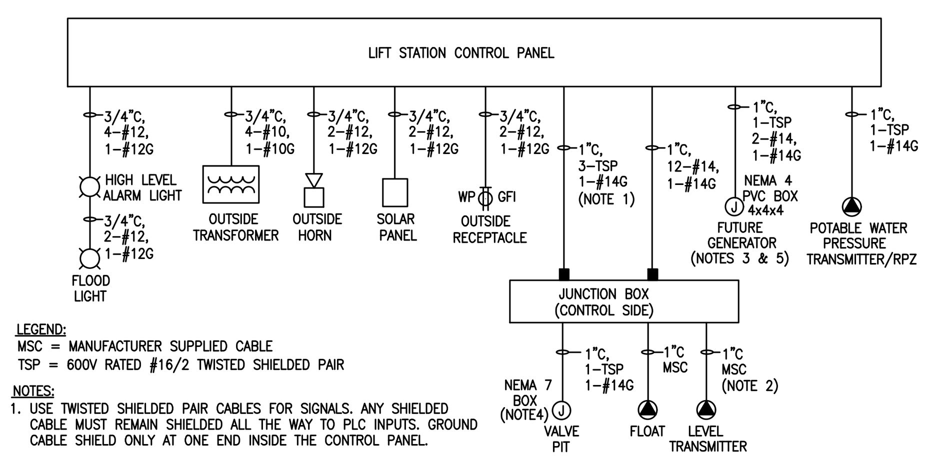
WUD PROJECT No.
00–000

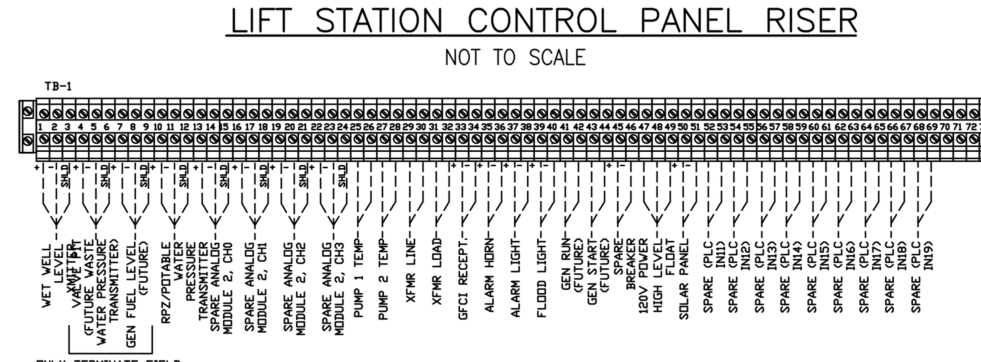
WUD PROJECT NAME



LEGEND:
MSC = MANUFACTURER SUPPLIED CABLE
TSP = 600V RATED #16/2 TWISTED SHIELDED PAIR

NOTES:
1. USE TWISTED SHIELDED PAIR CABLES FOR SIGNALS. ANY SHIELDED CABLE MUST REMAIN SHIELDED ALL THE WAY TO PLC INPUTS. GROUND CABLE SHIELD ONLY AT ONE END INSIDE THE CONTROL PANEL.
2. PROVIDE LIQUID TIGHT NONMETALLIC FLEXIBLE CONDUIT WITH SEAL TYPE FITTINGS FOR LEVEL TRANSMITTER CABLE INSIDE THE WET WELL.
3. COORDINATE WITH THE COUNTY FOR THE LOCATION OF FUTURE SKID MOUNTED GENERATOR INSIDE THE LIFT STATION FENCE.
4. PROVIDE AND INSTALL EXPLOSIONPROOF BOX INSIDE THE VALVE PIT. MIN. DIMENSION 4"x4"x4", CROUSE HINDS GUB01 OR APPR. EQUAL. PROVIDE CONDUIT OPENINGS AS REQUIRED. MOUNT THE BOX ON THE VALVE PIT WALL WITH 316 S.S. MOUNTING HARDWARE MIN. 24" FROM THE VALVE PIT FLOOR.
5. INSTALL GENERATOR JUNCTION BOX 24" ABOVE FLOOR WITH 316 S.S. UNISTRUT SUPPORT AND 316 S.S. MOUNTING HARDWARE. BOX SHALL NOT IMPOSE THE TRIPPING HAZARD.

