

RADIO-TELEMETRY CONTROL SYSTEM _____ WATER SYSTEM

TECHNICAL PROVISIONS

TP-1 GENERAL INFORMATION (Be explicit about your particular application)

These technical provisions set forth the minimum requirements for furnishing and installing a radio-telemetry control system for the _____ water system. The _____ water system is located _____ (see attached map). Items required by these specifications shall be installed at the pumphouse(s) and tank(s) as noted on the attached map. One hundred twenty (120) volts AC power is (is not) available at the transmitting site. The Contractor shall, in addition, upon completion, provide the Owner with three sets of schematic drawings (an "As-Built" of the attached schematic is acceptable) for the transmitter and receiver sites and an operation and maintenance (O&M) manual and instructions for each item installed. The O&M manuals shall consist of manufacturers' cut sheets and trouble shooting guides for each unit, and a description of operation of the installed system. The above items shall be furnished in strict accordance with the following specifications and as approved by the Owner. These items shall be manufactured/fabricated in accordance with the highest standards of workmanship in the industry.

Although this specification requires the installation of certain components, it is the Contractor's responsibility to build and install a complete and operational radio-telemetry system using the required components. This will require designing the system to work at this specific location. Payment will be made after performance of the system is tested as described in TP-12.

The system shall be made up of these basic components:

Transmitting Site - Tank

1. Pressure transducer to measure tank water level. The transducer will provide a 4 to 20 milliampere loop current output in proportion to the tank level. This transducer will be provided by the Owner.
2. Analog Encoder (analog transmitter) to convert loop current signal to digitized signal which is, in turn, transmitted by via the radio.
3. An RF transmitter with station type directional antenna used to transmit data from the tank site to the pumphouse. The system shall provide a continuous RF signal containing the tank level data (if AC power is available).

Receiving Site - Pumphouse

1. A station type directional antenna and RF receiver to receive the data signal from the tank site.
2. An analog receiver to decode the digital tank level signal.
3. A pump controller to accept the tank level signals and to output control signals to the pump at predetermined tank levels.

The proposed operation of the telemetry equipment with and without AC power at the tank site is explained below. Attached are electrical schematics for the transmitting and receiving sites for all

operational modes. The schematics should be considered minimum requirements for basic operation.

Description of Operation with AC Power at Transmitting Site

1. The operation of the transmit site is identical for either simplex or duplex pump operation at the receive site. The function of the transmit site is to transmit the level of the tank to the receive site, the action taken there will depend upon whether there is one or more pumps.

At the transmitting site the power will be continuously applied to the transducer, the analog, and the radio transmitter. The transducer will output a signal which varies from 4 to 20 milliamperes depending upon the level of water in the tank.

The transducer signal is applied to the analog transmitter which senses the signal, digitizes it, and output is applied to the radio for transmission to the receive site. Transmission of the radio signal is continuous.

At the receiving site, the radio-telemetry equipment will accept the radio signal and apply a serial digital input to the analog receiver. The analog receiver decodes the digital signal providing a 4 to 20 milliamperes signal identical to the transducer input at the transmit site and representative to the level of the tank.

The analog signal is applied to the pump controller which monitors for predetermined low and high levels. There are four relays in the controller each of which may be calibrated to close and open at predetermined low and high levels. Relay #1 will be set to turn on pump #1 at a desired low tank and to turn it off when the water reaches the desired level.

2. In a duplex pump installation there is no difference in the operation of the transmitting site. The operation of the receiving site will differ somewhat, however.

At the receiving site, a second relay in the pump controller is utilized to control the "lag" pump. The lag pump will be used to supply additional pumping capacity whenever the "lead" pump cannot meet the demand for water. An example of how this works follows.

The relay controlling the "lead" pump will be preset to close when the tank level drops to, say, 30% of its total capacity. Similarly, it will be programmed to open, turning off the pump, when the tank level reaches 80% capacity. Should the "lead" pump be turned on and succeed in filling the demand for increased water level to the extent that 80% capacity is obtained, then it will shut off and the "lag" pump will not be called upon to operate.

The relay of the pump controller associated with the "lag" pump will be programmed to close at, say, 20%, and to open at the same 80% capacity. Thus, if the "lead" pump is called upon but fails to keep up with the demand such that the level falls further to 20% capacity, then the "lag" pump is started to assist in pumping and both pumps will operate until the 80% level is achieved.

