveways, and visible utility lines on the project site.

The Equipment/Device Location Drawings shall show the location of all equipment, whether SCADA-related or not, on the interior and exterior of the facility. Dimensions shall be included to show clearances, heights, and other features to clearly indicate the installed locations. If demolition is required at existing facilities, the equipment to be removed shall be clearly identified on a separate drawing.

120.03.05. Process and Instrumentation Drawings

P&IDs shall show all of the major mechanical equipment and instrumentation for the process, as well as I/O signals to/from the PLC. Refer to the example drawings in Appendix B – Example P&IDs for the acceptable layout of this information. Other information to be shown on a P&IDs is discussed in this section. Loop numbers are used to create a unique tag for each instrument and piece of equipment on the P&IDs. The PDE shall use the loop numbering convention described in Section 2.

The following items shall be shown on P&IDs:

- Power Sources – Instruments and vendor control panels shall be shown with the appropriate power source as defined by the symbology on the legend sheets. Types of power sources could include but are not limited to a UPS system, a power feed from a control panel, a dedicated power supply, or a power feed from an electrical power distribution panel.
- Remote vs. Integrally Mounted Displays and Controls – P&IDs shall clearly indicate which instruments and valves have their displays and controls locally mounted at the device versus a remote location. The location of each instrument and valve shall be such that all displays and controls are accessible to an operator and technician. Placing displays and controls at inaccessible locations or areas that are difficult to access will be unacceptable.
- Types of Wiring - Some instruments are provided with their own power and communication cables while others need to be wired by the electrician. The P&IDs shall clearly indicate these

differences on the P&IDs with different line type symbology to clearly indicate how each instrument is wired.

- Vendor Control Panels – In addition to the control system designed by the PDE, there may be other control panels provided with the major mechanical equipment. These are referred to as vendor control panels. If these panels are connected to the SCADA system, they shall be shown on the P&IDs. Vendor control panels shall be differentiated with either a different line type or note that states which Division # (i.e., "discipline") is providing it. Any vendor panels shown on the P&IDs need to be coordinated with the appropriate specification section to ensure that the signals to the control system, communication medium, and panel devices are all properly coordinated.
- Failsafe Wiring – Each digital input (DI) to the control system shall be designated with notation to indicate failsafe wiring (i.e., contact opens on alarm or status indication).

120.03.06. Panel Layouts

PWW has developed standard SCADA system control panel layouts and component lists with which the PDE and control panel fabricator shall comply. Any deviation from the standard panel layout and components must be approved in writing by PWW prior to beginning fabrication. Any unapproved modifications cannot be included in any Request for Payment.

Panel layout drawings define the minimum and maximum size requirements for non-standard and/or vendor-supplied control panels. The control panel layout must establish that all of the components will fit within the panel, can be readily accessed for maintenance and/or replacement, and have the required manufacturer's clearances for ventilation.

The panel templates can be found in Appendix C – Example General and Design Drawings. The layout of all SCADA panels shall match the configuration shown on the drawings.

120.03.07. Vendor-Furnished/OEM Control Panels

Vendor provided control panels included as part of packaged systems must generally comply with requirements of these Standards, including brands and models of components described in Appendix A – Standard Components. It is not the intent of this specification that standard or stock control panels be redesigned per the workmanship and material sections defined in this Section. This section does, however, set minimum quality standards that must be met or exceeded. The control panel submittals shall clearly identify exceptions to these specifications.

- Power Supplies – Unless otherwise noted, power is provided to the OEM control panels from a single source as listed in the specifications or shown on the Drawings.
    - Power and distribution devices including, control power transformers, power supplies, fuses, circuit breakers, power distribution blocks, terminations and other required components shall be provided to generate all required voltages used by the control panel.
    - Panels including VFDs or motor starters shall be provided with an externally accessible main disconnect.
- Large and Networked PLCs
    - Where OEM panels are provided with PLC components tied to the Plant PCS over a control network, the components shall match the equipment provided by the PCSS for the units provided as part of Division 17.
    - Coordinate with the PCSS to verify that the equipment has been properly selected and that network addresses, data types and register addresses are properly identified.

- Small PLCs - Standard or stock OEM panels that are not networked and have I/O requirements totaling less than one full I/O rack, shall be provided with the vendor standard PLC.
- Owner Maintenance
  - All tools, information and equipment required to fully maintain or modify the provided OEM panels shall be provided. Tools and equipment shall include, but not be limited to:
    - Documented PLC/HMI source code and configuration files.
    - Licensed PLC/HMI development software.
    - Connecting cables.
    - Network interface devices.
    - One spare of each type of PLC card provided.
  - Where the PLC source code contains verifiable copyrighted material, the Vendor may request that distribution of the source code be limited outside of PWW's managers and users.

120.03.08. Installation Details

Installation details show the physical requirements for each installation in order for that instrument to be properly installed by the contractor. The details are not meant to replace the manufacturer's installation details and instructions but instead provide the contractor with general requirements specific to the design.

120.04 Specifications

The PDE shall prepare specifications in accordance with this SCADA Design and Configuration Standard. Any variation from the requirement of the Standard must be approved in writing by PWW.

The specifications shall be organized per the Construction Standards Institute (CSI). PWW currently uses the 16 division format.

The following is a sample listing of specifications:

TABLE 120-1. SPECIFICATIONS

16 Division Format	50 Division Format	Title
13300	40 9000	General Provisions
13302	40 9020	Testing
13303	40 9030	Training
13305	40 9645	Control Strategies
13310	40 9413	Computer Hardware and Software
13311	40 9443	PLC Hardware
13320	40 9510	Control and Data Networking Equipment
13321	40 9553	Fiber Optic Cabling
13330	40 9513	Control Panels and Panel Mounted Equipment
13335	40 9514	Uninterruptible Power Supply (UPS) (Single Phase)
13340	40 9100	Instruments

TABLE 120-1. SPECIFICATIONS

16 Division Format	50 Division Format	Title
13341	40 9141	Flow Devices
13342	40 9142	Level Devices
13343	40 9143	Pressure Devices
13344	40 9144	Temperature Devices
13345	40 9145	Analytical Devices
13346	40 9146	Miscellaneous Devices

120.05 Other Design Documents

In addition to drawings and specifications, there are other documents that shall be produced as part of the design. Two required documents are an Instrument List and an I/O List. Each of these lists shall be submitted in both electronic (Excel and pdf) and printed format, and shall follow the templates provided in Appendix D – Sample Equipment & Instrument and I/O lists.

The Instrument List identifies the instruments (and devices, such as limit switches) provided for the project as well as the instrument ranges and initial operational setpoints. The instrument list shall also identify the power requirements, the make and manufacturer of an instrument, and any specific operating or configuration requirements for the device.

An I/O list shows each input and output signal in a list. The preliminary I/O list shall be provided as part of the preliminary design, and the list, along with the control panel design, shall be finalized and approved by PWW prior to beginning fabrication of the control panel. This list shall be organized by I/O card to ensure signals are assigned to the PLC I/O cards to take into account system redundancy. For example, the design shall take signals from multiple pumps for a particular process and spread out the monitoring and control signals for each of those pumps over multiple cards, to prevent the failure of one I/O card from causing all pumps to fail. Spare I/O card points and spare rack slots (spaces) shall be designated in the I/O list.

The I/O list shall also include the SCADA tagname and shall include a space to add the ClearSCADA point ID after the ID has been assigned.

120.06 Coordination Meetings and Schedule

Project coordination meetings are mandatory as a part of any project, unless specifically waived by PWW in writing. Where the AESS is performed by or contracted by PWW (covered in Section 130.03), the meetings shall be held at PWW's designated location and shall include attendance by PWW, the PDE, the General Contractor (GC), the Process Control System Supplier's (PCSS's) Project Engineer, and the AESS Project Engineer. The PCSS shall prepare and distribute an agenda before the scheduled meeting date.

- A project kickoff coordination meeting shall be held to discuss the PCSS's and AESS's understanding of the project; discuss the project's submittal requirements; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware related issues; and request any additional information required from PWW. This meeting should be held prior to the submission of any technical shop drawings or submittals.

- A submittal review coordination meeting shall be held after the panel drawing submittal package has been reviewed and returned to the PCSS. The purpose of this meeting shall be to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AESS.

Additional meetings such as factory test coordination and field test coordination may be specified and included at the discretion of either PWW or the PDE. A complete schedule for the project shall be prepared showing all meetings, milestones, deliverables, testing, points of coordination with PWW and/or their contractors, and other significant activities. The schedule shall be updated no less frequently than once a month. All updates shall include a Summary Change document describing the changes that have been incorporated in the update. An example schedule is provided in Appendix I – Sample Schedule.

130 Contracting

130.01 Introduction

The entity that furnishes and installs all materials, equipment, labor and services, required to achieve a fully integrated and operational control system is identified as the PCSS. On each construction project, the GC shall procure the services of a PCSS to execute the process control system requirements specified on a given project. In most cases, the AESS services shall also be procured by the GC, however, PWW may choose to perform or hire these services. This decision will be finalized during design and will become part of the project specifications.

130.02 PCSS Qualifications Criteria

The PCSS shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. The company qualifications and individual resumes of the PCSS are subject to review and acceptance by PWW prior to beginning work on any project. For current PCSS qualification requirements, refer to Appendix F – PCSS Qualification Requirements. The company qualifications and individual resumes of the PCSS are subject to review and acceptance by PWW prior to beginning work on any project.

130.03 Applications Engineering

The entity that performs the software development, integration, and commissioning of the control system is identified as the Applications Engineering System Supplier (AESS). On all projects, the AESS scope of work shall include: PLC programming, testing of PLC logic, Main and Backup OIT graphics and control development and testing, and OIT software configuration. In some instances, at the discretion of PWW, the AESS may be required to program, configure, and test the HMI graphics and control and GeoSCADA database development, but typically these activities will be performed by PWW personnel. The cellular router and managed Ethernet switch final configurations, report development, and Access Control and Operational Video devices shall be performed by PWW personnel. Startup/training activities associated with the configured portions of the PLC/HMI/OIT systems shall also be the responsibility of the AESS.

To implement PWW's standard programming blocks, templates, and strategies; all AESS activities shall be performed in accordance with PWW's SCADA Programming Standards. The AESS may be performed by PWW or the Service's Authority's designee. This decision shall be made prior to final/conformed specification documents and shall be clearly noted in those documents whether the AESS activities will be part of the GC's responsibilities to subcontract or if they will be the responsibility of PWW and/or PWW's designee. Where the AESS activities are performed or contracted separately by PWW, the system programming and development shall not be furnished by the PCSS, the PDE, or the GC. The PCSS shall provide all programming required for witnessed factory testing (WFT) and unwitnessed factory testing (UFT), and shall provide one copy of all testing code to PWW in native electronic and printed format.

In the case where PWW provides or procures the AESS services, it is the PDE's responsibility to ensure that the contract documents provides enough time for the AESS to complete all Applications Engineering (AE) activities on the project. Where the AESS services are procured by the GC, it is the GC's responsibilities to ensure proper coordination of events. The following are the minimum time durations that shall be specified on every project where the AESS services are provided or procured by PWW:

- Completion of AESS's Programming - A minimum of ninety (90) calendar days are required for PWW or designee to complete the programming necessary prior to the system integration test (SIT). The allotted time period shall not start until panel layout drawings have been submitted and approved. Any additional time required for programming due to changes or errors in the design shall not extend the duration of the contract.
- Completion of AESS's Software Integration Test (if requested) at PCSS's facility - Twenty-one (21) calendar days after successful completion and acceptance of the WFT.
- Completion of AESS's Application Software operational readiness tests (ORTs) – Twenty-one (21) calendar days after successful completion and acceptance of the PCSS's ORT.

Refer to Section 190 for more information on SCADA system testing.

140 Control Hierarchy

140.01 Introduction

PWW utilizes a hierarchical control approach by having layers of control to provide a standard format for monitoring/control of each D&C remote site and configuration of the SCADA servers. At the lowest layer, local control provides the ability to operate the equipment at the device or from a local control panel, independent of the PLC. Remote control provides operations the ability to control the individual equipment or grouping of equipment from either the local OIT or remotely via computer workstations. Remote control shall consist of selecting an operational mode (manual or automatic), and sending control set points and commands to the PLC systems. In turn, each of these commands will activate preprogrammed control algorithms within the PLC software logic. In case of a PLC failure, a backup control system shall be provided to keep the site operational until the PLC can be fixed.

Utilizing this control approach provides operators and maintenance staff a uniform interface which improves their understanding of how to monitor/control the equipment, the control modes the equipment can attain, and how to override the controls when necessary due to failures or when required for routine maintenance. All services provided related to the D&C SCADA System shall support this control approach.

140.02 Local Control

Local controls shall be provided in the close proximity of each piece of equipment. Local controls shall be located on respective equipment motor control center (MCC), VFD or a panel containing motor starter only if the driven equipment can be observed from this location; otherwise, the local controls shall be located next to the equipment. Equipment controls shall be designed such that control is only from one location at a time.

The following are the general requirements for local control:

- Local controls shall be fully independent of the PLC controls and shall only incorporate hardwired interlocks such has high motor temperature, high discharge pressure, low level etc. wired in the motor starter circuit to stop the equipment on detection.
- Local controls shall always take precedence over any remote controls.
- Local controls shall be furnished with LED pilot light indication to display the operating status of the equipment.
- A three position Hand-Off-Remote (HOR) switch shall be provided for local controls near the equipment. When the HOR switch is in the “Hand” position, the equipment shall be operated by hardwired logic in the motor starter circuit. While in “Hand” position, any remote control signals from PLC shall be isolated from the motor starter circuit. Any user video display interfaces shall indicate that the equipment is in “Hand”.
- When the HOR switch is in the “Remote” position, the equipment operation shall be controlled by the PLC logic. All the hardwired interlocks wired in the motor starter circuit shall still be applicable. Any user video display interfaces shall indicate that the equipment is in “Remote.”

140.03 Remote Control

Remote control of the remote site and individual equipment shall be performed by the local PLC or the backup control system.

- When the HOR switch is in the “Remote” position, the equipment operation shall be manually or automatically controlled via the PLC logic. All the hardwired interlocks wired in the motor starter circuit shall still be applicable. An equipment “In Remote” status signal from the HOR switch position shall be wired to the PLC system.

While in “Remote “mode, the control system shall have the option of operating the equipment in following two modes.

- Remote-Manual: When Remote-Manual control is active, it means that the equipment is in the “Remote” position in the field and all control decisions shall be initiated by the operator using the software control functions shown on the local SCADA HMI or OIT screen. The operator shall be able to manually start/stop and adjust the speed (if applicable). This is the default mode.
- Remote-Auto: When Remote-Auto control is active, it means that the equipment is in the “Remote” position in the field and the equipment is controlled automatically by the logic programmed in the PLC or by the backup control system. The operator will need to engage “Auto” mode from the SCADA HMI or OIT screen to enable PLC control. The operator shall be able to change the start/stop control function related setpoints when this mode is engaged.

140.04 Backup Control

The primary control system for each site consists of a local PLC that interfaces the site’s input and output (I/O) signals for monitoring and control of the site’s instrumentation and equipment. The PLC will be programmed with custom control logic functions that will automate the operations at each site.

Should the PLC fail for any reason, a backup system consisting of an OIT + PLC combination unit will be used for interim limited automatic control functions. The OIT backup control system consists of a graphical touchscreen panel equipped with logic solving capabilities and integrated I/O for critical system controls. In some instances, as approved by PWW, it may be necessary to use an additional PLC with the Main OIT as a backup control system. Refer to Section 170 for more information on the OIT backup control system.

The use of hardwired controls as a backup to the PLC in lieu of the backup control system is strictly prohibited.

The backup control system will primarily be used as a traditional OIT system to monitor and control the equipment and instrumentation at each site. The system shall be networked over Ethernet through the wide area network (WAN) to the top-end SCADA system via Modbus Transmission Control Protocol/Internet Protocol (TCP/IP) for communication purposes.

The purpose of the backup control system is to operate the remote sites in a temporary, controlled manner until the primary system is restored. When the backup control system detects a PLC failure or a user initiates a remote command to place the backup controls in service, the system will automatically control the facility based on a pre-programmed logic sequence. A minimal set of I/O required to operate the facility shall be wired to the backup control system. The backup control system shall monitor the health of the PLC through a hardwired connection from the PLC power supply. The power supply is equipped with an alarm relay contact that signifies when the PLC is operating properly. The operating principle of the PLC power supply alarm relay contact is as follows:

- In normal operation, with the PLC in “run” operation, the alarm relay is activated and its contact is closed.
- The relay de-energizes and its associated contact opens whenever the PLC application stops, even partially, due to any of the following:
    - Occurrence of a detected software fault

- Incorrect rack output voltages
- Loss of supply voltage

Backup operations apply to the following types of remote sites:

- Wastewater Lift Stations
- Fresh Water Booster Pump Stations

140.04.01. Wastewater Lift Stations

For wastewater lift stations, the backup control system shall control the station's lift pumps to pump the sewage out of one or more wet wells. The backup control system will operate the pumps based on the measured wet well level. All wet wells shall be equipped with redundant level instruments. Signals from all instruments shall be connected to the PLC.

The following field signals shall also be interfaced to the backup control system:

- Wet well levels (4-20 mA analog inputs (AI))
- High-High float switch (DI)
- Start / Stop Commands to each lift pump (digital outputs (DOs))
- Any additional I/O as determined by the process control description and PDE in consultation with PWW during design required to operate the station in a controlled manner until the primary system is repaired.

The backup control system shall operate the lift pumps in response to the selected wet well level. Start and stop level setpoints shall be provided for each pump. The backup control system shall provide options for "Fixed" and "Alternating" pump sequences. For duplex pump configurations, the backup control system shall provide Lead / Lag & Duty / Standby options. For triplex pump configurations, the backup control system shall provide Lead / Lag 1 / Lag 2 and Lead / Lag / Standby options.

For VFD pumps, when the PLC fails, the 4-20 mA speed reference signal will drop to zero. To control the pumps independent of the speed signal, the VFDs must be configured by the PCSS to a default speed when the reference signal fails. The default VFD speed shall be determined on a case-by-case basis in consultation with PWW.

140.04.02. Water Booster Pump Stations

Normal operation of the water booster pumps is to control the booster pumps in response to a remote water storage tank level. The remote tank levels are normally transmitted to the local PLC at the pump station; however, if the PLC fails, the pump station may no longer be able to operate to maintain tank level depending on the specific communications configuration. Coordinate with PWW on this configuration.

The following field signals shall be interfaced to the backup control system:

- Station Discharge Pressure (4-20 mA AI)
- Start / Stop Commands to each booster pump (DOs)
- Any additional I/O as determined by the process control description and PDE in consultation with PWW during design required to operate the station in a controlled manner until the primary system is repaired.

The backup control system shall operate the booster pumps in response to the discharge pressure. Start and stop pressure setpoints shall be provided for each pump. The backup control system shall provide options for "Fixed" and "Alternating" pump sequences. For duplex pump configurations, the

backup control system shall provide Lead / Lag & Duty / Standby options. For triplex pump configurations, the backup control system shall provide Lead / Lag 1 / Lag 2 and Lead / Lag / Standby options.

For VFD pumps, when the PLC fails, the 4-20 mA speed reference signal will drop to zero. To control the pumps independent of the speed signal, the VFDs must be configured by the PCSS to a default speed when the reference signal fails. The default VFD speed shall be determined on a case-by-case basis in consultation with PWW.

150 Site Specific Design Requirements

150.01 Introduction

This section includes Prince William Water requirements regarding the design of various remote sites. Site types included in this section include:

- Wastewater Lift Stations
- Fresh Water Booster Stations
- Elevated Water Storage Tanks
- Fresh Water Metering Stations

It is the responsibility of the PDE to incorporate the following minimum requirements, including alarm management planning, into their contract documents.

150.02 Wastewater Lift Stations

Wastewater lift pump stations are generally comprised of a receiving well (wet well), often equipped with a screen or grinder to remove coarse materials; pumps and piping with associated valves; and a discharge flow measurement. In most cases, an emergency generator is provided for emergency site power.

The primary and backup control system at each wastewater lift station shall conform to the requirements of Section 140 of these Standards.

The following are primary requirements for lift station automation design:

- A high level float switch in the influent channel to notify operations if the bar rack (or screening system) is apparently blocked. The switch is wired to the PLC for alarm purposes.
- PLC control of the influent grinder is not required. This equipment will be operated in hand at all times when the lift station is online. The grinder running status and motor overload/failure shall be monitored.
- The primary method of level measurement in the wet well is hydrostatic pressure using submersible level transducers. PWW no longer uses nor allows bubbler systems for continuous level measurement.
- Redundant level measurement shall be provided and connected to the PLC and backup controller, utilizing signal conditioners and isolators.
- Floats shall be provided for alarming and backup control; however, control must be through the PLC (and backup control system if required). The use of hardwired controls (for primary or backup) is not permitted. Hardwired controls may be used as safety interlocks for the equipment. One High-High level float is required per wetwell.
- Pumps should be controlled based on operator enterable setpoints against the continuous wet well level. For VFD driven pumps, the speed will be adjusted to maintain an operator adjustable wet well level setpoint,
- All process control I/O for pumps shall be interfaced to the PLC by hard wired I/O and not by networked communications. Networked communication for data not used for control purposes is encouraged to take advantage of additional data monitoring opportunities. If networked, devices shall natively support and use Modbus TCP/IP Ethernet communication protocol.

Requests to use non-native protocol converters under special circumstances shall be made in writing to PWW, whose approval or disapproval shall be final. All available process data for networked devices must be accessible by the PLC.

- Other design considerations such as backup control, power monitoring, access control, and emergency generator integration shall be designed in accordance with this document.

150.03 Fresh Water Booster Stations

Fresh water booster stations are generally comprised of one (1) or more booster pumps, suction and discharge pressure, flow, and power instrumentation. In most cases, an emergency generator is provided for emergency site power.

The primary control system at each water booster station shall be a PLC that interfaces with the I/O signals for monitoring and control. Should the PLC fail for any reason, the backup control system shall be used for interim automatic control functions.

The following are general guidelines and preferences for automation design:

- The pumps should be controlled based one or more remote elevated storage tank levels. In most cases, pumps are constant speed and are controlled based on operator enterable setpoints.
- If all remote tank levels are unavailable, any operating pumps will continue to run and the pump will be stopped on high discharge pressure.
- All process control I/O for pumps shall be interfaced to the PLC by hard wired I/O and not by networked communications. Provide networked communication for data only, and enable supplemental data monitoring opportunities. Networked data communications shall use, Modbus TCP/IP Ethernet communication protocol. Networked connections to devices shall not be used for control or to replace hardwired requirements for alarms.
- Other design considerations such as backup control, power monitoring, access control, and emergency generator integration shall be designed in accordance with this document.
- All pressure transmitters for discharge pressure shall be Rosemont smart transmitters with a display.

150.04 Elevated Water Storage Tanks

Fresh water storage tanks shall be equipped with level instrumentation, a chlorine analyzer, and an altitude valve. In some instances, emergency generators and tank mixers are also required.

The primary control system at each elevated storage tank shall be a PLC that interfaces with the I/O signals for monitoring and control. Each PLC is equipped with an OIT for local monitoring of the PLC. Unless specifically required by PWW, backup control is not required for these sites.

The following are general guidelines and preferences for automation design:

- Redundant tank levels shall be provided for each tank.
- Tank level measurement shall be provided by pressure transmitters located in the tanks' valve vault or in the base of the tank (depending on the tank style).
- All pressure transmitters for tank level shall be Rosemont smart transmitters with a display.
- A chlorine residual analyzer shall be provided to measure and report water quality.
- PWW requires full control and monitoring of altitude valves.

- Each vault shall be monitored for unauthorized intrusions. Limit switches on hatches, doors, or other access points shall be used in conjunction with the access control system design.
- Other design considerations such as power monitoring, access control, and emergency generator integration shall be designed in accordance with this document.

150.05 Fresh Water Metering Stations

Fresh water metering stations are comprised of one (1) or more flow meters and pressure instrumentation. Where determined to be necessary by PWW, these site may also include control valves and/or chlorine analyzers, which must be included in the SCADA system.

The following are general guidelines and preferences for automation design:

- Flow meters shall be interfaced to the PLC for calculating the total flow. The use of a high-speed counting PLC module may be required.
- Each vault shall be monitored for unauthorized intrusions. Limit switches shall be used in conjunction with the access control system design.
- Valve monitoring is not required unless otherwise required by PWW.
- Other design considerations such as power monitoring and access control shall be designed in accordance with this document.
- Unless specifically required by PWW, backup control is not required for these sites.

150.06 Alarm Identification and Prioritization

The primary function of the alarm system is to alert the operator to deviations from normal operating conditions, i.e. abnormal operating situations. The ultimate objective is to prevent, or at least minimize, physical and economic loss through operator intervention in response to the condition that was alarmed. The secondary function of the alarm system is to serve as an alarm and event log so operations staff can analyze the events that have led to current or past incidents. The log can also be used for analysis to optimize D&C system operations.

150.06.01. Alarm Configuration

For each design package, the PDE shall ensure that the alarms to be generated by the SCADA system meets PWW's requirements. PWW has defined what conditions are to be configured as alarms, and what conditions are alerts or log entries.

Refer to Appendix E – Alarms, Alerts, and Logging Configuration for general configuration requirements. All equipment shall be provided with the appropriate relays, contacts, or outputs required to provide the indicated alarm or alert information. The PCSS shall configure any required communications, alarms, or alerts in manufacturer-furnished control panel. The PDE shall submit for approval a completed I/O list with the configuration of all alarms, alerts, or logging settings clearly identified. The submittal shall follow the template included in Appendix D – Example Equipment & Instrument and I/O Lists

160 Programmable Logic Controllers

160.01 Introduction

This section includes the PLCs for control of process instrumentation and equipment at the D&C remote sites. PWW has standardized on the Modicon M340 PLC platform from Schneider Electric. It is the responsibility of the PDE to incorporate the following requirements into their contract documents.

160.02 General Requirements

The following are the general requirements for all PLCs (minimum requirements for all parameters are specified in Appendix A – Standard Components):

- Provide PLC equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
- Each PLC system shall include a processor, power supply, I/O modules, and communication modules as required to meet system requirements.
- The PLC shall be capable of stand-alone operation in the event of failure of the communication link to the supervisory HMI subsystem.
- The PLCs shall communicate between the OIT; motor starters, VFDs, and other networked components; and field-mounted transducers, switches, controllers, and process actuators. The communication protocol shall be completely transparent to operators at the HMI or OIT.
- VFD status (Run Command, Run Status, Fault, Speed Command and Speed Feedback) signals shall be hardwired to the PLC. All other data is communicated via the network connection.
- Reduced voltage soft starters (RVSS) shall be configured to allow SCADA control when the RVSS is in bypass mode.
- Each I/O drop or I/O location shall include at least 25 percent spare points of each type used (AI, AO, DI, and DO) for future use. The spares shall be the same type of I/O modules supplied. Unpopulated modules may be required to meet this requirement.
- Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the same manner and order that they occur on the I/O modules, including conditioners, filters, fuses, and similar. Unwired spares are not acceptable.
- Where multiple sets of mechanical equipment and instruments are provided for process redundancy, arrange their field connections to I/O modules so that the failure of a single I/O module will not disable the redundant system. This applies to all I/O types. The acceptability of the I/O arrangement shall be at the discretion of PWW.
- The PLC chassis shall be sized to accommodate the number of modules required based on the I/O schedule plus the required spare slots. A minimum of 2 spare slots shall be provided for future expansion.
- The PLC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules. Power supply for the PLC shall accept 120 voltage alternating current (VAC) as input voltage.
- Each PLC (**including all I/O**) shall be powered from a UPS power conditioning system installed within the Communications Enclosure.

- DI modules shall be rated for 120 VAC.
- DO modules shall be relay type
- AI and analog output (AO) modules shall be 4-20 mA; isolated type.
- PLC Ethernet network communications (local network only) shall be via Modbus TCP network protocol. The PLC Modbus TCP module shall always be installed in chassis slot 1. If local Ethernet network communications are not required, leave the slot open for future installation.
- Each PLC shall be equipped with a remote telemetry unit (RTU) module to provide Distributed Network Protocol 3 (DNP3) /IP network communications back to the HMI subsystem. This module shall always be installed in chassis slot 2.

160.03 Standard Components

Refer to Appendix A – Standard Components for the current list of standard components that are already approved for use in the SCADA system by PWW. Any proposed substitution of manufacturer or model shall be submitted for review and approval by PWW. All submittals must include purchase, installation, and maintenance cost comparison information for the approved and proposed component, as well as availability/source for each.

160.04 Programming Software

PLC configuration and application development software (including licenses) shall not be provided on any project. The AESS shall supply and use their own licensed software. The AESS shall program all PLCs in the same version that PWW uses, and this must be discussed and agreed on prior to any programming.

All PLC, HMI, and OIT configuration and testing files and programs developed by the PCSS for the WFT and UFT shall be provided to PWW in native format, along with one printed copy at the conclusion of the testing.

170 Operator Interface Terminals

170.01 Introduction

This section includes the OITs for local process monitoring and backup control at the D&C remote sites. PWW has standardized on two devices, depending on the control requirements at each remote SCADA site. It is the responsibility of the PDE to incorporate the following requirements into their contract documents.

170.02 General Requirements

There are two standard local OITs which apply to the types of sites:

- Non-Controlled Sites – For water storage tanks, the OIT is only required for monitoring purposes.
- Controlled Sites – For water booster and wastewater lift stations, two OITs are used – the Main OIT and the Backup Controller OIT. Refer to the Standard Components table for information on the currently approved equipment.
- Non-Controlled Non-OIT Sites

Some sites do not require an OIT, and are identified as "Non-OIT" sites. These sites have communications and monitoring equipment, but do not have a graphic user interface. Except as required by PWW, sites that only include meters or pressure reducing valves will be Non-OIT sites.

The following are the general requirements for all OITs:

- OITs shall be mounted on the front of the PLC control panel and maintain the rating of the control panel.
- OITs shall be powered from the UPS system.
- The Main OIT shall communicate to the PLC via the Ethernet connection at the managed Ethernet switch.
- The Main OIT and the Backup Controller OIT communicate via the Communications Cabinet WAN connection at the managed Ethernet switch for remote monitoring and programming.
- All OITs shall be mounted no more than 5.5 feet or less than 4.5 feet from the horizontal centerline of the OIT to the floor.

170.03 Non-Controlled Sites

The following are the requirements for OITs at non-controlled sites:

- The communication between the OIT and the PLC shall be via the Ethernet connection.

170.04 Controlled Sites

At remote SCADA sites with control, the backup OIT is part of a solution which serves as a backup control system. The backup control system shall consist of the following components.

1. Main OIT – Shall communicate with the PLC via Modbus protocol via the OIT's Ethernet connection.

2. Backup Controller OIT – Mounts directly to the face of the panel and contains backup controller logic. The Backup Controller OIT is connected to Backup Controller I/O in the control cabinet.
3. Backup Controller OIT I/O – Provides the I/O interface for the Backup Controller for critical controls.
4. Interconnected Cabling – Provides connectivity between the OIT Controller and its Distributed I/O system. The cable is a manufacture's optional part with various lengths, but PWW requires the use of this part such that the Backup OIT display is mounted on the door while the I/O portion is mounted on DIN Rail on the cabinet back panel.

170.05 Programming Software

Programming and configuration software (including licenses) for the components noted in this Section shall not be provided on any project. The AESS shall supply and use their own licensed software. The AESS shall program all OITs in the same version that PWW uses and this must be discussed and agreed on prior to any programming.

All PLC, HMI, and OIT configuration and testing files and programs developed by the PCSS for the WFT and UFT shall be provided to PWW in native format, along with one printed copy at the conclusion of the testing.

180 Control Panels

180.01 Introduction

This section includes the requirements for the SCADA system control panels at all D&C remote SCADA sites. Each SCADA site shall be supplied with the following two control panels:

- Communications Panel
- PLC Panel

It is the responsibility of the PDE to incorporate the following requirements into the contract documents.

180.02 Communications Panel

The Communications Panel installed at each site serves as the communications hub for communicating site information back to PWW's Operations Control Center. Each panel includes a router with a cellular interface, and support for an alternate communication media for redundant communication. The panel also includes a Managed Ethernet Switch that manages several virtual local area networks (VLAN) including SCADA, Access Control, and Operational Video. Integrated Power over Ethernet (PoE) allows PoE enabled devices like cameras and access card readers to connect to the managed Ethernet switch or Router. The SCADA UPS system is also housed within this panel. All panel components (except terminal blocks and breakers) shall be rack mounted within a standard 19-inch rack frame.

The following are the requirements / features for all Communications Panels:

- Wall-mount style suitable for mounting standard 19-in. rack-mounted equipment.
- NEMA type 1 for indoor applications and NEMA type 3R for outdoor applications.
- Front and rear access to 19-in. rack equipment provided by three part design: door, center section and wall section.
- Integral top solar/drip shield
- Perforated, vented base with internal, expanded metal, serviceable filter.
- Seamless, foam-in-place gasket to prevent contaminants from entering the panel.
- Locking kit with keys for access control.
- Intrusion switch wired to the PLC.
- 1U Shelf
- Thermostatically-controlled fans to provide airflow to cool current and future internal equipment.

Communication panel layout templates are included within Appendix C – Example General and Design Drawings.

180.03 PLC Panel

The control panel at each site is a typical PLC arrangement provided at water and wastewater facilities based on Prince William Water configuration templates. Major components within the panel include the PLC, backup control system, and an OIT.

The following are the requirements for all control panels:

180.03.01. General

- These requirements apply to all control panels fabricated based on PWW's layout templates and custom-designed and approved panels.
- Panel shall be sized and arranged per the templates to accommodate all required equipment for a fully integrated and operational system.
- Each panel shall bear the UL label. Provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement.
- All panel doors shall have a hasp and staple for padlocking.
- Panels shall be equipped with an intrusion switch wired to the PLC.
- The devices designated for rear-of-panel mounting shall be arranged per the templates. Any variations from the layout template must be approved in writing by PWW. Approvals for variations from the template should not be expected.
- The panels shall be completely fabricated, instruments and devices installed and wired at the PCSS's facility.
- All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component.
- Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration.
- All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- Refer to ISA Recommended Practice RP60.3 for layout and arrangement of panels and panel mounted components if a variation from the templates is approved.
- The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component.
- All panels shall be supplied with suitable nameplates, which identify the panel and individual devices as required.
    - Front panel shall be labeled using Black 3-ply, laminated engraving stock nameplates with white lettering.
    - Subpanels shall be labeled using White 3-ply, laminated engraving stock nameplates with black lettering

180.03.02. Materials and Construction

- All panels shall be rated (NEMA) according to the installed environment.
- Panels shall be of continuous welded-steel construction. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

- Each panel shall be provided with full height, fully gasketed access doors. Front access doors with mounted devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.
- The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
- The panel shall be suitable for top and bottom conduit entry as required. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
- All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and fiber-reinforced plastic (FRP) panels will not require a paint finish.
- All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units and thermostatic controllers as required to prevent temperature buildup inside of panel. Panel cooling or heating equipment shall not compromise the NEMA rating of the panel.
- All panels shall be provided with thermostatically-controlled fans to provide airflow to cool current and future internal equipment.
- The finish exterior colors shall be American National Standards Institute (ANSI) 61 gray with a textured finish.
- Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.
- A folding shelf/desktop shall be mounted on the door inside the panel. PWW shall approve the submittal for this shelf/table.

180.03.03. Internal Construction

- All interconnecting wiring shall be stranded, type machine tool wire (MTW), and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
- Power distribution wiring on the line side of fuses or breakers shall be 12 American Wire Gauge (AWG) minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
- Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each

other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent of the cross-sectional area of the trough.

- Terminations
  - All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
  - Multi-level terminal blocks or strips shall not be used.
  - Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
  - Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.
  - AI /AO shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC panel. All active and spare PLC and controller points shall be wired to terminal blocks.
  - Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
  - Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
  - Circuit power from the PLC panel out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating breaker switch terminal block with an LED blown fuse indicator. (Phoenix Contact TCP type resettable Thermal Device circuit breaker Example: 2 amp version is Phoenix Contact part number 0712217, include base that provides LED for blown fuse indication). Each circuit must be sized accordingly.
  - All PLC discrete outputs to the field shall be isolated with an isolating breaker switch terminal block with an LED blown fuse indicator. (Phoenix Contact TCP type resettable Thermal Device circuit breaker Example: 2 amp version is Phoenix Contact part number 0712217, include base that provides LED for blown fuse indication). Each circuit must be sized accordingly.
- All wiring shall be clearly tagged and color coded. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:

TABLE 180-1. WIRE COLOR CODING SCHEME

Wiring System	Wire Color
120 VAC Hot Incoming	Black
120 VAC Hot Wiring downstream of panel circuit breaker	Red
120 VAC Hot Wiring derived from UPS system	Red with Black Stripe
Three Phase Power	Brown

TABLE 180-1. WIRE COLOR CODING SCHEME

Wiring System	Wire Color
120 VAC Neutral	White
Ground	Green
DC Power or Control Wiring	Blue
DC Common	White/Blue
DC Analog Signal Wiring	Black (+) / White (-)
Foreign Voltage	Yellow

- Surge protection shall be provided on all incoming power supply lines of the panel.
- Each field instrument deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker and blown fuse indication (Phoenix Contact TCP type resettable Thermal Device circuit breaker Example: 2 amp version is Phoenix Contact part number 0712217, include base that provides LED for blown fuse indication). Each circuit must be sized accordingly.
- Provide redundant 24 volt direct current (VDC) power supplies and redundancy module to power field instruments and panel devices.
- Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
- Each panel shall be equipped with a LED enclosure light that turns on via door switch when the door is open.
- Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, and minimum 2-port, 2.4A per port USB power outlet, mounted internally within a stamped steel device box with appropriate cover.
- Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections.
- Each panel shall be provided with a circuit breaker to interrupt incoming power.

Example PLC panel layouts are included within Appendix C – Example General and Design Drawings.

190 System Testing

190.01 Introduction

It is the responsibility of the PCSS to provide a functional process control system. Confirmation of an operational SCADA / control system is dependent upon results derived from formal test procedures.

The PCSS shall test the system so that PWW can verify all the points in the SCADA system. The PCSS shall coordinate all testing with PWW. Copies of signed off test procedures, forms and checklists constitutes the required test documentation.

Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause), and if the system or subsystem produces the correct result (effect), the specific test requirement will have been satisfied. In general, the following tests shall be performed and documented by the PCSS on a project:

- Factory Testing
  - UFT
  - WFT
  - SIT
- Field Testing
  - ORT
  - Site Acceptance Test (SAT)

All tests shall be conducted and documented in accordance with approved test procedures, forms and checklists. Tests may not commence without an approved test procedure and approved programming.

Specific requirements for control and SCADA system testing are provided in Appendix G – Acceptance Testing.

200 Backup Power and Miscellaneous Monitoring

200.01 Introduction

This section includes the requirements for backup power and miscellaneous monitoring including power and vibration. It is the responsibility of the PDE to incorporate the following requirements into their contract documents.

200.02 Uninterruptible Power Supply

An inline UPS shall be provided to condition the incoming power and to provide continuous power to all critical SCADA equipment at the site when power is lost. The following are the general requirements for all UPS systems:

- Critical SCADA Equipment includes:
  - Control Panel
  - Communications
  - Network
  - Access Control
  - Camera
- The UPS shall be mounted in the Communications Panel and power all critical loads shown within the Communication and PLC panels.
- The UPS shall include a maintenance bypass switch for bypass capability to service the UPS system. The bypass switch shall be rack mounted within the Communications Panel.
- The PDE shall size the UPS system to provide a minimum of 20 minutes of battery runtime at 150% of the calculated load at each site for the SCADA system. Provide extended battery modules as needed to provide the required backup runtime duration. The extended battery module shall also be rack mounted.
- The UPS components shall be located at the bottom of the Communications Panel.
- The UPS shall be furnished with a Modbus monitoring card for monitoring by the PLC. The card shall also support Simple Network Management Protocol (SNMP) for remote monitoring over the Ethernet WAN.
- The UPS shall be furnished with a relay output I/O common alarm and hard-wired to the PLC to provide notification in the event of a UPS failure.

200.03 Emergency Site Power

PWW may require the D&C remote site to be equipped with backup emergency power generators to keep the remote site operation during periods of semi-extended power outages. Sites with generators will include an ATS to transfer essential loads from one power source to another. At minimum, the ATS status for Commercial Power Available, Commercial Power Connected, Generator Available, and Generator Connected shall be transmitted to the PLC.

The SCADA system shall be able to monitor the following hard-wired I/O signals from the emergency power system:

- Generator Run Status (DI)
- Generator Failed Status (DI)
- Generator Fuel Tank Level (4-20 mA AI)
- Normal Source Power Available Status (DI)
- Normal Source Power Connected Status (DI)
- Generator Source Power Available Status (DI)
- Generator Source Power Connected Status (DI)
- ATS Fault Status (DI) (If available)

The ATS shall start the generator on loss of normal power and transfer the load from normal source power to generator source power. The emergency power system shall be provided with a hardwired "Remote Test" function from the PLC that allows the SCADA system to exercise the generator remotely.