LIFT STATION CONTROL PANEL RISER
NOT TO SCALE



WIRE TERMINAL TB–1
NOT TO SCALE

LIFT STATION CONTROL PANEL
ELECTRICAL RISER

74S

1. REMOTE TELEMETRY UNITS AND APPURTENANCES (R.T.U.)

A. The Remote Telemetry Units shall be microprocessor based, user programmable, Programmable Logic Controllers (PLC's) which shall serve as an interface to accumulate, process, transmit and receive discrete and analog status and control messages between the RTU base stations and the remote RTU sites located within a ten mile radius of the base station.

B. Each RTU shall be PLC based, with sufficient battery backed RAM, or EEPROM non–volatile backup memories to provide all discrete and analog status, monitoring and control functions and shall be designed to operate in an outdoor industrial environment.

C. The programmable controller shall be designed to operate in an industrial environment. The PLC shall be capable of operation in an ambient temperature range of 0°–60°C and a relative humidity of 5–95 percent, non–condensing. The PLC shall be capable of operation on supply voltages of 24VDC.

D. All components of the PLC system shall be of the same manufacturer who is regularly engaged in the manufacture of programmable controllers. The manufacturer shall have fully tested units similar to that being furnished in an industrial environment with associated electrical noise. The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

E. The processor and its associated memory shall be enclosed in a modular sheet metal enclosure. Memory shall consist of battery–backed RAM, which shall retain the control program in the event of AC power loss. Memory shall be not less than 8K user logic for any PLC and shall be adequate for all control functions specified. A minimum of 1920 on–board registers shall be addressable.

F. The relay logic instructions of the programmable controller shall include normally open; normally closed; transitional positive and negative contacts; timers in .01, .1, and 1.0– second resolution; and up/down counters. Register and table instructions shall include block moves, table to register, register to table, FIFO, table search, and table to table. Register matrix operations shall include bit sense, bit set/clear, and, or, exclusive or, bit rotate, and complement.

G. LED–type indicating lights shall be provided as follows: READY, RUN.

H. Programmable controllers and accessory equipment shall be Allen Bradley MicroLogix 1400, with memory module and two analog extension modules.

I. All RTUs shall be powered with 115 VAC through a power supply capable of float charging sealed Gel–cell batteries and shall include an AC power monitor with alarm output to the RTU on loss of AC power. Power supply shall be of sufficient capacity to provide all required DC power to all RTU equipment, discrete and analog input/output circuitry, under full load, communications interface equipment, radios and other radio interface/conditioning equipment and appurtenances as required. The primary power supply for radio, PLC and battery backup shall be 100 Watt, 24VDC Allen Bradley 1606–XLP100E. The batteries shall be lead acid sealed, 12 volt, 18 ampere–hour, model Power Sonic PS–12180. Two 12 volt batteries shall connected in series to get 24VDC battery backup. The Radio shall be powered through a relay contact and the PLC shall be able to power up or power down the radio as necessary.
As second power source, provide a Solar Panel with all necessary components including a solar controller. Solar panel shall be mounted on the antenna pole with stainless steel U–bolts. The solar panel Installation shall meet 150MPH wind loading requirements. Solar panel shall be 55 watt, 24 volt panel Solartech SPM055P–WP–F with pole mounting kit Sunwize 007954. The solar controller shall be Morningstar Sunsaver SS–10L–24V. See wiring schematics for general information.

J. Provide one spare PLC and one spare radio for every group of three lift stations or less.

K. All analog inputs shall be furnished with lightning surge protection devices. Sufficient I/O shall be provided for each RTU to accommodate future expansion.

1. Digital inputs shall be 24VDC from dry contacts.

2. All outputs shall be wired through interposing relays (item 27). All analog and digital inputs shall be wired to terminal strip.

3. Analog input circuits shall be isolated, 12–bit resolution type. Analog inputs shall be coordinated with the receivers but shall generally be isolated 24V 4–20 mA inputs powered from the PLC. Analog input hardware shall be provided as specified for all types of analog inputs being transmitted to the PLC.

L. The RTU hardware shall be assembled to the back plate of the control panel or placed in a separate panel enclosure with a back plate. All components shall be mechanically secured and fully wired. A bonding wire #12 AWG with crimped end terminals is required between the back plate and control panel.