Description of Operation with Solar Power at Transmitting Site

To limit the number of solar panels and storage batteries which would be required, the operation of a solar-powered transmitting site will be modified slightly by using an intermittent signal transmission rather than a continuous signal as described above. The intermittent signal is transmitted whether or not the tank level is such that there is a need for pumping.

The intermittent signal is controlled by a recycle timer which controls the 12 VDC power to transducer, and the radio transmitter. The recycle timer is adjusted to cause transmission for approximately 15 seconds every three minutes. Each time the signal is received at the receiving site, it updates the information which was retained from the previous transmission and initiates pump control if predetermined levels have been reached. The updated information (tank level) is stored at all times between signal transmission.

The only signal transmitted is the tank level, which will be used at the receiving site for the operation of a simplex or a duplex pump installation.

At the receiving site, the incoming signal is decoded exactly as described for a continuous transmission system. Where the transmitter is solar-powered, however, a feature of the analog receiver is utilized to achieve correct operation during the non-transmitting portion of the timer cycle. The analog receiver is strapped to "retain the last valid data", that is, it retains the level information it has in memory at the instant that the signal ceases to be received. For example, if the analog receiver had received a 50% level signal resulting in a 12 milliampere output to the pump controller, the 12 ma. current level will be held upon the loss of signal. Thus, the pump controller itself is unaware of the cyclic nature of the transmitted signal and it controls the pumps in accordance with the last signal received until another signal is received, approximately 3 minutes later. A fail timer shall be incorporated, set at 10 minutes, to shut pumps off if signal fails.

As stated previously, the receiving site operates the same whether or not an intermittent signal is utilized. Depending upon the tank level, the "lead" pump, and the "lag" pump, if applicable, is controlled by the relay(s) of the pump controller which has been programmed to start and stop the pump(s).

TP- 2 RF TRANSMITTER - TRANSMITTING SITE

The Contractor shall supply and install on a panel to be furnished by others, one MDS 9810 transceiver. The transmitter shall be rated continuous duty at 1 watt and 12.5 VDC. The Contractor shall install the panel in a NEMA enclosure, furnished and installed by others, at the transmitter location detailed on the attached map. The Contractor shall connect the transmitter to a pressure transducer via conduit and wiring installed by others. The transmitter shall be installed complete (as manufactured) without modifications. The transducer shall be powered from 12 VDC and provide an output of 4 to 20 milliamperes.

TP- 3 ENCODER

The Contractor shall supply and install on the same panel as the transmitter, an analog transmitter (digital encoder), Model DAT300-1 manufactured by DAQ Electronics, Inc. The module shall be mounted in a DXP2 frame assembly (less power supply).

TP- 4 RF RECEIVER - RECEIVING SITE

The Contractor shall supply and install on a panel furnished by others one MDS 9810 transceiver and shall install the panel in a NEMA enclosure supplied and installed by others at the location indicated on the attached map. The receiver shall be installed without modifications.

TP- 5 DECODER

The Contractor shall supply and install on the same panel as the radio receiver an analog receiver (digital decoder), Model DAR 300-1, manufactured by DAQ Electronics, Inc. The module shall be mounted in a DXP2 frame assembly with a 1.7a, 12 VDC integral power supply.

TP- 6 AC POWER SUPPLIES

At the transmitting sites where AC power is available, the Contractor shall supply and install on the same panel as the radio transmitter, analog transmitter, a power supply. The power supply shall be a regulated, filtered, and commercially available unit meeting the requirements of the Electronic Industries Association. The power supply shall be sized at 12.5 VDC to provide the maximum demand of the equipment at its location.

At the receiving sites the DAR300-1 analog receiver shall be provided along with a DXP2 frame assembly. This frame/supply assembly is adequate to provide the DC power for the analog, and radio receivers, and 12-volt control relays.

TP- 7 SOLAR PANEL

At the transmitting sites where AC power is not available the Contractor shall supply and install a Solarex SX-18, Arco Solar M-25, or equivalent solar panel.

The solar panel shall be mounted to receive maximum benefit from the sun, which is facing directly south at a 45 degree angle relative to the earth's surface.