When the "Remote Test" signal is sent from the PLC, the ATS shall start the generator, and shall transfer the pump station load to the generator. On removal of the signal, the ATS shall transfer the equipment load from generator source power to normal source power, if applicable.

The ATS shall be networked over Modbus TCP/IP to the PLC. The network data shall not replace the required hard-wired signals to the PLC.

200.04 Power Monitoring

Power monitoring shall be provided to measure the power availability, quality and consumption at each pump station site. Power monitoring shall be provided from PQMs and Power Monitoring Relays (PMR). PQMs shall support an external power source, and shall be powered by the UPS. The use of the PQMs and PMRs are largely dependent on the site type and equipment. The PDE shall confirm PWW's requirements on a site-by-site basis. A PMR may be omitted where an Automatic Transfer Switch is being installed since the Normal and Emergency Source Available statuses will be monitored by the PLC and provide the required power availability monitoring.

200.04.01. Pump Stations (Wastewater and Fresh Water)

- Site Power availability shall be monitored by a PMR.
- The PMR I/O shall be hard-wired to the PLC.
- Site power quality and consumption shall be monitored by a PQM.
- The PQM shall be networked to the PLC via Modbus Ethernet.
- The PQM shall be powered from the UPS to allow communication with the PLC during a loss of phase or power outage.
- All PQMs shall be mounted no more than 5.5 feet or less than 4.5 feet from the horizontal centerline of the display to the floor.
- Motor current for pumps shall be monitored using CT's on each power leg. The CTs shall provide a proportional 4-20mA analog signal to the PLC.
- If the pump has a VFD or soft starter equipped with power monitoring via network interface, this interface may be used to provide data with Prince William Water approval

200.04.02. Elevated Storage Tanks, Metering Stations, and Other Non-Pump Stations

- Site Power availability shall be monitored by a PMR.
- The PMR I/O shall be hard-wired to the PLC.

200.05 Vibration and Temperature Monitoring

Vibration and temperature monitoring shall be provided for large motors (100 HP and above). The PDE should follow the motor manufacturer's recommendations for monitoring and protection; however, the minimum following signals are required for SCADA system monitoring. The motor supplier shall factory install the sensors.

- Vibration (x, y, z)
- Motor winding temperature for each phase (3 RTDs in total)
- Each bearing RTDs

A signal conditioning device shall be provided for all vibration and RTD signals. An analog 4-20 mA signal for each of the vibration signal and RTD signal shall be wired to PLC system, alternatively, with Prince William Water approval, an Ethernet Modbus TCP communication link shall be established between the signal conditioner and PLC to allow continuous monitoring by PLC. The signal conditioner shall also provide two relay output dry contacts alarms, one for vibration and other for temperature
(common) to trip the motor on high vibration or high temperature. Vibration and temperature alarms shall also be wired to the PLC system.

210 Field Instrumentation

210.01 Introduction

This section includes PWW's requirements regarding field instrumentation at D&C remote sites. It is the responsibility of the PDE to incorporate the following requirements into their contract documents. The PDE shall be responsible to include additional instruments as necessary for the proper operation of the remote site.

Refer to Appendix A – Standard Components for approved manufacturers and models. Some components do not allow "or equal" or substitutions due to system compatibility requirements.

210.02 Level

210.02.01. Wet Well Level Measurement

Water level in each wastewater wet well shall be measured using two submersible type level transducers. The level signal from the transducer shall be wired to PLC system for continuous monitoring.

The following are the minimum guidelines and requirements for the level transducer selection and installation. The PDE shall coordinate with the civil and structural engineers to select the appropriate installation location and the electrical engineer for the signal wiring.

- The transducer shall be hung in the wet well within a stilling well supported by a steel rope with a weight attached to the bottom to stay away from the direct inflow and outflow in the wet well.
- Stilling wells and their mounting details shall be properly engineered for support in the wet well(s). Stilling Well detailed drawings must be included in the design package drawings. This detailed drawing must include pipe support locations and detailed mounting and drilling information.
- A pull box shall be installed above the stilling wells and shall be shown on the detail drawings
- The transducer shall be provided in a waterproof housing made of stainless steel and the cable shall be polyurethane material of Kevlar strength.
- The transducer shall be provided with a vent filter to terminate the vent tube that prevents moisture and insects from entering in to the vent tube. The vent filter shall be installed away from the wet well, preferably inside a temperature controlled building.
- The transducer shall be loop powered from the PLC with a 2-wire 4-20 mA output. The range shall be selected as per the depth of the wet well.
- Provide an intrinsically safe barrier where the transducer cable enters the non-classified building area.
- The transducer shall be rated for the area classification

210.02.02. Water Storage Tank Level Measurement

Level in all elevated water storage tanks shall be measured using two pressure type (level) transmitters. The level signal from the transmitters shall be wired to PLC system for continuous monitoring.

The following are the minimum guidelines and requirements for the level instrument selection and installation. The PDE shall coordinate with the civil and structural engineers and PWW to select the appropriate installation location and the electrical engineer for the signal wiring.

- The pressure transmitters shall be tapped to the tank outlet pipe upstream of any isolation valve in the outlet pipe to allow level monitoring. Each pressure transmitter tap shall include an isolation ball valve between the outlet pipe and transmitter. Another isolation valve shall be provided to vent each transmitter to atmosphere to check the zero, and shall also be provided with the attachment to check the pressure calibration in the field.
- New tank installations shall include a spare "hot tap" for future level/pressure monitoring.
- In unconditioned spaces, the connection from the pressure transmitter to the tank outlet pipe shall be heat traced on an independent circuit (if required and shall be determined on a case-by-case basis in consultation with PWW).
- Pressure transmitters shall be loop powered from the PLC with a 2-wire 4-20 mA output. The range shall be selected as per the height of the tank top from the elevation of intended location of pressure transmitter tapping.
- Pressure transmitter diaphragm shall be rated for potable water application.
- Pressure transmitters with displays shall not be mounted more 6 feet from the floor and shall be mounted in a way that the display can be viewed easily and directly.

210.02.03. Level Switch

High-High level in the wet well or dry well shall be detected by using a float switch.

The following are the minimum guidelines and requirements for the float switch selection and installation. The PDE shall coordinate with the civil and structural engineers to select the appropriate installation location and the electrical engineer for the signal wiring.

- The float shall be put in to the wet well supported on a steel pipe attached to the wet well wall and will be installed to keep it away from the direct inflow and outflow in the wet well.
- The float shall be rugged 5 ½" ball type, 316 SS construction with non-stick coating.
- The float switch shall be mercury free, SPDT NO & NC contact.
- Provide an intrinsic safe relay where the float cable enter the non-classified building area.
- The float shall be rated for the area classification.

210.03 Differential Pressure

Water booster sites centrifugal pumps shall be equipped with a differential pressure transmitter to allow continuous monitoring of differential pressure across the pump.

The following are the minimum guidelines and requirements for the differential pressure transmitter selection and installation. The PDE shall coordinate with the civil and structural engineers to select the appropriate installation location and the electrical engineer for the signal wiring.

- Differential pressure transmitter high side shall be tapped to the discharge side of the pump and low side be tapped to the suction side of the pump. The pressure transmitter taps shall include a 3-way isolation valve. The location and configuration of the taps shall be approved by PWW.

- In unconditioned spaces, the connection from the differential pressure transmitter taps to the pipe shall be heat traced on an independent circuit (if required and shall be determined on a case-by-case basis in consultation with PWW).
- Differential pressure transmitter shall be loop powered from the PLC with a 2-wire 4-20 mA output. The range shall be selected as per the discharge and suction pressure difference of the pump.
- Pressure transmitter diaphragm shall be rated for potable water application.
- Differential Pressure transmitters with displays shall not be mounted more 6 feet from the floor and shall be mounted in a way that the display can be viewed easily and directly.

210.04 Flow

In-line magnetic-type flowmeters shall be used for all water and wastewater flow metering except where the designer, with PWW's concurrence, does not find the magnetic flowmeter suitable for the application or water custody transfer flow metering application.

The following are the minimum guidelines and requirements for the meter selection and installation. The PDE shall coordinate with the civil and structural engineers to select the appropriate installation location and the electrical engineer for the signal wiring.

- Wherever possible, meter shall be installed on a vertical pipe with isolation valve before and after the meter. Piping and flowmeter placement shall be designed to maintain a full pipe under all operating conditions.
- Flowmeter shall be placed on a pipe with a minimum of 5 upstream and 3 downstream pipe diameters straight pipe length, or as recommended by the meter manufacturer, whichever is greater.
- A bypass piping with isolation valve shall be provided around the flowmeter to allow the maintenance of the meter without shutting down of process.
- Flowmeter piping shall be provided with a 1" flushing connection upstream and downstream of the meter.
- Size the flowmeter to maintain a minimum velocity of 2 ft. /sec on wastewater and sludge lines. Provide reducers as needed.
- Select the liner and electrodes materials and type per manufacturer recommendation compatible with the fluid being measured.
- Provide grounding rings with strap and ground wires.
- Flowmeter shall be powered with 120VAC power, 4-20 mA output to PLC, include a remote mounted transmitter with display.
- All flowmeter components shall be rated for the area classification per Electrical designer.
- Flow Meters with displays or analog readouts/counters shall not be mounted more 6 feet from the floor and shall be mounted in a way that the display can be viewed easily and directly.

For water custody transfer applications, flowmeter selection and installation details shall be recommended by the Designer for approval by PWW.

210.05 Miscellaneous

210.05.01. Ambient Temperature

Continuous ambient temperature inside pump station and water tank buildings shall be monitored by the PLC. The following are the minimum guidelines and requirements for the sensor selection and installation. The PDE shall coordinate the location of the power and signal wiring with PWW.

- Temperature transmitter for ambient temperature shall be wall mounted in a location approved by PWW.
- Temperature transmitter shall include a LCD display.
- The transmitter shall provide 4-20 mA output and shall be loop powered from the PLC.
- All Ambient Temperature Sensors shall be mounted no more than 5.5 feet or less than 4.5 feet from the horizontal centerline of the display to the floor.

210.05.02. Smoke Detection

Smoke detectors shall be installed inside the pump station and water tank buildings and the status shall be monitored by the PLC. The following are the minimum guidelines and requirements for the sensor selection and installation. The Designer shall coordinate the location of the power and signal wiring with PWW.

- Smoke detector shall be industrial grade ceiling mounted at a well-ventilated location, not in the vicinity of air ducts.
- The smoke detector shall be photoelectric type, 120VAC powered and provide NO & NC relay dry contacts which shall be wired to PLC system.

220 Access Control, Operational Video, and Lighting Controls

220.01 Introduction

This section addresses the access control and operational video remote system design requirements. Access control and operational video shall be designed and incorporated at all remote D&C sites.

220.02 Access Control

The access control system shall be used to record authorized entries and exits at each remote site. The system will notify PWW when authorized access has been recorded and when an unauthorized card or no card has been presented to the reader prior to the door opening.

The access control system at each site shall consist of a card reader controller at the designated primary entrance, intrusion switches at each door or hatch used for maintenance access or personnel entry, door exit controls, and a local audible horn, all of which are linked to the PLC. Site security will be enabled (armed) when all of the building doors and vault hatches are secured. When the card reader validates a user, a signal is sent to the PLC from the card reader instructing the PLC to disarm security. Security shall automatically re-enable when all building doors and vault hatches are completely closed again. An operator-adjustable PLC timer notifies operations when a site has been disarmed for an extended period of time.

A Request to Exit (REX) push button must be used to exit the facility.

The Access Control System design requirements are as follows:

- A minimum of one card reader is required per site. For buildings, the card reader shall be located at the primary entrance. For remote sites with no buildings, the card reader shall be located on or near the PLC panel.
- Each card reader shall be powered via PoE technology and networked within the Communication Panel.
- Each card reader has a cable extending from its back plate that is referred to as “the pigtail”. The pigtail is used to connect to the various components at the door location. For each card reader, provide a junction box with terminal blocks to facilitate system wiring.
- For all new buildings, door strikes shall be provided to lock and unlock doors based on authorized access. The door strikes shall be wired to and controlled by the card reader. The PLC shall not be used to control the doors.
- For existing buildings, coordinate with PWW if new door strikes are required in the existing door frames.
- All doors, whether provided with or without door strikes, shall be provided with mechanical key overrides. The mechanical keys will be keyed to PWW’s standards.
- A dry relay output from the card reader shall be wired to the PLC as a separate input for authorized entry.
- Intrusion detection switches shall be installed on all building doors, vault hatches, and PLC and communication panels. Each building entrance door shall be wired separately to discrete PLC

inputs. All hatch intrusion switches shall be wired in series to the PLC system (normally closed) for alarming. Panel switches shall be separate inputs to the PLC system.

- Door contacts shall be magnetic wide gap (up to 3-inch) type, high strength aluminum housing with prewired, armored cable rated for heavy-duty industrial service. Contacts shall be furnished with adjustable mounting brackets.
- Hatch style doors shall be provided with industrial rated limit switches with roller arm attachment. Switches shall be oil and water tight with a NEMA 4X rating. Switches shall include 1 NO and 1 NC contact.
- Rolling doors shall be provided with magnetic door contacts enclosed in an epoxy sealed aluminum housing. Factory connected armored cable shall be provided for electrical terminations. Actuating magnet shall be mounted on the rolling door using an adjustable L-bracket.

- An audible horn shall be installed on the PLC panel to sound when an unauthorized intrusion has been detected. Silence functionality shall be available from the OIT. Site process alarms shall not be connected to the audible horn.
- A REX push button shall be provided for personnel exiting the building or site and shall be wired directly to the card reader.

220.03 Operational Video

The use of cameras are primarily intended to reduce the need for an operator to initially visit the site when a process alarm is received. The video is used to allow the operator to quickly diagnose issues, and then plan the proper response thus reducing travel to and from the sites. Cameras are NOT intended for security surveillance; however, camera feeds shall be recorded and may be used to support future security initiatives.

The Operational Video design requirements are as follows:

- Indoor and outdoor cameras and accessories shall be as listed in Appendix A – Standard Components. There is no “or equal” for the required brand and model of camera.
- Cameras are powered by PoE communications.
- Outdoor cameras shall have a built-in heater, blower, and sun shield for increased protection in extreme temperature conditions. A separate power circuit may be required for the camera/enclosure heater.
- A minimum of two cameras shall be installed at each site. Where there are multiple rooms with process or control equipment, or an exterior door, a minimum of one camera will be required for each room.
- The installation locations for cameras should provide unimpeded viewing of all electrical gear, access door(s), and major equipment control panels. If required by PWW, provide additional cameras for full coverage of the process areas. Camera locations and the need for additional cameras shall be determined on a case-by-case basis in consultation with PWW during design.
- For all water storage tanks with enclosed storage areas and unobstructed views, a single camera may be used to capture all entry doors and the PLC control panel. An exterior camera shall be positioned to provide a view of the ladder cage.
- For outdoor only sites, sufficient cameras shall be provided to capture all vault hatches, and outdoor control panels. For water storage tanks, the camera view shall include a view of the ladder cage.

- Hardwired Motion Detected DOs shall be installed from the PLC to each camera(s) based on the number of doors that the camera is monitoring. PWW will identify the number of connections and cameras required based on the preliminary design.

220.04 Lighting Requirements

To support operational video cameras, in addition to general illumination for each facility, always-on LED lighting is required to illuminate the remote sites to allow clear visibility for the video cameras while the facilities are unattended. One or more LED light(s) may be required to be installed, depending on the facility floor plan.

The circuit powering the LED light(s) shall be solely controlled by the circuit breaker, and shall not have a separate control switch.

The LED light(s) shall be positioned to illuminate all areas visible to the operational video camera(s).

For areas observed by the operational video cameras, the quantity and location of LED light(s) shall be selected to provide a minimum of 10 Lux of illumination per 100 square feet of the facility.

230 Telemetry, Networking, and Cyber Security

230.01 Introduction

This section includes the requirements for networking, telemetry, and cyber security. It is the responsibility of the PDE to incorporate the following requirements into their contract documents.

230.02 Telemetry

Each D&C remote SCADA site will communicate with PWW's Operations Control Center using a redundant communications backbone provided and configured by PWW. Communications requirements and media may vary by site. The communications media will be determined by PWW based on the available services, with the design for the installation being developed by the facility designer.

One of the communications media will be cellular, and the facility designer shall include the following:

- The cellular system provided shall consist of a cellular router, two antennas, interconnecting cabling, and connectors. The cellular router will provide the WAN failover, routing, and security required by PWW.
- The cellular router shall be installed in the Communications Panel and provided with a kit for mounting on DIN Rail.
- All cables and connectors shall be compatible with the cellular router and recommended for the installed location.
- Each cellular router shall be provided with two outdoor Omni-directional antennas for maximum bandwidth. The antennas shall be mounted on the outside face of the building (or pole-mounted at sites without buildings). The antennas shall be outdoor rated and compatible with the router and service. The base of building-mounted antennas shall be mounted a minimum of 12 inches above the highest point on the building. The base of pole-mounted antennas shall be a minimum of 12 inches above any obstacle within 25 feet of the pole in any direction.
- Each antenna shall be supplied with an individual surge protector to protect against to direct lightning strikes and induced surges.
- The Cellular Router must be properly grounded per Cisco recommendations.
- Equipment programming configuration and cellular service will be ordered and coordinated by PWW.
- The cellular router, power supply, antenna, surge protector, and accessories shall be as listed in Appendix A – Standard Components. No "or equal" or substitutions are permitted. **Prior to ordering, the PCSS shall contact PWW's SCADA Program Manager to discuss ordering and option part number specifics to ensure new service and technology requirements are met and coordinated.**

Site developers shall provide easements and clearly identified crossings from the facility to the closest point of connection to the Comcast cable network. Handholes shall be installed on either end of crossings and at an approved location outside the facility, and shall be marked as property of PWW. A 2-inch conduit, suitable for the installation of Comcast cables, shall be provided from the facility entrance handhole to the communications cabinet. Coordinate with Comcast on the location of the network connection point and characteristics of the handholes and conduit installation, and indicate

the location on all relevant drawings. PWW shall make all arrangements for service utilizing the developer-provided path.

230.03 Networking

Each D&C SCADA site has the following two physical networks for local and remote communications:

- WAN
- VLAN

The WAN provides the system-wide communications across the D&C system. The WAN is designed to support communications to the following four sub-networks:

1. PLC
2. Access Control
3. Operational Video
4. System Management

Each of these networks are connected through a managed Ethernet Switch located within the Communications Panel. The following are the minimum requirements for the managed Ethernet Switch:

- The managed Ethernet Switch shall be a 19" rack mount style switch, 1U size with metal enclosure. The managed Ethernet Switch shall be an industrial grade switch.
- The switch shall be provided with twenty-four (24) 10/100/1000 PoE Ports, and four (4) Gigabit Ethernet Uplink Ports.
- The switch shall be provided with two (2) Rugged Type 10/100/1000 Copper SFP Modules
- The Ethernet Switch must be properly grounded per Cisco recommendations.
- Redundant power supplies
- The operating voltage shall be 100 – 240 VAC, derived from the UPS.
- Equipment programming configuration shall be performed by PWW.
- The Ethernet Switch and any accessories shall be as listed in Appendix A – Standard Components. No "or equal" or substitutions are permitted. **Prior to ordering, the PCSS shall contact PWW's SCADA Program Manager to discuss ordering and option part number specifics to ensure new service and technology requirements are met and coordinated.**

A separate **virtual** PLC VLAN shall be configured by PWW to connect the PLC to other SCADA devices located at each site. These devices may include pump soft starts and VFDs, power monitors, and other components. Because they are only on the PLC VLAN, their traffic cannot directly pass through the WAN. Their data must be packaged and transmitted through the PLC.

Communications shall be via Modbus TCP protocol only. The PLC Ethernet VLAN shall be networked using the managed Ethernet switch and/or the Router's Ethernet Switch NIM. PWW shall perform all switch and router programming configurations and provide IP address information to the PCSS for any devices accessing the VLAN or WAN.

PWW shall provide all IP addresses for all networked equipment and communications devices. The Contractor shall submit a Request for Information at an appropriate time during the network configuration.

230.04 Cyber Security

The D&C SCADA has been designed around numerous cyber security references, standards, and guidelines including ANSI, ISA, AWWA, DHS, IEC, NIST, and NERC. The design includes firewalls, DMZs, intrusion detection systems, and other security provisions as recommended by these various organizations. PWW cyber security design has been validated by an independent 3rd party expert cyber security firm.

PWW will perform all configurations of communication network routers, switches, and modems. The installation contractor is responsible for configuring all VFD, Soft Starts, PQMs, ATS, or similar VLAN devices in compliance with Prince William Water requirements.

For purposes of design, the PDE is not required to include any additional security appliances and components other than what has already noted within this document. The Designer shall follow the physical network configuration requirements described in Appendix H – Remote Site Network Configuration Requirements

Apart from the cellular interface card in the site router, Wireless Technologies shall not be used in the design of the SCADA control systems for any purposes without prior written requests and approval of the Senior SCADA Program Manager.

Wired/Wireless Technologies that provide any remote access to SCADA devices or networks by anyone other than Prince William Water staff are strictly forbidden without prior written requests and approval of the Senior SCADA Program Manager.

Appendix A

Standard Components

Appendix A - Standard Components

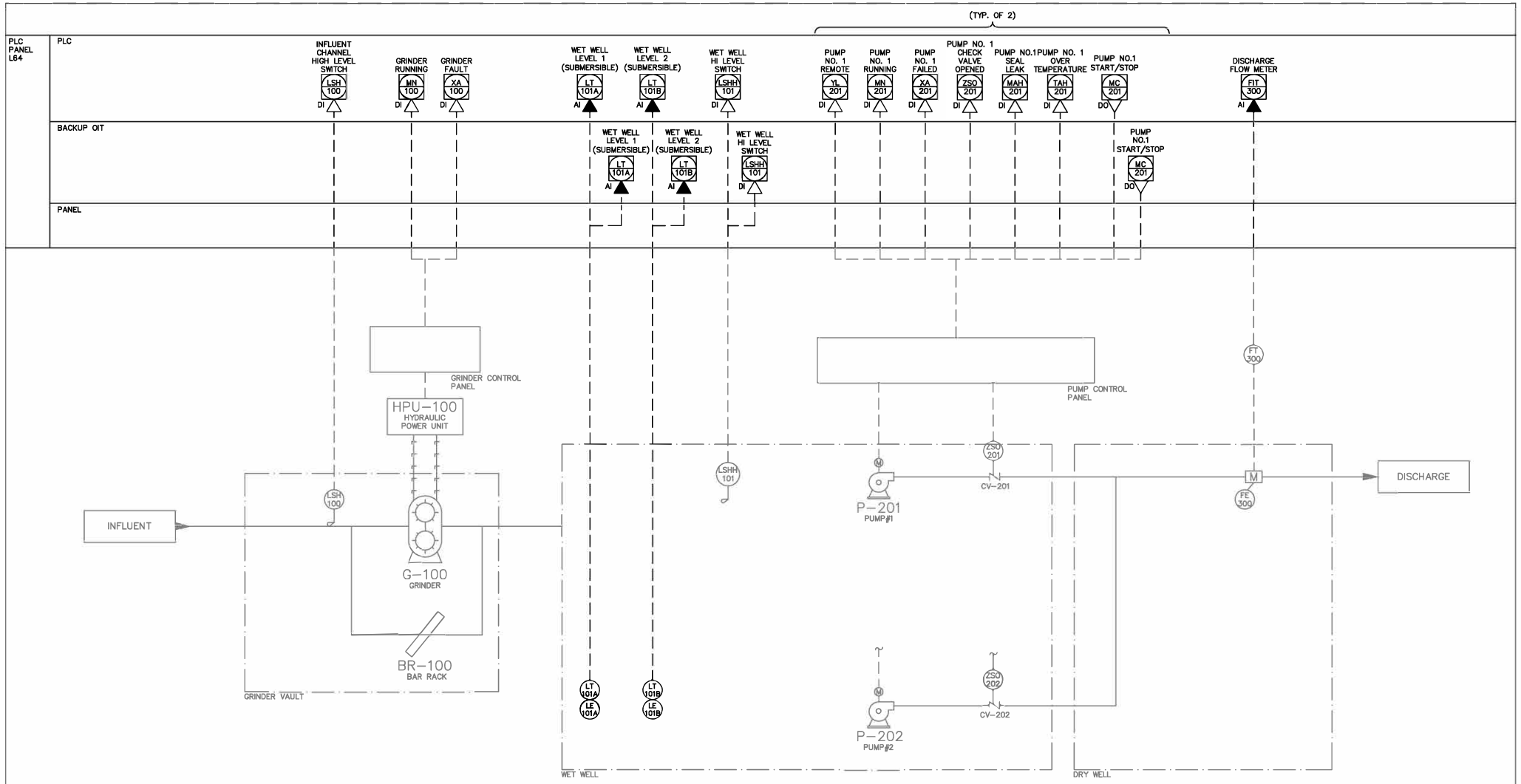
CATEGORY / ITEM	Manufacturer	Model / Part Number	Comments	Substitution Allowed?
MISCELLANEOUS				
Enclosure	Hoffman			With Approved Submittal
Thermostats	Hoffman			With Approved Submittal
Heaters	Hoffman			With Approved Submittal
Fans	Hoffman			With Approved Submittal
Alarm Horn	Edwards Signaling			With Approved Submittal
Power Supplies	Phoenix Contact			With Approved Submittal
Signal Isolators	Phoenix Contact			With Approved Submittal
Isolated / Safety Switches	Phoenix Contact			With Approved Submittal
Intrinsic Safety Barriers	Phoenix Contact			With Approved Submittal
Relays	Phoenix Contact			With Approved Submittal
Receptacle	Phoenix Contact			With Approved Submittal
Terminal Blocks - 120VAC	Phoenix Contact.		120VAC blocks shall be beige	With Approved Submittal
Terminal Blocks - 24VDC	Phoenix Contact.		24VDC blocks shall be blue	With Approved Submittal
Fuse Terminals	Phoenix Contact		With blown fuse indicator	With Approved Submittal
Circuit Breakers	Square D			With Approved Submittal
Surge Arrestors	Square D			With Approved Submittal
Surge Protectors	Square D			With Approved Submittal
Fuses	Bussman			With Approved Submittal
Uninterruptable Power Supply (UPS)	Falcon UPS		Rackmount, rated for load requirements and environment	No, however, selected model submittal and approval required
UPS Network & Modbus Card	Falcon	MEGA-BA506-4-2022	This is the new internal version.	No
Folding Shelf/Desktop			Installed in PLC Panel	With Approved Submittal
1U Vented Shelf			Installed in Comm Panel	With Approved Submittal
INSTRUMENTS				
PQM	PC&S	DKM-411	with Modbus TCP	With Approved Submittal
PMR	ATC Diversified Electronics	SLU-100-ASA or -ASD series		With Approved Submittal
Level Transducer	Mercoid Bird	PBLT2-20-60		With Approved Submittal
Tank level w/display	Rosemount	SMART 1151	Primary level sensor	With Approved Submittal
Tank level w/o display	Dwyer	Model 626	Backup level sensor	With Approved Submittal
Float Switch Dry Well	Contegra	FS 202		With Approved Submittal
Float Switch Wet Well	Contegra	FS 90		With Approved Submittal
Differential Pressure	Siemens	Sitrans P250		With Approved Submittal
Flowmeter	ABB	ProcessMaster		With Approved Submittal
Ambient Temperature	Dwyer	RHP Series RHP-2N44-LCD		With Approved Submittal
Smoke Detection	Gentex Corporation	8000 Series		With Approved Submittal
Chlorine Monitor	Hach	CL17		With Approved Submittal
Fuel Level Transmitter	Flowline	LU80-84 Series	Generator Belly Tanks	With Approved Submittal
	Flowline	LG10 Series	All Other Day Tanks	With Approved Submittal
PROGRAMMABLE LOGIC CONTROLLER				
Modicon M340	Modicon	M340		No
CPU / Processor	Modicon	BMXP341000		No
Upgraded CPU / Processor	Modicon	SCADA Contractor to evaluate the capabilities of the standard processor against the design, and recommend an upgraded processor if necessary.		No
Memory Cards	Modicon	BMXRMS008MP		No
Power Supply	Modicon	BMXCPSxx00		No
Chassis	Modicon	BMXXBPxx00		No
Digital Input Module	Modicon	BMXDAI1604		No
Digital Output Module	Modicon	BMXDRA0815		No
Analog Input Module	Modicon	BMXAMI0x10		No
Analog Output Module	Modicon	BMXAMO0410		No
LAN Communication Module	Modicon	BMXNOE0100		No
WAN Communication Module	Modicon	BMXNOR0200H		No
High Speed Counter Module	Modicon	BMXEHC0800		No
ACCESS CONTROL				
Access Card Reader	Isonas	RC-04-PRX-M	w/o key pad and enabled for HID formatted cards	No
REX	Submit hardware recommendation			Submit for Approval
Electric Door Strike	Submit hardware recommendation			Submit for Approval

CATEGORY / ITEM	Manufacturer	Model / Part Number	Comments	Substitution Allowed?
NETWORK				
Cellular Router	**Cisco**	**Cisco IR1101-K9 Industrial Integrated Services Router Rugged**		**No**
Industrial Integrated Services Router Rugged	Cisco	IR1101-K9		No
SNTC-8X5XNBD Industrial ISR 1101	Cisco	CON-SNT-IR101K9K		No
Network Essentials License for Cisco IR1101 Industrial ISR	Cisco	SL-IR1101-NE		No
Utilities Industry Solutions; For tracking only	Cisco	IOT-UTILITIES		No
Not related to an IoT Utilities Solution; For tracking only.	Cisco	IOT-UTIL-OTHER		No
UNIVERSAL (NETWORK ESSENTIALS)	Cisco	SIR1101UK9-1612		No
CAT4 LTE Pluggable Verizon	Cisco	P-LTE-VZ		No
Cisco OEM PRI for WP7601	Cisco	OEM-PRI-WP7601		No
FW for WP7601 Verizon	Cisco	FW-WP7601-VZ		No
LTE SMA dipole antenna 698-960,1448-1511,1710-2690	Cisco	LTE-ANTM-SMA-D		No
Din Rail kit for the IR1101	Cisco	IR1101-DINRAIL		No
Multiband Omni-Directional Stick Outdoor 4G Antenna	Cisco	ANT-4G-OMNI-OUT-N=	2 Required, Main/Diversity	No
4G Outdoor Antenna Lightning Arrestor	Cisco	4G-ACC-OUT-LA	2 Required	No
50W AC to DC power supply	Cisco	PWR-IE50W-AC-L		No
***This model of router is DIN-RAIL mountable and not directly 19" rack mounted and therefore must be mounted to a plate/panel within the Communications Panel. Additionally, the power input is 12-48VDC so the specified power supply above must be provided and DIN-RAIL mounted on the same panel.**				
MANAGED ETHERNET SWITCH				
Cisco IE 9320 Series*	Cisco			No
IE9320 with 24 Port PoE+ Downlinks with 4 GE Uplinks (385W)	Cisco	IE-9320-24P4S-E		No
SNTC-8X5XNBD 24 Port PoE Downlinks with 4 GE Uplinks	Cisco	CON-SNT-IE93224E		No
PoE, PSU for IE9320, 100-240VAC/100-250VDC	Cisco	PWR-RGD-AC-DC-H	< 11 PoE devies: 2 Required	No
Higher PoE, 250W PSU for IE9320, 100-240VAC/100-250VDC	Cisco	PWR-RGD-AC-DC-250	> 10 PoE devies: 2 Required	No
Cisco Copper SFP Module, 10/100/1000Base-TX RJ45, -40 to +85 deg C.	Cisco	GLC-T-RGD=	2 Required, generics are not acceptable.	No
Software for Catalyst IE9300 rugged series	Cisco	IE9300_SW		No
Not related to an IoT Solution; For tracking only	Cisco	IOT-OTHER		No
Not related to an IoT Solution; For tracking only.	Cisco	NO-IOT-SOLUTION		No

CATEGORY / ITEM	Manufacturer	Model / Part Number	Comments	Substitution Allowed?
NON-CONTROLLED SITE OIT				
Advanced Touchscreen Panel	Schneider Electric	Harmony HMIGTO1310	320 x 240 pixels QVGA - 3.5" TFT -	No
CONTROLLED SITE OIT				
Advanced Touchscreen Panel	Schneider Electric	Harmony HMIGTO6310	800 x 600 pixels SVGA - 12.1" - TF	No
Accessories - SD Memory Card	Schneider Electric		SD Card 32GB per manf specs	No
BACKUP OIT CONTROLLER				
Small touch HMI Controller	Schneider Electric	Harmony HMISCU8B5	320x240 pixels QVGA - 5.7"	No
OIT includes: Touchscreen capabilities. Color LCD screen.				
Supports these Protocols, at minimum:				
a) Modbus				
b) Modbus TCP/IP				
c) CANopen				
Required Accessories:				
Provide one of the following remote control cables for panel SCU with 3 meter or 5 meter length as required. Remote control cable assembly shall be provided with all equipment needed to allow for the I/O connection portion of the backup controller to remain din-rail mountable in the PLC cabinet's back plate rather than running the I/O wiring to the door for a cleaner and safer installation.				
a) HMIZSURDP (3m)				
b) HMIZSURDP5 (5m)				
VIDEO				
Outdoor Camera	iPro	WV-S65340-Z4N1		No
Indoor Camera	iPro	WV-S61301-Z2		No
Accessories - brackets, dome covers, SD memory card, etc.	iPro		microSDXC memory card with a minimum of 256GB storage with speed class 10 or higher	No

Appendix B

Example P&IDs



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
A					
B					
C					

PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
CHECKED		
APP		

REF.

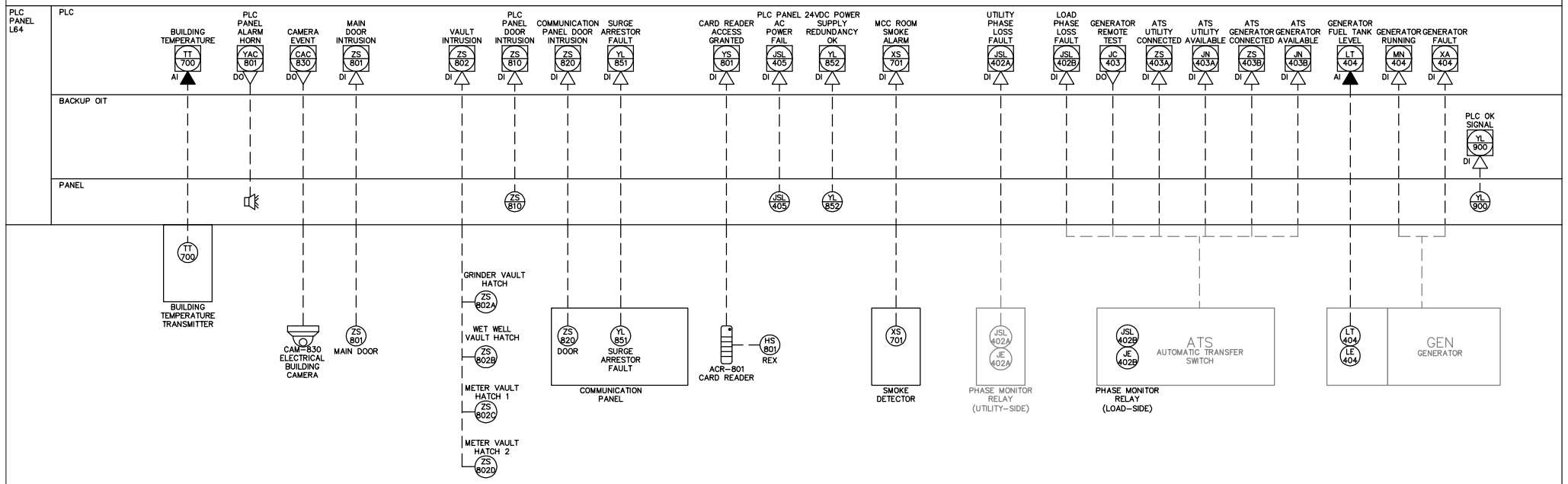
DO NOT SCALE

SCALE NONE

PROCESS & INSTRUMENTATION DIAGRAM 1

DWG. NO. DWG NO. SHT 1 OF 1

REV. C



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
A					
B					
C					

PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
CHECKED		
APP		

REF.

DO NOT SCALE

SCALE NONE

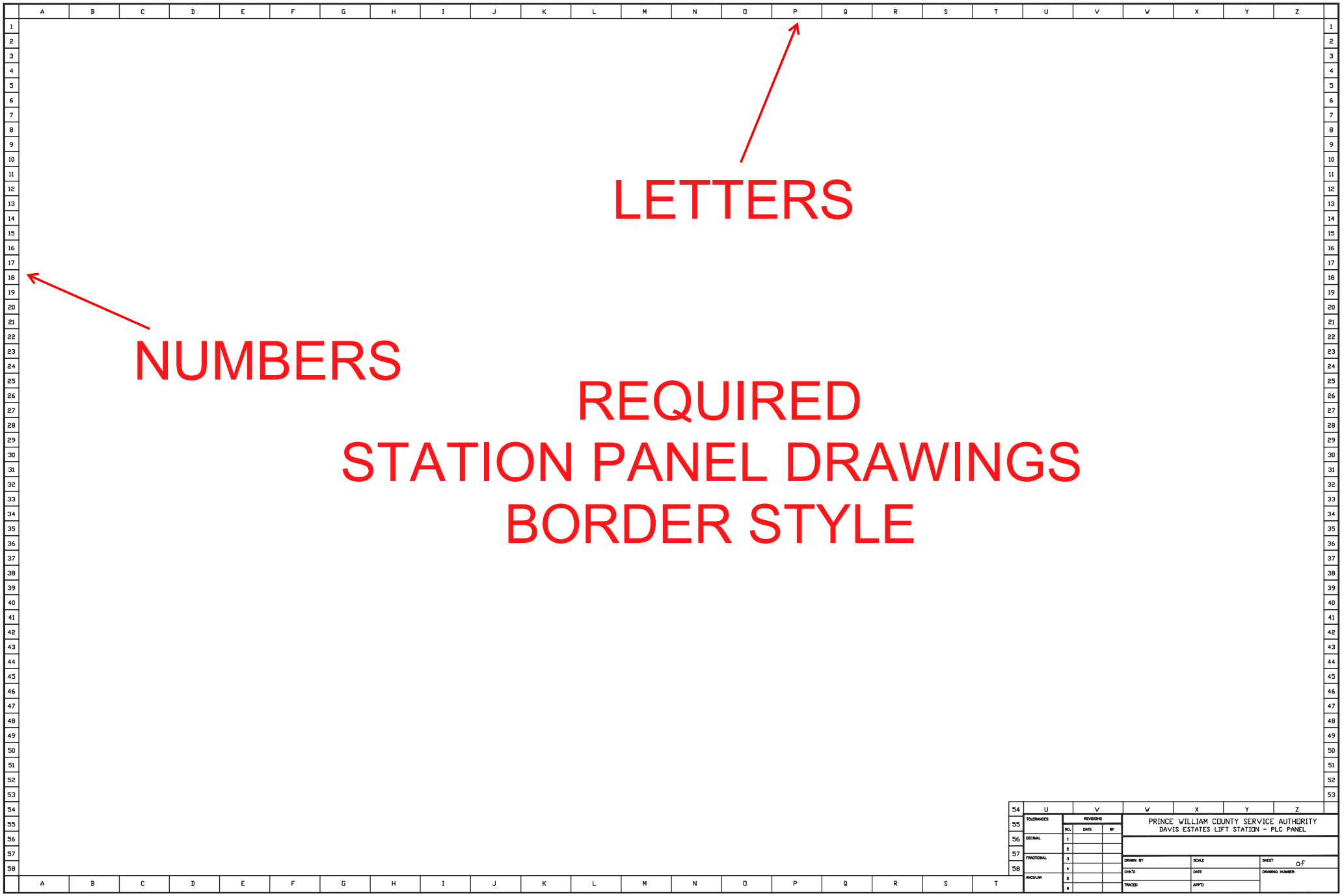
PROCESS & INSTRUMENTATION DIAGRAM 2

DWG. NO. DWG NO. SHT 1 OF 1

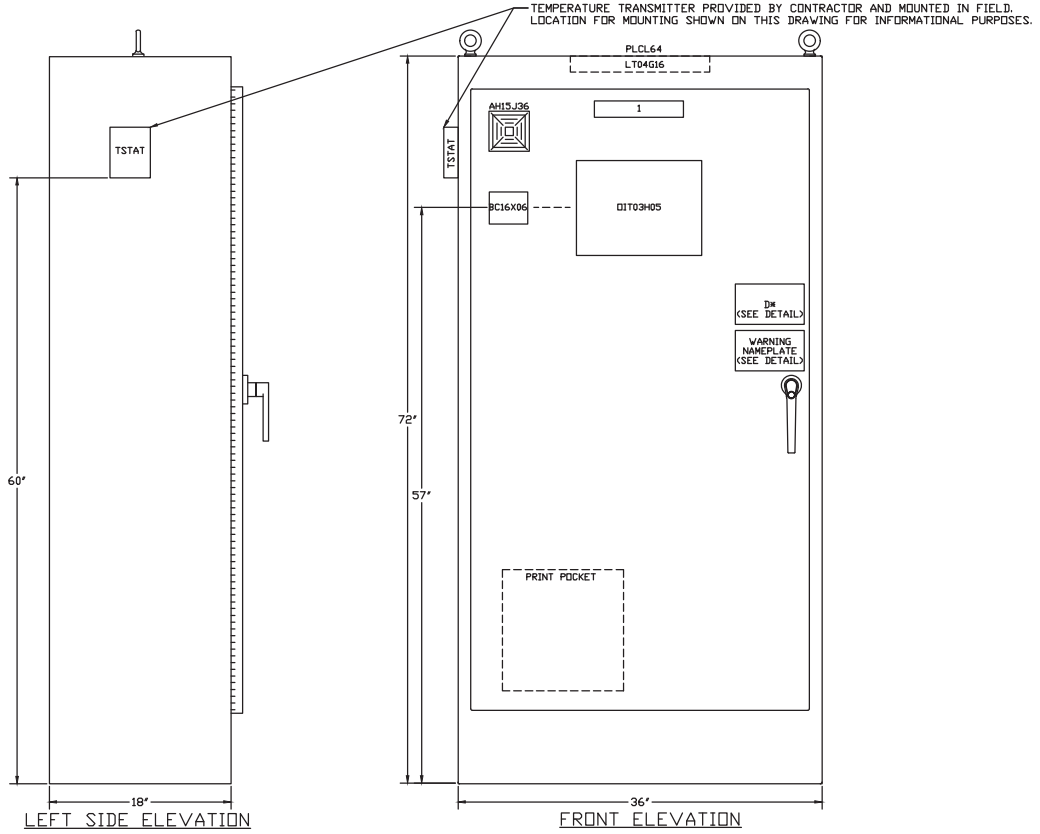
REV. C

Appendix C

Example General and Design Drawings


LETTERS
NUMBERS
REQUIRED
STATION PANEL DRAWINGS
BORDER STYLE
TOLERANCES
DECIMAL
FRACTIONAL
ANGULAR
REVISIONS
NO.
DATE
BY
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
DAVIS ESTATES LIFT STATION - PLC PANEL
DRAWN BY
CHK'D
TRACED
SCALE
DATE
APP'D
SHEET
of
DRAWING NUMBER

Typical Pump Station Control Panel



NAMEPLATE LEGEND TABLE

ITEM	QTY	DESCRIPTION			
1	1	PLC-L64			
2	1	FU0.5	BUSSMANN	MODEL	GMA-500-R
3	1	FU1.0	BUSSMANN	MODEL	GMA-1-R
4	1	FU2.0	BUSSMANN	MODEL	GMA-2-R
5	1	FU3.0	BUSSMANN	MODEL	GMA-3-R
6	1	FU4.0	BUSSMANN	MODEL	GMA-4-R

ADDITIONAL PANEL LABELS:

DM = "Intrinsically Safe Circuits" (to be placed by contractor at conduit opening)
"Warning - Explosion Hazard - ; To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

Provides intrinsically safe circuit extensions for use in Hazardous Locations when connected per panel control drawing D1315-L64-06, 07, AND 08."

