

## TANK and WELL CONTROL SYSTEM

### SYSTEM TECHNICAL DESCRIPTION

#### A. Station Hardware:

- User Interface.  
The station hardware shall include a user interface for operations viewing and configuration. The keypad/display shall allow the user to view the status of any/all pumps being monitored, computed or historic conditions, current and historic faults and configuration of operational parameters.
  
- Status.  
The user shall be able to select any of the monitored conditions to be included in an automatic scrolling display that presents the current value and status of the condition. The following parameters shall be available for the user to select:
  - Tank Level
  - Well pumps running locally or at any of the remote well locations
  - Cellular signal strength
  - Main power
  - Battery Power
  - Any channels being monitored - digital, analog or Modbus

The user shall be able to stop the display on any parameter of interest and request additional information about that particular parameter. Information shall include:

- For each digital input:
  - the number of cycles for the current day
  - the total run-time in the non-normal state for the current day
  - alarm limits for number of cycles in a day
  - alarm limits for the total run-time in a day
- For each analog input:
  - high alarm limit
  - low alarm limit
- For well pumps:
  - current status on/off
  - total run-time today
  - total number of cycles today

The display shall automatically cycle through all of the parameters that the user has selected showing the current status and value of each. The status shall include:

- Normal or in alarm
- Acknowledged or not
- Reason in alarm
  - Analog value too low
  - Analog value too high
  - Inflow rate too high
  - Loss of analog signal

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- Alarms.  
Any monitored parameter that exceeds the normal operating conditions as defined by the user, shall enter into an alarm state.

The local display shall automatically display all parameters that are in the alarm state. When all alarm states have returned to normal, the display shall automatically revert to the user-configured scrolling display or to the main menu if no scrolling display has been configured.

A unique event shall be created for each alarm state. Each event shall be stored locally for viewing in a chronological order. Each event may also be automatically transmitted to the web-service based on a user-specified configuration.

The system shall contain a store and forward buffer capable of saving hundreds of events for later transmission if immediate cellular transmission is not possible due to cellular coverage issues. The system shall automatically try to re-establish cellular connection on a continuous basis.

- Update Rate.  
The Tank control unit shall report its tank level at least every 6 hours. Any Well Pumps shall report upon start and stop. Any alarm exceptions shall be reported immediately. End of Day comprehensive summaries shall be reported at midnight. The user shall have the ability to request a status or End of Day report on demand from the keypad.

Each Well controller has two update rates that determine how often the Tank controller level is read. When the well is on, the faster update rate is used to prevent the tank from overflowing.

- Local Programming.  
The user shall be able to program the entire system from the integral keypad and display.

Programming parameters for each monitored condition shall include:

- Channel Name
- Status only or report on alarms
- Delay until considered in alarm
- Report on return to normal state
- Relay to control when in/out of alarm
- For digital monitoring:
  - Alarm on change from open/close
  - Alarm on change from close/open
- For analog monitoring:
  - High and low alarm limits
  - Loss of signal alarm limits
- For system monitoring:
  - Loss of primary power
  - Loss of Modbus communication
  - Low backup battery power

The user shall be able to specify parameters allowing the monitoring unit to compute volumetric outflow volume and inflow rate for a single, duplex or triplex pump station.

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- History.  
The monitoring system shall include a History screen allowing the user to review the following:
  - Date and time of alarms
    - Into alarm conditions
    - Out of alarm conditions
  - Date and time of system events
    - Relay controls
    - Parameter changes
    - Communication with the web-service

- Well Control.  
Each Aquavx Tank and Well Control System shall have the ability to control up to 16 Well Pumps.

Each Well controller has a set of on and off set points based on the level in the tank. Each Well controller communicates with the Tank control system to read the current tank level and determine if the well control relay should be activated or deactivated. Communication is totally independent of the Aquavx web-service as an independent network between each Well controller and Tank controller is created.

Each Well controller has built-in fail safes to turn wells off if communication is lost to either the Tank controller or the Aquavx web-service. If the communication to the Tank controller is lost, an alarm message is sent to the Aquavx web-service for reporting to appropriate personnel.

From the Tank controller, the operator can view and control each of the Wells.

- Operator On-site:  
The monitoring system shall include an operator on-site login/logout function.
  - The login function shall allow an authorized person to acknowledge that they are on-site.
  - An automatic message shall be sent to the web-base service to record that the authorized person is on-site.
  - The logout function shall allow an authorized person to acknowledge that they have left the site.
  - An automatic message shall be sent to the web-base service to record that the authorized person has left the site.
- Security.  
The monitoring system shall include a user-configurable access code that must be entered prior to any programming or control operations.

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- Physical.  
The monitoring system shall consist of the following:
  - Enclosures: NEMA 4X and Panel/Flush mount
    - NEMA 4X hinged enclosure: 11.83"W x 13.45"H x 6.31"D, weight 9.5 lbs
    - Panel/Flush mount:
      - Front Panel: 9.34"W x 6.72"H
      - Enclosure: 8.2"W x 5.2"H x 3.6"D, weight 3.3 lbs.
  - I/O:
    - 10 digital/pulse inputs, 0-5Hz, dry contact, open-collector or closure to ground
    - 4 analog inputs, 4-20ma or 1-5VDC
    - 2 relay outputs, 0-1A
    - 20 Modbus RTU read coil/input status channels
    - 30 Modbus RTU read holding/register channels
    - 8 Modbus RTU write coil registers
    - Removable terminal blocks, #14-22 AWG
  - User Interface: 2x20 line LCD backlight display, 20 key keypad
  - Serial Port: Modbus RTU Slave/Master or Local Programming, RS232/RS485
  - Cellular: Quad-band LTE/4G CATM1 Verizon. FCC, PTCRB, UL and ATT/4G CATM1 certified.
    - Dual-band CATM1 LTE/4G Verizon Certified. FCC, UL certified.
    - Antenna: Standard stubby, 3dbi. External OMNI high gain 5dbi or 9dbi antenna kit available.
  - Operating Temperature: -22°F to 158°F (-30°C to 70°C).
  - Operating Humidity: 0% to 90% @ 140°F.
  - Power: 15 VDC, 1 A, Din-rail mounted, UL rated power supply standard
  - 12-hour minimum battery backup, included.
  - Surge protection on power and inputs
- Warranty.  
Two-year limited factory warranty shall be standard on the hardware with the purchase of a new unit and a one-year limited factory warranty on the modem.
- Manufacturer.  
Monitoring system shall be manufactured in the United States by Cattron (formerly Antx), Cedar Park, TX 78613.