The solar panel may be self-regulated or non-regulated.

TP- 8 VOLTAGE REGULATOR

At transmitting sites where AC power is not available, the Contractor shall supply and install inside the enclosure a Speciality Concepts, Inc., Model ASC 12/8-A voltage regulator with temperature compensation or equal between the solar array and the battery. If an equivalent voltage regulator is used, the charging voltage shall conform to the charging scheme recommended by the battery manufacturer.

The temperature compensation device shall be installed according to manufacturer recommendations to be found in the installation and operation manual.

TP- 9 BATTERY

At the transmitting sites where AC power is not available the Contractor shall furnish and install within the pressure sensing vault a GNB, Inc., Solar Electrics 125C90 sealed lead calcium acid, deep cycle, SSB-154 90 amp-hour battery, or equivalent.

TP-10 ANTENNAS

Antennas shall be designed so the radio-telemetry system meets FCC and the performance requirements. Station type directional antennas shall be used for both the transmitting and receiving sites. The Contractor shall supply the antennas and install them on a 2-inch galvanized support pipe to be installed by others.

TP-11 CONNECTIONS BETWEEN INDIVIDUAL UNITS

All individual units shall be mounted on the panels in such a manner that they can be easily replaced or removed for servicing. The connecting points between the units shall be easily disconnected. The control relays shall be appropriately labeled. Antenna connections to the radio shall be with N Type connectors and tape wrapped to be made weatherproof where necessary. A connector shall also be installed by the vendor where the antenna cable passes through the enclosure. All other inputs and outputs from the below listed units shall be terminated on terminal strips mounted within the provided NEMA enclosure.

1. Transceiver
2. Analog Transmitter
3. Analog Receiver
4. Power Supplies
5. Control Relays

TP-12 PERFORMANCE REQUIREMENT

The radio-telemetry system must be designed and installed to ensure long term reliability of the system. After the installation is complete, the following shall be performed:

1. Perform an SWR test. Record reflected power reading. The system will not be accepted with a value of >0.2 Watts. Note: This test should be performed before the antenna system is secured. Deactivate timer and hopper for this test.
2. Record radio system address.
3. Record RSSI readings (remote).
4. Check and record the radio mode (master or remote).
5. Check the radio for data interface parameters:

Baud rate = 1200
Data bits = 8
Parity = none
Stop bits = 1

6. Examine the antenna/cable assembly for quality of workmanship. The cable connection to the antenna shall be sealed with tape, covered with vulcanizing rubber, and then sealed with tape (Andrews tape kit).

No payment shall be made until this performance is certified by the Project Manager. The Contractor will not be required to bear the expense of a special trip to the installation site to conduct this test if the Project Manager was absent after being notified 48 hours in advance of the scheduled test.

TP-13 OWNER RESPONSIBILITIES

In order to provide a smooth installation of the telemetry controls, the Owner will accomplish the following:

1. Forward to the Contractor's shop the back panels for the transmitter and receiver enclosures for the mounting of their equipment.
2. Provide and install a NEMA 4 enclosure for the mounting of the transmitter panel and a NEMA 12 enclosure for the mounting of the receiver panel.
3. Provide and install Beldon, 9913 RG8U Coax antenna cable, and American 22 gauge quad (2 pair) control cable or equivalent.
4. Provide and install all necessary conduit for the electrical, control, and antenna cables, and also string all necessary wiring within the conduit.
5. Provide and install an Ametek Model 88C pressure transducer transmitter as well as the associated plumbing.
6. Provide 120 VAC power up to and including the surface mount electrical outlet for the transmitter and/or receiver box.
7. Provide and install an Essex 2410-0101-3340 pump controller.
8. Provide and install 2-inch G.I. pipe or appropriate support equipment without mounting brackets, for the antennas and solar panel(s).
9. Provide and install all necessary wiring from the receiver terminal strip to the pump control panel.
10. Provide and install all necessary wiring from the pressure transmitter to the transmitter terminal strip. Stranded type wires shall be used.
11. Provide and install Number 12 AWG THHN stranded wire with ground power cable from the solar panel to the transmitter.
12. Place one copy of the O&M Manual received from the Contractor in the receiver enclosure.
13. Provide and install a shelf or mount on which to set the battery.
14. Adjust the Ametek 88C and Essex 2410 Controller with the tank full.