WARNING NAMEPLATE DETAIL

S-L CONTROLS DWG. D1315-L64-01
VOLTAGE: 120VAC, 60Hz, SINGLE PHASE
AMPS: 15

ENCLOSURE RATING: UL TYPE 12

CAUTION: MULTIPLE SOURCES ARE PROVIDED FROM FIELD TERMINALS. EACH SOURCE SHOULD BE DISCONNECTED FOR SERVICING.

NAMEPLATES:
ENGRAVED, RIGID, LAMINATED PLASTIC TYPE WITH ADHESIVE BACK BLACK WITH WHITE LETTERS EXCEPT WARNING NAMEPLATE WHICH SHALL BE RED WITH WHITE LETTERS.

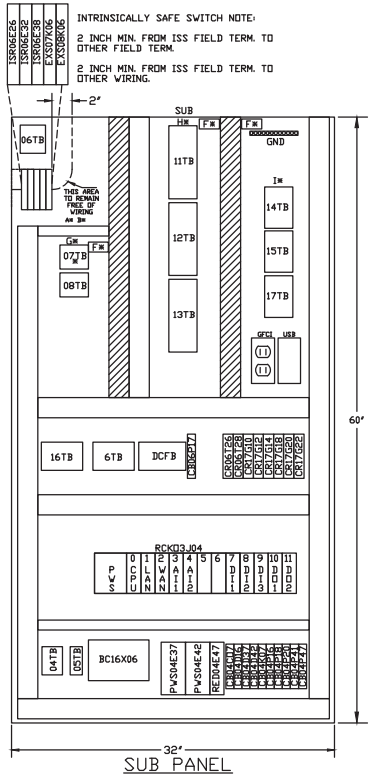
WIRING

1) ☐ - INDICATES TERMINAL BLOCK
2) DASHED LINES INDICATE WIRING REMOTE TO CONTROL PANEL.
3) WIRING
   INCOMING 120VAC UPS HOT (L) - 14 GA. RED w BLACK STRIPE MTW
   INCOMING 120VAC NEUTRAL (NU) ---------- 14 GA. WHITE MTW
   INTERNAL 120VAC HOT (LU) ---------- 14 GA. RED MTW
   INTERNAL 120VAC HOT ---------- 16 GA. RED MTW
   EXTERNALLY ENERGIZED 120VAC ----------14 GA. YELLOW MTW
   DC VOLTAGE (+) ---------- 16 GA. BLUE MTW
   DC VOLTAGE (-) ---------- 16 GA. WHITE w BLUE STRIPE MTW
   4-20mA LOOP --18 GA. TWISTED SHIELDED PAIR (BLACK / WHITE)
4) PROVIDE 20% SPARE TERMINALS
5) UL HAZARDOUS LOCATION/INTRINSICALLY SAFE CIRCUIT APPROVED NO. ; TO BE PROVIDED TIME OF MANUFACTURING
6) ELECTRICAL CONNECTION TORQUES:
   TERMINAL: 12 INCH POUNDS

NOT TO BE USED FOR CONSTRUCTION

TOLERANCES	REVISIONS	PRINCE WILLIAM COUNTY SERVICE AUTHORITY	
DECIMAL	NO. DATE BY	LIFT STATION - PLC PANEL	
FRACTIONAL		DRAWN BY	SCALE NONE SHEET of
ANGULAR		CHK'D	DATE DRAWING NUMBER
		TRACED	APP'D

Typical Pump Station Control Panel



07TB = SHEET 07 AND TB INCLUDES TERMINAL BLOCKS, FUSE BLOCKS, AND DISCONNECTS PER THAT SHEET.

BILL OF MATERIAL

TAG	QTY	PART NO.	DESCRIPTION	MANUFACTURER	REFERENCES:
PLCL64	1	A723618FSG	ENCLOSURE, NEMA 12, FREESTANDING	HOFFMAN	
SUB	1	A72P36F1	SUB PANEL	HOFFMAN	
LT	1	LEDAIS35	LED LIGHT	HOFFMAN	LT04G16
SW	1	ALFSWD	SWITCH, DOOR ACTIVATED	HOFFMAN	SW13L32
GND	1	PTK12GTA	GROUND BAR	SQUARE D	
AH	1	870P-N5	ALARM HORN	EDWARDS	AH15J36
PWS	2	2904376	POWER SUPPLY, 150W, 24VDC	PHOENIX CONTACT	PWS04E37, PWS04E42
RED	1	2866514	REDUNDANCY MODULE	PHOENIX CONTACT	RED04E47
CPU	1	BMXP341000	PROCESSOR, MODBUS	MODICON	CPU03K04
PWS	1	BMXCPS3500	POWER SUPPLY	MODICON	PWS04R08
WAN	1	BMXNOR0200H	RTU MODULE	MODICON	WAN03K04
LAN	1	BMXNOE0100	ETHERNET MODULE	MODICON	LAN03K04
AI	2	BMXAMI0410	ANALOG INPUT, 4 CH, 4-20mA	MODICON	AI07X06, AI08X06
DI	3	BMXDAI1604	DISCRETE INPUT, 16 PT, 120VAC	MODICON	DI11X06, DI12X06, DI13X06
DO	2	BMXDRA0805	DISCRETE OUTPUT, 8 PT, RELAY	MODICON	DO14B06, DO15B06
IOTB	7	BMXFTB2000	I/O TERMINAL BLOCK, 20 PIN	MODICON	AI07X06, AI08X06, DI11X06, DI12X06, DI13X06, DO14B06, DO15B06
RACK1	1	BMXXBP1200	12 SLOT CHASSIS	MODICON	RCK03J04
OIT	1	HMIGTO6310	TOUCH SCREEN, 12.1"	SCHNEIDER ELECTRIC	OIT03H05
BC	1	HMISCU6B5	HMI & CONTROLLER	SCHNEIDER ELECTRIC	BC16X06
BC	1	HMIZSURDP	HMI & CONTROLLER CABLE	SCHNEIDER ELECTRIC	
CB15	1	QDU115	CIRCUIT BREAKER, 15A	SQUARE D	CB04CD7
CB10	6	QDU110	CIRCUIT BREAKER, 10A	SQUARE D	CB04D16, CB04D37, CB04D42, CB04K07, CB04P41, CB04P47
CB1	4	M9F42101	CIRCUIT BREAKER, 1A	SQUARE D	CB04P16, CB04P18, CB04P20, CB06P17
CR	8	RPM12BD	RELAY, SPDT, 24VDC, 15A	SCHNEIDER ELECTRIC	CR06T26, 28, CR17G10, 12, 14, 18, 20, 22
CR	8	RPZF1	SOCKET, SPDT RELAY	SCHNEIDER ELECTRIC	CR06T26, 28, CR17G10, 12, 14, 18, 20, 22
EXS	2	2865366	I.S. BARRIER, SIGNAL SPLITTER	PHOENIX CONTACT	EXS07K06, EXS08K06
ISR	3	2865450	INTRINSICALLY SAFE SWITCH	PHOENIX CONTACT	ISR06E26, ISR06E32, ISR06E38
GFCI	1	GFRST15W	RECEPTACLE, GFCI, 15A	HUBBELL	GFCI04L09
USB	1	USB4ACW	USB CHARGER, 2 TYPE A, 2 TYPE C	HUBBELL	USB04L12
GFCI/USB	2	58361-1/2	UTILITY BOX, SINGLE GANG	STEEL CITY	GFCI04L09, USB04L12
DCFB	19	3046090	FUSE BLOCK, BLOWN FUSE, 10-30V	PHOENIX CONTACT	FU06###, FU07###, FU08###, FU14H38, FU16###
ACFB	67	3046100	FUSE BLOCK, BLOWN FUSE, 60-150V	PHOENIX CONTACT	FU04P08, FU11###, FU12###, FU13###, FU14###, FU15###
FU0.5	57	GMA-500-R	0.5A FUSE	BUSSMANN	FU11###, FU12###, FU13###, FU16###
FU1.0	10	GMA-1-R	1A FUSE	BUSSMANN	FU06C26, 32, 38, FU06P20, 26, 28, FU07Q06, FU08Q06, 13, 18
FU2.0	2	GMA-2-R	2A FUSE	BUSSMANN	FU06C11, P23
FU3.0	16	GMA-3-R	3A FUSE	BUSSMANN	FU14###, FU15###
FU4.0	1	GMA-4-R	4A FUSE	BUSSMANN	FU04P08
ACTB	100	3044102	TERMINAL BLOCK, AC, GRAY	PHOENIX CONTACT	
DCTB	40	3044115	TERMINAL BLOCK, DC, BLUE	PHOENIX CONTACT	
DS	2	3046139	DISCONNECT TERMINAL BLOCK	PHOENIX CONTACT	DS17###
GROUND	20	3044128	TERMINAL BLOCK, GROUND, GRN/YEL	PHOENIX CONTACT	
ENDSTOP	50	0800886	END STOP, GRAY	PHOENIX CONTACT	

ADDITIONAL PANEL LABELS:

LABEL TEXT

AW = "Intrinsically Safe Field Wiring Terminals"
BW = "WARNING - EXPLOSION HAZARD - Substitution of Components May Impair Intrinsic Safety"
CW = "Intrinsically Safe Circuits" (to be placed by contractor at conduit opening)
FW = "FIELD WIRING"
GW = "ANALOG INPUT" (Terminal Block Group Label)
HW = "DIGITAL INPUT" (Terminal Block Group Label)
IW = "DIGITAL OUTPUT" (Terminal Block Group Label)

REVISION LIST:
1.) CHANGED DISCRETE OUTPUT FUSES TO 3A
2.) CHANGED DI FUSED BLOCKS TO CIRCUIT BREAKERS, CHANGED DI DISCONNECTS TO FUSED BLOCK

NOT TO BE USED FOR CONSTRUCTION

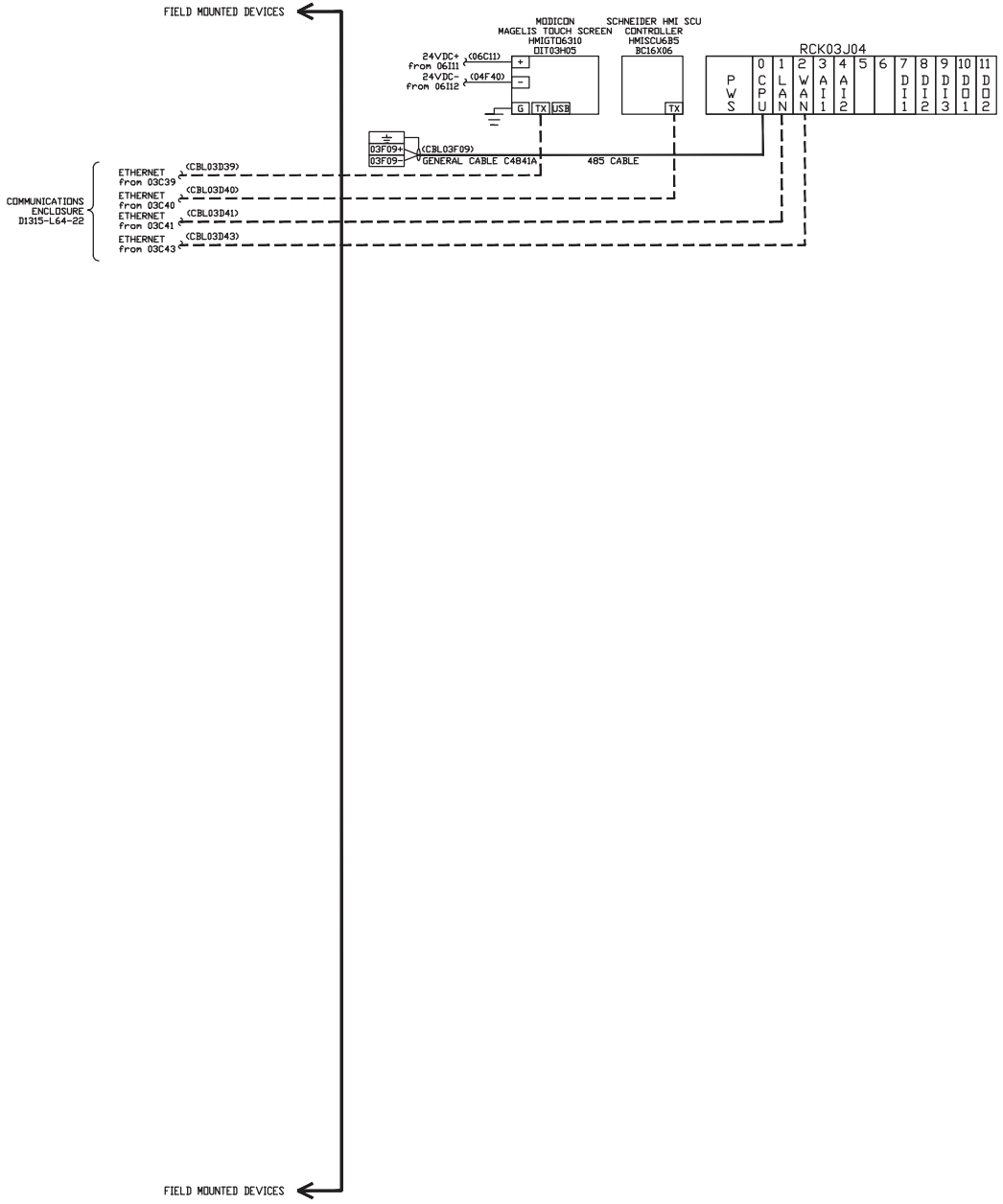
REVISIONS			
NO.	DATE	BY
1	1/20/21	MDN
2	3/14/21	MDN
3		
4		
5		
6		

TOLERANCES: DECIMAL, FRACTIONAL, ANGULAR

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

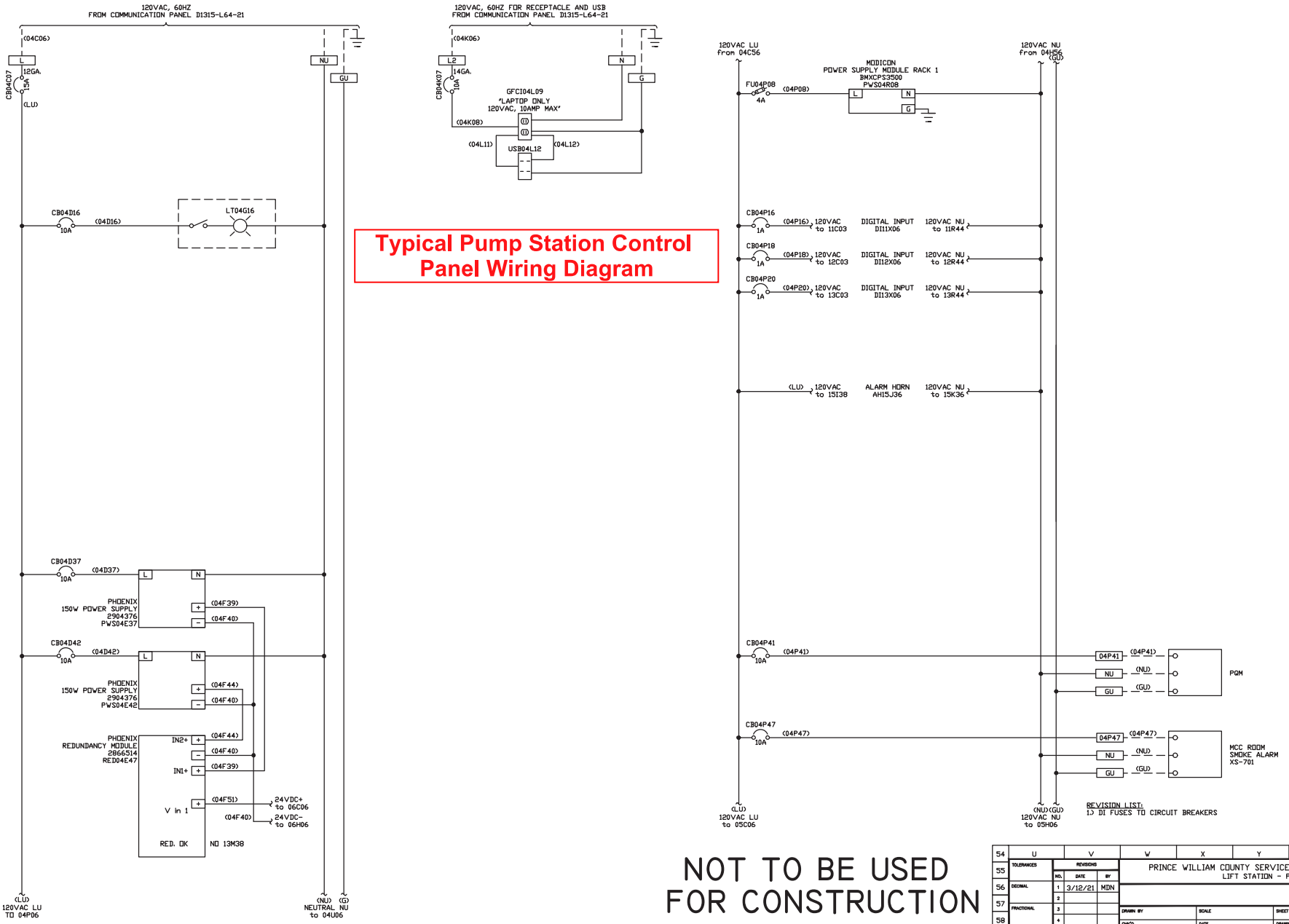
DRAWN BY | SCALE NONE | SHEET
CHK'D | DATE | DRAWING NUMBER
TRACED | APP'D

Typical Pump Station Control Panel Wiring Diagram



NOT TO BE USED FOR CONSTRUCTION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY	
LIFT STATION - PLC PANEL	
TOLERANCES	REVISIONS (NO. / DATE / BY)
DECIMAL	
FRACTIONAL	
ANGULAR	
DRAWN BY	SCALE: NONE
CHK'D	DATE
TRACED	APP'D
SHEET	DRAWING NUMBER


120VAC, 60HZ
FROM COMMUNICATION PANEL D1315-L64-21
(04C06)
L
12GA.
CB04C07
15A
(LU)
NU
GU
CB04D16
10A
(04D16)
LT04G16
CB04D37
10A
(04D37)
L
N
PHOENIX
150W POWER SUPPLY
2904376
PWS04E37
+
−
(04F39)
(04F40)
CB04D42
10A
(04D42)
PHOENIX
150W POWER SUPPLY
2904376
PWS04E42
(04F44)
PHOENIX
REDUNDANCY MODULE
2866514
RED04E47
IN2+
IN1+
V in 1
(04F51)
24VDC+
to 06C06
24VDC−
to 06H06
RED. OK
NO 13M38
(LU)
120VAC LU
TO 04P06
(NU)
NEUTRAL NU
to 04U06
(G)
120VAC, 60HZ FOR RECEPTACLE AND USB
FROM COMMUNICATION PANEL D1315-L64-21
(04K06)
L2
14GA.
CB04K07
10A
N
G
GFCI04L09
"LAPTOP ONLY
120VAC, 10AMP MAX"
(04K08)
(04L11)
USB04L12
(04L12)
Typical Pump Station Control
Panel Wiring Diagram
120VAC LU
from 04C56
120VAC NU
from 04H56
(GU)
MODICON
POWER SUPPLY MODULE RACK 1
BMXCPS3500
PWS04R08
FU04P08
4A
(04P08)
L
N
G
CB04P16
1A
(04P16)
120VAC
to 11C03
DIGITAL INPUT
DI11X06
120VAC NU
to 11R44
CB04P18
1A
(04P18)
120VAC
to 12C03
DIGITAL INPUT
DI12X06
120VAC NU
to 12R44
CB04P20
1A
(04P20)
120VAC
to 13C03
DIGITAL INPUT
DI13X06
120VAC NU
to 13R44
(LU)
120VAC
to 15I38
ALARM HORN
AH15J36
120VAC NU
to 15K36
CB04P41
10A
(04P41)
04P41
NU
GU
(NU)
(GU)
PQM
CB04P47
10A
(04P47)
04P47
NU
GU
(NU)
(GU)
MCC ROOM
SMOKE ALARM
XS-701
(LU)
120VAC LU
to 05C06
(NU)(GU)
120VAC NU
to 05H06
REVISION LIST:
1) DI FUSES TO CIRCUIT BREAKERS
NOT TO BE USED
FOR CONSTRUCTION
TOLERANCES
DECIMAL
FRACTIONAL
ANGULAR
REVISIONS
NO.
DATE
BY
1
3/12/21
MDN
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL
DRAWN BY
CHK'D
TRACED
SCALE
DATE
APP'D
SHEET
DRAWING NUMBER

INTENTIONALLY BLANK
FOR FUTURE USE

NOT TO BE USED
FOR CONSTRUCTION

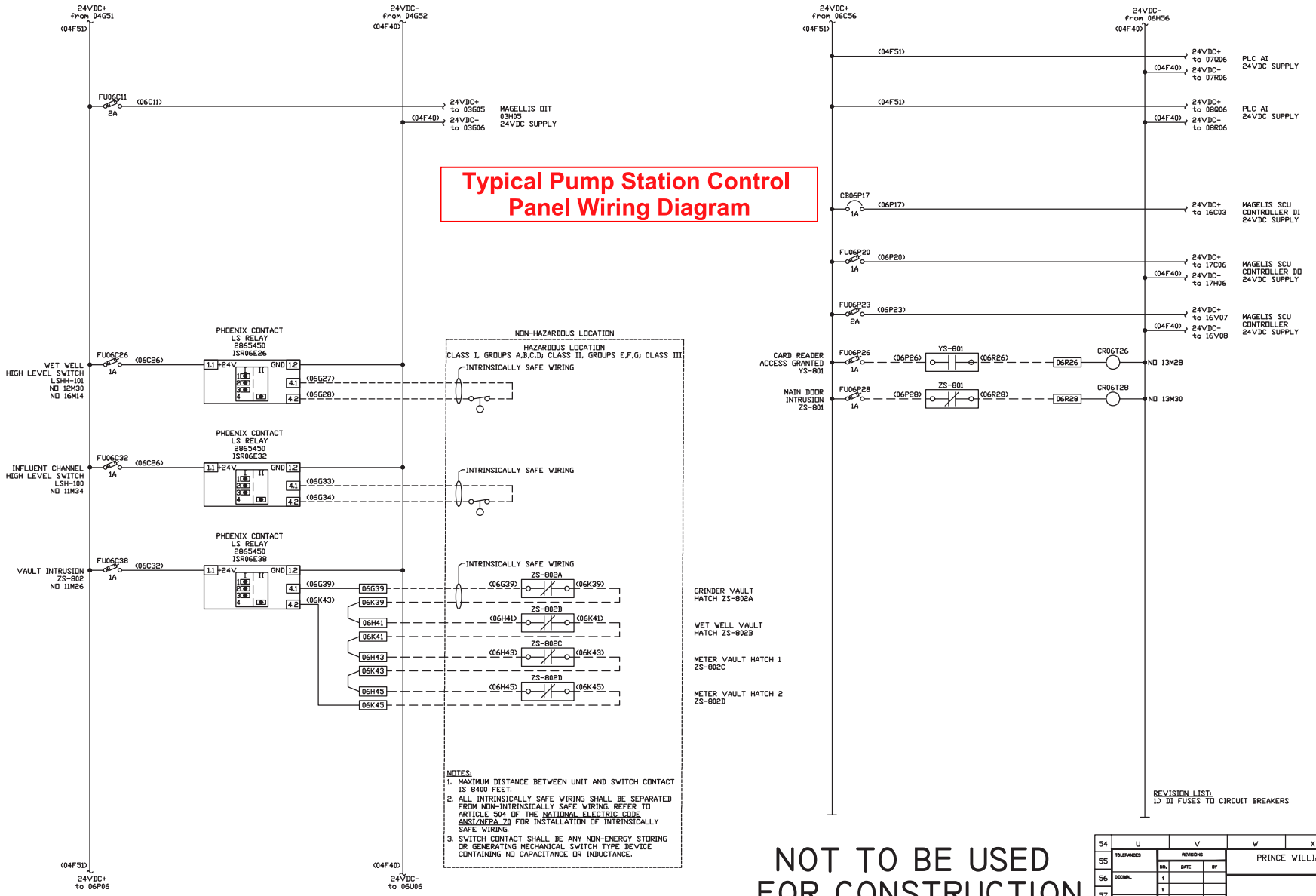
TOLERANCES	
DECIMAL	
FRACTIONAL	
ANGULAR	

REVISIONS		
NO.	DATE	BY
1		
2		
3		
4		
5		
6		

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

DRAWN BY	SCALE	SHEET
CHK'D	DATE	DRAWING NUMBER
TRACED	APP'D	

Typical Pump Station Control Panel Wiring Diagram

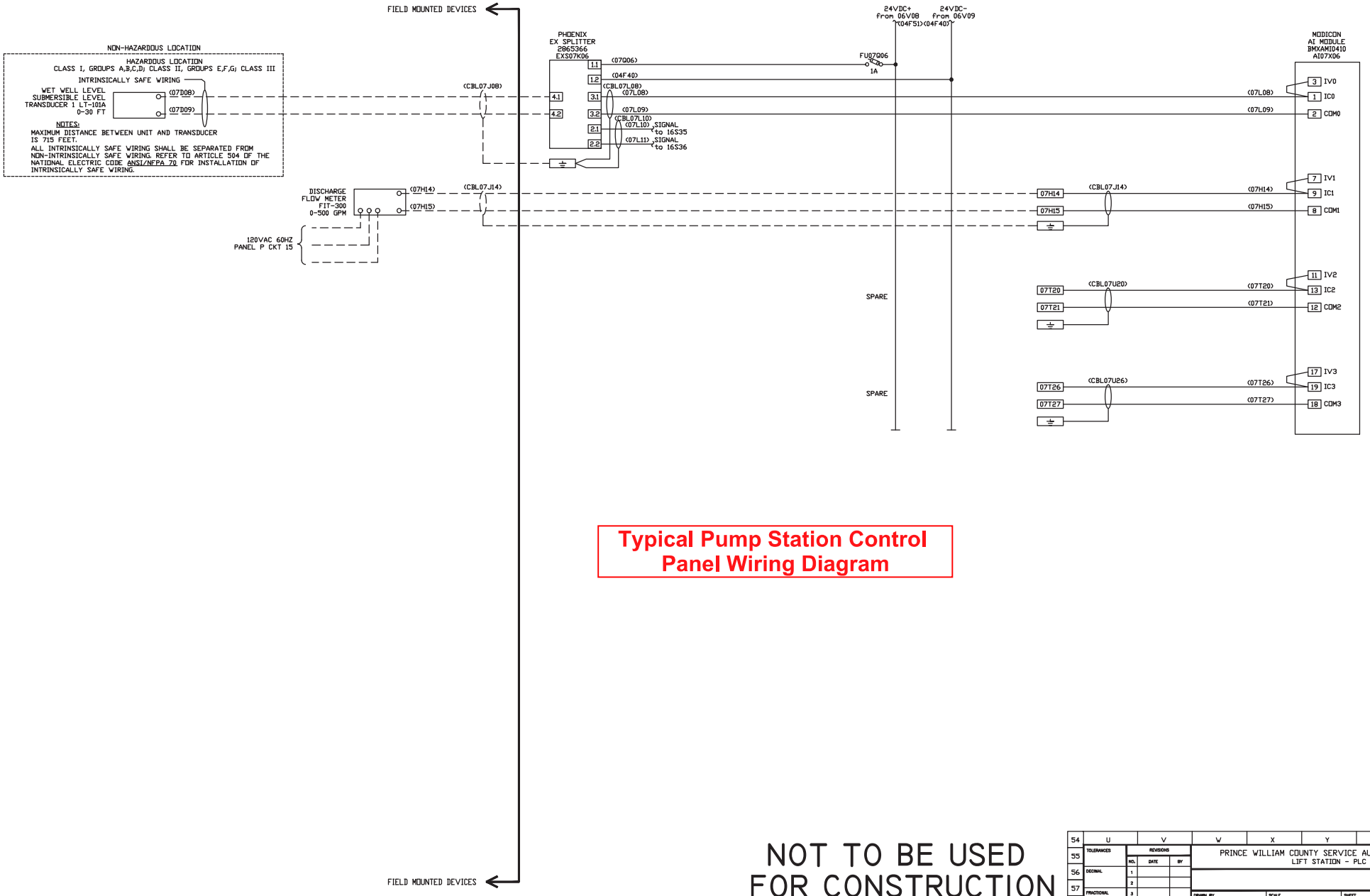


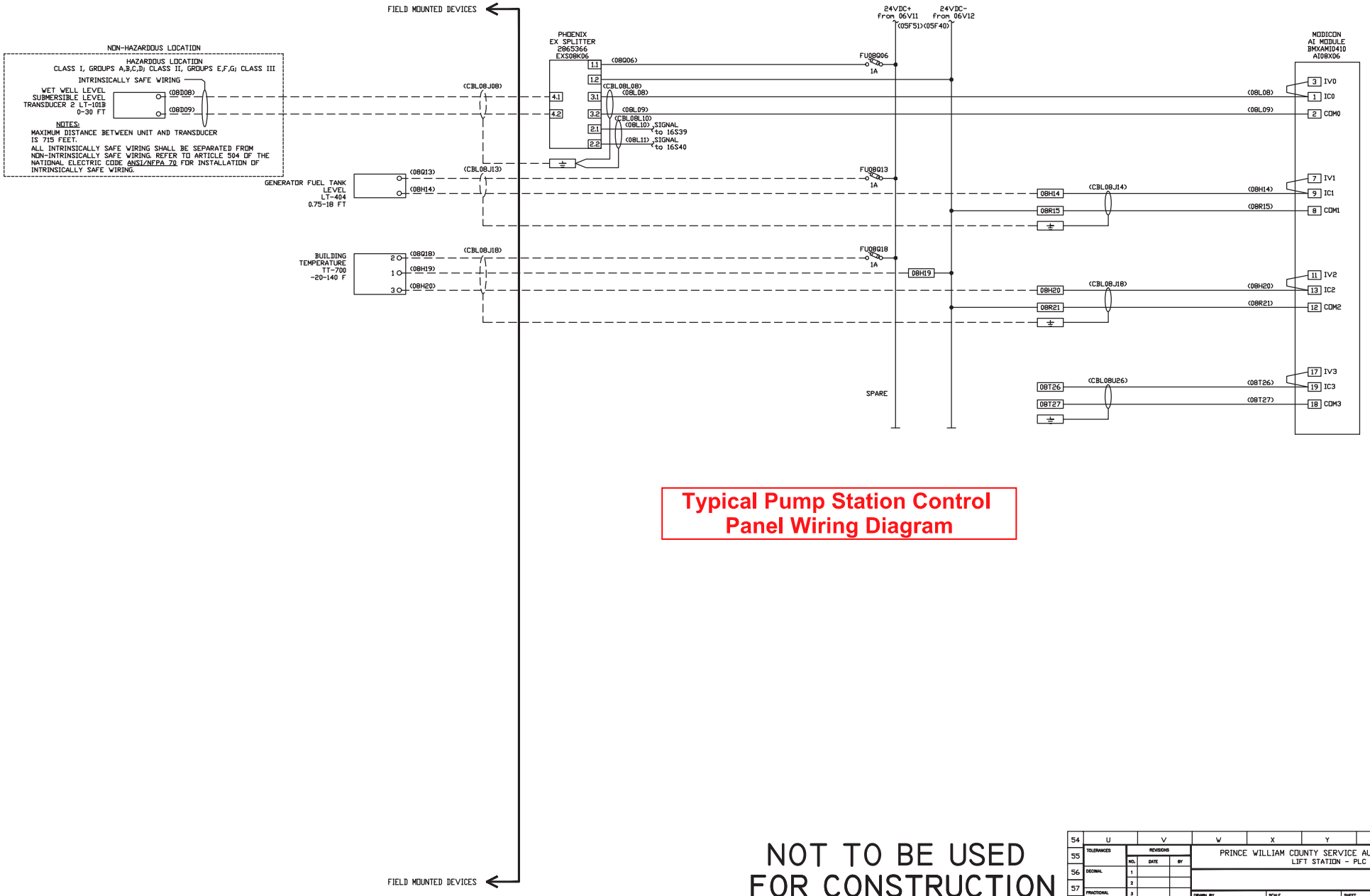
NOTES:
1. MAXIMUM DISTANCE BETWEEN UNIT AND SWITCH CONTACT IS 8400 FEET.
2. ALL INTRINSICALLY SAFE WIRING SHALL BE SEPARATED FROM NON-INTRINSICALLY SAFE WIRING. REFER TO ARTICLE 504 OF THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 FOR INSTALLATION OF INTRINSICALLY SAFE WIRING.
3. SWITCH CONTACT SHALL BE ANY NON-ENERGY STORING OR GENERATING MECHANICAL SWITCH TYPE DEVICE CONTAINING NO CAPACITANCE OR INDUCTANCE.