M. The following is a summary of approved remote telemetry equipment/materials and manufacturers.

REMOTE TELEMETRY UNIT
SPECIFICATIONS (SHT 1 OF 5)

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Equipment/Material	Manufacturer
RF Lightning Surge Suppressor	A) PolyPhaser Corporation – IS–50NX–C2
Analog Surge Suppressor	A) EDCO Inc. – PC 642C–036 (Qty. 4)
Antenna Cable	A) Andrews Heliax – LDF4–50A Low Loss Coaxial Cable
5 Watt Ethernet/Serial Radio to communicate w/ towers NTEL 1, NTEL 2, CTEL 1, STEL, WTEL	A) Microwave Data System – SD4–CES–NNSNN
10 Watt Ethernet/Serial Radio to communicate with tower CTEL 2	A) Microwave Data System – ORBIT MXNXL2XNNNNNNS1F5DUNN
Programmable Logic Controller Processor	A) Allen Bradley MicroLogix 1400/1766–L32BXB, with memory module 1766–MM1 & two analog extension modules 1762–IF4
120VAC to 24VDC Power Supply	A) Allen Bradley – 1606–XLP100E
Antenna – 450MHz – 475MHz	A) Sinclair – SY307–SF3SNM(ABK) – (Single array Yagi antenna) B) Sinclair – SY3072–SF3SNM(ABK) – (Dual array Yagi antenna)
Antenna – 216MHz – 235MHz	A) Type to be determined after new Tower CTEL 2 is established.
RF Coaxial Connector	A) Andrews – L4TNM–PSA or L4TNF–PSA
Vapor Phase Corrosion Inhibitor Capsules	A) Hoffman Model A–HC15E B) ZERUST Model VC–6–2

I/O List:

Pump No. 1 Run	digital input I/0
Pump No. 2 Run	digital input I/1
Pump No. 1 HOA	digital input I/2
Pump No. 2 HOA	digital input I/3
Generator Run (future)	digital input I/4
Back–up Float Fail	digital input I/5
Power Fail	digital input I/6
High Level Alarm	digital input I/7
Phase Monitor Alarm	digital input I/8
Main Breaker OFF	digital input I/9
Generator Breaker ON	digital input I/10
Pump No. 1 Start	digital output O/0
Pump No. 2 Start	digital output O/1
Portable Generator Start (future)	digital output O/2
Radio Power Control	digital output O/3
Lift Station Level	analog Input IV1 (extension module 1)
Gen. Fuel Level or water pressure (future)	analog Input IV2 (extension module 1)
Force Main Pressure (future)	analog Input IV3 (extension module 1)
Potable water pressure	analog Input IV4 (extension module 1)

2. RTU COMMUNICATIONS INTERFACE

A. Bi–directional communications of status, commands and radio diagnostics between the RTUs and the RTU base station shall be provided by the RTU communications interface subsystem. The PLC MODBUS serial interface port shall serve as the RTU communications interface. The data transmission rate shall be set to operate at 9600 Baud (synchronous) in RTU mode.

B. The RTU communications interface shall control the modem during the polling sequence. It shall be possible to assign a base address to each RTU through the data interface. The addressing scheme shall allow a minimum of 247 RTUs for each data link. The communications protocol shall be master–slave MODBUS RTU.

3. RTU RADIO SECTION AND APPURTENANCES

A. The radio to communicate with any towers except CTEL 2 shall consist of a Microwave Data Systems model SD4–CES–NNSNN 5–watt (continuous) digital FSK modulation type radio transceiver with integral RF modem, RS–232 synchronous serial interface and cable, private line coded squelch and carrier defeat timer to inhibit communications lockup. Radio transceiver shall include automatic frequency, control, loop–back and SMART diagnostics remote maintenance module to monitor; power out, RSSI, voltage level, internal temperature and forward/reflected power.
Radio enclosure shall include RF shield. The interface cable from radio to RF surge suppressor shall be 36" long, RG142 cable with N. Male RF connectors. The radio to communicate with CTEL 2 shall be as shown in above equipment lists.