TP-14 GENERAL ELECTRICAL

All work shall comply with applicable rules of the National Electrical Code. All material will be new and UL approved.

Where circuits and terminals are provided for connection of wires by the Owner, a spare and clear path within the panel shall be provided by the Contractor. The electrical system shall be adequately grounded. All wiring shall have not less than 600-volt insulation and all power wiring shall be in

complete conformity with national, state, and local electrical codes and NEMA standards. Wiring shall be colored-coded or numbered at terminations.

TP-15 DIAGRAMS AND APPROVAL

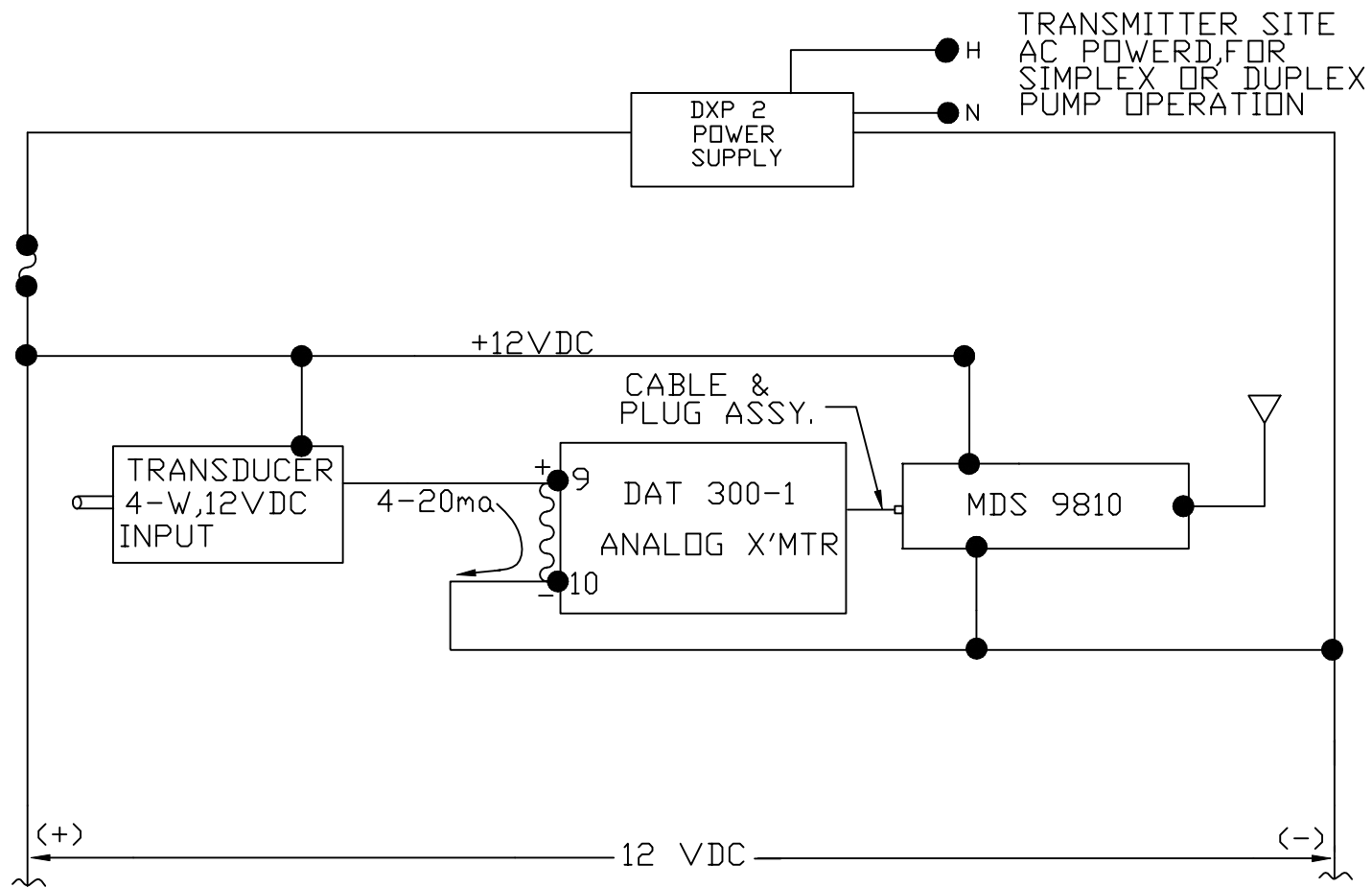
Three copies of the As-Built wiring diagram and schematic for each transmitter and receiver installation indicating all major appurtenant components and appropriate maintenance manuals shall be submitted to the Project Manager by the Contractor within one week of the installation.