REVISION LIST:
1.) DI FUSES TO CIRCUIT BREAKERS

NOT TO BE USED FOR CONSTRUCTION

TOLERANCES	PRINCE WILLIAM COUNTY SERVICE AUTHORITY
DECIMAL	LIFT STATION - PLC PANEL
FRACTIONAL	
ANGULAR	
REVISIONS NO. / DATE / BY	
DRAWN BY / SCALE / SHEET	
CHK'D / DATE / DRAWING NUMBER	
TRACED / APP'D	


FIELD MOUNTED DEVICES
NON-HAZARDOUS LOCATION
HAZARDOUS LOCATION
CLASS I, GROUPS A,B,C,D; CLASS II, GROUPS E,F,G; CLASS III
INTRINSICALLY SAFE WIRING
WET WELL LEVEL SUBMERSIBLE LEVEL TRANSDUCER 1 LT-101A 0-30 FT
(07D08)
(07D09)
NOTES:
MAXIMUM DISTANCE BETWEEN UNIT AND TRANSDUCER IS 715 FEET.
ALL INTRINSICALLY SAFE WIRING SHALL BE SEPARATED FROM NON-INTRINSICALLY SAFE WIRING. REFER TO ARTICLE 504 OF THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 FOR INSTALLATION OF INTRINSICALLY SAFE WIRING.
(CBL07J08)
PHOENIX EX SPLITTER 2865366 EXS07K06
4.1
4.2
(07Q06)
(04F40)
(CBL07L08)
(07L08)
3.1
(07L09)
3.2
(CBL07L10)
(07L10) SIGNAL to 16S35
2.1
(07L11) SIGNAL to 16S36
2.2
24VDC+ from 06V08 (04F51)
24VDC- from 06V09 (04F40)
FU07Q06 1A
MODICON AI MODULE BMXAMI0410 AI07X06
3 IV0
1 IC0
2 COM0
(07L08)
(07L09)
DISCHARGE FLOW METER FIT-300 0-500 GPM
(07H14)
(07H15)
(CBL07J14)
120VAC 60HZ PANEL P CKT 15
07H14
07H15
7 IV1
9 IC1
8 COM1
SPARE
07T20
07T21
(CBL07U20)
(07T20)
(07T21)
11 IV2
13 IC2
12 COM2
07T26
07T27
(CBL07U26)
(07T26)
(07T27)
17 IV3
19 IC3
18 COM3
Typical Pump Station Control Panel Wiring Diagram
NOT TO BE USED FOR CONSTRUCTION
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL
TOLERANCES
DECIMAL
FRACTIONAL
ANGULAR
REVISIONS
NO.
DATE
BY
DRAWN BY
CHK'D
TRACED
SCALE
DATE
APP'D
SHEET
DRAWING NUMBER



Typical Pump Station Control Panel Wiring Diagram

NOT TO BE USED FOR CONSTRUCTION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

INTENTIONALLY BLANK
FOR FUTURE USE

NOT TO BE USED
FOR CONSTRUCTION

TOLERANCES	
DECIMAL	
FRACTIONAL	
ANGULAR	

REVISIONS

NO.	DATE	BY
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PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

DRAWN BY	SCALE	SHEET
CHK'D	DATE	DRAWING NUMBER
TRACED	APP'D	

INTENTIONALLY BLANK
FOR FUTURE USE

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TOLERANCES	
DECIMAL	
FRACTIONAL	
ANGULAR	

REVISIONS

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PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

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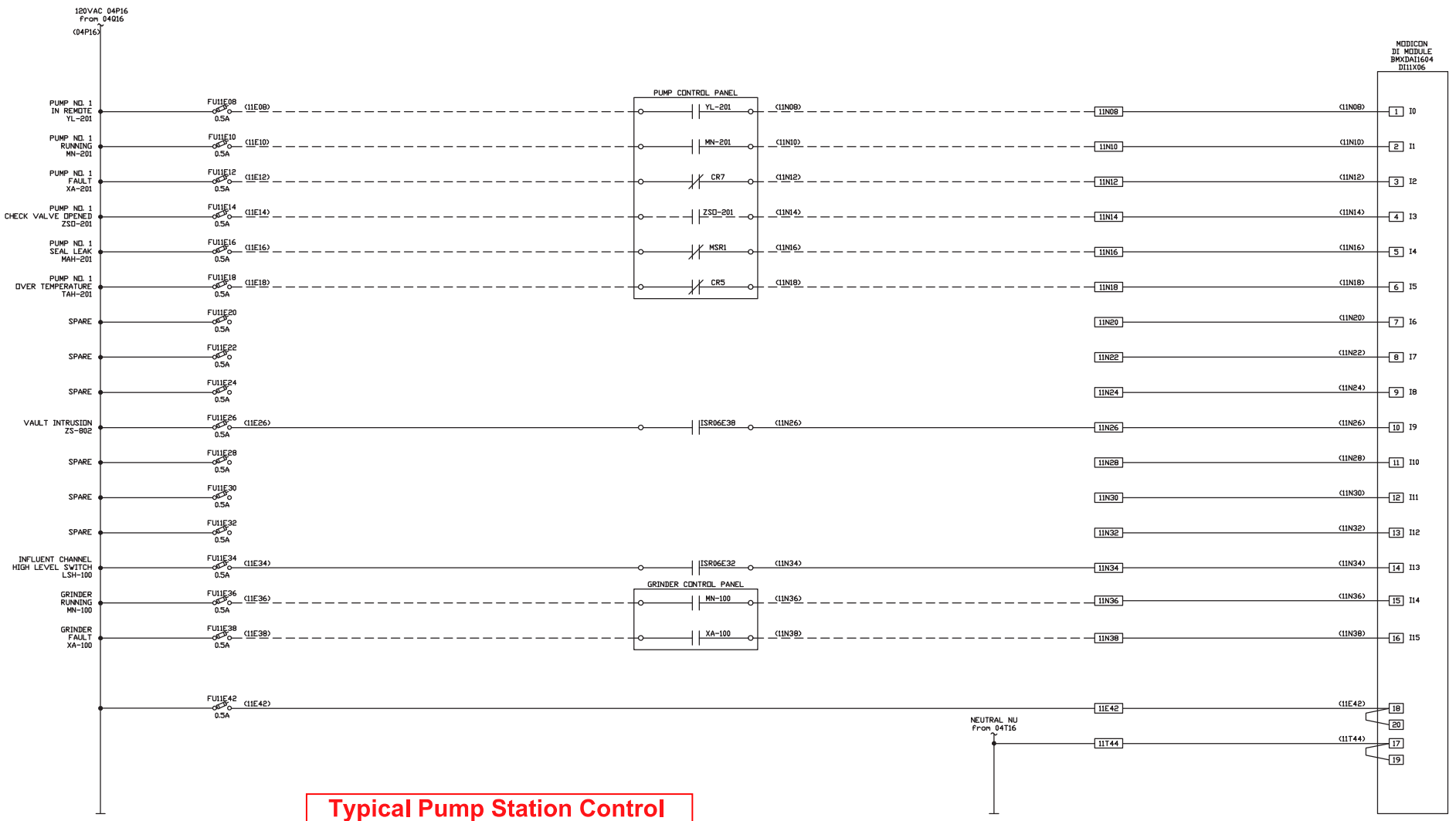
CHK'D	DATE	DRAWING NUMBER
TRACED	APP'D	



Typical Pump Station Control Panel Wiring Diagram

NOT TO BE USED FOR CONSTRUCTION

REVISION LIST:
1.) CONTACT POSITION UPDATED
2.) DISCONNECT TO FUSED DISCONNECT, UPDATED PER 50% COMMENTS

TOLERANCES	REVISIONS
DECIMAL	NO. / DATE / BY
FRACTIONAL	1
ANGULAR	2
	3
	4
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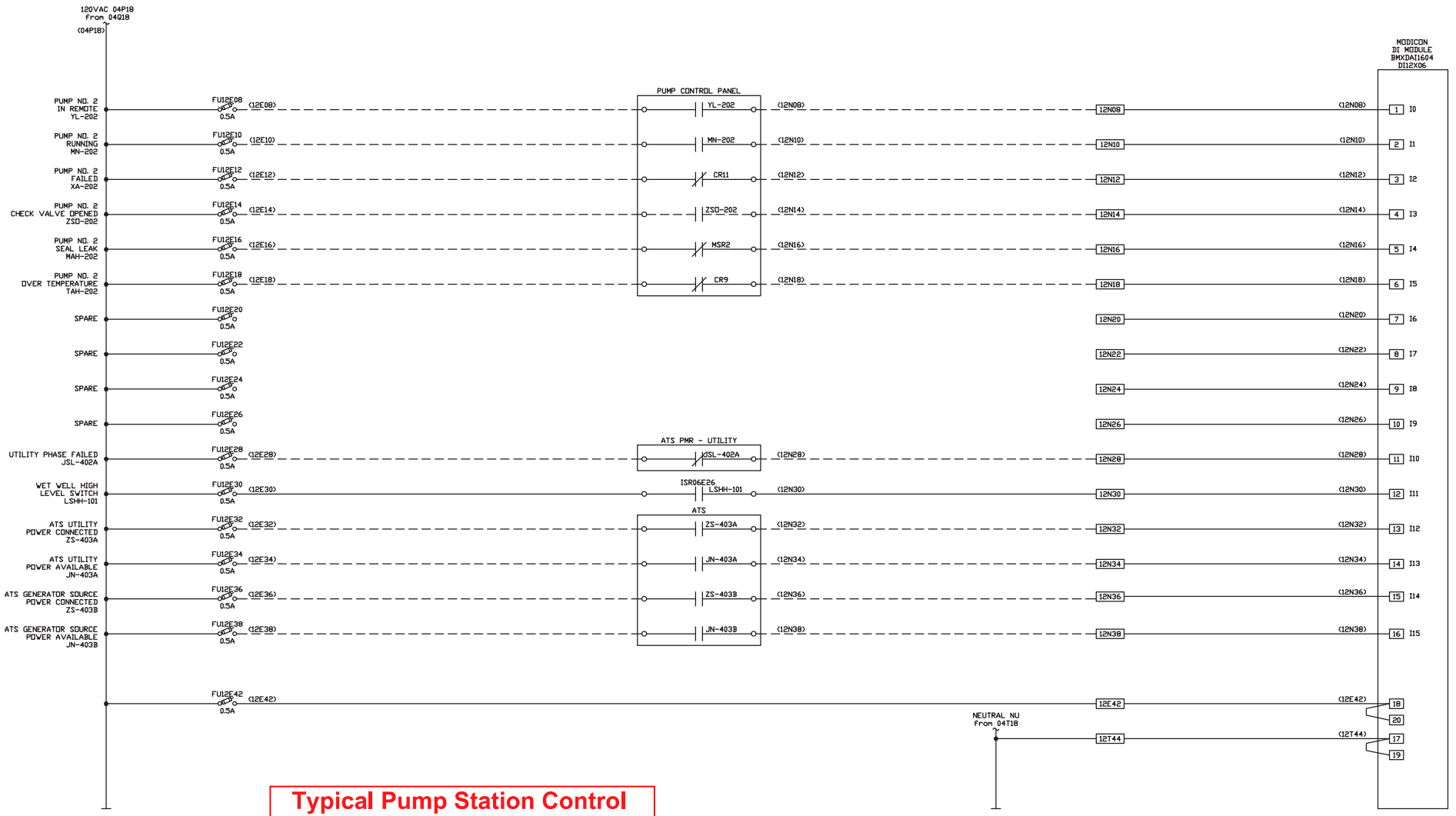
	6

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

DRAWN BY	SCALE	SHEET
CHK'D	DATE	DRAWING NUMBER
TRACED	APP'D	



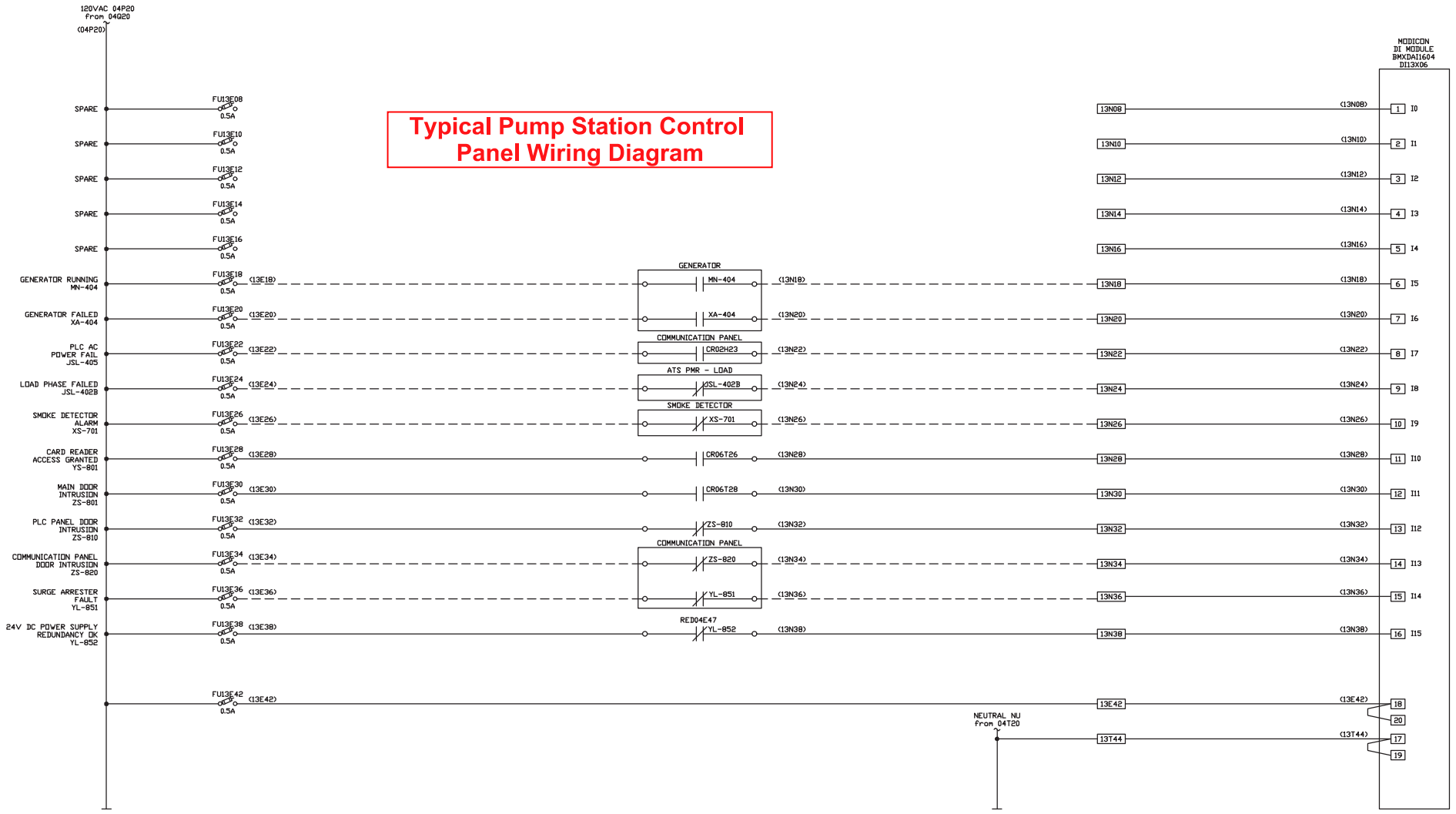
Typical Pump Station Control Panel Wiring Diagram

NOT TO BE USED FOR CONSTRUCTION

REVISION LIST:
1.) CONTACT POSITION UPDATED
2.) DISCONNECT TO FUSED DISCONNECT, UPDATED PER 50% COMMENTS

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

Typical Pump Station Control Panel Wiring Diagram



REVISION LIST:
1.) DISCONNECT TO FUSED DISCONNECT

NOT TO BE USED
FOR CONSTRUCTION

TOLERANCES	REVISIONS		
	NO.	DATE	BY
DECIMAL	1		
	2		
FRACTIONAL	3		
	4		
ANGULAR	5		
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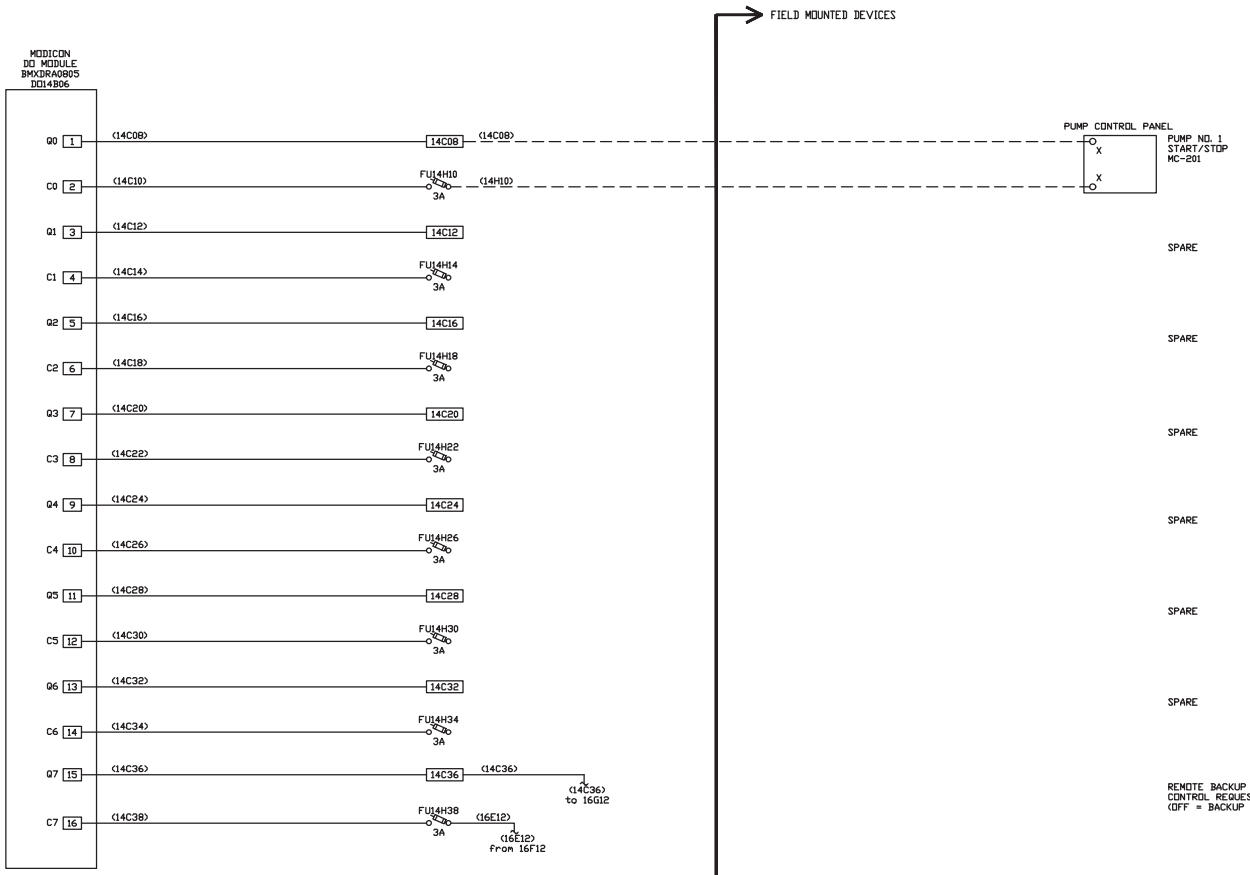
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

DRAWN BY	SCALE	SHEET
CHK'D	DATE	DRAWING NUMBER
TRACED	APP'D	

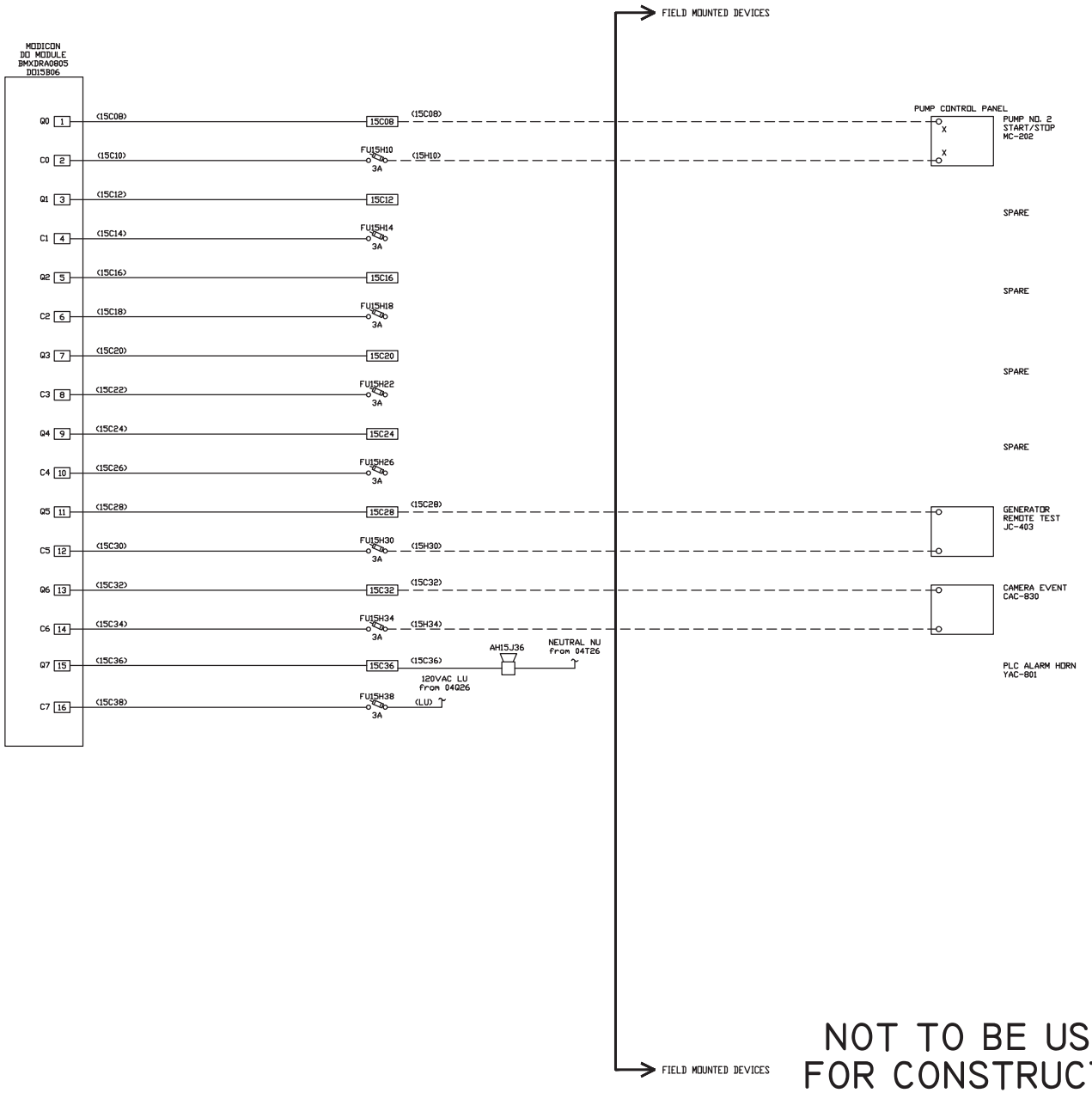


Typical Pump Station Control Panel Wiring Diagram

NOT TO BE USED FOR CONSTRUCTION

REVISION LIST:
1.) CHANGED DISCRETE OUTPUT FUSES TO 3A
2.) ADDED REMOTE BACKUP CIT CONTROL

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL



Typical Pump Station Control Panel Wiring Diagram

NOT TO BE USED FOR CONSTRUCTION

REVISION LIST:
1) CHANGED DISCRETE OUTPUT FUSES TO 3A

REVISIONS		
NO.	DATE	BY
1		
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TOLERANCES
DECIMAL
FRACTIONAL
ANGULAR

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

DRAWN BY | SCALE | SHEET
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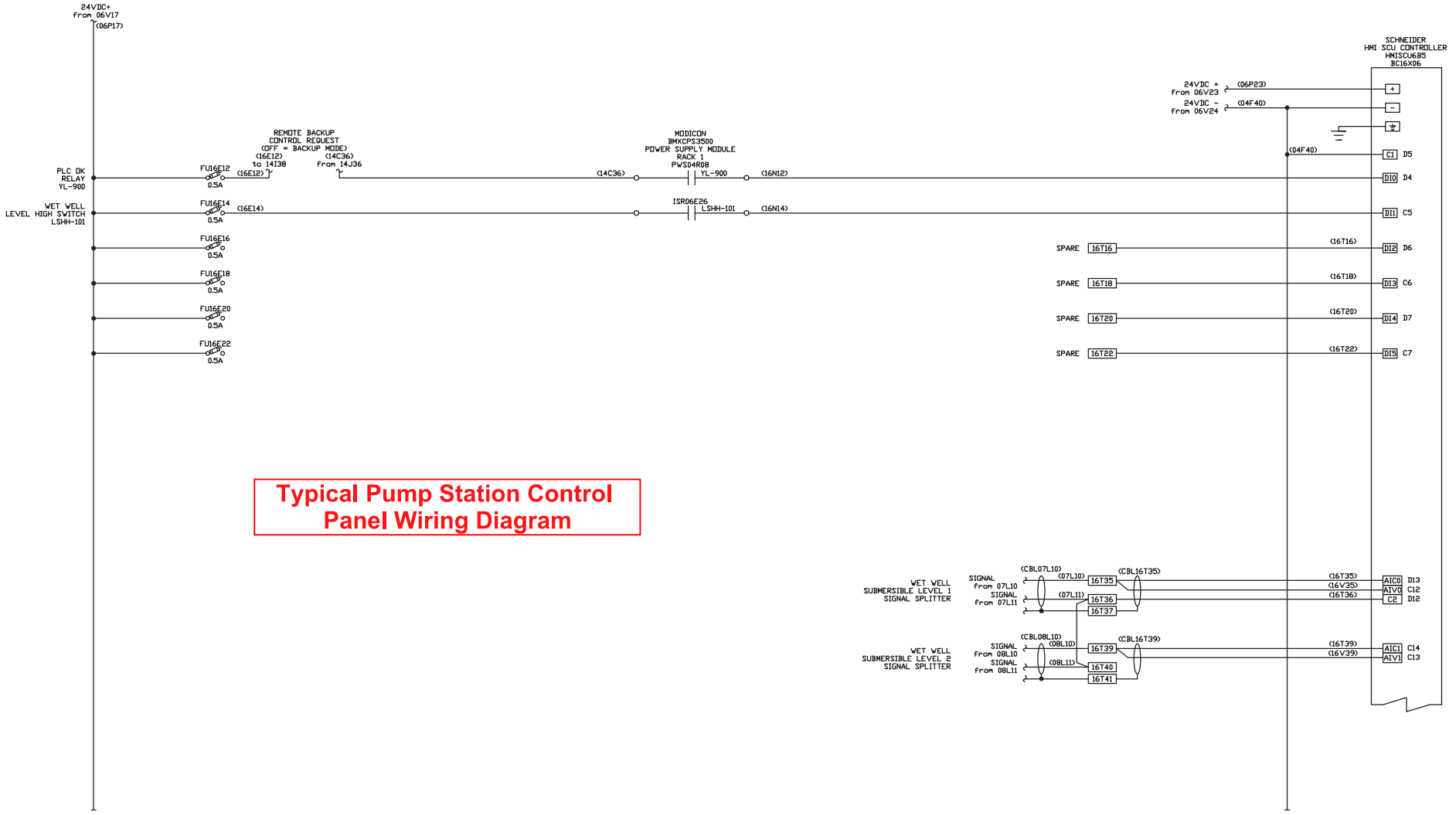
TRACED | APP'D



Typical Pump Station Control Panel Wiring Diagram

REVISION LIST:
1.) DISCONNECT TO FUSED DISCONNECT, REMOTE BACKUP OIT CONTROL

NOT TO BE USED FOR CONSTRUCTION

TOLERANCES	REVISIONS (NO. / DATE / BY)
DECIMAL	1
	2
FRACTIONAL	3
	4
ANGULAR	5
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PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

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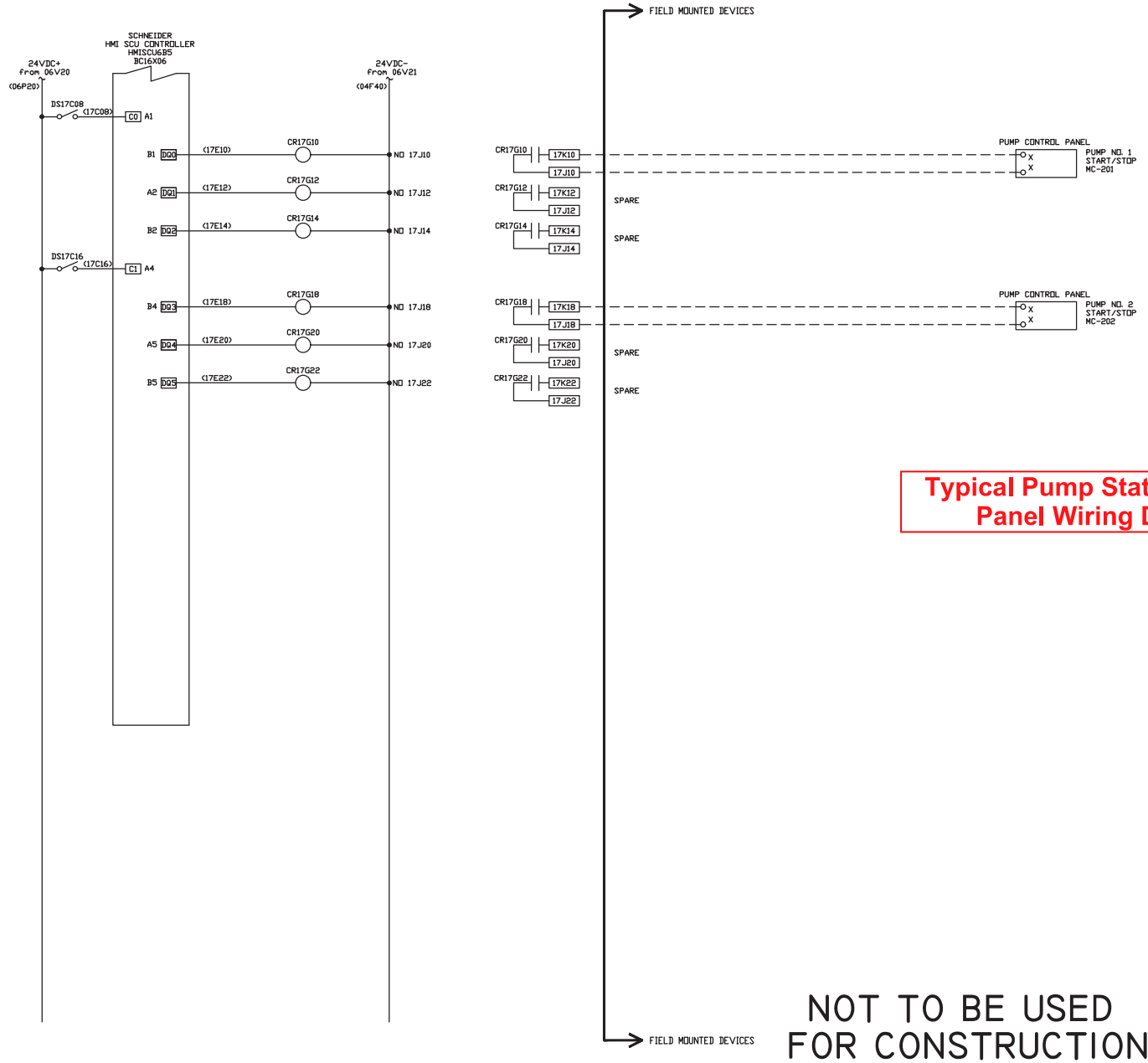
TRACED	APP'D	



Typical Pump Station Control Panel Wiring Diagram

NOT TO BE USED FOR CONSTRUCTION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

INTENTIONALLY BLANK
FOR FUTURE USE

NOT TO BE USED
FOR CONSTRUCTION

TOLERANCES	
DECIMAL	
FRACTIONAL	
ANGULAR	

REVISIONS

NO.	DATE	BY
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PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - PLC PANEL

DRAWN BY	SCALE	SHEET
CHK'D	DATE	DRAWING NUMBER
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TOLERANCES	
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PRINCE WILLIAM COUNTY SERVICE AUTHORITY
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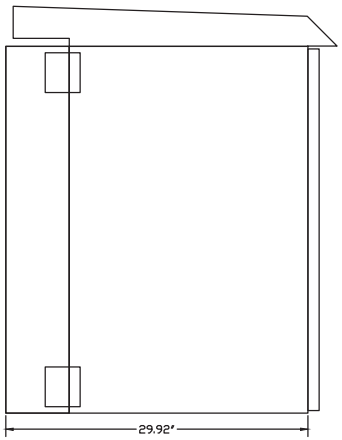
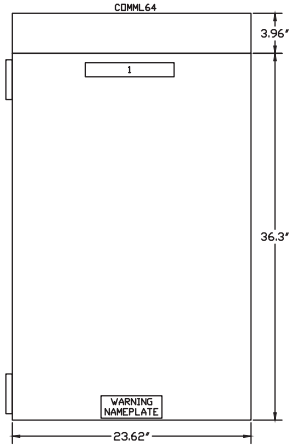
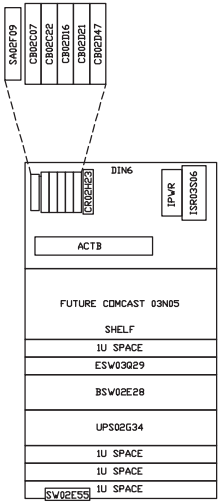


RIGHT SIDE ELEVATION



FRONT ELEVATION



RACK

BILL OF MATERIAL

TAG	QTY	PART NO.	DESCRIPTION	MANUFACTURER
COMML64	1	PTHS362424G3-P1932	ENCLOSURE, NEMA 3R, WALLMOUNT	HOFFMAN
COMML64	1	PTRA36T	RACK ANGLES, TAPPED	HOFFMAN
COMML64	1	CMFK	MOUNTING FEET	HOFFMAN
SW02E55	1	ALFSWD	SWITCH, DOOR ACTIVATED	HOFFMAN
DIN	1	RCB1122BK15	6U RACKMOUNT DIN RAIL PANEL	RACKMOUNT
SHELF	1	SRSHELF2P1U	1U SHELF	TRIPP LITE
BSW02E28	1	EHBPL1500R-PDU1U	UPS BYPASS SWITCH	EATON
UPS02G34	1	SSGL5KRM-1	UPS, 1500VA,, RACKMOUNT	FALCON
NMB03L05	1	SNMP-MEGA-INT	UPS NETWORK / MODBUS CARD	FALCON
SA02F09	1	2907918	SURGE ARRESTER, 120VAC	PHOENIX CONTACT
ISR03Q06	1	IR1101-K9	INTEGRATED SERVICES ROUTER	CISCO
IPWR03Q04	1	PWR-IE50W-AC-L=	POWER SUPPLY	CISCO
ISR03Q06	1	P-LTE-VZ	NETWORK INTERFACE MODULE LTE	CISCO
ESW03Q29	1	IE-4010-4S24P	ETHERNET SWITCH	CISCO
ESW03Q29	2	PWR-RGD-AC-DC-H	POWER SUPPLY, 150W	CISCO
SFP03D##	2	GLC-T-RGD	SFP MODULE 1000 BASE-T	CISCO
LP03T11-12	2	DGXZ+06NFNF-A	LIGHTNING PROTECTOR	POLYPHASER
(1)	2	QDU120	CIRCUIT BREAKER, 20A	SQUARE D
(2)	2	QDU115	CIRCUIT BREAKER, 15A	SQUARE D
CB02D21	1	QDU110	CIRCUIT BREAKER, 10A	SQUARE D
CR02H23	1	RPM22F7	RELAY, DPDT, 120VAC, 15A	SCHNEIDER ELECTRIC
CR02H23	1	RPZF2	SOCKET, DPDT RELAY	SCHNEIDER ELECTRIC
ACTB	9	3044102	TERMINAL BLOCK, AC, GRAY	PHOENIX CONTACT
GROUND	3	3044128	TERMINAL BLOCK, GROUND, GRN/YEL	PHOENIX CONTACT

(1) CB02C07, CB02C22
(2) CB02D16, CB02D47

Typical Pump Station Communications Panel

NAMEPLATE LEGEND TABLE

ITEM	QTY	DESCRIPTION
1	1	COMM-L64

WARNING NAMEPLATE DETAIL

S-L CONTROLS DWG. D1315-L64-20
VOLTAGE: 120VAC, 60Hz, SINGLE PHASE
AMPS: 20

ENCLOSURE RATING: UL TYPE 3R

CAUTION: MULTIPLE SOURCES ARE PROVIDED FROM FIELD TERMINALS. EACH SOURCE SHOULD BE DISCONNECTED FOR SERVICING.

NAMEPLATES:
ENGRAVED, RIGID, LAMINATED PLASTIC TYPE WITH ADHESIVE BACK BLACK WITH WHITE LETTERS EXCEPT WARNING NAMEPLATE WHICH SHALL BE RED WITH WHITE LETTERS.

WIRING

1) ☐ - INDICATES TERMINAL BLOCK
2) DASHED LINES INDICATE WIRING REMOTE TO CONTROL PANEL.
3) WIRING
   INCOMING 120VAC HOT (L) ---------- 12 GA. BLACK MTW
   INCOMING 120VAC NEUTRAL (N,NU) ---------- 12 GA. WHITE MTW
   INTERNAL 120VAC UPS HOT (LU)-14 GA. RED w BLACK STRIPE MTW
   INTERNAL 120VAC HOT ---------- 14 GA. RED MTW
   INTERNAL 120VAC NEUTRAL ---------- 14 GA. WHITE MTW
4) PROVIDE 20% SPARE TERMINALS
5) ELECTRICAL CONNECTION TORQUES:
   TERMINAL: 12 INCH POUNDS

REVISION LIST:
1.) CISCO ISR4320 REPLACED WITH IR-1101

NOT TO BE USED FOR CONSTRUCTION

TOLERANCES
DECIMAL
FRACTIONAL
ANGULAR

REVISIONS			
NO.	DATE	BY
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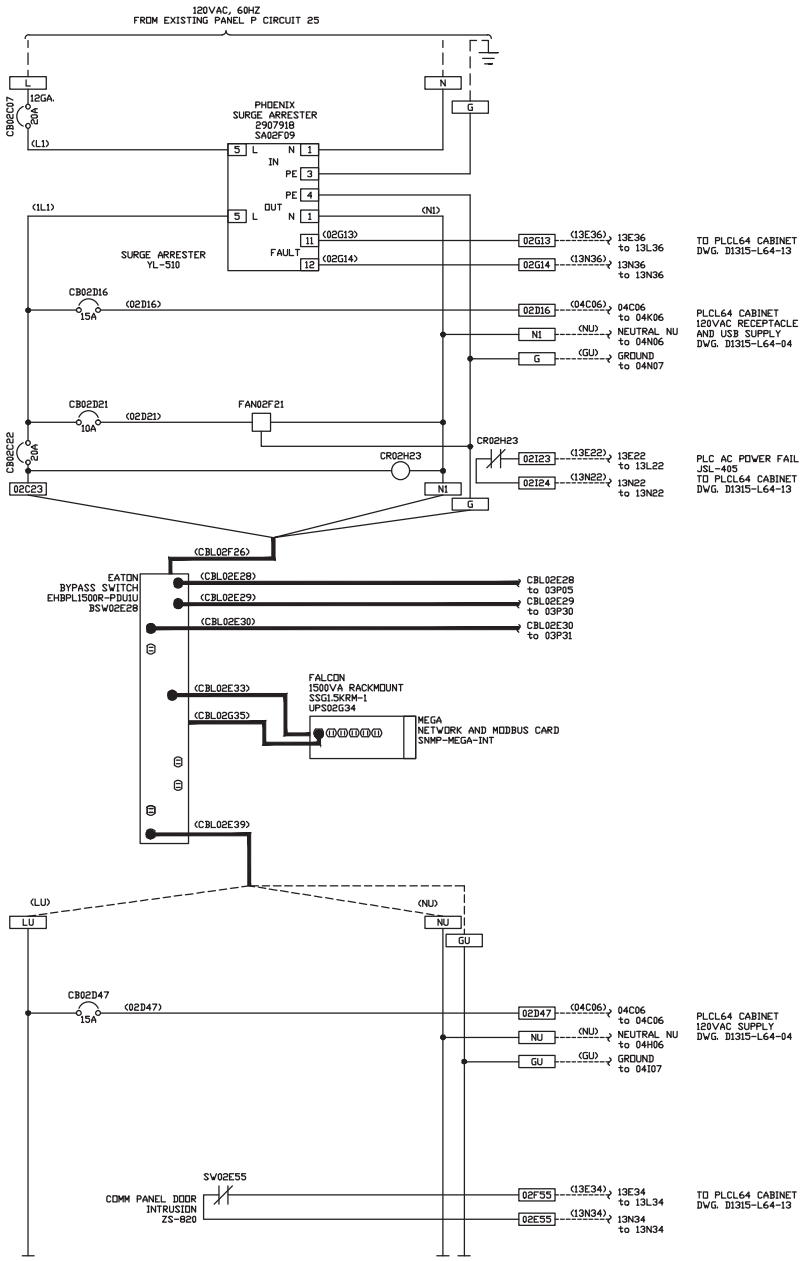
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - COMM PANEL

DRAWN BY	SCALE	SHEET
CHK'D	DATE	DRAWING NUMBER
TRACED	APP'D	

Typical Pump Station Communications Panel Wiring Diagram



NOT TO BE USED
FOR CONSTRUCTION

TOLERANCES	REVISIONS		
	NO.	DATE	BY
DECIMAL	1		
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FRACTIONAL	3		
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ANGULAR	5		
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PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - COMM PANEL