REMOTE TELEMETRY UNIT
SPECIFICATIONS (SHT 2 OF 5)

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B. Remote terminal unit antenna to communicate with any towers except CTEL 2 shall be a heavy–duty, pole–mounted, grounded, 450 MHz – 470MHz Yagi, directional type furnished with a minimum of 30 feet of Andrews Heliax (LDF4–50A) low loss coaxial antenna cable or approved equal, line adapter, lightning protector and appurtenances. Antenna and accessories shall be an SY307–SF3SNM(ABK) as manufactured by Sinclair or approved equal. Dual array Yagi antennae Sinclair SY3072–SF3SNM(ABK) shall be required if the Remote Receive Signal Strength (RSSI) is less than 95 dbm. Minimum antenna height shall be 18 feet above grade. On new mast installations, fabricate the antenna from 21 feet length of schedule 40 galvanized steel continuous pipe (2 inch diameter) or approved equal. Paint lower 4 feet with asphaltum paint and cap the top of the pipe. RF lightning surge suppressor shall be IS–50NX–C2 by Polyphaser Corporation. Yagi antenna shall have a pig tail with N–Male connector. Coaxial antenna cable shall have an N–Female connector Andrew L4TNF–PSA on one end and an N–Male connector Andrew L4TNM–PSA connector on other end. The antenna connectors on the antenna mast shall be wrapped with rubber tape and heat shrink tubing. Heat shrink tubing shall be Alpha FIT–321–1inch. The antenna orientation toward the receiving communication tower shall be set using appropriate instruments. The antenna to communicate with CTEL 2 to be determined after the tower is established.

C. The complete communications subsystem including all interconnecting cables shall contain lightning, surge and transient protection. All antennae masts shall be grounded.

D. Radios shall be programmed by PBCWUD technicians for the frequency of the tower that the radio will be communicating with. See attached RTU Schedule for location of stations. Frequencies are as follows:

1. North Tower 1 (NTEL 1) – Remote transmit–465.1500 MHz – Receive–460.1500 MHz
For stations located north of Lantana Rd., south of Roebuck Rd., and east of S.R. 7
2956 Pinehurst Dr., Greenacres, FL (Coordinates: 26°38.017'N, 80°09.352'W)

2. North Tower 2 (NTEL 2) – Remote transmit–456.8625 MHz – Receive–451.8625 MHz
For stations located north of Forest Hill Blvd., and east of S.R. 7
8130 North Jog Rd., West Palm Beach, FL (Coordinates: 26°47'52.50"N, 80°08'12.97"W)

3. Central Tower 1 (CTEL 1) – Remote transmit–465.750 MHz – Receive–460.750 MHz
For stations located south of Lantana Rd. and North of Clint Moore Rd.
12751 Hagen Ranch Rd., Delray Beach, FL (Coordinates: 26°29.260'N, 80°10.018'W)

4. Central Tower 2 (CTEL 2) – Transmit and Receive frequencies to be determined after the new CTEL 2 is built. For stations located south of Lantana Rd. and North of Clint Moore Rd. (Coordinates: TBD)

5. South Tower (STEL) – Remote transmit–465.075 MHz – Receive–460.075 MHz
For stations located south of Clint Moore Rd.
22438 S.W. 7th Street, Boca Raton, FL (Coordinates: 26°20.586'N, 80°11.840'W)

6. West Tower (WTEL) – Remote transmit–465.525 MHz – Receive–460.525 MHz
For stations located north of S.R. 80 and west of S.R. 7; plus all stations located north of Roebuck Rd.
20 S.R. 880, Loxahatchee, FL (Coordinates: 26°41.05'N, 80°23.37'W)

4. RTU ELECTRICAL TRANSIENT PROTECTION

A. All electrical and electronic elements shall be protected against damage due to electrical transient induced in interconnecting lines from lightning discharges and nearby electrical systems.

B. Manufacturer's Requirements: All surge suppressor devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years.

C. Suppressor Locations: As a minimum, provide surge suppressors at the following locations:

1. At any connections between field mounted instrument and electronic equipment.

2. At the field, panel, or assembly connections of all analog signal circuits that have any portion of the circuit extending outside of a protecting building.