TP-16 BASIS FOR PAYMENT

Installation of the radio-telemetry control system at _____ shall be paid for based on the unit invoiced price in accordance with the attached unit bid price and acceptance of Owner.

TP-17 WARRANTY

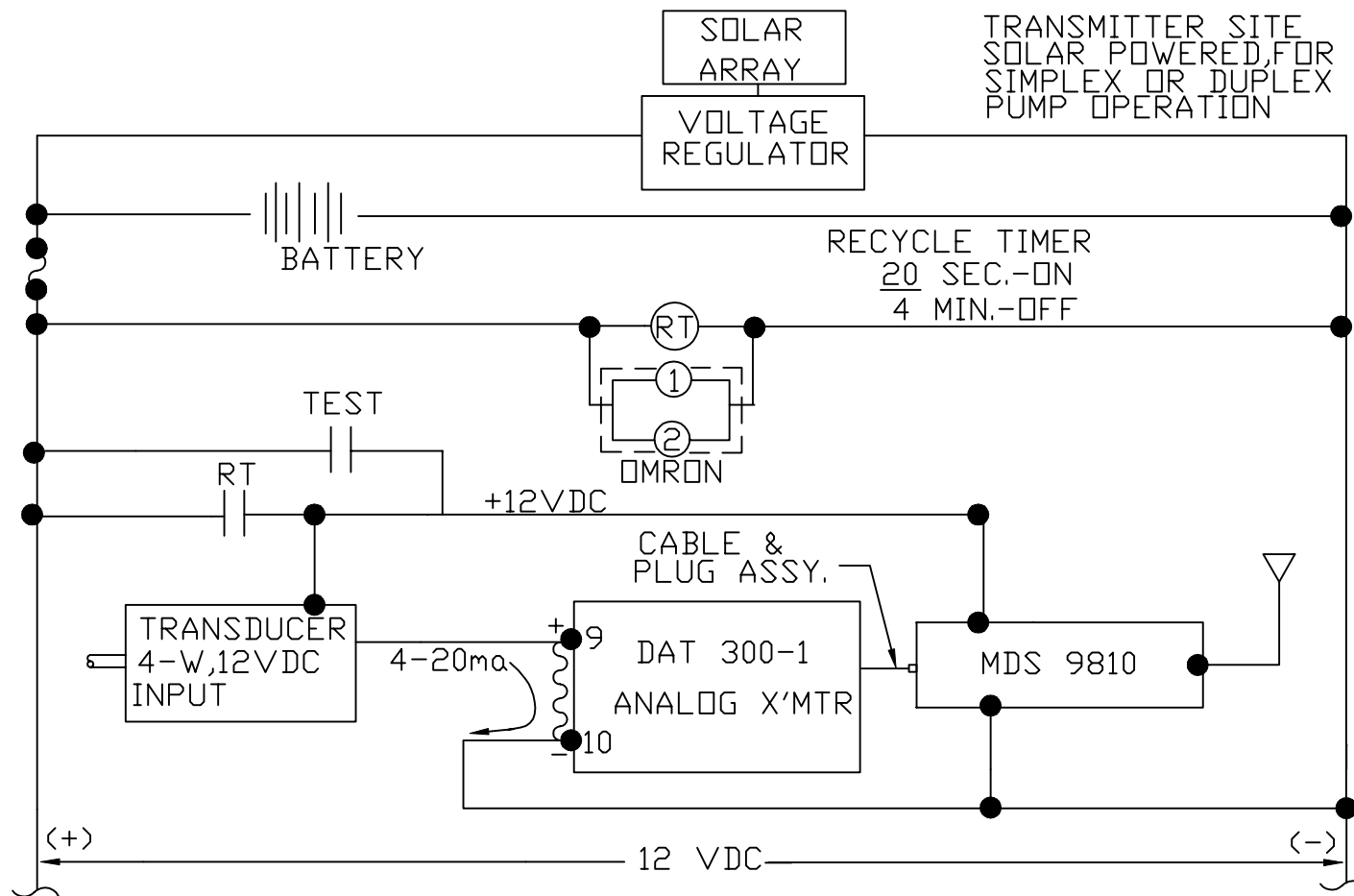
All apparatus shall be guaranteed against defective materials and workmanship for one year from the date of the performance test certification. The Contractor shall provide warranty service when requested by the Project Manager. The Contractor shall bear all costs for transportation, labor, and replacement parts associated with a service call required under the warranty. The Contractor shall be reimbursed his costs of making a service call to the installation site and any repair work he performs if it is determined the telemetry system was damaged by vandalism or an act of God. The Contractor shall also be reimbursed his costs if he travels on a warranty call and finds the system does not work because of a non-functioning device which was not part of his installation (i.e. blown fuse, tripped circuit breaker, etc.).