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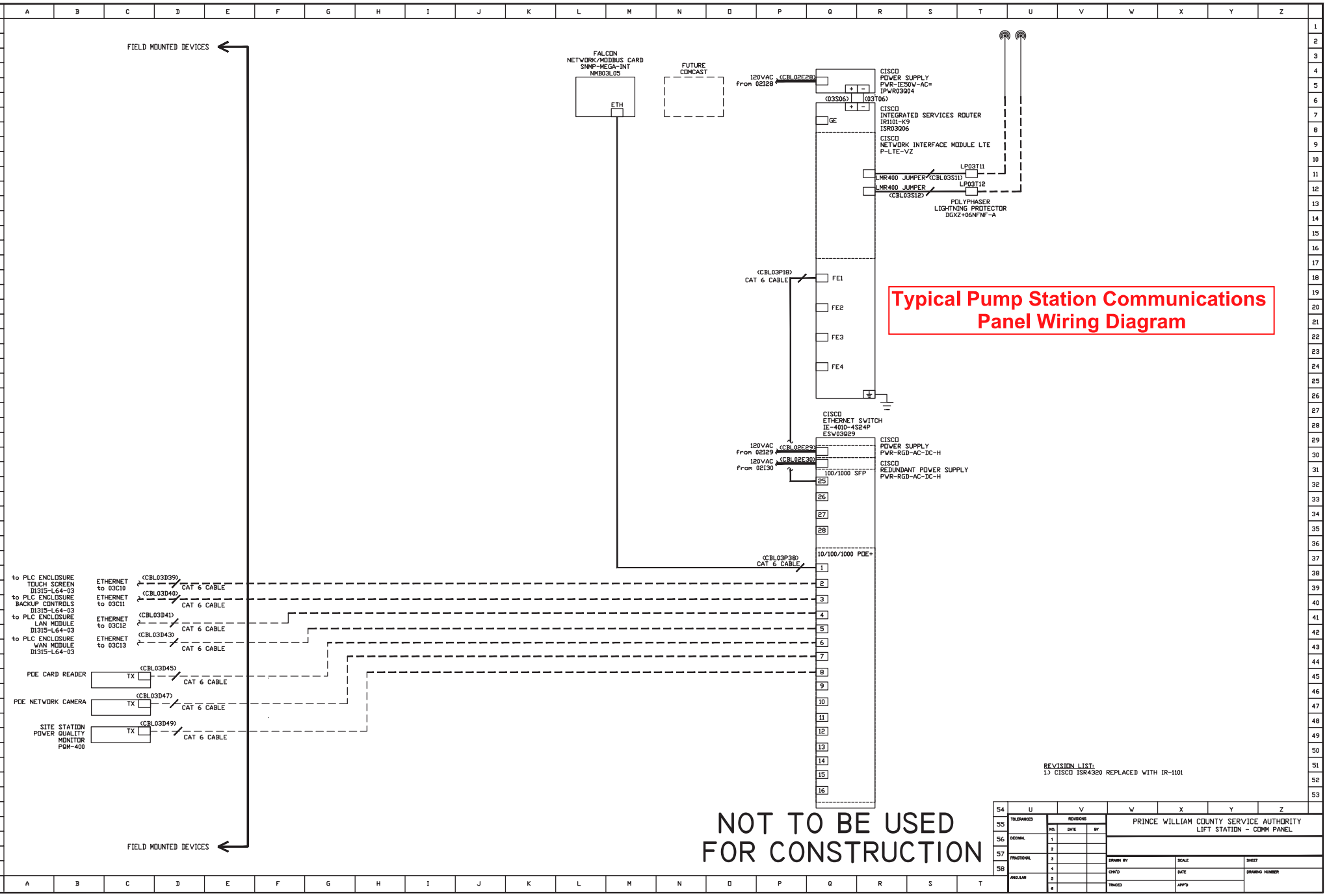
FIELD MOUNTED DEVICES
FALCON
NETWORK/MODBUS CARD
SNMP-MEGA-INT
NMB03L05
ETH
FUTURE
COMCAST
120VAC (CBL02E28)
from 02I28
CISCO
POWER SUPPLY
PWR-IE50W-AC=
IPWR03Q04
(03S06)
(03T06)
CISCO
INTEGRATED SERVICES ROUTER
IR1101-K9
ISR03Q06
GE
CISCO
NETWORK INTERFACE MODULE LTE
P-LTE-VZ
LP03T11
LMR400 JUMPER (CBL03S11)
LMR400 JUMPER (CBL03S12)
LP03T12
POLYPHASER
LIGHTNING PROTECTOR
DGXZ+06NFNF-A
(CBL03P18)
CAT 6 CABLE
FE1
FE2
FE3
FE4
Typical Pump Station Communications Panel Wiring Diagram
CISCO
ETHERNET SWITCH
IE-4010-4S24P
ESW03Q29
120VAC (CBL02E29)
from 02I29
120VAC (CBL02E30)
from 02I30
CISCO
POWER SUPPLY
PWR-RGD-AC-DC-H
CISCO
REDUNDANT POWER SUPPLY
PWR-RGD-AC-DC-H
100/1000 SFP
25
26
27
28
10/100/1000 POE+
(CBL03P38)
CAT 6 CABLE
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
to PLC ENCLOSURE
TOUCH SCREEN
DI315-L64-03
ETHERNET
to 03C10
(CBL03D39)
CAT 6 CABLE
to PLC ENCLOSURE
BACKUP CONTROLS
DI315-L64-03
ETHERNET
to 03C11
(CBL03D40)
CAT 6 CABLE
to PLC ENCLOSURE
LAN MODULE
DI315-L64-03
ETHERNET
to 03C12
(CBL03D41)
CAT 6 CABLE
to PLC ENCLOSURE
WAN MODULE
DI315-L64-03
ETHERNET
to 03C13
(CBL03D43)
CAT 6 CABLE
POE CARD READER
TX
(CBL03D45)
CAT 6 CABLE
POE NETWORK CAMERA
TX
(CBL03D47)
CAT 6 CABLE
SITE STATION
POWER QUALITY
MONITOR
PQM-400
TX
(CBL03D49)
CAT 6 CABLE
FIELD MOUNTED DEVICES
NOT TO BE USED
FOR CONSTRUCTION
REVISION LIST:
1.) CISCO ISR4320 REPLACED WITH IR-1101
TOLERANCES
DECIMAL
FRACTIONAL
ANGULAR
REVISIONS
NO.
DATE
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PRINCE WILLIAM COUNTY SERVICE AUTHORITY
LIFT STATION - COMM PANEL
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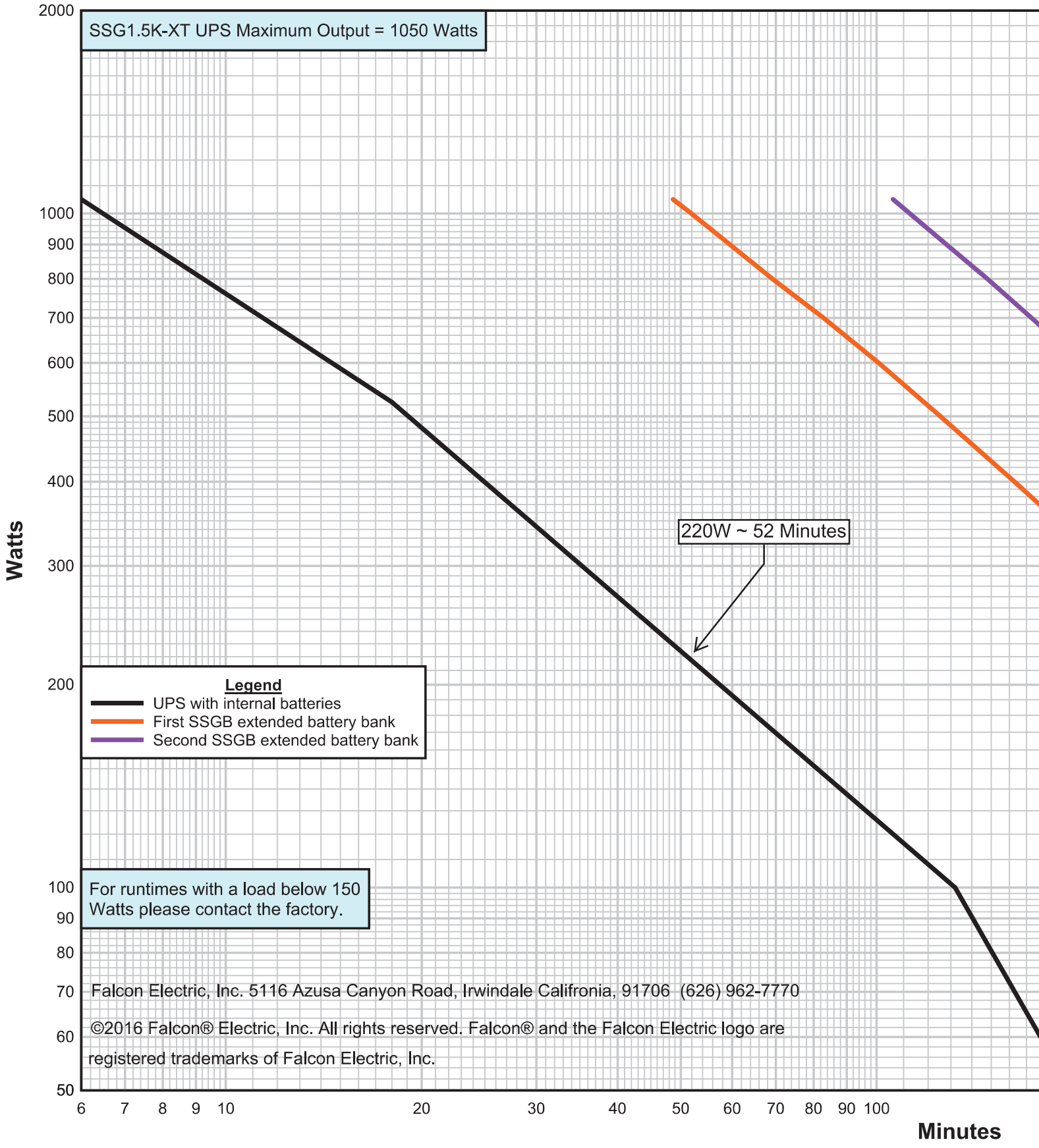
DRAWING NUMBER

120VAC UPS Draw Calculation

L64-Comm	VA	Qty	Scaling	Watts
24VDC PS	165	1	0.33	54.45
PLC	119.6	1	0.25	29.9
IR 1101	20	1	1	20
Switch 4010	100	1	1	100
Power Monitor	5	1	1	5
Smoke Detector	8.4	1	1	8.4
				217.75

SSG1.5K-XT UPS Battery Runtimes



Falcon Electric, Inc. 5116 Azusa Canyon Road, Irwindale Califronia, 91706 (626) 962-7770

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Heat Calculation

L64-PLC	Watts	Qty	Scaling	Watts
PLC	23	1	1	23
PS1 and PS2	19.9	1	1	19.9
OIT	10	1	1	10
Backup Control	15	1	1	15
				0
				0
				67.9
			BTU/Hr	231.82

Product selection result

Project

- Title: PWCSA - L64
- Create date: Oct 14, 2020
- Amend date: Dec 14, 2020

User

- Company:
- Name:
- Address:
- City:

Enclosure

Type	
Height	72 inch
Width	36 inch
Depth	18 inch

Wall

Material	Mild Steel
k	5.5 W/m²K
Insulation	R0 = 0 inch

Location

for Indoor enviroments / NEMA Type 12

Single housing for wall mount

Surface according to VDE 0660 part 600 48ft²

Temperature

Min. ambient temperature	32 °F
Max. ambient temperature	125 °F
Min. admissible temperature	32 °F
Max. admissible temperature	131 °F

Rated connection value

Rated voltage:	115 V
Frequency	60 Hz

Dissipation based on manual input 232 BTU/h

Switch cabinet acclimatisation

Total dissipation in enclosure	68 W
Heat Dissipation from environment	0 BTU/h
Heat Dissipation to environment	272 BTU/h
Required cooling capacity	**0 BTU/h**
Required heating capacity	0 BTU/h

Product selection result

Warning

Ensure there is sufficient clearance for air flow around the cooling unit to prevent a so-called air short-circuit. There should be a minimum distance of approximately 200 mm (7.9 inches) to the next component in the housing and 400 mm (15.7 inches) outside the housing

Heat Calculation

L64-Comm	Watts	Qty	Scaling	Watts
UPS - Falcon	157	1	1	157
IR1101	30	1	1	30
Switch 4010	112	1	1	112
		1	1	0
				0
		1	1	0
				299.0
			BTU/Hr	1020.8

Product selection result

Project

- Title: PWCSA - L64 - Comm
- Create date: Oct 15, 2020
- Amend date: Jan 5, 2021

User

- Company:
- Name:
- Address:
- City:

Enclosure

Type	
Height	40 inch
Width	24 inch
Depth	30 inch

Wall

Material	Mild Steel
k	5.5 W/m²K
Insulation	R0 = 0 inch

Location

for Indoor enviroments / NEMA Type 12

Single housing for wall mount

Surface according to VDE 0660 part 600 31ft²

Temperature

Min. ambient temperature	32 °F
Max. ambient temperature	127 °F
Min. admissible temperature	32 °F
Max. admissible temperature	131 °F

Rated connection value

Rated voltage:	115 V
Frequency	60 Hz

Dissipation based on manual input 1,020 BTU/h

Switch cabinet acclimatisation

Total dissipation in enclosure	299 W
Heat Dissipation from environment	0 BTU/h
Heat Dissipation to environment	119 BTU/h
Required cooling capacity	**901 BTU/h**
Required heating capacity	0 BTU/h
Required air flow	217 CFM

Product selection result

A fan type PF 65000 with filter PFA 60000 and an air flow rate of 230 CFM *

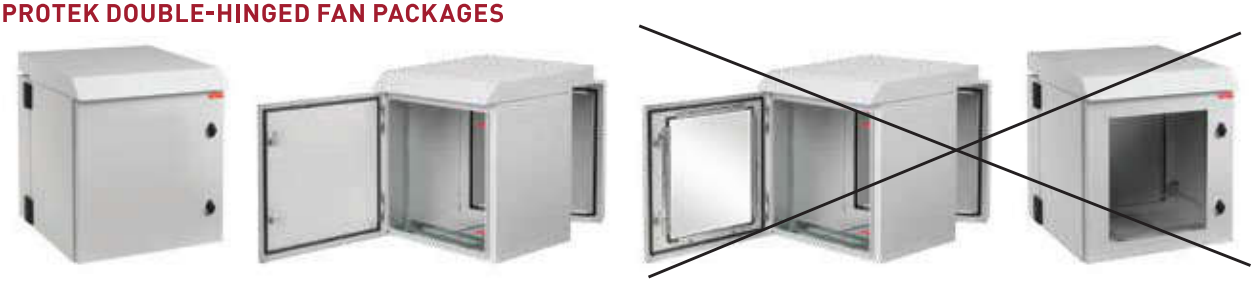
Caution delta is less than 10 K.

Warning

Ensure there is sufficient clearance for air flow around the cooling unit to prevent a so-called air short-circuit. There should be a minimum distance of approximately 200 mm (7.9 inches) to the next component in the housing and 400 mm (15.7 inches) outside the housing

* Capacity at above specified conditions.

PROTEK DOUBLE-HINGED FAN PACKAGES



INDUSTRY STANDARDS

UL 508A Listed; File Number E61997
cUL Listed per CSA C22.2 No. 94; File Number E61997
Solid Door: Type 3R
Window Door: Type 1

NEMA / EEMAC: Type 1 or 3R
IEC 60529, IP30 or IP 32, IK 10

APPLICATION

PROTEK Double-Hinged Fan Package cabinets are an excellent, off-the-shelf choice for mounting 19-in. rack, panel-mounted devices or other electronic equipment. An integral top solar/drip shield and thermostatically-controlled fans provide airflow to cool internal equipment. Cabinets are available in UL Type 3R for outdoor use. A UL Type 1 window version is available for indoor applications. The cabinets are designed to provide both front and rear access to 19-in. rack-mounted equipment, while ensuring protection against water, dirt and other contaminants. PROTEK is an excellent choice for applications where space is at a premium and the only option is wall mounting. PROTEK comes in a broad range of sizes, materials and configurations to meet many demanding applications.

FEATURES

- Front and rear access to 19-in. rack equipment provided by three-part design: door, center section and wall section
- Solid door provides complete physical and visual protection
- Integral top solar/drip shield
- Two thermostatically controlled, long-life, high-performance fans mounted into top
- Window door, made of .25-in. scratch-resistant safety glass and mechanically fastened, provides visual monitoring of internal equipment while maintaining equipment protection
- All seams are fully welded and ground smooth
- Perforated, vented base with internal, expanded metal, serviceable filter
- Door, center section and wall section are provided with ground studs to facilitate proper bonding and grounding of the cabinet
- Premium seamless, foam-in-place gasket prevents contaminants from entering the cabinet
- Keylocking wing knob provides access control to the cabinet; two keys are included with each cabinet
- One set of plated, self-grounding, tapped 10-32 rack angles per EIA universal spacing standards, adjustable front-to-back within the center section of the cabinet
- Additional rack angles in tapped- or square-hole versions can be added to the cabinet
- Wall section welded panel studs which accommodate standard panels (steel and wood available), can be ordered separately

SPECIFICATIONS

- Doors made of 16 gauge; wall and center sections made of 14 gauge steel
- Integral top with two 6-in. fans powered by 120 VAC via cord with standard NEMA plug, provide 230 CFM of airflow
- Window made of .25-in. safety glass
- Rack angles with 10-32 tapped holes per EIA universal standards are made of 12 gauge plated steel
- Incoming air filter made of expanded aluminum
- M6 door and body ground studs are masked from paint
- Twenty 10-32 rack angle equipment mounting screws included with cabinet
- Foam-in-place gasket made of durable polyurethane
- Inline thermostat turns fans on when temperature exceeds 85 F/30 C

FINISH

Pretreated steel coated with light-gray, low-gloss, lightly textured RAL 7035 polyester powder

LOAD RATING

Height	Rating
24 in.	250 lb./113.4 kg
36 in.	300 lb./136.0 kg
48 in.	350 lb./158.7 kg

ACCESSORIES

Locks and handles
Panels (steel and wood)
Grounding kits
Power Distribution Units (PDUs)
Rack angles

NOTES

Performance data based on:

- Effective measured airflow provided by integral fans is 272 CFM
- Delta T or ΔT (Ambient Temperature – Maximum in-cabinet Temperature)
  - Ambient air must be cooler than maximum in-cabinet temperature
  - For applications that have less than a ΔT of 5 F, use PROTEK with AC unit
- Total Cooling = (Air cooling + Cabinet cooling)
- Air Cooling [Watts = .316 x CFM x ΔT] Cabinet cooling [Watts = (.22 x Area) / ΔT]

Example: Cabinet height 24 in. x 24 in. deep with ambient temperature 110 F, with a maximum internal cabinet temperature 120 F (ΔT = 10 F). The cabinet and fans will provide a total cooling capability of 762 Watts or 1300 BTU.

(See Performance Chart)

BULLETIN: DWDH2

PRINCE WILLIAM COUNTY SERVICE AUTHORITY

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DRAWING INDEX

GENERAL

DRAWING NUMBER	DRAWING DESCRIPTION	REV	REV DATE
GEN-I-0	DRAWING INDEX	A	03/21
GEN-I-1	INSTRUMENTATION LEGEND I	A	03/21
GEN-I-2	INSTRUMENTATION LEGEND II	A	03/21
GEN-I-3	INSTRUMENTATION LEGEND III	A	03/21
GEN-E-1	ELECTRICAL LEGENDS AND ABBREVIATIONS	A	03/21

SITE :

DRAWING NUMBER	DRAWING DESCRIPTION	REV	REV DATE
	- SITE PLAN		
	- SYSTEM ARCHITECTURE		
	- PROCESS & INSTRUMENTATION DIAGRAM 1		
	- PROCESS & INSTRUMENTATION DIAGRAM 2		
	- PLC RISER DIAGRAM		
	- MOTOR PROTECTION CIRCUIT		
	- ELECTRICAL PERMIT DRAWING		-
	STILLING WELL DETAIL PLANS AND SECTION		-
	STILLING WELL DETAIL ADDITIONAL DETAILS AND NOTES	-	

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE

PROJECT INFORMATION

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GEN-I-0

REV. A

GENERAL INSTRUMENT OR FUNCTION SYMBOLS

SHARED DISPLAY/ SHARED CONTROL				
PRIMARY CHOICE	SECONDARY CHOICE	COMPUTER SOFTWARE	DISCRETE	LOCATION AND ACCESSIBILITY
○	◇	⬡	○	FIELD MOUNTED AND NORMALLY OPERATOR ACCESSIBLE
⊖	◇	⬡	⊖	PRIMARY CONTROL PANEL MOUNTED AND NORMALLY OPERATOR ACCESSIBLE
○	◇	⬡	⊖	PRIMARY CONTROL PANEL MOUNTED AND NOT NORMALLY OPERATOR ACCESSIBLE
⊖	◇	⬡	⊖	SECONDARY CONTROL PANEL MOUNTED AND NORMALLY OPERATOR ACCESSIBLE
⊖	◇	⬡	⊖	SECONDARY CONTROL PANEL MOUNTED AND NOT NORMALLY OPERATOR ACCESSIBLE

INSTRUMENTS SHARING COMMON HOUSING

PILOT LIGHT — FUTURE INSTRUMENTS

MISCELLANEOUS SYMBOLS

- M — MOTOR
- M — VARIABLE SPEED MOTOR
- MS — MOTOR STARTER
- VFD — VARIABLE FREQUENCY DRIVE
- P — PURGE OR FLUSHING DEVICE
- I — INTERLOCK
- ETH — ETHERNET MODBUS TCP TO RS-485 MODBUS SERIAL CONVERTER
- OMNI ANTENNA
- DIRECTIONAL ANTENNA
- CAMERA
- POWER QUALITY MONITOR
- CARD READER

TYPICAL TAG NUMBERS & DESIGNATION

HS 101 A HOA 13

- INSTRUMENT TYPE SEE "INSTRUMENTATION FUNCTION CODE" TABLE
- ADDITIONAL INSTRUMENT IDENTIFICATION SEE "HAND SWITCH ABBREVIATIONS"
- INSTRUMENT IDENTIFICATION
- USED TO DENOTE THE DIVISION THE INSTRUMENT IS SUPPLIED UNDER OR IF THE INSTRUMENT IS EXISTING OR FUTURE.
- WHEN USED, LETTER DISTINGUISHES BETWEEN MULTIPLE, SIMILAR DEVICES.

HAND SWITCH ABBREVIATIONS

AO = AUTO/OFF
AM = AUTO/MANUAL
CM = COMPUTER/MANUAL
CL = COMPUTER/LOCAL
E-STOP = EMERGENCY STOP
FR = FORWARD/REVERSE
FOR = FORWARD/OFF/REVERSE
FS = FAST SLOW
FOS = FAST/OFF/SLOW
HOA = HAND/OFF/AUTO
LA = LOCAL/AUTO
LLS = LEAD/LAG/STANDBY
LOC = LOCAL/OFF/COMPUTER
LOS = LOCKOUT/STOP
LR = LOCAL/REMOTE
LUO = LINE/UPS/OFF
OC = OPEN/CLOSE
OCA = OPEN/CLOSE/AUTO
OO = ON/OFF
OOA = ON/OFF/AUTO
OSC = OPEN/STOP/CLOSE
REX = REQUEST TO EXIST
RSL = RAISE/STOP/LOWER
SS = START/STOP
SOR = START/OFF/RESET
VB = VFD/BYPASS

INSTRUMENTATION FUNCTION CODE

	FIRST LETTERS		SUCCEEDING LETTERS		
	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	MEASURED/INITIATING VARIABLE	VARIABLE MODIFIER	READOUT/PASSIVE FUNCTION	OUTPUT/ACTIVE FUNCTION	FUNCTION MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE			CONTROL	CLOSED
D	USER'S CHOICE	DIFFERENCE, DIFFERENTIAL			DEVIATION
E	VOLTAGE		SENSOR, PRIMARY ELEMENT		
F	FLOW, FLOW RATE	RATIO			
G	USER'S CHOICE		GLASS, GAUGE, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT		INDICATE		
J	POWER		SCAN		
K	TIME, SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE				MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE, TOTALIZE	INTEGRATE, TOTALIZE		
R	RADIATION		RECORD		RUN
S	SPEED, FREQUENCY	SAFETY		SWITCH	STOP
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL, PROBE		
X	UNCLASSIFIED (1)	X-AXIS	ACCESSORY DEVICES, UNCLASSIFIED (1)	UNCLASSIFIED (1)	UNCLASSIFIED (1)
Y	EVENT, STATE, PRESENCE	Y-AXIS		AUXILIARY DEVICES	
Z	POSITION, DIMENSION	Z-AXIS SAFETY INSTRUMENT SYSTEM		DRIVER ACTUATOR, UNCLASSIFIED, FINAL CONTROL ELEMENT	

TABLE NOTES:
(1) WHEN USED SYMBOL OR SIGNAL LINE IS ANNOTATED.

PUMP STATIONS

LOOP NUMBER RANGE	PROCESS / AREA
100-199	STATION INFLUENT / SUCTION
200-299	PUMPING
300-399	STATION EFFLUENT / DISCHARGE
400-499	STATION POWER / ELECTRICAL SYSTEMS
500-599	SUPPLEMENTAL SYSTEMS / MISCELLANEOUS
600-699	WATER QUALITY MONITORING / CHEMICAL ADDITION
700-799	BUILDING MANAGEMENT
800-899	SECURITY / ACCESS CONTROL
900-999	BACKUP CONTROL

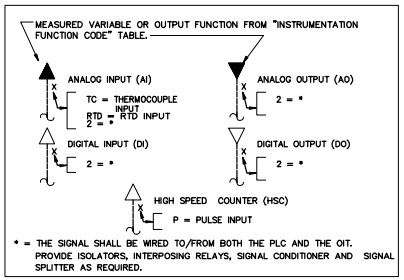
ELEVATED STORAGE TANKS

LOOP NUMBER RANGE	PROCESS / AREA
100-199	PRIMARY PIPING INCLUDING LEVEL MEASUREMENT
200-299	PUMPING (IF PRESENT AT SITE)
300-399	STATION OUTLET / DISCHARGE (IF PUMPING PRESENT AT SITE)
400-499	STATION POWER / ELECTRICAL SYSTEMS
500-599	SUPPLEMENTAL SYSTEMS / MISCELLANEOUS
600-699	WATER QUALITY MONITORING / CHEMICAL ADDITION
700-799	BUILDING MANAGEMENT
800-899	SECURITY / ACCESS CONTROL
900-999	BACKUP CONTROL

METERING/PRESSURE REDUCING STATIONS

LOOP NUMBER RANGE	PROCESS / AREA
100-199	PRE-METERING / PRE-PRESSURE REDUCING
200-299	METERING / PRESSURE REDUCING
300-399	POST-METERING / POST PRESSURE REDUCING
400-499	STATION POWER / ELECTRICAL SYSTEMS
500-599	SUPPLEMENTAL SYSTEMS / MISCELLANEOUS
600-699	WATER QUALITY MONITORING / CHEMICAL ADDITION
700-799	BUILDING MANAGEMENT
800-899	SECURITY / ACCESS CONTROL
900-999	BACKUP CONTROL

I/O SIGNALS



PRIMARY ELEMENTS

- FE — MAGNETIC FLOW METER
- FE — TURBINE OR PROPELLER FLOW METER
- FE — ROTAMETER
- FE — WEIR
- FE — ORIFICE PLATE
- FE — VENTURI TUBE
- FE FE — ULTRASONIC FLOW METER
- FE — SONAR FLOW METER
- FE — FLUME
- FE — THERMAL MASS FLOW METER
- FE X — GENERAL INSERTION FLOW METER (IM=INSERT MAG)
- LS — BALL FLOAT SWITCH
- LS — DRY WELL FLOAT SWITCH
- LS — LEVEL SWITCH
- LE — ULTRASONIC LEVEL SENSOR
- LE — RADAR LEVEL SENSOR
- LT — SUBMERSIBLE LEVEL TRANSDUCER
- LIT — LEVEL INDICATING TRANSMITTER
- LT — LEVEL TRANSMITTER

INSTRUMENT LINE SYMBOLS

- ELECTRICAL SIGNAL (EXISTING)
- ELECTRICAL SIGNAL (NEW)
- VENDOR SUPPLIED CABLE
- COMMUNICATION LINK - COPPER (HARDWIRED)
- PNEUMATIC SIGNAL
- HYDRAULIC SUPPLY

GENERAL NOTES

1. IN GENERAL THIS LEGEND SHEET AND THE P&IDS ARE BASED ON THE INTERNATIONAL SOCIETY OF AUTOMATION (ISA) STANDARDS FOR PRACTICES FOR INSTRUMENTATION. SOME MODIFICATIONS, ADDITIONS AND ALTERATIONS HAVE BEEN MADE AS REQUIRED TO ACCOMMODATE PROJECT REQUIREMENTS.
2. SOME PROCESS ITEMS SUCH AS EQUIPMENT ISOLATION VALVES, BYPASS LINES, ETC., WHICH ARE NOT CRITICAL FOR AN UNDERSTANDING OF THE INSTRUMENTATION FUNCTIONS ARE NOT SHOWN ON THE P&IDS.
3. SEE ELECTRICAL AND MECHANICAL SHEETS AND SPECIFICATIONS FOR ADDITIONAL CONTROL AND INTER LOCK REQUIREMENTS.
4. LIGHTER WEIGHT LINES, SHOWN AS _____, INDICATE EQUIPMENT, INSTRUMENTS OR PIPING THAT ARE EXISTING. WEIGHTED LINES, SHOWN AS _____ OR HEAVIER _____, INDICATE EQUIPMENT, INSTRUMENTS OR PIPING THAT ARE NEW. DASHED WEIGHTED LINES, SHOWN AS _ _ _ _ _, INDICATED EQUIPMENT, INSTRUMENTS OR PIPING THAT ARE GROUPED AS A PACKAGE.

- BUBBLER TUBE
- TT — TEMPERATURE TRANSMITTER
- TIT — TEMPERATURE INDICATING TRANSMITTER
- TS — TEMPERATURE SWITCH
- PT — PRESSURE TRANSMITTER
- PIT — PRESSURE INDICATING TRANSMITTER
- LE — CAPACITANCE LEVEL SENSOR
- PI — PRESSURE GAUGE
- PS — PRESSURE SWITCH
- PDI — DIFFERENTIAL PRESSURE GAUGE
- TI — TEMPERATURE GAUGE
- AT X — GENERAL ANALYZER (pH=pH, DO=DISSOLVED OXYGEN, H2S=HYDROGEN SULFIDE, LEL=% LOWER EXPLOSIVE LIMIT, TEMP=TEMPERATURE, COND=CONDUCTIVITY, CL2=CHLORINE)
- VE — VIBRATION SENSOR
- VT — VIBRATION TRANSMITTER
- ZSO — VALVE OPEN CONTACT
- ZSO — VALVE CLOSE CONTACT

ELECTRICAL / AIR SOURCES

- 120V, UPS ——→ UPS POWERED ELECTRICAL SOURCE
- 120V, ES ——→ ELECTRICAL SOURCE
- IA ——→ INSTRUMENT AIR SOURCE

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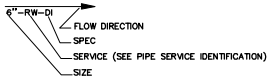
INSTRUMENTATION LEGEND 1

DWG. NO. DWG NO. SHT 1 OF 1

GEN-I-1

REV. A

TYPICAL PIPE TAG NUMBERS & DESIGNATION



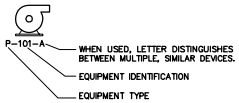
PIPE LINE SYMBOLS

- PIPE UNION
- FLEXIBLE BELLOWS TYPE COUPLING
- FLEXIBLE COUPLING (GENERAL SYMBOL)
- QUICK CONNECT TYPE COUPLING
- HOSE CONNECTION
- Y-STRAINER
- REDUCER/ENLARGER
- AIR FILTER
- PIPE MATERIAL TRANSFER (SS / DI)
- CAP
- BLIND FLANGE
- CONTINUED PIPE
- CONCENTRIC FLANGE MOUNTED DIAPHRAGM SEAL
- THREADED DIAPHRAGM SEAL
- ANNULAR SEAL
- OPEN EQUIPMENT DRAIN
- DIFFUSER
- BASKET STRAINER
- FILTER
- HOSE
- PULSATION DAMPNER
- MAJOR PROCESS LINE
- MINOR PROCESS LINE
- DOUBLE WALLED PIPE
- E (S) ELECTRIC (OR STEAM) TRACING
- DRAWING CONTINUATION (TO/FROM LOCATION)
- B/L BOUNDARY LIMITS (NO N ON THE P&IDS)

VALVE SYMBOLS

- GATE VALVE (GV)
- PLUG VALVE (PV)
- BUTTERFLY VALVE (BFV)
- BALL VALVE (BV)
- BACK FLOW PREVENTER VALVE (BFPV)
- GLOBE VALVE (GLV)
- PINCH VALVE (PCHV)
- DIAPHRAGM VALVE (DV)
- SWING CHECK VALVE (CV)
- BALL CHECK VALVE (BCV)
- SOLENOID VALVE (SV)
- TELESCOPIC VALVE (TV)
- NEEDLE VALVE (NV)
- KNIFE VALVE (KNV)
- MUD VALVE (MV)
- PRESSURE REGULATING VALVE (PREGV)
- BACK PRESSURE REGULATING VALVE (BPV)
- DIFFERENTIAL PRESSURE REGULATING VALVE W/ EXTERIOR TAPS
- ALTITUDE VALVE (AV)
- SELF-CONTAINED DIFFERENTIAL PRESSURE REGULATING VALVE (SOLENOID OPERATED)
- SURGE RELIEF VALVE (SRV)
- VACUUM RELIEF VALVE (VRV)
- AIR-VACUUM RELEASE VALVE (AVRV)

TYPICAL EQUIPMENT TAG NUMBERS & DESIGNATION



PIPE SERVICE IDENTIFICATION

CA	COMPRESSEO AIR
DR	DRAIN
FM	FORCE MAIN
FW	FINISHED WATER
OVF	OVERFLOW
PA	PURGE AIR
RW	RAW WATER
SAN	SANITARY SEWER
SL	SLUDGE
SPL	SAMPLE
SW	SEAL WATER
VT	VENT

PIPE SPECIFICATION IDENTIFICATION

DI	DUCTILE IRON
GS	GALVANIZED CARBON STEEL
PVC	POLYVINYL CHLORIDE
SS	STAINLESS STEEL
STL	STEEL
TEF	TEFLON PIPE

VALVE ACTUATORS

- HAND (MANUALLY) OPERATED
- DIAPHRAGM, SPRING OPPOSED
- DIAPHRAGM, PRESSURE-BALANCED
- ROTARY MOTOR, (SHOWN TYPICALLY WITH ELECTRIC SIGNAL. MAY BE HYDRAULIC OR PNEUMATIC)
- SOLENOID
- ELECTROHYDRAULIC
- CYLINDER, SINGLE-ACTING, SPRING OPPOSED WITHOUT POSITIONER OR PILOT.
- CYLINDER, DOUBLE ACTING, WITHOUT POSITIONER OR PILOT
- EXAMPLE OF CYLINDER WITH POSITIONER
- ANY CYLINDER THAT IS ASSEMBLED WITH A PILOT SO THAT ASSEMBLY IS ACTUATED BY ONE CONTROLLED INPUT. PILOT MAY BE POSITIONER, SOLENOID VALVE, SIGNAL CONVERTER, etc.
- FLOAT ACTUATOR

GENERAL ABBREVIATION

AC	– AIR COMPRESSOR
ACR	– ACCESS CARD READER
AI	– ANALOG INPUT
AO	– ANALOG OUTPUT
AOL	– ALWAYS ON LIGHT
ATS	– AUTOMATIC TRANSFER SWITCH
B/L	– BOUNDARY LIMIT
BR	– BAR RACK
CAM	– CAMERA
CA	– CELLULAR ANTENNA
CB	– CIRCUIT BREAKER
CH	– CHART RECORDER
COM	– COMMUNICATION CONTROL PANEL
CPU	– CENTRAL PROCESSING UNIT
CT	– UTILITY CURRENT TRANSFORMER PANEL
DI	– DIGITAL INPUT
Disc	– DISCONNECT
DO	– DIGITAL OUTPUT
DS	– DOOR SWITCH
Enet	– ETHERNET CABLE
ETH	– SERIAL TO ETHERNET CONVERTER
ETM	– ELAPSED TIME METER
FC	– FAIL CLOSED
FLA	– FULL LOAD AMPERES
FLS	– GENERATOR FUEL LEVEL SENSOR
FO	– FAIL OPEN
FS	– FLOOD SWITCH
GEN	– GENERATOR
HMI	– HUMAN MACHINE INTERFACE
HPU	– HYDRAULIC POWER UNIT
HSQ	– EXISTING HSQ PANEL
HV	– HIGH VOLTAGE PANEL BOARD
IP	– INTERNET PROTOCOL
JB	– JUNCTION BOX
LCP	– LOCAL CONTROL PANEL
LV	– LOW VOLTAGE PANEL BOARD
MAG	– MAGNETIC FLOW METER
MB	– METERBASE UTILITY
MCC	– MOTOR CONTROL CENTER
MM	– MUFFIN MONSTER
MS	– MOTOR STARTER
MSR	– MOISTURE SENSING RELAY
NC	– NORMALLY CLOSED
NO	– NORMALLY OPEN
OIT	– OPERATOR INTERFACE TERMINAL
PCP	– PUMP CONTROL PANEL
PLC	– PROGRAMMABLE LOGIC CONTROLLER
PM	– PHASE MONITOR
PMR	– PHASE MONITORING RELAY
POE	– POWER OVER ETHERNET
PQM	– POWER QUALITY MONITOR
REX	– REQUEST TO EXIT
RIO	– REMOTE INPUT/OUTPUT
RTU	– REMOTE TERMINAL UNIT CONTROL PANEL
SCADA	– SUPERVISORY CONTROL AND DATA ACQUISITION
SD	– SMOKE DETECTOR
SED	– SERVICE ENTRANCE DISCONNECT
SJB	– HSQ JUCTION BOX
STP	– SHIELDED TWISTED PAIR
Tstat	– THERMOSTAT
TX	– TRANSFORMER
UH	– UNIT HEATER
UPS	– UNINTERRUPTIBLE POWER SUPPLY
VFD	– VARIABLE FREQUENCY DRIVE

PROCESS EQUIPMENT SYMBOLS

PARTIAL LIST ADDITIONAL SYMBOLS MAY BE SHOWN ON THE FLOW DIAGRAMS

- CENTRIFUGAL PUMP
- PLUNGER / POSITIVE DISPLACEMENT PUMP
- PROGRESSING CAVITY PUMP
- DIAPHRAGM METERING PUMP
- AIR OPERATED DIAPHRAGM PUMP
- ROTARY PUMP
- ROTARY BLOWER
- CENTRIFUGAL BLOWER
- BELT CONVEYOR
- SCREW CONVEYOR
- GRINDER
- MIXER
- SUBMERSIBLE PUMP
- EDUCTOR
- WELL PUMP
- STATIC MIXER
- CALIBRATION COLUMN
- VERTICAL TURBINE PUMP
- PERISTALTIC PUMP
- EYEWASH SHOWER
- BAR RACK

GATE SYMBOLS

- SLUICE GATE (SLG)
- SLIDE GATE (SG)
- WEIR SLIDE GATE (WSG)
- BUTTERFLY GATE
- BULK HEAD GATE/STOP LDG (BHG)

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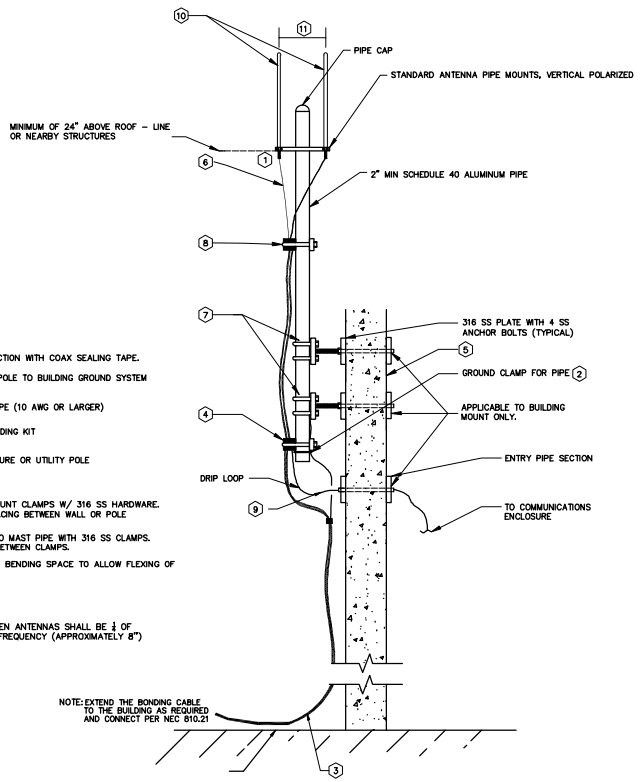
INSTRUMENTATION LEGEND II

DWG. NO. DWG NO. SHT 1 OF 1

GEN-I-2

REV. A

SAMPLE
LTE Outdoor Antenna Mounting Details



NOTES:

1. PROTECT CONNECTION WITH COAX SEALING TAPE.
2. BOND ANTENNA POLE TO BUILDING GROUND SYSTEM PER NEC
3. GROUND WIRE TYPE (10 AWG OR LARGER)
4. RF CABLE GROUNDING KIT
5. BUILDING STRUCTURE OR UTILITY POLE
6. ANTENNA CABLE
7. 316 SS WALL MOUNT CLAMPS W/ 316 SS HARDWARE. MINIMUM 20" SPACING BETWEEN WALL OR POLE MOUNTS
8. SECURE CABLE TO MAST PIPE WITH 316 SS CLAMPS. MAXIMUM 3 FT. BETWEEN CLAMPS.
9. PROVIDE ENOUGH BENDING SPACE TO ALLOW FLEXING OF HELIAX CABLE
10. OMNI ANTENNAS
11. DISTANCE BETWEEN ANTENNAS SHALL BE $\frac{1}{2}$ OF THE OPERATING FREQUENCY (APPROXIMATELY 8")

GENERAL NOTES:
ANTENNA SUPPORTING MAST AND CLAMP, ALONG WITH THE RF CABLE, MUST BE GROUNDED AND BONDED TO THE BUILDING GROUNDING SYSTEM.