3. Between the radio and external mounted antenna.

REMOTE TELEMETRY UNIT
SPECIFICATIONS (SHT 3 OF 5)

77S

D. Surge Suppressors for Analog Signal Connections: Surge suppressors for analog signal circuits shall:

1. Have a dual–pair (four wire) module with the base.

2. Employ three–stage hybrid technology.

3. Be epoxy encapsulated with a nonflammable phenolic enclosure. Epoxy encapsulation shall be flame retardant.

4. Meet or exceed the following performance criteria:

a. Peak Source Current: 10,000 amps
b. Voltage Clamp Rating: 36 volts
c. Temperature Range: –40 degrees C to +85 degrees C
d. Maximum Operating Voltage: 30V dc
e. Operating Current: 4 to 20 mA dc

5. The suppressor shall be of the type PC 642C–036 by EDCO Inc. or approved equal.

E. RF Surge Suppressors: RF surge suppressors shall:

1. Meet or exceed the following technical specifications:

a. Surge: 50kA IEC 1000–4–5 8/20ms Waveform 500 Joules
b. Turn on: 600 VDC +/–20%
c. Turn on time: 2.5ns for 2kV/ns
d. Frequency Range: 125MHz to 1GHz
e. VSWR: ≤1.1 to 1 over frequency range
f. Insertion Loss: ≤0.1 dB over frequency range
g. Temperature: –45°C to +85°C Storage/Operating +50°C
h. Unit Impedance: 50 Ohm
i. Mounting: Flange

2. The suppressor shall be of the type IS–50NX–C2 by PolyPhaser Inc. or approved equal.

5. RTU CORROSION PROTECTION

A. All indoor and outdoor cabinets, panels and consoles shall be fitted with vapor phase corrosion inhibitor capsules capable of protecting 5–cubic feet of space for one year; Hoffman Model A–HC15E, ZERUST Model VC–6–2 or approved equal. Capsules shall be labeled with the date of activation.

6. RTU FABRICATION

A. Cabinets and panels shall provide mounting for power supplies, control equipment, input/output subsystems, panel mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.

B. Terminal blocks shall be factory assembled on a miniature mounting channel and the channel bolted to the steel strap. Terminals shall be miniature screw type with integral fuse holder unless otherwise required. Terminal blocks shall provide access to screw terminals without disabling the fuses.

C. The terminals shall be marked vertically with a permanent, continuous marking strip from top to bottom. One side of each terminal strip shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Owner, a vendor's pre–engineered and prefabricated wiring termination system will be acceptable.

D. Wiring shall comply with accepted standard instrumentation and electrical practices and codes. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.

E. All wiring shall be bundled and run open or enclosed in vented plastic wire way, as required. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring. A copper ground bus shall be installed the full length of each panel. Interior panel wiring and field wiring shall be tagged at all terminations with machine–printed plastic sleeves. The wire number shall be the ID number listed in the input/output schedules.

REMOTE TELEMETRY UNIT
SPECIFICATIONS (SHT 4 OF 5)

78S

F. Wires shall be color coded as follows:
Neutral – White
Ground – Green
Power – Red
Signal – Black and White
Control – Violet
Special – Blue

G. Panels shall be provided with a main circuit breaker.

J. Stand alone RTU panel enclosures shall have the following specifications:

1. Enclosure shall be manufactured with 14 gauge Type 304, Powder Coated White, Stainless Steel Bodies and Doors, NEMA 4X.

2. Enclosure shall have seams continuously welded and ground smooth with no holes or knockouts.

3. Enclosure shall have a seamless foam–in–place gasket that assures a watertight and dust–tight seal. Glued–in place gaskets will not be accepted.

4. Enclosure shall have a rolled lip around three sides of door and all sides of enclosure to exclude liquids and contaminants.

5. All external hardware shall be stainless steel with piano hinge, three–point latch with roller fitting top and bottom and single handle with padlock fitting and stainless steel external parts.

6. Enclosure shall have an internal high impact thermoplastic data–pocket.

7. Enclosure shall have collar studs provided for mounting the Remote Telemetry Unit Panel. Collars studs will be placed identically in all enclosures and identical to existing Lift Station installations to facilitate moving of the Remote Telemetry Unit back–panel to another enclosure or lift station location as necessary.