MATERIAL LIST

1. TRANSDUCER AMETEX MODEL 88C
2. DAQ DAT300-1 ANALOG TRANSMITTER
3. MDS 9810 SPREAD SPECTRUM
4. TRANSCEIVER
5. DAQ DXP2 FRAME ASSEMBLY W/LELL POWER.

REVISION	DATE	BRIEF	BY
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLIC HEALTH SERVICE INDIAN HEALTH SERVICE NAVAJO NATION			
SPREAD SPECTRUM RADIO TELEMTRY ELECTRICAL SCHEMATIC (AC POWER) TRANSMITTER SITE			
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA			
DRAWN BY: JIM.Y DATE: 01-07-00	CHECKED BY: DPS DATE: 01-31-00	APPR. BY: R.B.M DATE: 02/00	AUTOCAD (RT-TRAN.-AC.)
SHEET 1 OF 2			



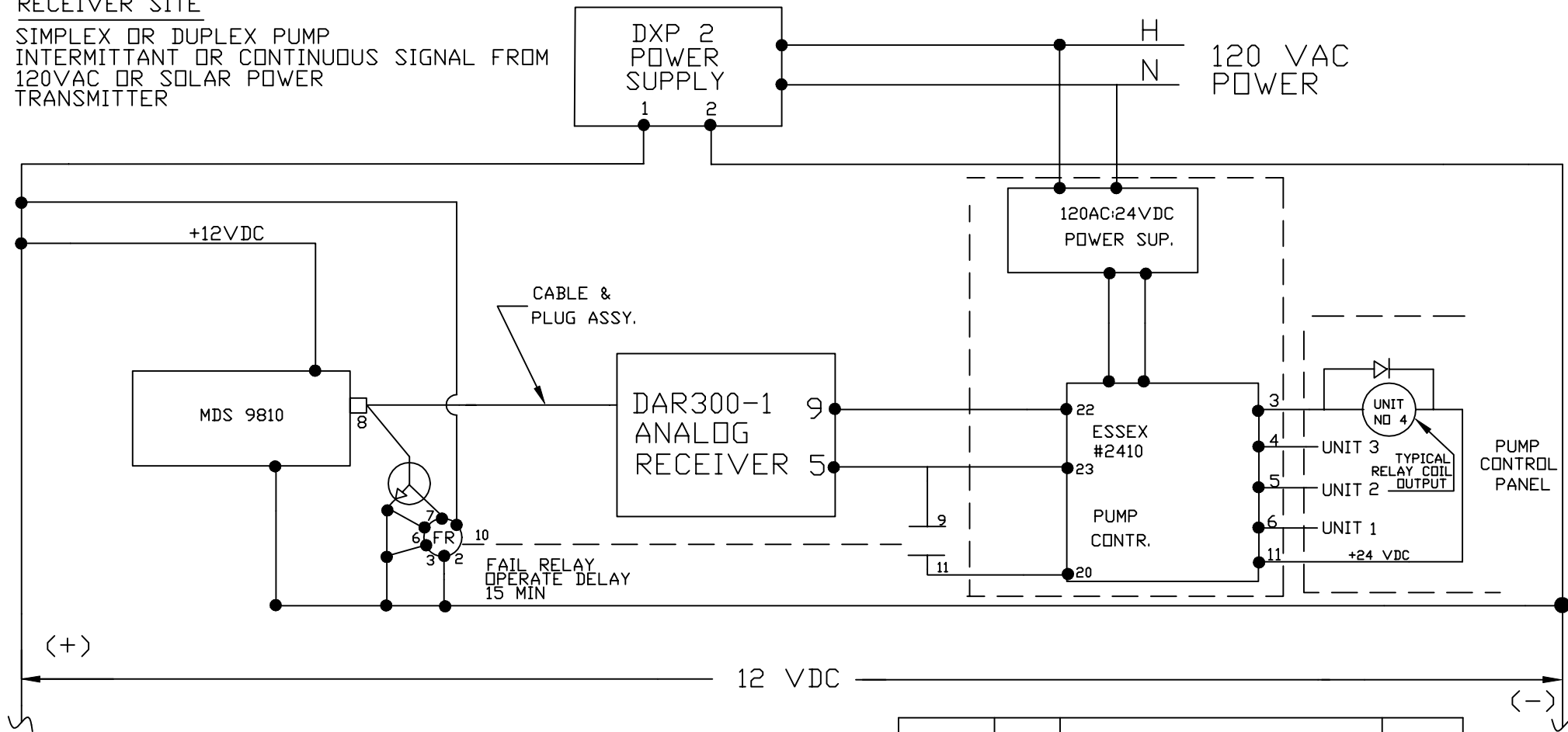
MATERIAL LIST

- 1.SOLAREX SX-20 OR ARCO SOLAR M-25 SOLAR PANEL
- 2.SCI MODEL ASC 12/8-A VOLTAGE REGULATOR
- 3.ABSOLYTE WATCHMAN SSB-154 80 AH BAT.
- 4.TRANDUCER AMETEX MODEL 88C
- 5.DAQ DAT300-1 ANALOG TRANSMITTER
- 6.MDS 9810 SPREAD SPECTRUM
- 7.TRANSCEIVER
- 8.RECYCLE TIMER P&D CRD-48-20180, 12VDC
OR 2 EA, OMRON H3CA-A.
- 9.DAQ DXP2 FRAME ASSEMBLY W/LESS POWER.

REVISION	DATE	BRIEF	BY
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLIC HEALTH SERVICE INDIAN HEALTH SERVICE NAVAJO NATION			