DETAIL A – ANTENNA
NTS

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–
INSTRUMENTATION LEGEND III

DWG. NO.
DWG NO. SHT 1 OF 1
GEN-I-3

REV.
A

SYMBOL	DESCRIPTION
	HOME RUN TO DESIGNATED EQUIPMENT. BRANCH CIRCUIT CONDUIT WITH 2 NO. 12 AWG BRANCH CIRCUIT CONDUCTORS AND 1 NO. 12 AWG GROUND CONDUCTOR UNLESS OTHERWISE NOTED. NUMBER OF ARROWS INDICATE NUMBER OF CIRCUITS. FOR MINIMUM SIZE CONDUIT PERMITTED REFER TO THE SPECIFICATIONS.
	CONDUIT CONCEALED IN WALL, IN SLAB ABOVE, OR ABOVE CEILING.
	CONDUIT CONCEALED IN OR BELOW FLOOR OR UNDERGROUND.
	CONDUIT RUN EXPOSED. RUN PARALLEL OR PERPENDICULAR TO STRUCTURE OR WALL.
	'X' INDICATES EXPLOSION PROOF CONDUIT SEAL FITTING.
	CONCRETE ENCASED DUCTBANK. WIDTH VARIES, SEE DUCTBANK SECTION/DETAILS FOR REQUIREMENTS AND WIDTH
	CONDUIT STUBBED OUT AND CAPPED
(2) 3"C. 3#3/0, 1#2G	DENOTES A QUANTITY OF TWO (2) 3-INCH CONDUITS EACH CONTAINING THREE NO. 3/0 AWG CONDUCTORS AND 1 NO. 2 AWG GROUND CONDUCTOR.
2-2/C#16 STP	DENOTES A QUANTITY OF TWO INSTRUMENT CABLES. EACH CABLE TO CONSIST OF TWO NO. 16 AWG CONDUCTORS TWISTED TOGETHER AND COVERED WITH A METALLIC SHIELD AND AN OVERALL PROTECTIVE JACKET. REFER TO THE SPECIFICATIONS FOR THE EXACT CABLE TO BE PROVIDED.
2-3/C#16 STP	SAME AS ABOVE EXCEPT CABLE TO CONSIST OF THREE NO. 16 AWG CONDUCTORS TWSTED, SHIELDED AND COVERED WITH AN OVERALL PROTECTIVE JACKET. REFER TO THE SPECIFICATIONS FOR THE EXACT CABLE TO BE PROVIDED.
(3) 4"C.	THREE 4-INCH CONDUITS
	FLEXIBLE METAL CONDUIT "WHIP" (3/4"C., 2#12, 1#12G UNLESS OTHERWISE NOTED) FOR LIQUID TIGHT MOTOR CONNECTIONS
	'X' INDICATES CONDUIT SEAL FITTING IN OTHER THAN CODE REQUIRED LOCATIONS.
	INDICATES MOTOR STARTER AND/OR MOTOR CONTROL EQUIPMENT WITHIN THE ENCLOSURE.
S_a	SINGLE POLE SWITCH "a" INDICATES FIXTURES CONTROLLED.
S^2_a	DOUBLE POLE SWITCH "a" INDICATES FIXTURES CONTROLLED.
S^3_c	THREE WAY SWITCH "c" INDICATES FIXTURES CONTROLLED.
S^4_a	FOUR WAY SWITCH "a" INDICATES FIXTURES CONTROLLED.
ETM	ELAPSED TIME METER
PB	PULLBOX
DC	SECURITY DOOR CONTACT
WP	SECURITY SYSTEM CARD ACCESS READER WP – WEATHER PROOF ENCLOSURE.
CCTV	CLOSED CIRCUIT TV CAMERA

SYMBOL	DESCRIPTION
	GROUND SYSTEM GRID OR LOOP, 36" BELOW FINISHED GRADE UNLESS OTHERWISE NOTED.
	EXOTHERMIC WELD CONNECTION
	3/4" x 10'-0" GROUND ROD. UNLESS SPECIFIED OTHERWISE.
	GROUND ROD TEST WELL STATION (SEE DETAIL SHEET FOR REQUIREMENTS)
	PUSH BUTTON STATION
	LIGHTING PANELBOARD (LP–#) SHOWN ON PLAN PER ACTUAL PANEL DIMENSIONS
	POWER PANELBOARD (PP–#) OR DISTRIBUTION PANELBOARD (DP–#) SHOWN ON PLAN PER ACTUAL PANEL DIMENSIONS
	LIGHTING CONTACTOR PANELBOARD (LCP–#) SHOWN ON PLAN PER ACTUAL PANEL DIMENSIONS
J OR (J)	JUNCTION BOX
TC	TERMINAL CABINET
	INDICATED EQUIPMENT AND MATERIALS TO BE DEMOLISHED
OUST	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 12 CONSTRUCTION (OR GASKETED AND SUITABLE FOR USE IN A WET LOCATION WHERE NEMA STANDARDS DO NOT APPLY) UNLESS OTHERWISE NOTED.
DAMP OR WET	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 4X CONSTRUCTION (OR GASKETED AND SUITABLE FOR USE IN A WET LOCATION WHERE NEMA STANDARDS DO NOT APPLY) UNLESS OTHERWISE NOTED.
CORROSIVE	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 4X CONSTRUCTION (OR CORROSION RESISTANT CONSTRUCTION SUITABLE FOR USE IN A WET LOCATION WHERE NEMA STANDARDS DO NOT APPLY) UNLESS OTHERWISE NOTED.
CLASS I, DIV. 1 GROUP D	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL CONFORM TO N.E.C REQUIREMENTS FOR THE HAZARDOUS AREA CLASSIFICATION SHOWN.
VOLTS_PRI XX_KVA VOLTS_SEC 3P/4W	T — TRANSFORMER, RATINGS AND CONNECTIONS AS NOTED. UNLESS OTHERWISE NOTED ON THE SINGLE LINE DIAGRAMS, ALL DRY TYPE TRANSFORMERS SERVICING ADMINISTRATIVE AND LABORATORY SPACES SHALL HAVE A K FACTOR OF 4. ISOLATION TRANSFORMERS SHALL HAVE A K–20 RATING.
A TO 5	CURRENT TRANSFORMER QUANTITY A = PRIMARY AMPERES
PTZ	PAN, TILT, ZOOM CAMERA LENS CONTROLS
REX	REQUEST TO EXIT
LS	LS OR ■ — LIQUID LEVEL (FLOAT) SWITCH NORMALLY OPEN, CLOSES ON RISING LEVEL NORMALLY CLOSED, OPENS ON RISING LEVEL
PS	PS OR ■ — PRESSURE OR VACUUM SWITCH NORMALLY OPEN, CLOSES ON RISING PRESSURE NORMALLY OPEN, CLOSES ON DROPPING PRESSURE NORMALLY CLOSED, OPENS ON RISING PRESSURE NORMALLY CLOSED, OPENS ON DROPPING PRESSURE
FS	FS OR ■ — FLOW SWITCH (AIR, WATER, ETC.) NORMALLY OPEN, CLOSES ON INCREASED FLOW NORMALLY CLOSED, OPENS ON INCREASED FLOW

ONE LINE OR CONTROL DIAGRAM	PLAN	DESCRIPTION
	—	PILOT LIGHT, COLOR AS NOTED * R – RED G – GREEN B – BLUE W – WHITE A – AMBER
	—	CONTROL RELAY COIL, NUMBER AS INDICATED
	—	PILOT LIGHT, PUSH–TO–TEST TYPE, COLOR AS NOTED ABOVE.
ZS	ZS OR ■	POSITION (LIMIT SWITCH) NORMALLY OPEN NORMALLY OPEN – HELD CLOSED NORMALLY CLOSED NORMALLY CLOSED – HELD OPEN
	—	PUSHBUTTON, MOMENTARY CONTACT, SPRING RETURN, NORMALLY CLOSED
	—	PUSHBUTTON, MOMENTARY CONTACT, SPRING RETURN,NORMALLY OPEN
	ES	EMERGENCY STOP PUSHBUTTON WITH RED MUSHROOM HEAD OPERATOR (MAINTAINED CONTACT)
STOP START	PBL	START–STOP PUSHBUTTON CONTROL STATION (MOMENTARY CONTACT) WITH LOCKOUT DEVICE ON STOP
	PBM	START–STOP PUSHBUTTON CONTROL STATION, MAINTAINED CONTACT WITH LOCKOUT DEVICE ON STOP
L R (XO) (0X)	LR	LOCAL/REMOTE SELECTOR SWITCH
A B C* (XOO) (0X0) (00X)	*	3 POSITION SELECTOR SWITCH, MAINTAINED CONTACT O–OPEN X–CLOSED POSITION / TOP CONTACT / MIDDLE CONTACT / BOTTOM CONTACT A / X / O / O B / O / X / O C / O / O / X NAMEPLATE (A/B/C) HOA – HAND/OFF/AUTO HOR – HAND/OFF/REMOTE LOR – LOCAL/OFF/REMOTE RSL – RAISE/STOP/LOWER TOA – TEST/OFF/AUTO
RANGE SETPOINT		TIME DELAY RELAY RANGE AS NOTED SETPOINT AS NOTED # NUMBER AS INDICATED * TDE – TIME DELAY AFTER ENERGIZATION ON DELAY TDD – TIME DELAY AFTER DE–ENERGIZATION OFF DELAY NOTC– NORMALLY OPEN, TIMED CLOSING WHEN ENERGIZED NCTO– NORMALLY CLOSED, TIMED OPENING WHEN ENERGIZED NOTO– NORMALLY OPEN, TIMED OPENING WHEN DE–ENERGIZED NCTC– NORMALLY CLOSED, TIMED CLOSING WHEN DE–ENERGIZED
NOTC NCTO NOTO NCTC		
* - #		FIELD INSTRUMENT, TAG NO. AS INDICATED * INDICATES INSTRUMENT TYPE DEFINED ON LOOP SHEETS OR P & ID # INDICATES LOOP NO.
TS	TS OR T OR ■	TEMPERATURE SWITCH OR THERMOSTAT NORMALLY OPEN, CLOSES ON RISING TEMPERATURE NORMALLY OPEN, CLOSES ON DROPPING TEMPERATURE NORMALLY CLOSED, OPENS ON RISING TEMPERATURE NORMALLY CLOSED, OPENS ON DROPPING TEMPERATURE

ONE LINE OR CONTROL DIAGRAM	PLAN	DESCRIPTION
LA	—	LIGHTNING ARRESTER
		GROUND OR GROUND ROD
30A	—	FUSE, AMPERE RATING AS NOTED
	HTR	STRIP HEATER OR HEATING ELEMENT
	—	INDUCTOR
	TG	TACHOMETER GENERATOR
	—	CONTACT, NORMALLY OPEN (NO)
	—	CONTACT, NORMALLY CLOSED (NC)
	—	OVERLOAD RELAY HEATER
M	M	MOTOR OPERATED VALVE OR GATE
	—	INDICATES LIMITS OF ELECTRICAL EQUIPMENT OR WIRING ENCLOSURE
ATS N S 100A	—	AUTOMATIC OR MANUAL TRANSFER SWITCH NO.1 (ATS–1). (MTS–1) "N" INDICATES NORMAL OR PREFERRED SOURCE "S" INDICATES STANDBY OR ALTERNATE SOURCE 100A INDICATES CONTINUOUS CURRENT RATING
*	—	SPECIAL CAPACITOR * SC – SURGE CAPACITOR PF – POWER FACTOR CORRECTION CAPACITOR
*	—	TUNED POWER FACTOR CORRECTION CAPACITOR
5	M	MOTOR, NUMERAL INDICATES HORSEPOWER
FRAME TRIP	CB	LOW VOLTAGE AIR OR MOLDED CASE CIRCUIT BREAKER, 3 POLE UNLESS OTHERWISE NOTED.
		COMBINATION MOTOR CIRCUIT PROTECTOR AND MAGNETIC MOTOR STARTER, FULL VOLTAGE NON–REVERSING UNLESS OTHERWISE NOTED: * FVR – FULL VOLTAGE REVERSING RVNR – REDUCED VOLTAGE NON–REVERSING RVAT – REDUCED VOLTAGE AUTOTRANSFORMER RVSS – REDUCED VOLTAGE SOLID STATE 2S1W – TWO SPEED, ONE WINDING RS2W – TWO SPEED, TWO WINDING (DIAGRAMATICALLY SHOWN, CONTRACTOR SHALL FIELD LOCATE)
		NON–FUSIBLE DISCONNECT SWITCH 600 VOLT, 3 POLE * AMPERE RATING NOTED IF OTHER THAN 30A (DIAGRAMATICALLY SHOWN, CONTRACTOR SHALL FIELD LOCATE)
	F	FUSIBLE DISCONNECT SWITCH, 600 VOLT, 3 POLE, * AMPERE RATING AND FUSE SIZE AS NOTED * AMPERE RATING NOTED IF OTHER THAN 30A FUSE RATING (DIAGRAMATICALLY SHOWN, CONTRACTOR SHALL FIELD LOCATE)

A / E–4 — SHEET NO. WHERE DETAIL IS DRAWN

SYMBOL WHERE THERE IS A DETAIL

DETAIL 1/4" = 1'-0" — A / E–3 — SHEET NO. WHERE THERE IS A DETAIL

SYMBOL WHERE DETAIL IS DRAWN

DETAIL SYMBOL

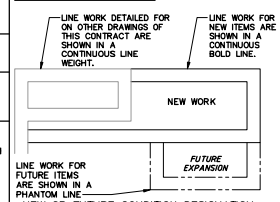
1 / E–4 — SHEET NO. WHERE SECTION IS DRAWN

SYMBOL WHERE THERE IS A SECTION

SECTION 1/4" = 1'-0" — 1 / E–3 — SHEET NO. WHERE SECTION IS TAKEN

SYMBOL WHERE SECTION IS DRAWN

SECTION SYMBOL



NEW OR FUTURE CONDITION DESIGNATION

ABBREVIATIONS	
A	AMPS
AC	ALTERNATING CURRENT
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AL	ALUMINUM
AIC	AMPERE INTERRUPTING CAPACITY
AMP	AMPERE
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
BLDG	BUILDING
C	CONDUIT
CB	CIRCUIT BREAKER
CGD	COMBUSTIBLE GAS DETECTOR
CKT	CIRCUIT
CLB	CURRENT LIMITING BREAKER
CLF	CURRENT LIMITING FUSE
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CONTROL RELAY
CS	CONTROL SWITCH/CONTROL STATION
CT	CURRENT TRANSFORMER
CU	COPPER
CWS	CONDUIT WALL SEAL
DC	DIRECT CURRENT
DIA	DIAMETER
DMU	DIGITAL METERING UNIT
DN	DOWN
EC	EMPTY CONDUIT
ELEC	ELECTRICAL
PLC	PROGRAMMABLE LOGIC CONTROLLER
PMT	POWER MONITORING TRANSMITTER
PQM	POWER QUALITY METER
RTD	RESISTANCE TEMPERATURE DETECTOR
SPD	SURGE PROTECTING DEVICE
SSRV	SOLID STATE REDUCED VOLTAGE
TB	TERMINATION BOX

DEMOLITION GENERAL NOTES:

1. CONTRACTOR SHALL DISCONNECT ALL ELECTRICAL POWER CONNECTIONS FOR ALL EQUIPMENT TO BE REMOVED IN ORDER TO ALLOW SAFE AND COMPLETE REMOVAL OF ALL ASSOCIATED EQUIPMENT IN THIS AREA.
2. ITEMS SHOWN HATCHED ARE IDENTIFIED FOR DEMOLITION UNLESS OTHERWISE STATED IN THE DRAWING. DEMOLISHED EQUIPMENT SHALL BE DISCONNECTED, REMOVED, AND RETURNED TO THE OWNER FOR REVIEW OF POSSIBLE RE–USE.
3. NOTIFY THE SERVICE AUTHORITY PRIOR TO THE DEMOLITION OF ANY EQUIPMENT THAT WILL CAUSE PHYSICAL DAMAGE.
4. SURVEY THE EXISTING ELECTRICAL SYSTEMS AND EQUIPMENT IDENTIFIED FOR REMOVAL WITH OWNER AND REPRESENTATIVES FROM OTHER TRADES PRIOR TO PERFORMING ANY DEMOLITION WORK.
5. REMOVE EXPOSED CONDUITS, OUTLET BOXES, PULLBOXES AND HANGERS MADE OBSOLETE BY THE ALTERATIONS, UNLESS DESIGNATED TO REMAIN. PATCH SURFACES AND PROVIDE BLANK COVERS FOR ABANDONED OUTLETS.
6. ABANDONED CONDUITS CONCEALED IN FLOOR OR CEILING SLABS OR IN WALLS, SHALL BE CUT FLUSH WITH THE SLAB OR WALL AT THE POINT OF ENTRANCE.THE CONDUITS SHALL BE SUITABLY PLUGGED AND THE AREA REPAIRED IN A FLUSH, SMOOTH AND APPROVED MANNER.

DEMOLITION GENERAL NOTES (CONT):

7. DUCTS WHICH ARE NOT TO BE REUSED SHALL BE PLUGGED WHERE THEY ENTER BUILDINGS AND MADE WATER TIGHT.

GENERAL NOTES:

1. CONTRACTOR SHALL COORDINATE NEW ELECTRICAL WORK WITH ALL OTHER ASSOCIATED DISCIPLINES.
2. CONTRACTOR SHALL FIELD VERIFY ALL NEW UNDERGROUND CONDUIT ROUTING AND CROSSINGS WITH ALL OTHER NEW AND EXISTING UTILITIES INCLUDING UNDERGROUND EXISTING ELECTRICAL UTILITIES.
3. CONTRACTOR SHALL FIELD VERIFY AND CONFIRM SPACE PROVIDED IS SUFFICIENT FOR EQUIPMENT SHOWN ON SINGLE LINE DIAGRAM.
4. MAINTAIN AT LEAST 3' –6" IN FRONT OF ELECTRICAL EQUIPMENT PER NEC ARTICLE 110.
5. PROVIDE A COMPLETE GROUNDING SYSTEM IN ACCORDANCE WITH ARTICLE 250 OF THE NATIONAL ELECTRIC CODE.
6. ALL EQUIPMENT SHALL BE GROUNDED.
7. GROUNDING TO BE TIED BACK TO EXISTING GROUNDING SYSTEM AT SWITCHBOARDS.

GENERAL NOTES (CONT):

8. CONTRACTOR SHALL MAINTAIN 12" MINIMUM SEPARATION BETWEEN POWER AND SIGNAL CONDUIT.
9. CONTRACTOR SHALL SEAL–OFF CONDUITS ENTERING OR LEAVING HAZARDOUS LOCATIONS AREAS PER NEC.

GENERAL NOTE

THIS IS A STANDARD LEGEND. SOME SYMBOLS MAY NOT APPEAR ON THE DRAWINGS.

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
A	ORIGINAL ISSUE				

PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
CHECKED		
APP		

REF.

DO NOT SCALE

SCALE NONE

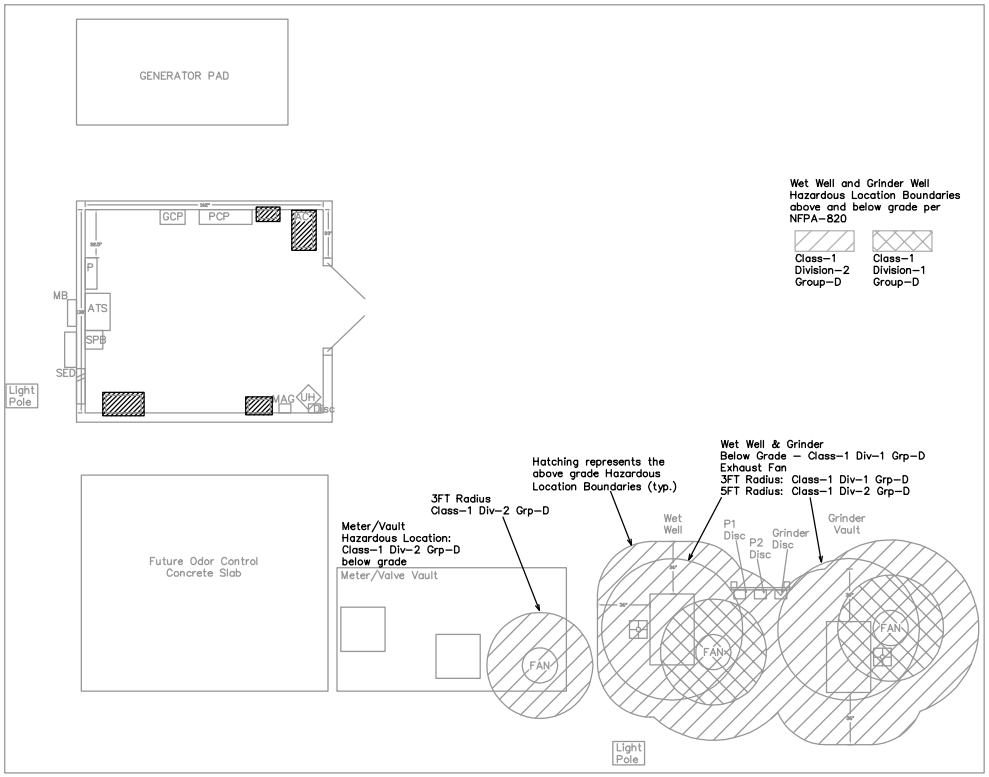
DWG. NO.

ELECTRICAL LEGENDS AND ABBREVIATIONS

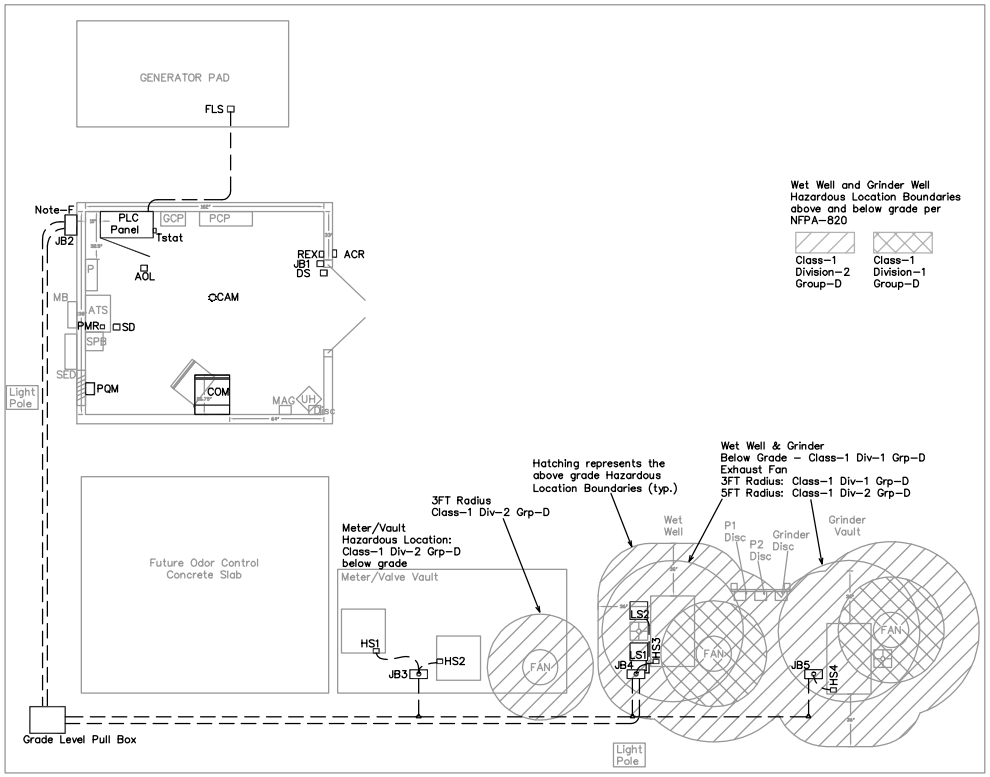
DWG NO. SHT 1 OF 1

GEN-E-1

REV. A



SITE AREA DEMOLITION PLAN



SITE AREA NEW WORK PLAN

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
A	ORIGINAL ISSUE				

PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
CHECKED		
APP		
REF.		

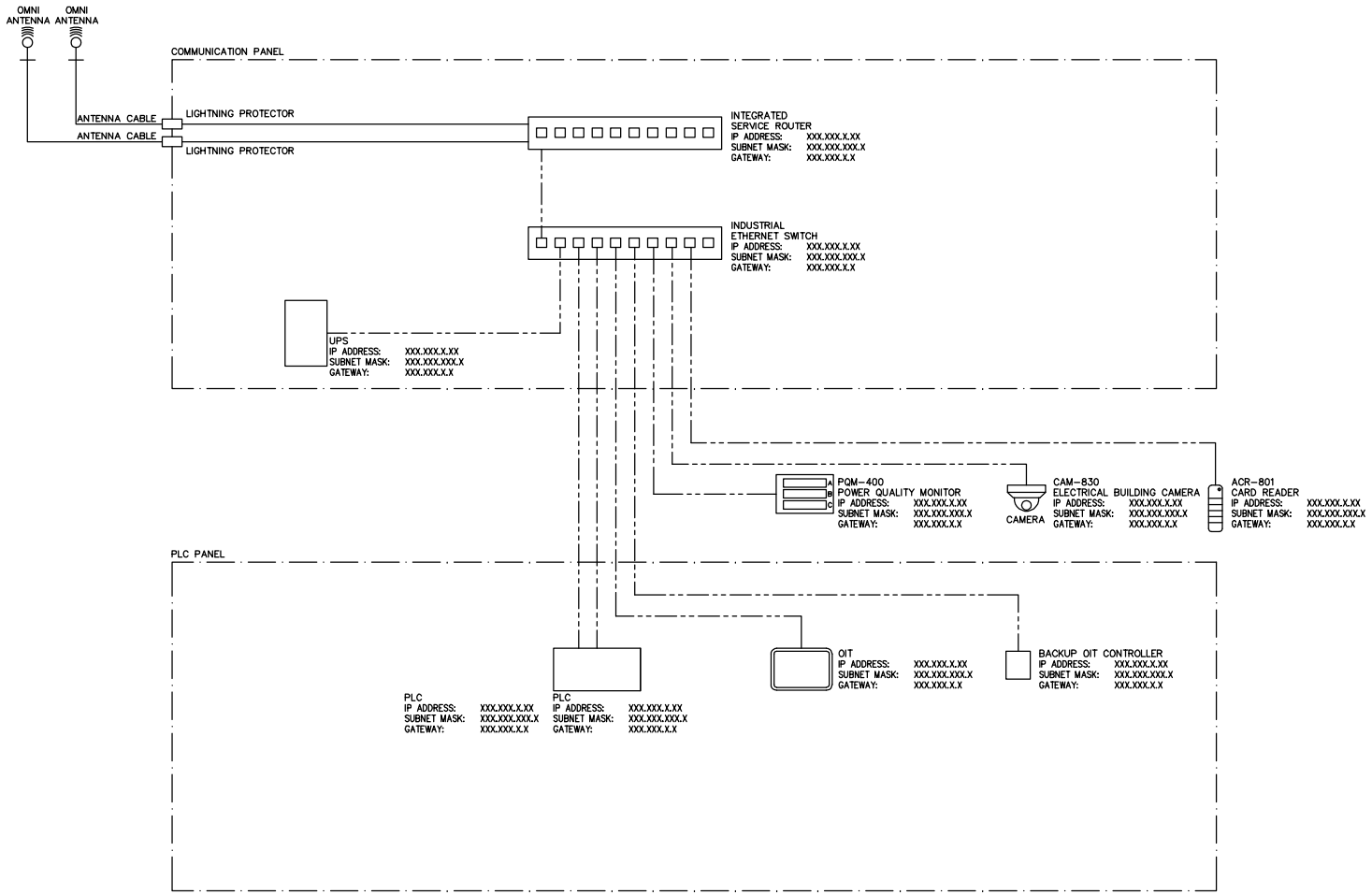
DO NOT SCALE

SCALE NONE

SITE PLAN

DWG. NO. SHT 1 OF 1

REV. C



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
A					
B					
C					

PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
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REF.

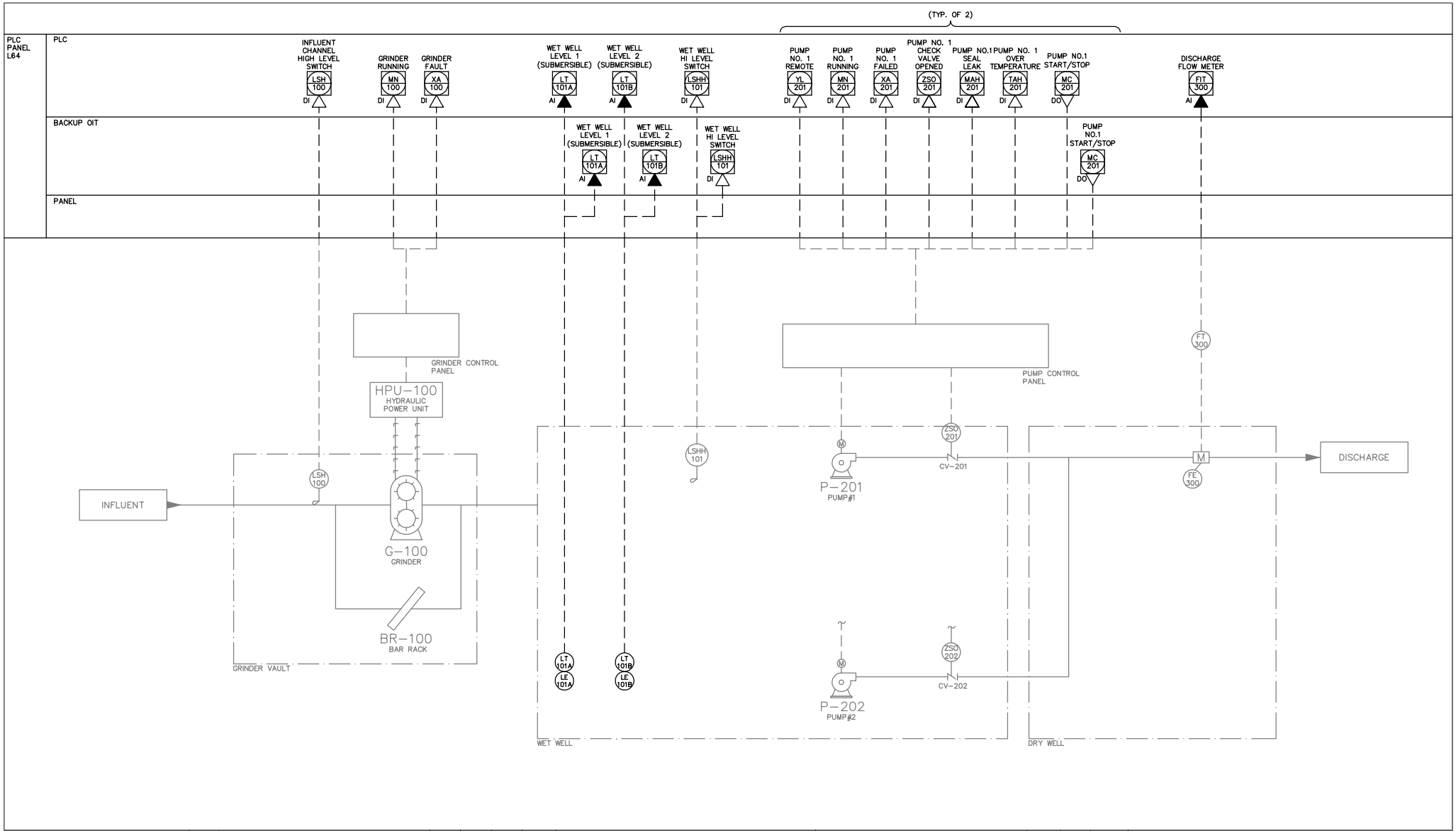
DO NOT SCALE

SCALE NONE

SYSTEM ARCHITECTURE

DWG. NO. SHT 1 OF 1

REV. C



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
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PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
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APP		

REF.

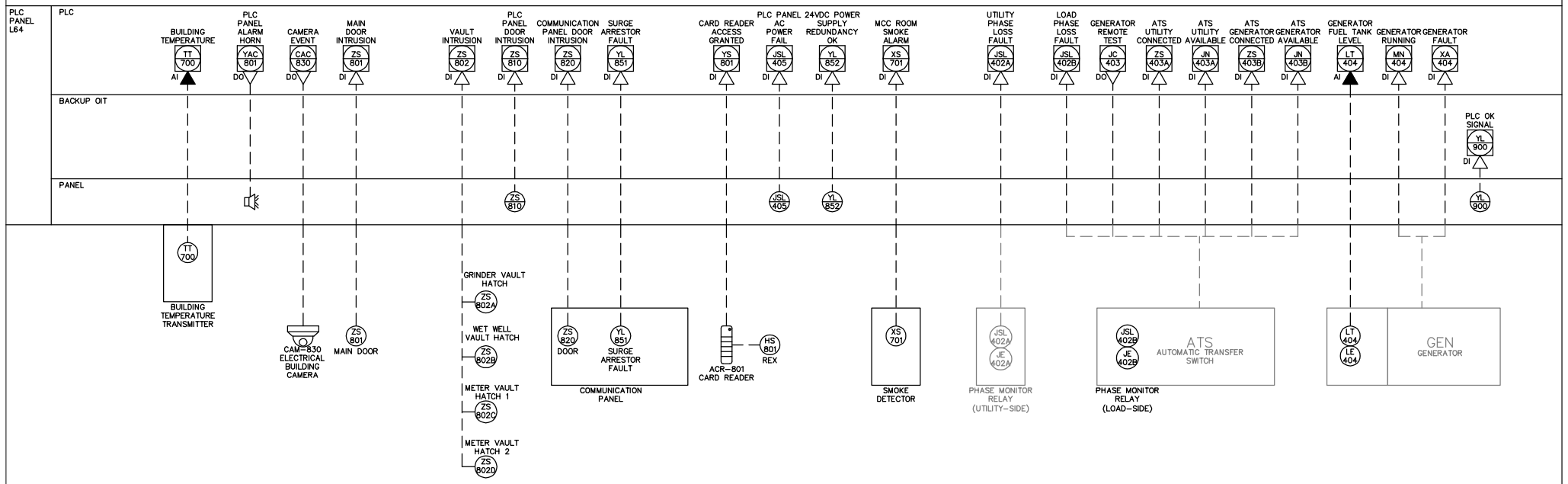
DO NOT SCALE

SCALE NONE

PROCESS & INSTRUMENTATION DIAGRAM 1

DWG. NO. DWG NO. SHT 1 OF 1

REV. C



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
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PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
CHECKED		
APP		

REF.

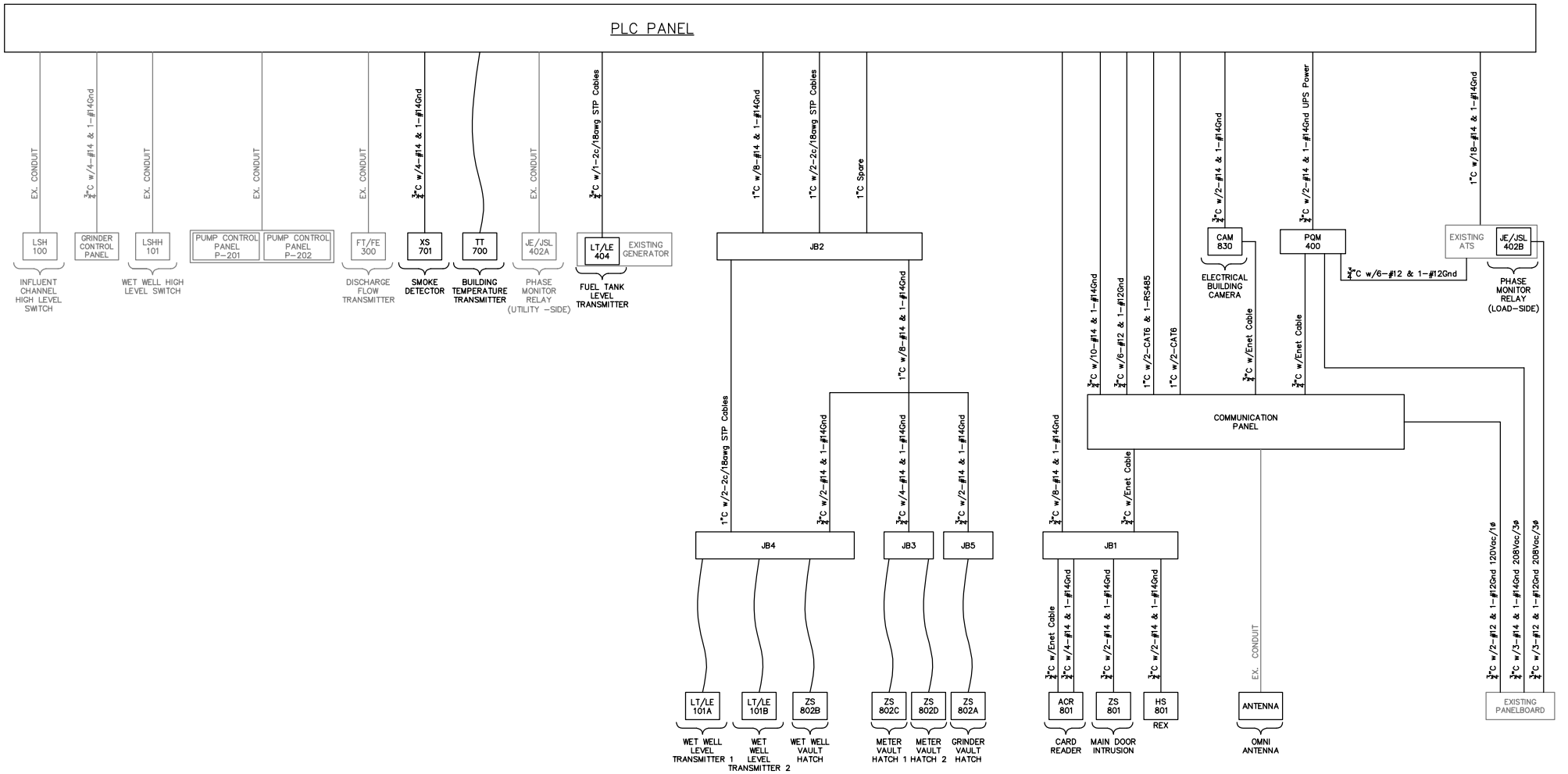
DO NOT SCALE

SCALE NONE

PROCESS & INSTRUMENTATION DIAGRAM 2

DWG. NO. DWG NO. SHT 1 OF 1

REV. C



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
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PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
CHECKED		
APP		

REF.

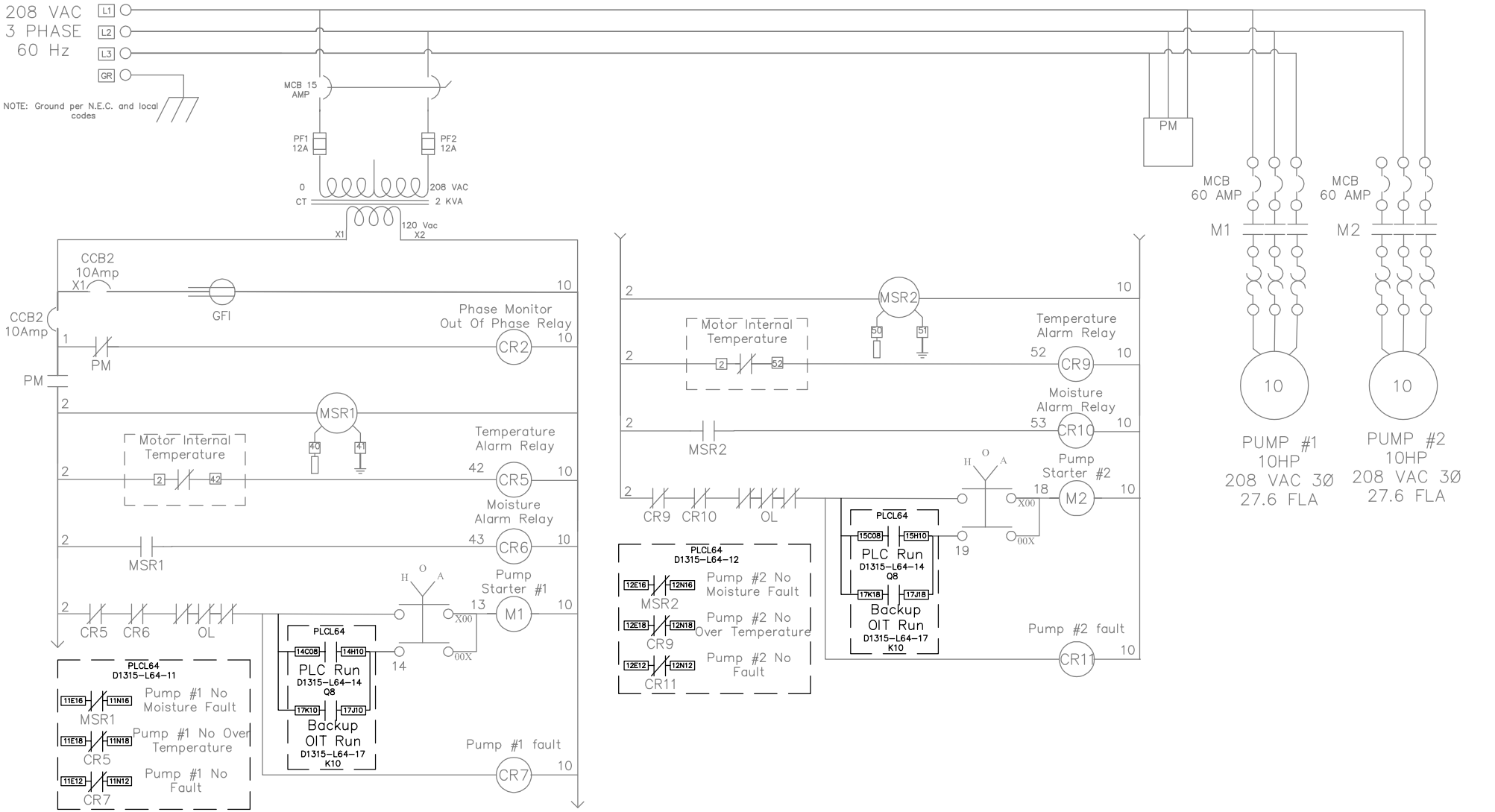
DO NOT SCALE

SCALE NONE

PLC RISER DIAGRAM

DWG. NO. DWG NO. SHT 1 OF 1

REV. C



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
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PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
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REF.