8. Enclosure shall be lockable 30 inches in height by 24 inches in width and 12 inches in depth (30"H x 24"W x 12"D).

9. Enclosure shall be the product of a U.L. Listed manufacturer and made in accordance with the NEMA Type 4X standard.

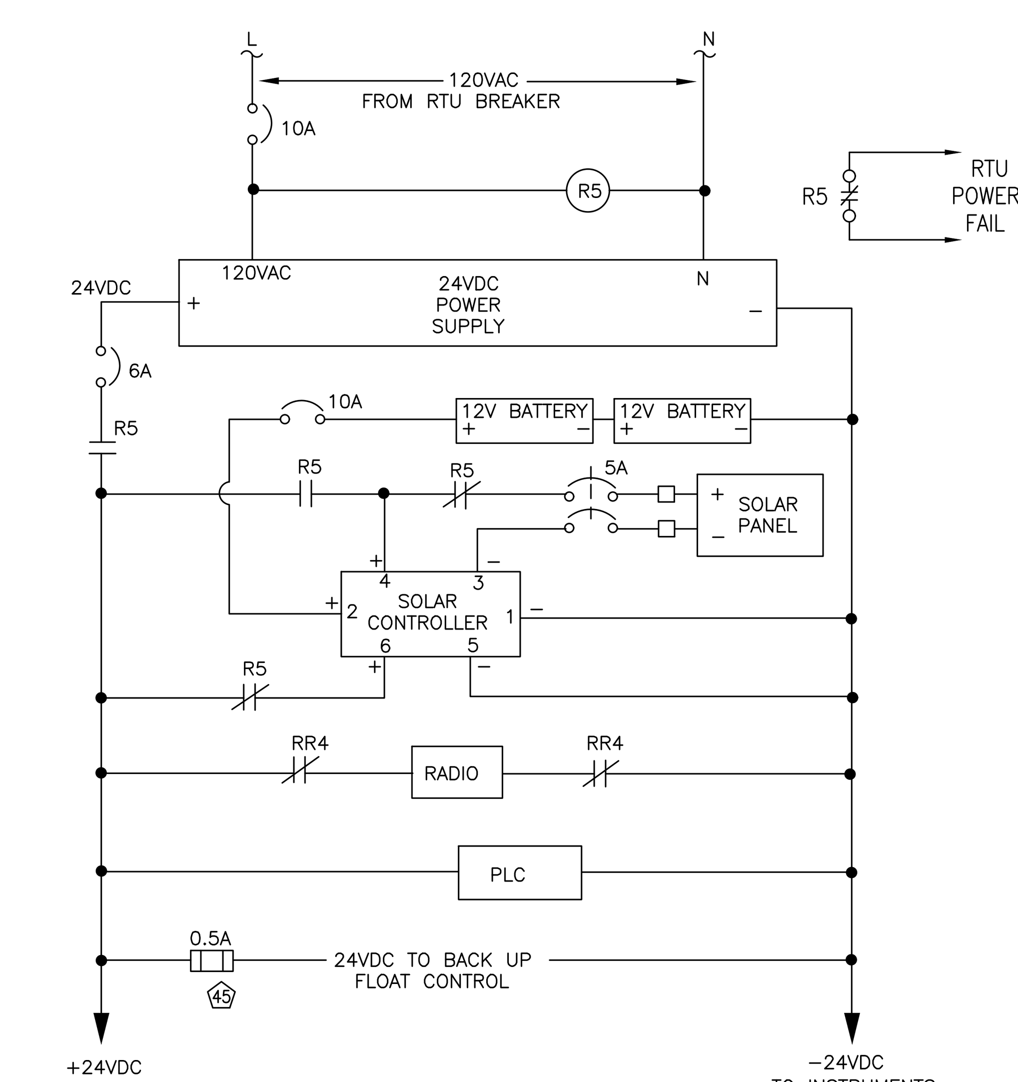
10. Enclosure shall be by Hoffman Enclosures, Inc., or approved equal. The back–panel shall be stainless steel or aluminum.

11. Enclosure shall have a welded drip shield along the top front of the enclosure to guard against water intrusion. The drip shield shall extend 2–3–inches from top front edge of enclosure and be manufactured from stainless steel.

12. For RTUs to be incorporated into pump station electrical control panels: equipment shall be mounted on the back plate of the control panel.