SPREAD SPECTRUM RADIO TELEMTRY ELECTRICAL SCHEMATIC (SOLAR POWER) TRANSMITTER SITE			
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA			
DRAWN BY: JIM.Y	CHECKED BY: DPS	APPR. BY: R.B.M	AUTOCAD
DATE: 01-07-00	DATE: 01-31-00	DATE: 02/00	(RT-TRAN-SOL.)
SHEET 1 OF 2			

RECEIVER SITE

SIMPLEX OR DUPLEX PUMP
INTERMITTANT OR CONTINUOUS SIGNAL FROM
120VAC OR SOLAR POWER
TRANSMITTER



MATERIAL LIST

1. MDS 9810 SPREAD SPECTRUM TRANSCEIVER
2. DAQ DAR300-1 ANALOG RECEIVER
3. ESSEX ENG. 2410 PUMP CONTROLLER
4. DAQ DXP2 FRAME ASSEMBLY WITH 1.7a POWER SUPPLY
5. OTHER SUPPLY - 24VDC POWER SUPPLY
6. TIMER RELAY - OMRON HC3A - A
7. COMMON 123 AP NPN TRANSISTOR

REVISION	DATE	BRIEF	BY
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLIC HEALTH SERVICE INDIAN HEALTH SERVICE NAVAJO NATION			
SPREAD SPECTRUM RADIO TELEMETRY (AC OR SOLAR Tx) RECEIVER SITE			
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA			
DRAWN BY: J.Y DATE: 01-31-00	CHECKED BY: D.S DATE: 01-31-00	APPR. BY: R.B.M DATE: 02-00	AUTOCAD RT-REC V
SHEET 2 OF 2			