DO NOT SCALE

SCALE NONE

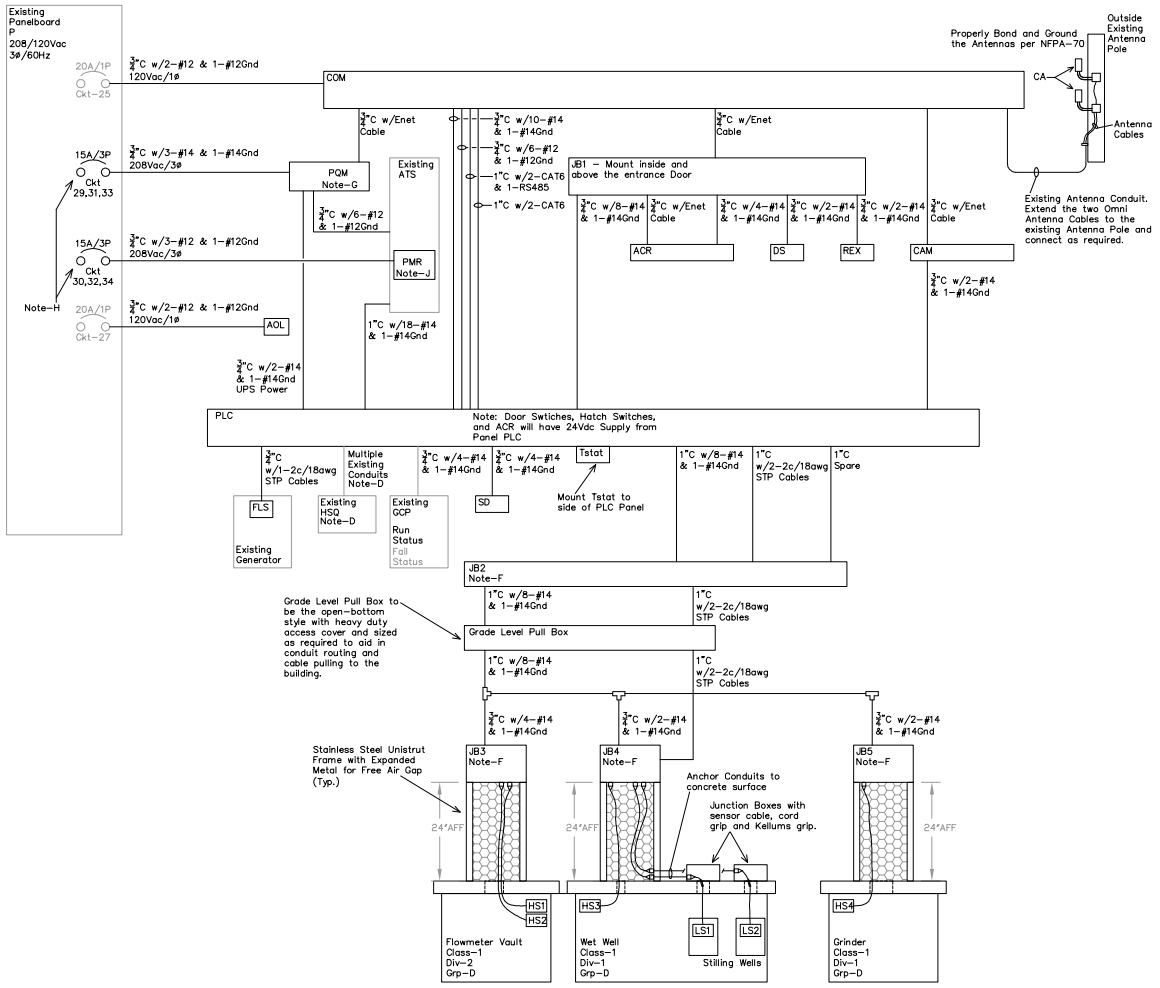
MOTOR PROTECTION CIRCUIT

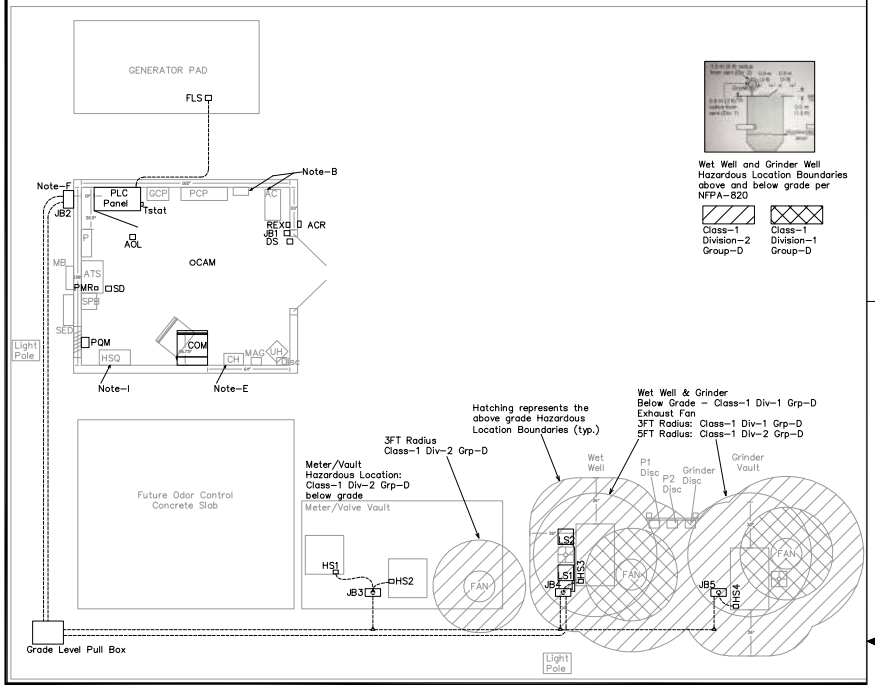
DWG. NO.

DWG NO. SHT 1 OF 1

REV. C

Electrical Power Distribution





GENERAL NOTES:

1. All new equipment is shown in bold and shall be installed where shown. It is the contractors responsibility to ensure that all noted dimensions and clearances are maintained or exceeded.
2. The contractor shall reference NFPA-820 and these drawings for hazardous location boundaries and classifications.
3. Coordinate the complete installation with the existing equipment and facilities.
4. Conductors:
   - 4.1. All single conductor wire installed shall be 600V Rated THHN/THWN Stranded Copper.
   - 4.2. Shielded Twisted Pair Cable shall be UL Type TC (1277) PVC-Nylon/PVC, 2 Conductor 18AWG (7x26) Bare Copper, PVC-NYL Insulation E2 Color Code, Overall Foil Shield, Black PVC Outer Jacket, 600V TC 150V NPLF 90C Wet/Dry SUN RES DIR BUR
   - 4.3. Ethernet Cable shall be Cat-6 Heavy Duty Cable
   - 4.4. RS485 Cable shall be General Cable C4841A.
5. All equipment shall be provided with Lamacoid Nameplates ($\frac{1}{8}$" Letters Minimum)
6. Enclosures:
   - 6.1. Outside: Nema-4X Stainless Steel
   - 6.2. Inside: Nema-12 Minimum
7. All conduit used on the project shall match existing conduit for similar installation's as required. Conduit minimum size shall be $\frac{3}{4}$"-conduit. If a device only has $\frac{1}{2}$"-conduit entry, use $\frac{3}{4}$"-conduit to the maximum extent possible, then reduce to $\frac{1}{2}$"-conduit for device conduit entry.
8. All conduit used on the project shall match existing conduit for similar installation's as required. Conduit minimum size shall be $\frac{3}{4}$"-conduit. If a device only has $\frac{1}{2}$"-conduit entry, use $\frac{3}{4}$"-conduit to the maximum extent possible, then reduce to $\frac{1}{2}$"-conduit for device conduit entry.

INSTALLATION NOTES:

A. Locate each piece of new equipment where shown or as noted.
B. Air Compressor to be removed.
C. Not Used.
D. Install Junction Box above HSQ Panel for temporary connections to HSQ Panel during construction. HSQ Panel to be removed upon completion.
E. Remove Chart Recorder and all associated conduit/wire. Extend new conduit/wire from Mag to PLC for Flowrate Analog Signal.
F. Mount Junction Boxes (JB2, JB3, JB4 & JB5) with a Stainless Steel Unistrut frame. Provide 24" clearance between the bottom of the enclosure and the top surface of the concrete slab at the vaults and 24"-AFF on the building wall.
G. PQM: Mount the PQM where shown. Install current sensors on the ATS load cables and extend cables to PQM as required. Extend 3ø Power from the Panelboard for the Voltage Monitoring Circuit. Extend the Ethernet Cable to the COM Panel for Data Transfer. Extend UPS Power from COM and connect as required.
H. Replace existing Circuit Breakers with a new Circuit Breaker for each device. Coordinate type and ratings with the existing Panelboard circuit breakers.
I. The Existing HSQ is to be removed at the completion of this project. Intercept all signal and sensor conduits and extend as required to the new PLC Panel. Install a new junction box with finger safe terminal blocks if required.
J. PMR: Move the HSQ Panel from Circuit-8 to Circuit-2, replace the single pole breakers in circuits 8, 10 & 12 with a 3-Pole Circuit Breaker. Mount the PMR inside the ATS and extend conduit/wire as required to power the PMR. Extend dry contact wiring as required to PLC.

ABBREVIATION LIST:

AC	Air Compressor
ACR	Access Card Reader
AFF	Above Finished Grade
AOL	Always ON Light
ATS	Automatic Transfer Switch
CA	Cellular Antenna
CAM	Camera
COM	Communication Control Panel
CH	Chart Recorder
CT	Utility Current Transformer Panel
DS	Door Switch
Enet	CAT-6 Ethernet Cable
ETM	Elapsed Time Meter
FLS	Generator Fuel Level Sensor
FM	Flowmeter
GCP	Grinder Control Panel
HS	Hatch Switch
HSQ	Existing HSQ Panel
HV	High Voltage Panelboard
JB	Junction Box
LCP	Level Controller Panel
LS	Level Sensor (Analog)
LV	Low Voltage Panelboard
MAG	Magnetic Flow Meter
MB	Meterbase Utility
MM	Muffin Monster
PCP	Pump Control Panel
PLC	PLC Control Panel
PMR	Phase Monitor Relay
PQM	Power Quality Meter
REX	Request to Exit Pushbutton
SD	Smoke Detector
SED	Service Entrance Disconnect
SPB	Service Entrance Pull Box
SJB	HSQ Junction Box
STP	Shielded Twisted Pair
Tstat	Thermostat
UPS	Uninterruptible Power Supply
VV	Valve Vault
WW	Wet Well

PROJECT INFORMATION:

Name:
Address:

PLAN NOTE: The plans are in accordance the National Electrical Code (NEC) and NFPA-820.
SCOPE:
The scope of the this project is to replace the existing HSQ Panel with new PLC & COM Panels with additional sensors and access control. The new panels and sensors are shown in bold and located approximately where shown. Since the old electrical panels are being removed and the new 3-Phase circuits are for power monitoring and sensing equipment, the existing facility electrical load will not increase. All equipment shall be suitable for the installation environment to include the temperature rating.

Seal

Electrical Permit Drawing

Power Distribution / Process Controls / Lighting

REVISIONS		
REV.	CHANGE:	DATE:

PWCSA
SCADA SYSTEM UPGRADE
ELECTRICAL DIAGRAMS AND NOTES

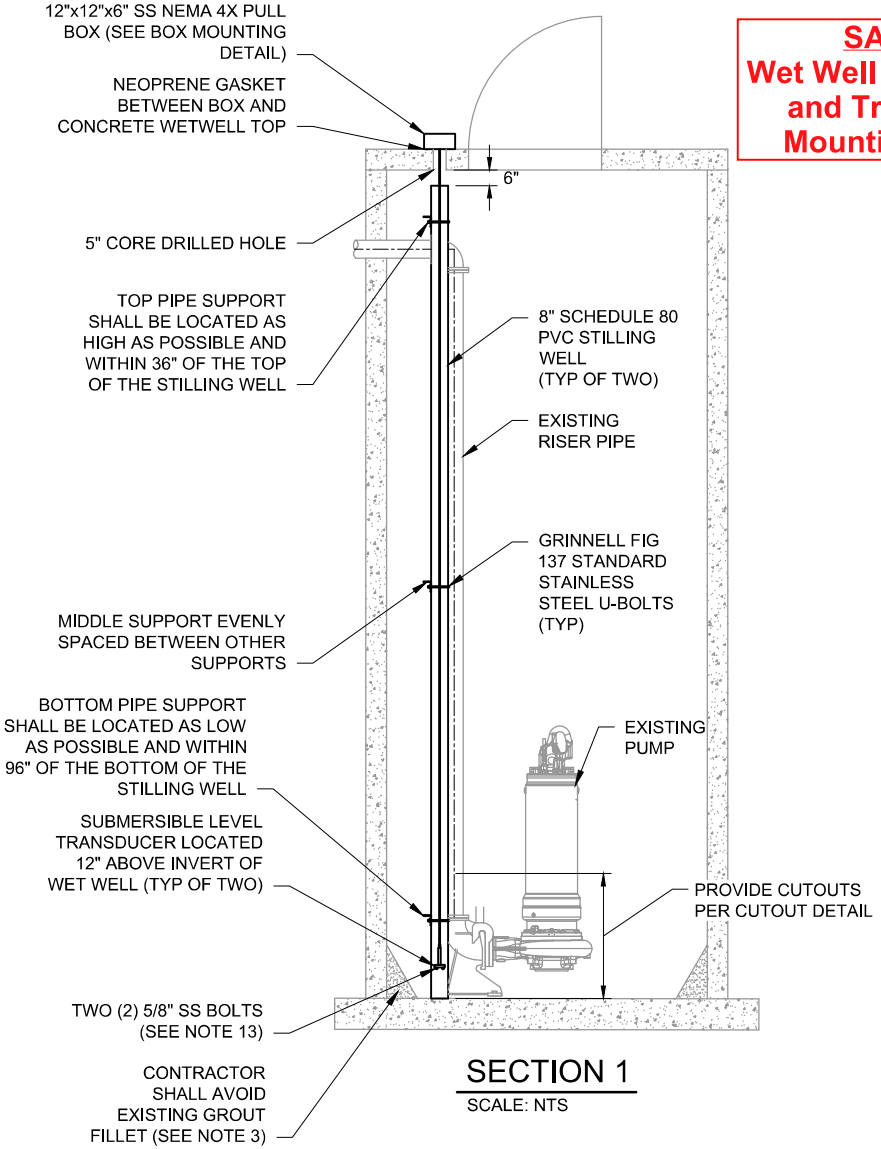
PWCSA
PRINCE WILLIAM COUNTY, VA

SHEET E-1 OF 1 DATE:

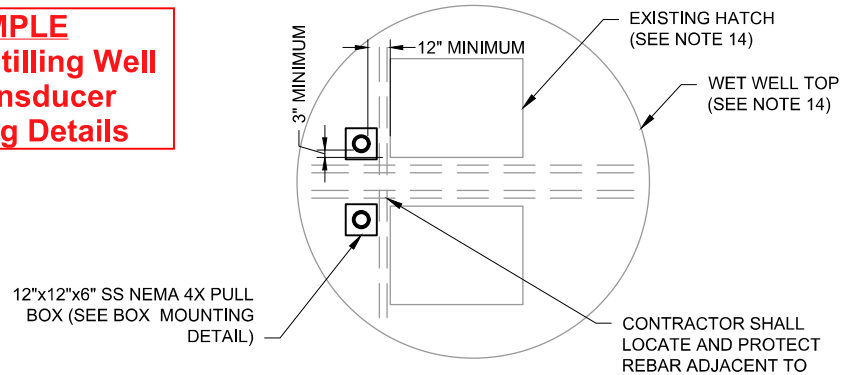
DRAWN BY:
DESIGNED BY:
CHECKED BY:

SCALE: AS REQUIRED
DWG: E-1

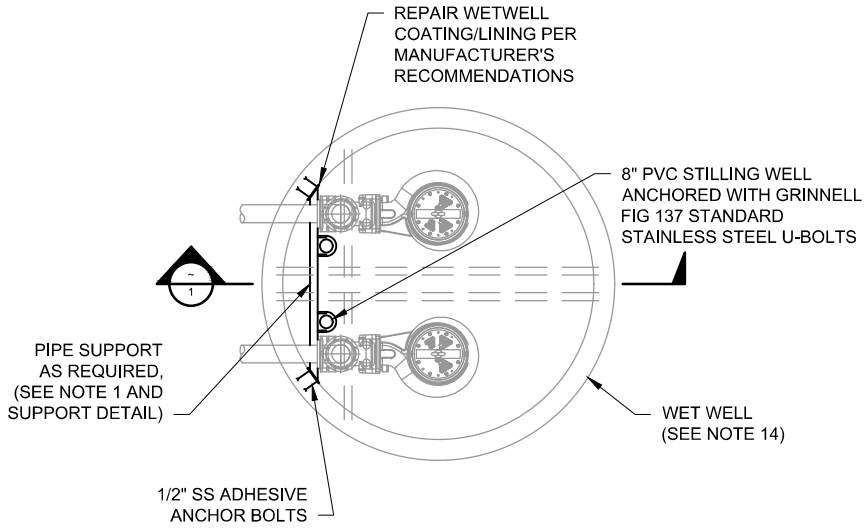
SAMPLE
Wet Well Stilling Well and Transducer Mounting Details



SECTION 1
SCALE: NTS

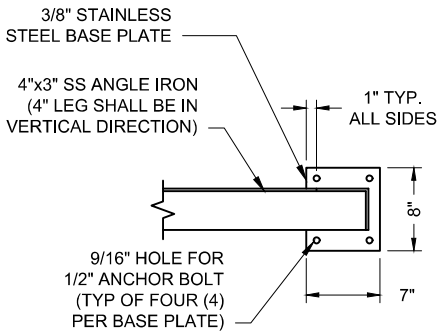


TOP PLAN
SCALE: NTS



BOTTOM PLAN
SCALE: NTS

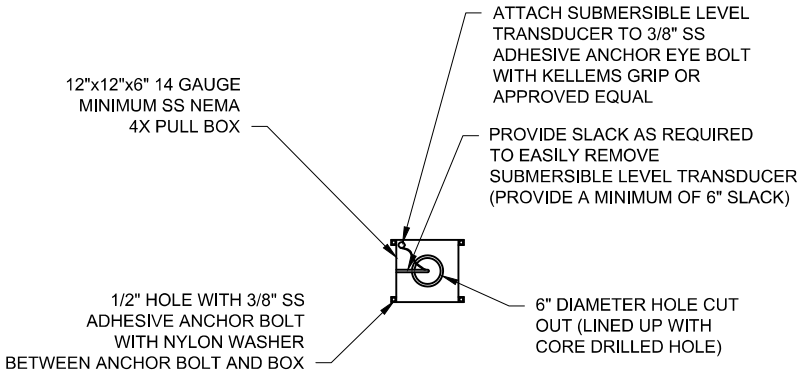
FIGURE NO.	M1
TITLE	PLANS AND SECTION
	STILLING WELL DETAIL
SCALE	NTS
PROJECT	
DATE	
PROJ. NO.	



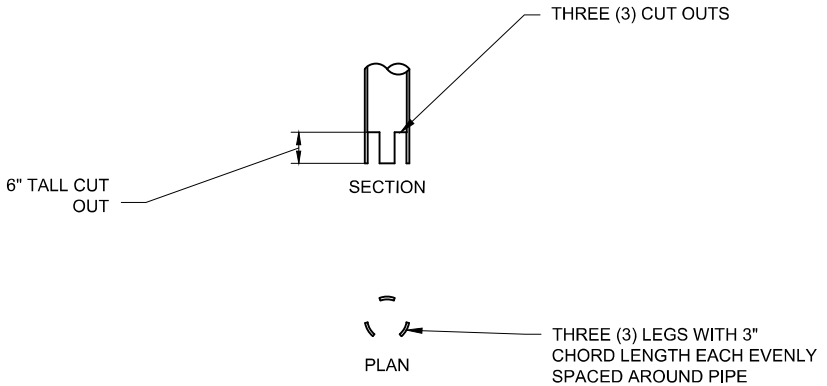
1 SUPPORT DETAIL
SCALE: NTS

NOTES:

1. PIPE SUPPORT SHOWN IS TYPICAL; CONTRACTOR SHALL AVOID CONCRETE ANCHOR BOLTS IF POSSIBLE, BY THE FOLLOWING OPTIONS:
   A. CONTRACTOR SHALL SUPPORT ANGLE IRON PIPE SUPPORT OFF OF RISER PIPES UTILIZING GRINNELL FIG 137 STANDARD STAINLESS STEEL U-BOLTS.
   B. CONTRACTOR SHALL SUPPORT STILLING WELL OFF OF EXISTING ANGLE IRON UTILIZING GRINNELL FIG 137 STANDARD STAINLESS STEEL U-BOLTS.
2. STILLING WELL AND RISER PIPE SHALL BOTH BE SUPPORTED OFF OF 4" VERTICAL FACE OF ANGLE IRON, IF RISER PIPE AND STILLING WELL ARE ON OPPOSITE SIDES OF STILLING WELL SUPPORT, ANGLE IRON SHALL BE REPLACED WITH 4"X3" RECTANGULAR STAINLESS STEEL TUBE.
3. A MINIMUM OF 12" WIDE SECTION OF CONCRETE WITH THREE UNDISTURBED REBAR SHALL BE MAINTAINED ACROSS THE ENTIRE WETWELL ON BOTH SIDES OF NEW PENETRATIONS IN TWO PERPENDICULAR AXES. CONTRACTOR SHALL ENSURE ALL REBAR HAS 3" MINIMUM COVER FROM NEW PENETRATIONS.
4. IF GROUT FILLET AND STILLING WELL INTERFERE CONTRACTOR SHALL EITHER:
   A. ROTATE CUT OUTS AND ADJUST LENGTH OF CUT OUTS TO MATCH GROUT.
   B. CHIP OUT GROUT AS REQUIRED.
5. ALL METAL SHALL BE 316 STAINLESS STEEL.
6. ADHESIVE ANCHOR BOLTS SHALL BE HILTI HY 200 EPOXY ADHESIVE ANCHORING SYSTEM OR APPROVED EQUAL.
7. CONTRACTOR SHALL INSPECT THE CONCRETE WET WELL AND TOP FOR STRUCTURAL DAMAGE, CORROSION, OR ANY OTHER ISSUES THAT COULD CAUSE STRUCTURAL FAILURE. CONTRACTOR SHALL CEASE WORK AND NOTIFY INVOLVED PARTIES IF ANY ADVERSE CONDITIONS ARE PRESENT.
8. CONTRACTOR SHALL ADD PIPE SUPPORTS AS REQUIRED TO RIGIDLY SUPPORT THE STILLING WELL.
9. ALL CORE DRILLS SHALL BE CIRCULAR AND COMPLETED WITH A SHARP DIAMOND DRILL.
10. CENTER OF CORE DRILL HOLE SHALL BE LINED UP WITH CENTER OF PVC STILLING WELL WITHIN 2".
11. STILLING WELL SUPPORTS SHALL BE A MAXIMUM SPACING OF 10', WITH A MINIMUM OF THREE PROVIDED.
12. NO CABLE TERMINATIONS OR JUNCTIONS SHALL BE MADE WITHIN THE PULL BOX.
13. STAINLESS STEEL BOLTS SHALL BE POSITIONED AT HEIGHT TO HOLD SUBMERSIBLE LEVEL TRANSDUCER AT SPECIFIED HEIGHT AND SPACED 2-1/2" ON CENTER. PROVIDE ONE (1) STAINLESS STEEL NYLOC NUT PER BOLT AND TWO (2) WASHERS PER BOLT.
14. WET WELL AND COVER SHOWN AS CIRCULAR COVER FOR REFERENCE; DETAIL IS APPLICABLE FOR RECTANGULAR WET WELL AND/OR COVERS. WET WELL IS SHOWN WITH TWO HATCHES FOR REFERENCE; DETAIL IS APPLICABLE FOR SINGLE DOUBLE LEAF HATCHES.
15. CONTRACTOR IS RESPONSIBLE FOR DETERMINING APPLICABILITY OF DETAIL, WHEN EXISTING CONDITIONS VARY FROM WHAT IS SHOWN. CONTRACTOR SHALL NOTIFY ALL INVOLVED PARTIES OF NECESSARY MODIFICATIONS PRIOR TO ORDER MATERIALS OR BEGINNING CONSTRUCTION.



2 BOX MOUNTING DETAIL
SCALE: NTS



3 CUT OUTS DETAIL
SCALE: NTS

FIGURE NO. M2
TITLE ADDITIONAL DETAILS AND NOTES
STILLING WELL DETAIL
SCALE NTS
PROJECT
DATE
PROJ. NO.

Appendix D

Example Equipment & Instrument and I/O Lists

Instrumentation List

Site ID	DWG	QTY	TAG ID	Description	Function	Make	Model	Part Number	Range / Output	Units	Power	Notes
		1	LT-101A	Pressure (Level) Transducer	Wet Well Level	KPSI	750	750S14D4B013.002000.000B10050B	0-30	Feet	24 VDC Loop	Lightning Protection
		1	LT-101B	Pressure (Level) Transducer	Wet Well Level	KPSI	750	750S14D4B013.002000.000B10050B	0-30	Feet	24 VDC Loop	Lightning Protection
		1	PQM-400	Power Quality Monitor	Power Data	PC&S		DKM-411	Modbus TCP		120VAC from UPS	Self Enclosed Assembly
		1	JSL-402B	Phase Monitor Relay - Load Side	Site Loss-of-Power	ATC Diversified Electronics	SLU-100 series	SLU-100-ASA	SPDT		Integral	
		1	LIT-404	Ultrasonic Level Transmitter	Fuel Tank Level	EchoSpan (Flowline)	LU81	LU81-5101	0.75 - 18	Feet	24 VDC Loop	
		1	XS-701	Smoke Detector	Building Smoke Alarm	System Sensor	100 Series	2151	SPDT		120 VAC	
		1	TT-700	Temperature Transmitter	Building Temperature	Dwyer	RHP-E/N Series	RHP2N44LCD	-20 - 140	°F	24 VDC Loop	
		1	ACR-801	Card Reader	Card Access	Isonas	RC-04 Series	RC-04 PRX-M	SPDT		Power over Ethernet	Include Pigtail Cable
		1	HS-801	Request to Exit Push Button	Request to Exit	SDC	440 Series	446U	DPST			
		1	ZS-801	Magnetic Contact	Door Opened	Edward Signaling	2500 Series	2507A-L	SPDT			Main Door
		1	ZS-802A	Magnetic Contact	Door Opened	GE Security	2800 Series	2844TW-M	SPDT			Grinder Vault Hatch
		1	ZS-802B	Magnetic Contact	Door Opened	GE Security	2800 Series	2844TW-M	SPDT			Wet Well Vault Hatch
		1	ZS-802C	Magnetic Contact	Door Opened	GE Security	2800 Series	2844TW-M	SPDT			Meter Vault Hatch 1
		1	ZS-802D	Magnetic Contact	Door Opened	GE Security	2800 Series	2844TW-M	SPDT			Meter Vault Hatch 2
		1	CAM-830	PTZ Network Camera (indoor)	Operational Video	Panasonic		WV-S6130	Ethernet		Power over Ethernet	
		1	-	LED Lighting	Building Illumination	Metalux	WNLED Series	4WNLED-LD4-50SL-F-UNV-L850-CD-1-U				
		2	-	Multiband Omni-Directional Stick Outdoor 4G Antenna	Outdoor Antenna	Cisco		ANT-4G-OMNI-OUT-N				

Existing Devices

XX		1	JSL-402A	Phase Monitor Relay -Utility		SSAC		RLM611	SPDT			Inside ATS
XX		1	LSHH-101	Wet Well High Level Switch								
XX		1	LSH-100	Influent Channel High Level Switch								
XX		1	FE-300	Discharge Flow Meter								
XX		1	FIT-300	Flow Transmitter		ABB	MAG-XM		0-500	GPM		
XX		2	CV-201 & 202	Check Valves								
XX		1	G-100	Grinder								

I/O List

ISA Tag	Description	Type	Rack	Slot	Point	Alarms	Range	Units	Power	Backup OIT	Notes
LT-101A	Wet Well Lvl 1 (Submersible) Raw	AI	0	3	0	-	0 - 30	FT	24VDC Loop powered	Yes	w/ ISB
FIT-300	Discharge Flow Meter Raw	AI	0	3	2	-	0 - 500	GPM	120 VAC (External)	-	
		AI	0	3	2	-	-	-	-	-	
		AI	0	3	3	-	-	-	-	-	
LT-101B	Wet Well Lvl 2 (Submersible) Raw	AI	0	4	0	-	0 - 30	FT	24VDC Loop powered	Yes	w/ ISB
LT-404	Generator Fuel Tank Level Raw	AI	0	4	1	-	0.75 - 18	FT	24VDC Loop powered	-	
TT-700	Building Temperature Raw	AI	0	4	2	-	-20 - 140	°F	24VDC Loop powered	-	
		AI	0	4	3	-	-	-	-	-	
YL-201	Pump No. 1 Remote Raw	DI	0	7	0	-	-	-	-	-	
MN-201	Pump No. 1 Running Raw	DI	0	7	1	-	-	-	-	-	
XA-201	Pump No. 1 Failed Raw	DI	0	7	2	-	-	-	-	-	Normally Closed
ZSO-201	Pump No. 1 Check Valve Opened Raw	DI	0	7	3	-	-	-	-	-	
MAH-201	Pump No. 1 Seal Leak Raw	DI	0	7	4	-	-	-	-	-	Normally Closed
TAH-201	Pump No. 1 Over Temperature Raw	DI	0	7	5	-	-	-	-	-	Normally Closed
		DI	0	7	6	-	-	-	-	-	
		DI	0	7	7	-	-	-	-	-	
		DI	0	7	8	-	-	-	-	-	
ZS-802	Vault Intrusion Raw	DI	0	7	9	-	-	-	-	-	Normally Closed (w/ ISB)
		DI	0	7	10	-	-	-	-	-	
		DI	0	7	11	-	-	-	-	-	
		DI	0	7	12	-	-	-	-	-	
LSH-100	Influent Channel High Level Switch Raw	DI	0	7	13	-	-	-	-	-	w/ ISB
MN-100	Grinder Running Raw	DI	0	7	14	-	-	-	-	-	
XA-100	Grinder Fault Raw	DI	0	7	15	-	-	-	-	-	
YL-202	Pump No. 2 Remote Raw	DI	0	8	0	-	-	-	-	-	
MN-202	Pump No. 2 Running Raw	DI	0	8	1	-	-	-	-	-	
XA-202	Pump No. 2 Failed Raw	DI	0	8	2	-	-	-	-	-	Normally Closed
ZSO-202	Pump No. 2 Check Valve Opened Raw	DI	0	8	3	-	-	-	-	-	
MAH-202	Pump No. 2 Seal Leak Raw	DI	0	8	4	-	-	-	-	-	Normally Closed
TAH-202	Pump No. 2 Over Temperature Raw	DI	0	8	5	-	-	-	-	-	Normally Closed

		DI	0	8	6	-	-	-	-	-	
		DI	0	8	7	-	-	-	-	-	
		DI	0	8	8	-	-	-	-	-	
		DI	0	8	9	-	-	-	-	-	
JSL-402A	Utility Phase Failed Raw	DI	0	8	10	-	-	-	-	-	Normally Closed
LSHH-101	Wet Well Hi Level Switch Raw	DI	0	8	11	-	-	-	-	Yes	w/ ISB
ZS-403A	ATS Utility Connected Raw	DI	0	8	12	-	-	-	-	-	
JN-403A	ATS Utility Available Raw	DI	0	8	13	-	-	-	-	-	
ZS-403B	ATS Generator Connected Raw	DI	0	8	14	-	-	-	-	-	
JN-403B	ATS Generator Available Raw	DI	0	8	15	-	-	-	-	-	
		DI	0	9	0	-	-	-	-	-	
		DI	0	9	1	-	-	-	-	-	
		DI	0	9	2	-	-	-	-	-	
		DI	0	9	3	-	-	-	-	-	
		DI	0	9	4	-	-	-	-	-	
MN-404	Generator Running Raw	DI	0	9	5	-	-	-	-	-	
XA-404	Generator Fault Raw	DI	0	9	6	-	-	-	-	-	
JSL-405	PLC AC Power Fail Raw	DI	0	9	7	-	-	-	-	-	Normally Closed
JSL-402B	Load Phase Failed Raw	DI	0	9	8	-	-	-	-	-	Normally Closed
XS-701	MCC Room Smoke Alarm Raw	DI	0	9	9	-	-	-	-	-	Normally Closed
YS-801	Card Reader Access Granted Raw	DI	0	9	10	-	-	-	-	-	
ZS-801	Main Door Intrusion Raw	DI	0	9	11	-	-	-	-	-	Normally Closed
ZS-810	PLC Panel Door Intrusion Raw	DI	0	9	12	-	-	-	-	-	Normally Closed
ZS-820	Communication Panel Door Intrusion Raw	DI	0	9	13	-	-	-	-	-	Normally Closed
YL-851	Surge Arrestor Fault Raw	DI	0	9	14	-	-	-	-	-	Normally Closed
YL-852	24VDC Power Supply Redundancy OK Raw	DI	0	9	15	-	-	-	-	-	Normally Closed
MC-201	Pump No.1 Start/Stop Raw	DO	0	10	0	-	-	-	-	Yes	
		DO	0	10	1	-	-	-	-	-	
		DO	0	10	2	-	-	-	-	-	
		DO	0	10	3	-	-	-	-	-	
		DO	0	10	4	-	-	-	-	-	

		DO	0	10	5	-	-	-	-	-	
		DO	0	10	6	-	-	-	-	-	
xx-xxx	Remote Backup Control Request	DO	0	10	7	-	-	-	-	Yes	DI in Backup OIT
MC-202	Pump No.2 Start/Stop Raw	DO	0	11	0	-	-	-	-	Yes	
		DO	0	11	1	-	-	-	-	-	
		DO	0	11	2	-	-	-	-	-	
		DO	0	11	3	-	-	-	-	-	
		DO	0	11	4	-	-	-	-	-	
JC-403	Generator Remote Test Raw	DO	0	11	5	-	-	-	-	-	
CAC-830	Camera Event Raw	DO	0	11	6	-	-	-	-	-	
YAC-801	PLC Alarm Horn Raw	DO	0	11	7	-	-	-	-	-	

YL-900	PLC OK signal					-	-	-	-	Yes	

Appendix E

Alarms, Alerts, and Logging Configuration

Appendix E - Alarm Identification and Prioritization

The primary function of the alarm system is to alert the operator to deviations from normal operating conditions, i.e. abnormal operating situations. The ultimate objective is to prevent, or at least minimize, physical and economic loss through operator intervention in response to the condition that was alarmed. The secondary function of the alarm system is to serve as an alarm and event log so operations staff can analyze the events that have led to current or past incidents. The log can also be used for analysis to optimize D&C system operations.

The facility design shall include all necessary PLC I/O and equipment and instrumentation to support and enable alarms for all process variables and monitored equipment. The Designer shall submit the recommended and proposed alarm configuration for review and acceptance (or acceptance as modified) by PWW.

Alarm Identification

For each design package, the PDE shall ensure that the alarms to be generated by the SCADA system meets PWW's requirements. PWW has defined what conditions are to be configured as alarms, and what conditions are alerts or log entries.

The Designer shall submit for approval a completed I/O list with the configuration of all alarms, alerts, or logging settings clearly identified. The design shall include hardware and software provisions to monitor and alarm all process variables and equipment condition and status, unless specifically excluded by PWW. Each alarm shall meet the definition as stated by ISA 18.2:

An alarm is an audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a response.

Alarms generated by the D&C SCADA system shall meet the above definition and specific criteria defined below:

"An alarm is an audible and/or visible means of indicating" - There must be an indication of the alarm. An alarm limit can be configured to generate control actions or log data but if this limit is not audibly or visually indicated it should not be considered an alarm.

"to the operator" - The indication must be targeted to the operator to be an alarm, not to provide information to an engineer, maintenance technician, or manager.

"an equipment malfunction, process deviation, or abnormal condition" - The alarm must indicate a problem, not a normal process condition or normal operational event (e.g., pump stopped, valve closed). The SCADA system should be configured to determine if any events have occurred unexpectedly (i.e., are "abnormal"). If an unexpected or abnormal event has occurred and operator action is required, this notification should be classified as an alarm.

"requiring a response." - There must be a defined operator response to correct the condition and bring the process back to a desired (safe and/or productive) state. If the operator does not need to respond, then the condition should not be an alarm. A notification that has no associated operator action should be defined as an alert or message. Acknowledging the alarm or logging a measurement is not considered an operator response (does not correct the abnormal situation). Typical operator responses to alarm include:

- Change the desired setpoint of an operating sequence
- Close a valve or gate
- Start a backup pump
- Issue a corrective work order

Conditions that **do NOT** meet the above criteria shall not be designated as an alarm.

Alarm Identification

For each alarm identified and/or designed by the PDE, an associated alarm priority shall be assigned. PWW utilizes three alarm priorities which are presented in Table 1 to convey the seriousness of the specific process condition:

Table 1 – Alarm Priorities

Alarm Priority	Severity	Percentage of Total Alarms
Emergency	Severe	3 – 7% (5%)
High	Major	15 – 25% (20%)
Low	Minor	70 – 80% (75%)

To assist in the assignment of alarm priorities, the following tables will help determine the most appropriate priority for the alarm. The first and most important of these tables is for the "Areas of Impact and Severity of Consequences" (Table2). To use the table, each Impact Category should be considered separately for the alarm. The PDE should focus on "How severe are the consequences, if the alarm occurs and no operator action is taken in response?" Note that any single scenario may have different severities in the different impact categories which are normal and expected. Industry best practices recommend assigning the overall severity for the event to be whichever one is worst.

Table 2 - Areas of Impact and Severity of Consequences

Impact Category	Severity: NONE	Severity: MINOR	Severity: MAJOR	Severity: SEVERE
Personnel Safety	No injury or health effect	▪Slight injury or health effect ▪No disability ▪No lost time or recordable	Injury affects work performance max of one week Reversible health effects	Lost time injury > 1 week Severe injuries Life threatening situation
Public or Environmental	No effect	▪Local environmental effect ▪Little, if any clean-up ▪Negligible financial consequence ▪Internal or routine reporting	Spill causes some non-permanent damage Single complaint Single exceedance of prescribed limit Reporting required at the local agency level	Impacts community Repeated exceedances Major environmental impact Extensive cleanup or financial consequences State or EPA reporting required
Production Loss / Downtime	No loss	▪Staff level reporting required	Departmental level reporting required	Senior management level reporting required

The second table, "Maximum Time to Respond" (Table 3), helps determine the time an operator needs to take action in order to prevent or mitigate the undesired consequence caused by an abnormal condition. The response time is how much time is available to take the effective action from when the alarm sounds to when the consequence becomes unavoidable, regardless of the action.

Table 3 - Maximum Time to Respond

Category	Maximum	Meaning
No Alarm	> 30 Minutes	May not qualify as an alarm.
Promptly	15 to 30 Minutes	This alarm must be dealt with, but you can first make a quick phone call or complete a new task.
Rapidly	5 to 15 Minutes	Quickly wrap up the phone call. Finish an ongoing short task. Don't start anything new - this alarm has to be dealt with.
Immediately	< 5 Minutes	Drop what you are doing and respond to this alarm right now. Hang up the phone. Interrupt a conversation.

Table 4 combines the results of the two tables together to help determine the most appropriate priority for the alarm. For all "Emergency" alarms, industry best practices recommended that pre- alarms be created and set to a "High" priority (if practical), so the operator to take effective action in response to the pre-alarm. On parameters such as toxic and flammable gas detectors, this is usually not practical to have a pre-alarm condition.

Table 4 – Priority Determination Grid

Maximum Time to Call-Out	Consequences	Consequences Severity: MAJOR	Consequences Severity:
> 30 Minutes	No Alarm	No Alarm	No Alarm
15 to 30 Minutes	Low	Low	High
5 to 15 Minutes	Low	High	High
< 5 Minutes	High	Emergency	Emergency

Appendix F

PCSS/AESS Qualification Requirements

PCSS QUALIFICATION REQUIREMENTS

A. The PCSS shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. PWW defines a "systems integrator" as an organization that complies with all of the following criteria:

   1. Employs personnel who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA Certified Control Systems Technician (CCST) Level 1 certification or have a minimum of 10 years of verifiable system startup experience. Key personnel shall include, as a minimum, the lead field technician.

   2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to the designed project.

   3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of PWW’s main office at 4 County Complex Court, Woodbridge, VA 22192, with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled start up to two months after startup completion.

C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

AESS QUALIFICATION REQUIREMENTS

E. Because the AESS is a Critical Sub Contractor PWW requires that the AESS shall be a "systems integrator" regularly engaged in the design, installation, and programming of Graphical SCADA systems and Programmable Logic Control systems, OITs and their associated subsystems as they are applied to the municipal water and wastewater industry. PWW defines a "systems integrator" as an organization that complies with all of the following criteria:

   4. Employs personnel who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall have a minimum of 10 years of verifiable SCADA, PLC, and OIT systems programming and startup experience. Key personnel shall include, as a minimum, the lead programmer.