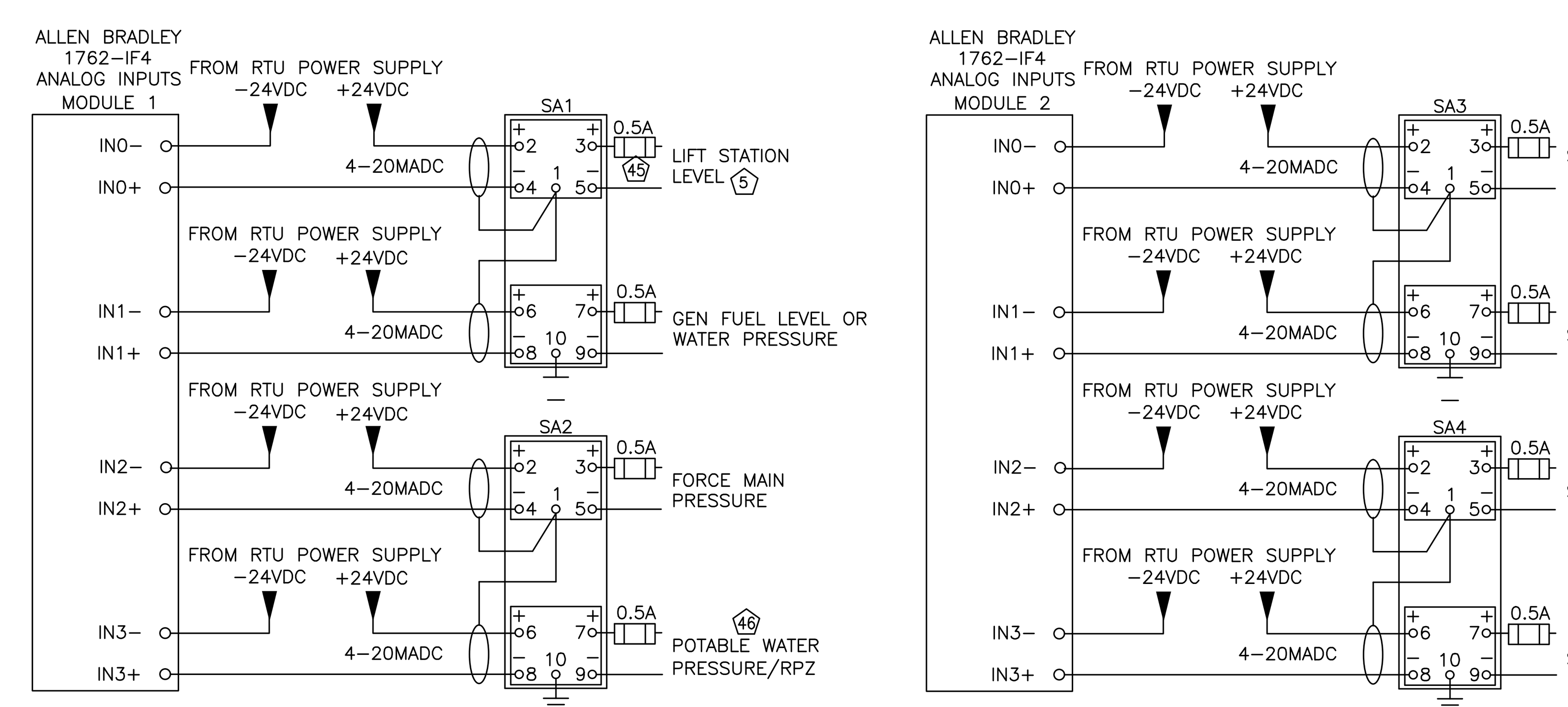
REMOTE TELEMETRY UNIT
SPECIFICATIONS (SHT 5 OF 5)

79S



NOTES:
1. (X) SEE BILL OF MATERIALS.

RTU WIRING DIAGRAM



PLC ANALOG INPUTS WIRING DIAGRAM

RTU WIRING AND PLC ANALOG INPUT WIRING DIAGRAM

80S

LIFT STATION
REMOTE TELEMETRY UNIT (RTU)
STANDARD DETAILS

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WATER UTILITIES DEPARTMENT
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NO.	DATE	REVISION / REMARKS	BY
	DEC 2021	GENERAL REVISION	J.L.
*	JAN 2023	GENERAL REVISION	J.L.

E–4

SHEET NUMBER 0 OF 0

SEAL

Mar 17, 2023