   5. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the AESS. Potential references shall be for projects where the AESS's contract was of similar size to the designed project.

   6. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

F. The AESS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of PWW's main office at 4 County Complex Court, Woodbridge, VA 22192, with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the AESS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled start up to two months after startup completion.

G. An AESS not directly contracted by PWW shall submit a qualifications package to PWW for review and approval prior to being selected for the work.

Appendix G

Acceptance Testing

SYSTEM TESTING

A. General

1. Testing of each panel and/or system shall be scheduled, performed in an orderly sequence, and conducted in the presence of, and to the satisfaction of the Engineer. Testing shall be conducted for each component and system in accordance with the PCSS's submitted plan that has been reviewed by the Engineer.
2. UPS and Network Switches are installed in the Communications Panel. Because the PLC Panel functionality is largely dependent on this equipment, all PLC Panel and Communications Panel testing shall be performed with both panels interconnected to demonstrate all required functionality.
3. Testing shall include the operation of all hardware, AESS logic, and custom control features.
4. The following Factory Testing shall be provided for the PCS PLC Control Panel and Communications Panel:
    a. Unwitnessed Factory Test (UFT)
    b. Witnessed Factory Test (WFT) (Optional if requested)
    c. System Integration Test (SIT) (Optional if requested)
5. The following Field Testing shall be provided for the PCS PLC Control Panel and Communications Panel:
    a. Operational Readiness Test (ORT)
    b. Site Acceptance Test (SAT)

B. Factory Testing Requirements

1. Unwitnessed Factory Test (UFT)
    a. The purpose of the UFT is for the PCSS to check the hardware portion of the system prior to the WFT. This type of testing should be part of any quality firm's internal Quality Assurance / Quality Control (QA/QC) procedures.
    b. Tests to be performed shall include, but not be limited to, the following:
        1) Panels and enclosure inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish.
        2) System audit to verify all components have been staged for the test and have been documented properly with correct model numbers, serial numbers, etc.
        3) Panel wire pull tests to ensure all wiring has been connected with the appropriate torque to prevent wires from coming loose.
        4) UPS test to verify all UPS backed loads are kept online when in operations.
        5) Network test to verify all communications are functional. Network tests shall include demonstrating that all Ethernet and Serial links are able to communicate between devices as required and proper data is received. Tests shall include but are not limited to:
            a) UPS to PLC communications

b) PLC to [Main] OIT communications

c) PLC to Managed Switch (network ping test)

d) OIT to Managed Switch (network ping test)

e) Backup OIT to Managed Switch (network ping test)

f) UPS to Managed Switch (network ping test)

g) Camera to Managed Switch (network ping test)

h) Access Badge/Card Reader (network ping test)

6) PLC I/O point checkout to verify proper control panel wiring and I/O module set-up.

c. Upon successful completion of UFT, the PCSS shall submit a record copy of test results to PWW and request scheduling of the WFT.

2. Witnessed Factory Test (WFT) (Optional if requested)

a. The purpose of WFT is to allow PWW to witness the functionality, performance, and stability of entire hardware system prior to the AESS testing the software portion. This test shall be a repeat of the UFT.

b. Upon successful completion of WFT, the PCSS shall submit a record copy of test results to PWW and notify the AESS in writing that the system is ready for SIT. The AESS shall schedule and complete the SIT within 30 days of receipt of the submittal.

3. System Integration Test (SIT) (Optional if requested)

a. The purpose of SIT is to allow the AESS to test entire hardware and software system as a complete integrated system prior to installation in the field. During the SIT, the AESS shall have unrestricted access to the entire PLC system to verify the functionality of the PLC program and OIT application.

b. The SIT shall be run by the AESS, with assistance from PCSS as needed. The test shall be conducted at PCSS's facility. Normal access to the system shall be from 7:30 am to 4:00 pm Monday through Friday.

C. Field Testing Requirements

1. Operational Readiness Test (ORT)

a. The purpose of the ORT is to check that the process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test determines if the equipment is ready for operation.

b. The ORT shall take place prior to startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.

c. The following steps shall be performed as part of the ORT:

1) Instrument calibration, configuration, and set-up. Calibrate, configure, and set-up all components and instruments to perform the specified functions.

2) PCSS hardware and I/O testing. The purpose of the PCSS hardware and I/O signal testing is to check that the process equipment, instrument installation, calibration, configuration, field wiring, and the control panels are set-up correctly to monitor

and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.

3) I/O Testing to the HMI and OITs with AESS. The purpose of the I/O testing to the HMI and OITs with AESS is to check that the instruments and field equipment are connected properly and work from the end device, through the PLC, to the HMI and OITs.

4) Testing of Automatic Control Strategies with AESS.

5) Testing and demonstration of the backup control system and strategies.

6) Network Tests that include demonstrating that all Ethernet and Serial links are able to communicate between devices as required and proper data is received. Tests shall include but are not limited to:

a) UPS to PLC communications

b) PLC to [Main] OIT communications

c) PQM to PLC communications

d) PLC to Managed Switch (network ping test)

e) OIT to Managed Switch (network ping test)

f) Backup OIT to Managed Switch (network ping test)

g) UPS to Managed Switch (network ping test)

h) Camera to Managed Switch (Video Check)

i) Access Badge/Card Reader (network ping test)

Specific control strategies shall be verified using actual process equipment and instruments, or other means, to verify the logic performs as expected. Testing shall verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communications, out-of-range testing for analog inputs, loss of power, and all other strategies specified in the control strategies. This test shall be run by the AESS, with assistance from the PCSS as necessary.

2. Site Acceptance Test (SAT)

a. After system is started-up and running the process in automatic control to extent possible, system shall undergo a Site Acceptance Test. While this test is proceeding, PWW shall have full use of system. Only operating personnel shall be allowed to operate equipment associated with live processes. Operations shall remain responsibility of PWW and decision of the operators shall be final.

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

c. Any malfunction during test shall be analyzed and corrections made by PCSS. Throughout duration of SAT, no modifications shall be made to system without prior approval from PWW.

D. Additional Field Testing Requirements

1. Demonstrate the control features of each panel and associated field mounted instrumentation and control equipment, to verify that each panel performs the required control functions and logic as shown on the Contract Drawings or as specified. Control features shall include relay energization, initiation of alarm conditions, resets, interlocks, set point activation, and other functions of the control panels.
2. Equipment shall be field demonstrated to operate satisfactorily in the presence of the Owner, and shall be conducted in accordance with the PCSS's testing and demonstration plan that has been reviewed by the Engineer. Field demonstrations shall be performed after successful installation, calibration and testing of each control panel.
3. In addition to demonstrating the operation of standard control features, special control panel functions shall be demonstrated as specified for each panel as specified below.
4. The Contractor shall provide the necessary test equipment, process media, materials, supplies, and qualified test personnel to perform the field demonstrations as specified herein.
5. Field instrumentation control signals that are required to demonstrate the operation of associated control panels may be simulated upon approval of the Engineer.
6. In the event of failure of the field demonstration, the Contractor shall perform the necessary corrections and re-demonstrate, at his own cost and expense, the equipment as directed by the Engineer.

E. The PCSS shall provide competent personnel to participate in all testing.

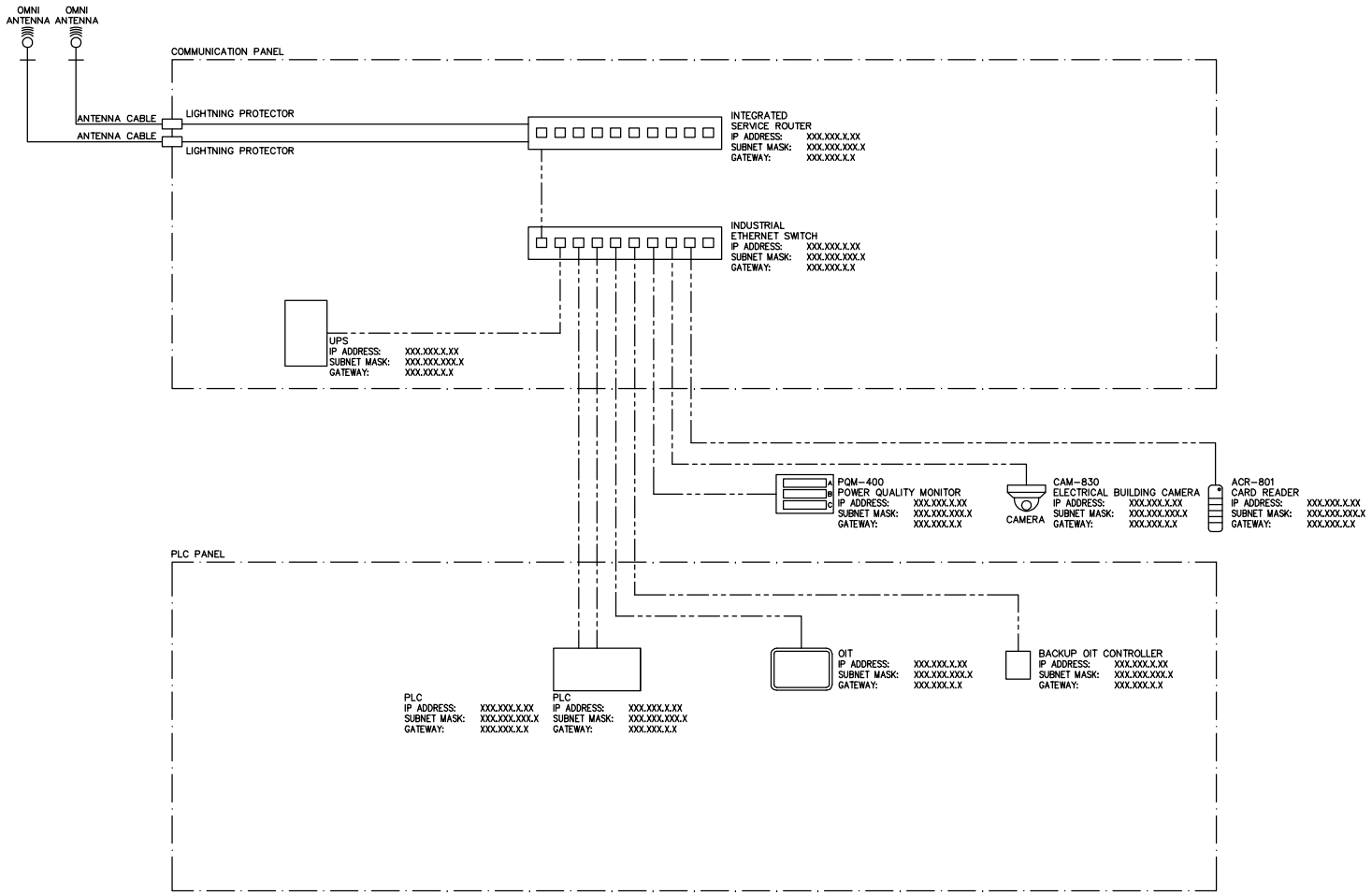
F. The PCSS shall provide competent personnel to participate in the testing and startup of the facility as scheduled below and as specified in Section 01660, Testing and Startup.

G. Time Durations

1. Contractor and PCSS shall allot for and allow the following minimum time duration for each specified item.
    a. Completion of AESS's Programming - A minimum of ninety (90) calendar days are required for the AESS to complete the programming necessary prior to the System Integration Test. The allotted time period shall not start until panel layout drawings have been submitted and approved, but may also start as late as 90 days prior to anticipated panel delivery date.
    b. Completion of AESS's Optional Software Integration Test at PCSS's facility - Twenty-one (21) calendar days after successful completion and acceptance of the Witnessed Factory Test.
    c. Completion of AESS's Application Software Operational Readiness Tests – Twenty-one (21) calendar days after successful completion and acceptance of the PCSS's Operational Readiness Testing.

Appendix H

Remote Site Network Configuration Requirements



REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
A					
B					
C					

PROJECT INFORMATION

PRINCE WILLIAM COUNTY SERVICE AUTHORITY,

SCADA PROJECT

	BY	DATE
DRAWN		
CHECKED		
APP		

REF.

DO NOT SCALE

SCALE NONE

SYSTEM ARCHITECTURE

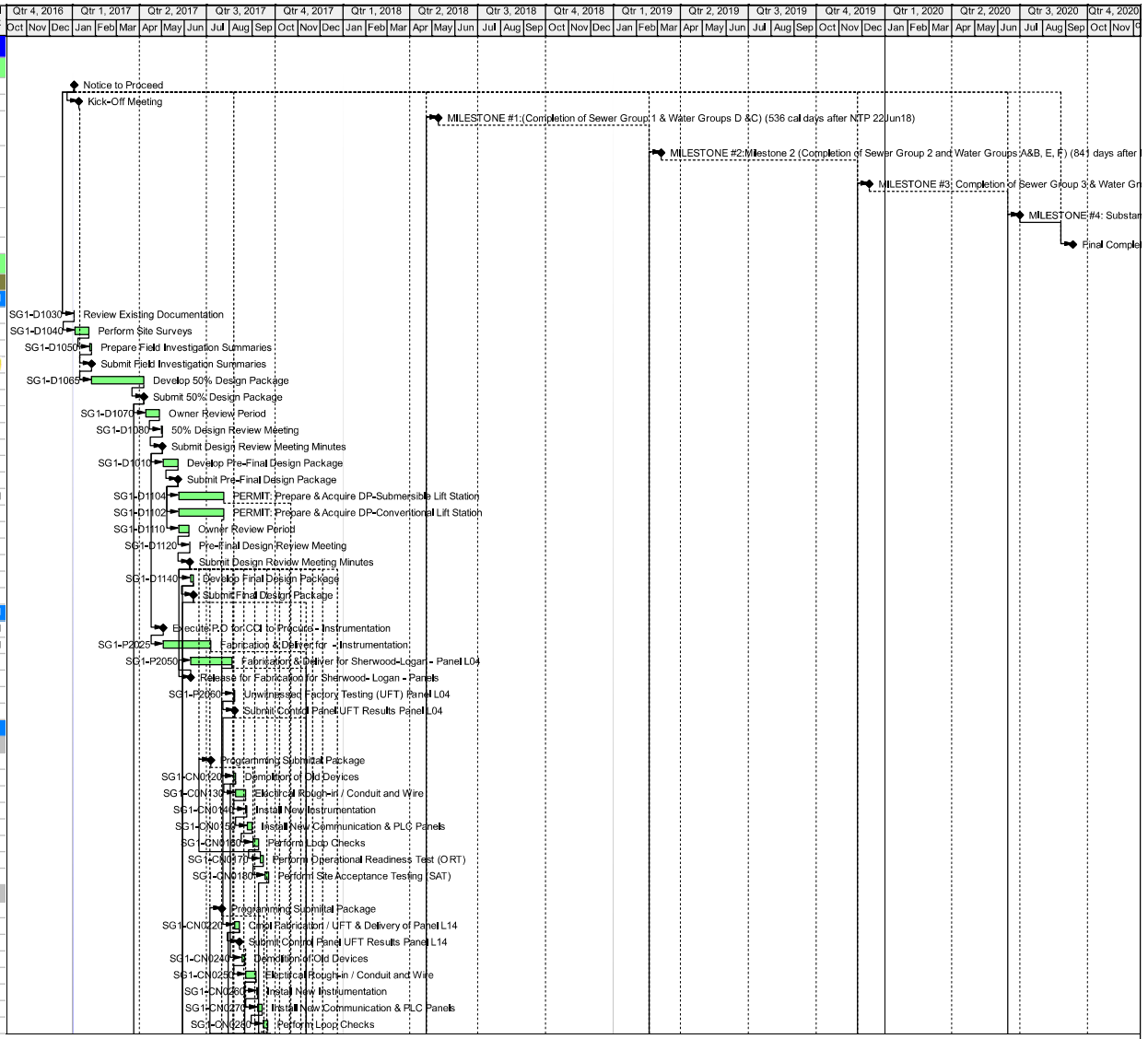
DWG. NO. SHT 1 OF 1

REV. C

Appendix I

Sample Schedule

Activity ID	Activity Name	Orig Dur	Start	Finish	Total Float
PWCSA SCADA Baseline DD3Jan17		933d	03-Jan-17	10-Sep-20	45d
MILESTONES		922d	03-Jan-17	10-Sep-20	45d
MS1000	Notice to Proceed	0d	03-Jan-17*		24d
MS1020	Kick-Off Meeting	0d	10-Jan-17		36d
MS1030	MILESTONE #1:(Completion of Sewer Group 1 & Water Groups D &C) (536 cal days after NTP 22Jun18)	0d		09-May-18*	31d
MS1040	MILESTONE #2:Milestone 2 (Completion of Sewer Group 2 and Water Groups A&B, E, F) (841 days after NTP 23Apr19)	0d		05-Mar-19*	35d
MS1050	MILESTONE #3: Completion of Sewer Group 3 & Water Groups G, H) (1110 days after NTP 17Jan20)	0d		11-Dec-19*	24d
MS1060	MILESTONE #4: Substantial Completion (1313 days after NTP 07Aug20)	0d		30-Jun-20*	27d
MS1070	Final Completion (1415 days after NTP 17Nov20)	0d		10-Sep-20*	45d
MILESTONE 1 PROJECTS		345d	03-Jan-17	09-May-18	31d
SEWER GROUP 1		345d	03-Jan-17	09-May-18	31d
DESIGN		143d	03-Jan-17	24-Jul-17	107d
SG1-D1030	Review Existing Documentation	1d	03-Jan-17	03-Jan-17	24d
SG1-D1040	Perform Site Surveys	13d	04-Jan-17	23-Jan-17	24d
SG1-D1050	Prepare Field Investigation Summaries	3d	24-Jan-17	26-Jan-17	24d
SG1-D1060	Submit Field Investigation Summaries	0d		26-Jan-17	24d
SG1-D1065	Develop 50% Design Package	50d	27-Jan-17	07-Apr-17	24d
SG1-D1020	Submit 50% Design Package	0d		07-Apr-17	24d
SG1-D1070	Owner Review Period	15d	10-Apr-17	28-Apr-17	24d
SG1-D1080	50% Design Review Meeting	2d	01-May-17	02-May-17	24d
SG1-D1090	Submit Design Review Meeting Minutes	0d		02-May-17	24d
SG1-D1010	Develop Pre-Final Design Package	15d	03-May-17	23-May-17	24d
SG1-D1100	Submit Pre-Final Design Package	0d		23-May-17	24d
SG1-D1104	PERMIT: Prepare & Acquire DP-Submersible Lift Station	42d	24-May-17	24-Jul-17	107d
SG1-D1102	PERMIT: Prepare & Acquire DP-Conventional Lift Station	42d	24-May-17	24-Jul-17	33d
SG1-D1110	Owner Review Period	10d	24-May-17	07-Jun-17	24d
SG1-D1120	Pre-Final Design Review Meeting	1d	08-Jun-17	08-Jun-17	24d
SG1-D1130	Submit Design Review Meeting Minutes	0d		08-Jun-17	24d
SG1-D1140	Develop Final Design Package	3d	09-Jun-17	13-Jun-17	49d
SG1-D1150	Submit Final Design Package	0d		13-Jun-17	49d
PROCUREMENT		67d	03-May-17	07-Aug-17	106d
SG1-P2030	Execute P.O for CCI to Procure - Instrumentation	0d	03-May-17		128d
SG1-P2025	Fabrication & Deliver for - Instrumentation	45d	03-May-17	06-Jul-17	128d
SG1-P2050	Fabrication & Deliver for Sherwood-Logan - Panel L04	40d	09-Jun-17	04-Aug-17	24d
SG1-P2040	Release for Fabrication for Sherwood- Logan - Panels	0d	09-Jun-17		24d
SG1-P2060	Unwitnessed Factory Testing (UFT) Panel L04	1d	07-Aug-17	07-Aug-17	24d
SG1-P2070	Submit Control Panel UFT Results Panel L04	0d		07-Aug-17	53d
CONSTRUCTION		179d	07-Jul-17	28-Mar-18	31d
L04 - Occoquan Creek LS		55d	07-Jul-17	22-Sep-17	35d
SG1-CN0110	Programming Submittal Package	0d	07-Jul-17		85d
SG1-CN0120	Demolition of Old Devices	2d	07-Aug-17	08-Aug-17	24d
SG1-C0N130	Electrical Rough-in / Conduit and Wire	10d	09-Aug-17	22-Aug-17	35d
SG1-CN0140	Install New Instrumentation	2d	23-Aug-17	24-Aug-17	35d
SG1-CN0150	Install New Communication & PLC Panels	5d	25-Aug-17	31-Aug-17	35d
SG1-CN0160	Perform Loop Checks	5d	01-Sep-17	08-Sep-17	35d
SG1-CN0170	Perform Operational Readiness Test (ORT)	5d	11-Sep-17	15-Sep-17	35d
SG1-CN0180	Perform Site Acceptance Testing (SAT)	5d	18-Sep-17	22-Sep-17	35d
L14 - Occoquan Plant LS		55d	21-Jul-17	06-Oct-17	35d
SG1-CN0210	Programming Submittal Package	0d	21-Jul-17		85d
SG1-CN0220	Cmpl Fabrication / UFT & Delivery of Panel L14	5d	08-Aug-17	14-Aug-17	53d
SG1-CN0230	Submit Control Panel UFT Results Panel L14	0d		14-Aug-17	53d
SG1-CN0240	Demolition of Old Devices	2d	18-Aug-17	21-Aug-17	24d
SG1-CN0250	Electrical Rough-in / Conduit and Wire	10d	22-Aug-17	05-Sep-17	24d
SG1-CN0260	Install New Instrumentation	2d	06-Sep-17	07-Sep-17	36d
SG1-CN0270	Install New Communication & PLC Panels	5d	08-Sep-17	14-Sep-17	36d
SG1-CN0280	Perform Loop Checks	5d	15-Sep-17	21-Sep-17	36d



Project Start: 03-Jan-17
Project Finish: 10-Sep-20
Data Date: 03-Jan-17
Run Date: 15-Nov-16
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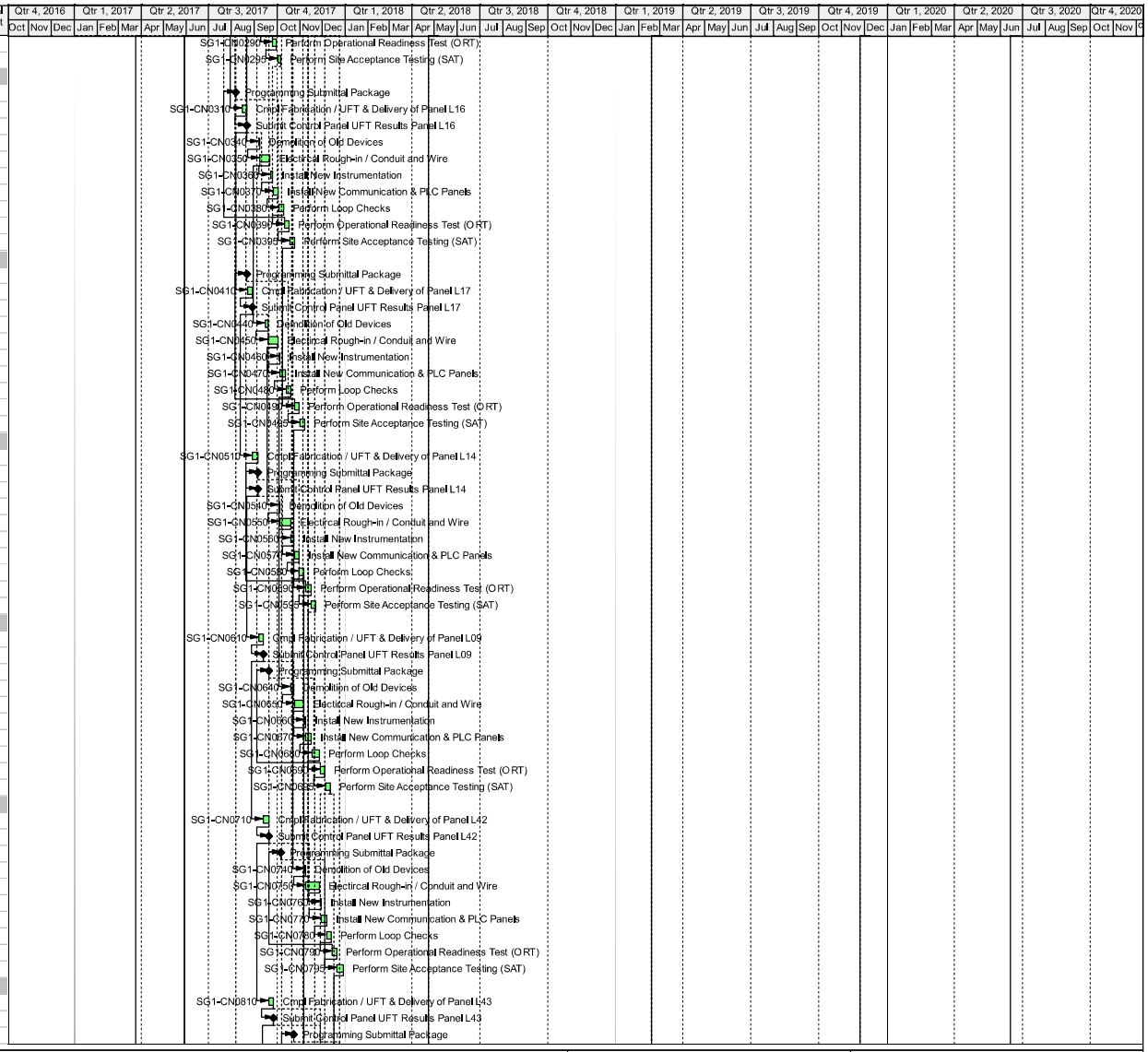
Actual Work
Remaining Work
Critical Remaining Work
Milestone

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
Distribution & Collection SCADA System Replacement
Proposed Baseline Project Schedule
(All Activities Sort)

Activity ID	Activity Name	Orig Dur	Start	Finish	Total Float
SG1-CN0290	Perform Operational Readiness Test (ORT)	5d	25-Sep-17	29-Sep-17	35d
SG1-CN0295	Perform Site Acceptance Testing (SAT)	5d	02-Oct-17	06-Oct-17	35d
L16 - Featherstone LS		55d	07-Aug-17	24-Oct-17	34d
SG1-CN0330	Programming Submittal Package	0d	07-Aug-17		84d
SG1-CN0310	Cmpl Fabrication / UFT & Delivery of Panel L16	5d	15-Aug-17	21-Aug-17	57d
SG1-CN0320	Submit Control Panel UFT Results Panel L16	0d		21-Aug-17	57d
SG1-CN0340	Demolition of Old Devices	2d	06-Sep-17	07-Sep-17	24d
SG1-CN0350	Electrical Rough-in / Conduit and Wire	10d	08-Sep-17	21-Sep-17	24d
SG1-CN0360	Install New Instrumentation	2d	22-Sep-17	25-Sep-17	34d
SG1-CN0370	Install New Communication & PLC Panels	5d	26-Sep-17	02-Oct-17	34d
SG1-CN0380	Perform Loop Checks	5d	03-Oct-17	10-Oct-17	34d
SG1-CN0390	Perform Operational Readiness Test (ORT)	5d	11-Oct-17	17-Oct-17	34d
SG1-CN0395	Perform Site Acceptance Testing (SAT)	5d	18-Oct-17	24-Oct-17	34d
L17 - Belmont LS		55d	21-Aug-17	07-Nov-17	34d
SG1-CN0430	Programming Submittal Package	0d	21-Aug-17		84d
SG1-CN0410	Cmpl Fabrication / UFT & Delivery of Panel L17	5d	22-Aug-17	28-Aug-17	57d
SG1-CN0420	Submit Control Panel UFT Results Panel L17	0d		28-Aug-17	57d
SG1-CN0440	Demolition of Old Devices	2d	15-Sep-17	18-Sep-17	24d
SG1-CN0450	Electrical Rough-in / Conduit and Wire	10d	19-Sep-17	02-Oct-17	24d
SG1-CN0460	Install New Instrumentation	2d	03-Oct-17	04-Oct-17	33d
SG1-CN0470	Install New Communication & PLC Panels	5d	05-Oct-17	12-Oct-17	33d
SG1-CN0480	Perform Loop Checks	5d	13-Oct-17	19-Oct-17	33d
SG1-CN0490	Perform Operational Readiness Test (ORT)	5d	25-Oct-17	31-Oct-17	34d
SG1-CN0495	Perform Site Acceptance Testing (SAT)	5d	01-Nov-17	07-Nov-17	34d
L08 -Powells Creek LS		59d	29-Aug-17	22-Nov-17	34d
SG1-CN0510	Cmpl Fabrication / UFT & Delivery of Panel L14	5d	29-Aug-17	05-Sep-17	57d
SG1-CN0530	Programming Submittal Package	0d	05-Sep-17		84d
SG1-CN0520	Submit Control Panel UFT Results Panel L14	0d		05-Sep-17	57d
SG1-CN0540	Demolition of Old Devices	2d	03-Oct-17	04-Oct-17	24d
SG1-CN0550	Electrical Rough-in / Conduit and Wire	10d	05-Oct-17	19-Oct-17	24d
SG1-CN0560	Install New Instrumentation	2d	20-Oct-17	23-Oct-17	24d
SG1-CN0570	Install New Communication & PLC Panels	5d	24-Oct-17	30-Oct-17	24d
SG1-CN0580	Perform Loop Checks	5d	31-Oct-17	06-Nov-17	24d
SG1-CN0590	Perform Operational Readiness Test (ORT)	5d	08-Nov-17	15-Nov-17	34d
SG1-CN0595	Perform Site Acceptance Testing (SAT)	5d	16-Nov-17	22-Nov-17	34d
L09 - Deweys Creek LS		65d	06-Sep-17	11-Dec-17	33d
SG1-CN0610	Cmpl Fabrication / UFT & Delivery of Panel L09	5d	06-Sep-17	12-Sep-17	73d
SG1-CN0620	Submit Control Panel UFT Results Panel L09	0d		12-Sep-17	73d
SG1-CN0630	Programming Submittal Package	0d	20-Sep-17		83d
SG1-CN0640	Demolition of Old Devices	2d	20-Oct-17	23-Oct-17	33d
SG1-CN0650	Electrical Rough-in / Conduit and Wire	10d	24-Oct-17	06-Nov-17	33d
SG1-CN0660	Install New Instrumentation	2d	07-Nov-17	08-Nov-17	33d
SG1-CN0670	Install New Communication & PLC Panels	5d	09-Nov-17	16-Nov-17	33d
SG1-CN0680	Perform Loop Checks	5d	17-Nov-17	27-Nov-17	33d
SG1-CN0690	Perform Operational Readiness Test (ORT)	5d	28-Nov-17	04-Dec-17	33d
SG1-CN0695	Perform Site Acceptance Testing (SAT)	5d	05-Dec-17	11-Dec-17	33d
L42 - Ridgeleigh LS#1 - Submersible PS		72d	13-Sep-17	29-Dec-17	31d
SG1-CN0710	Cmpl Fabrication / UFT & Delivery of Panel L42	5d	13-Sep-17	19-Sep-17	78d
SG1-CN0720	Submit Control Panel UFT Results Panel L42	0d		19-Sep-17	78d
SG1-CN0730	Programming Submittal Package	0d	06-Oct-17		81d
SG1-CN0740	Demolition of Old Devices	2d	07-Nov-17	08-Nov-17	31d
SG1-CN0750	Electrical Rough-in / Conduit and Wire	10d	09-Nov-17	27-Nov-17	31d
SG1-CN0760	Install New Instrumentation	2d	28-Nov-17	29-Nov-17	31d
SG1-CN0770	Install New Communication & PLC Panels	5d	30-Nov-17	06-Dec-17	31d
SG1-CN0780	Perform Loop Checks	5d	07-Dec-17	13-Dec-17	31d
SG1-CN0790	Perform Operational Readiness Test (ORT)	5d	14-Dec-17	20-Dec-17	31d
SG1-CN0795	Perform Site Acceptance Testing (SAT)	5d	21-Dec-17	29-Dec-17	31d
L43 - Ridgeleigh LS#2 - Submersible PS		77d	20-Sep-17	16-Jan-18	31d
SG1-CN0810	Cmpl Fabrication / UFT & Delivery of Panel L43	5d	20-Sep-17	26-Sep-17	83d
SG1-CN0820	Submit Control Panel UFT Results Panel L43	0d		26-Sep-17	83d
SG1-CN0830	Programming Submittal Package	0d	23-Oct-17		81d



Project Start: 03-Jan-17
Project Finish: 10-Sep-20
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Actual Work
Remaining Work
Critical Remaining Work
Milestone

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
Distribution & Collection SCADA System Replacement
Proposed Baseline Project Schedule
(All Activities Sort)

Activity ID	Activity Name	Orig Dur	Start	Finish	Total Float
SG1-CN0840	Demolition of Old Devices	2d	22-Nov-17	27-Nov-17	24d
SG1-CN0850	Electrical Rough-in / Conduit and Wire	10d	28-Nov-17	11-Dec-17	24d
SG1-CN0860	Install New Instrumentation	2d	12-Dec-17	13-Dec-17	31d
SG1-CN0870	Install New Communication & PLC Panels	5d	14-Dec-17	20-Dec-17	31d
SG1-CN0880	Perform Loop Checks	5d	21-Dec-17	29-Dec-17	31d
SG1-CN0890	Perform Operational Readiness Test (ORT)	5d	02-Jan-18	08-Jan-18	31d
SG1-CN0895	Perform Site Acceptance Testing (SAT)	5d	09-Jan-18	16-Jan-18	31d
L56 - Belmont Town Center LS - Submersible PS		82d	27-Sep-17	30-Jan-18	31d
SG1-CN0910	Cmpl Fabrication / UFT & Delivery of Panel L56	5d	27-Sep-17	03-Oct-17	88d
SG1-CN0920	Submit Control Panel UFT Results Panel L56	0d		03-Oct-17	88d
SG1-CN0930	Programming Submittal Package	0d	06-Nov-17		81d
SG1-CN0940	Demolition of Old Devices	2d	05-Dec-17	06-Dec-17	24d
SG1-CN0950	Electrical Rough-in / Conduit and Wire	10d	07-Dec-17	20-Dec-17	24d
SG1-CN0960	Install New Instrumentation	2d	21-Dec-17	26-Dec-17	34d
SG1-CN0970	Install New Communication & PLC Panels	5d	27-Dec-17	03-Jan-18	34d
SG1-CN0980	Perform Loop Checks	5d	04-Jan-18	10-Jan-18	34d
SG1-CN0990	Perform Operational Readiness Test (ORT)	5d	17-Jan-18	23-Jan-18	31d
SG1-CN0995	Perform Site Acceptance Testing (SAT)	5d	24-Jan-18	30-Jan-18	31d
L59 - Powells Landing LS - Submersible PS		87d	04-Oct-17	13-Feb-18	31d
SG1-CN1110	Cmpl Fabrication / UFT & Delivery of Panel L59	5d	04-Oct-17	11-Oct-17	93d
SG1-CN1120	Submit Control Panel UFT Results Panel L59	0d		11-Oct-17	93d
SG1-CN1130	Programming Submittal Package	0d	21-Nov-17		81d
SG1-CN1140	Demolition of Old Devices	2d	21-Dec-17	26-Dec-17	24d
SG1-CN1150	Electrical Rough-in / Conduit and Wire	10d	27-Dec-17	10-Jan-18	24d
SG1-CN1160	Install New Instrumentation	2d	11-Jan-18	12-Jan-18	32d
SG1-CN1170	Install New Communication & PLC Panels	5d	16-Jan-18	22-Jan-18	32d
SG1-CN1180	Perform Loop Checks	5d	23-Jan-18	29-Jan-18	32d
SG1-CN1190	Perform Operational Readiness Test (ORT)	5d	31-Jan-18	06-Feb-18	31d
SG1-CN1195	Perform Site Acceptance Testing (SAT)	5d	07-Feb-18	13-Feb-18	31d
L74 - Neabsco LS - AB Conversion		92d	12-Oct-17	28-Feb-18	31d
SG1-CN1210	Cmpl Fabrication / UFT & Delivery of Panel L74	5d	12-Oct-17	18-Oct-17	98d
SG1-CN1220	Submit Control Panel UFT Results Panel L74	0d		18-Oct-17	98d
SG1-CN1230	Programming Submittal Package	0d	07-Dec-17		81d
SG1-CN1240	Demolition of Old Devices	2d	04-Jan-18	05-Jan-18	24d
SG1-CN1250	Electrical Rough-in / Conduit and Wire	10d	08-Jan-18	22-Jan-18	24d
SG1-CN1260	Install New Instrumentation	2d	23-Jan-18	24-Jan-18	35d
SG1-CN1270	Install New Communication & PLC Panels	5d	25-Jan-18	31-Jan-18	35d
SG1-CN1280	Perform Loop Checks	5d	01-Feb-18	07-Feb-18	35d
SG1-CN1290	Perform Operational Readiness Test (ORT)	5d	14-Feb-18	21-Feb-18	31d
SG1-CN1300	Perform Site Acceptance Testing (SAT)	5d	22-Feb-18	28-Feb-18	31d
L11 - "B" Station LS		97d	19-Oct-17	14-Mar-18	31d
SG1-CN1310	Cmpl Fabrication / UFT & Delivery of Panel L11	5d	19-Oct-17	25-Oct-17	103d
SG1-CN1320	Submit Control Panel UFT Results Panel L11	0d		25-Oct-17	103d
SG1-CN1330	Programming Submittal Package	0d	21-Dec-17		81d
SG1-CN1340	Demolition of Old Devices	2d	23-Jan-18	24-Jan-18	24d
SG1-CN1350	Electrical Rough-in / Conduit and Wire	10d	25-Jan-18	07-Feb-18	24d
SG1-CN1360	Install New Instrumentation	2d	08-Feb-18	09-Feb-18	33d
SG1-CN1370	Install New Communication & PLC Panels	5d	12-Feb-18	16-Feb-18	33d
SG1-CN1380	Perform Loop Checks	5d	20-Feb-18	26-Feb-18	33d
SG1-CN1390	Perform Operational Readiness Test (ORT)	5d	01-Mar-18	07-Mar-18	31d
SG1-CN1395	Perform Site Acceptance Testing (SAT)	5d	08-Mar-18	14-Mar-18	31d
L18 - Dumfries LS		102d	26-Oct-17	28-Mar-18	31d
SG1-CN1410	Cmpl Fabrication / UFT & Delivery of Panel L18	5d	26-Oct-17	01-Nov-17	106d
SG1-CN1420	Submit Control Panel UFT Results Panel L18	0d		01-Nov-17	106d
SG1-CN1430	Programming Submittal Package	0d	09-Jan-18		81d
SG1-CN1440	Demolition of Old Devices	2d	08-Feb-18	09-Feb-18	24d
SG1-CN1450	Electrical Rough-in / Conduit and Wire	10d	12-Feb-18	26-Feb-18	24d
SG1-CN1460	Install New Instrumentation	2d	27-Feb-18	28-Feb-18	24d
SG1-CN1470	Install New Communication & PLC Panels	5d	01-Mar-18	07-Mar-18	24d
SG1-CN1480	Perform Loop Checks	5d	08-Mar-18	14-Mar-18	24d
SG1-CN1490	Perform Operational Readiness Test (ORT)	5d	15-Mar-18	21-Mar-18	31d

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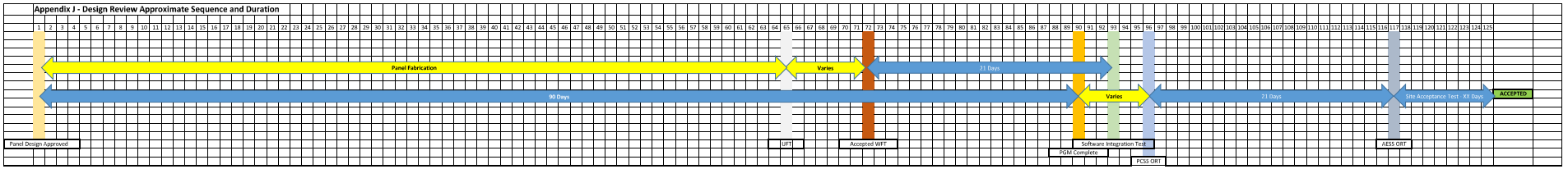
Remaining Work
Critical Remaining Work
Milestone

PRINCE WILLIAM COUNTY SERVICE AUTHORITY
Distribution & Collection SCADA System Replacement
Proposed Baseline Project Schedule
(All Activities Sort)

Appendix J

Design Review Approximate Sequence and Duration


Appendix J - Design Review Approximate Sequence and Duration
Panel Fabrication
Varies
21 Days
90 Days
Varies
21 Days
Site Acceptance Test - XX Days
ACCEPTED
Panel Design Approved
LIFT
Accepted WFT
Software Integration Test
PGM Complete
PCSS ORT
AESS ORT