PLC Supervisory Control And Data Acquisition - Wastewater Treatment Plant

WASTEWATER TREATMENT PLANT SCADA

PROJECT OBJECTIVES

- Replace existing control systems with modern controls during a major plant expansion.

- New motor controls, instruments, and valve actuators, use networked communications whenever possible.

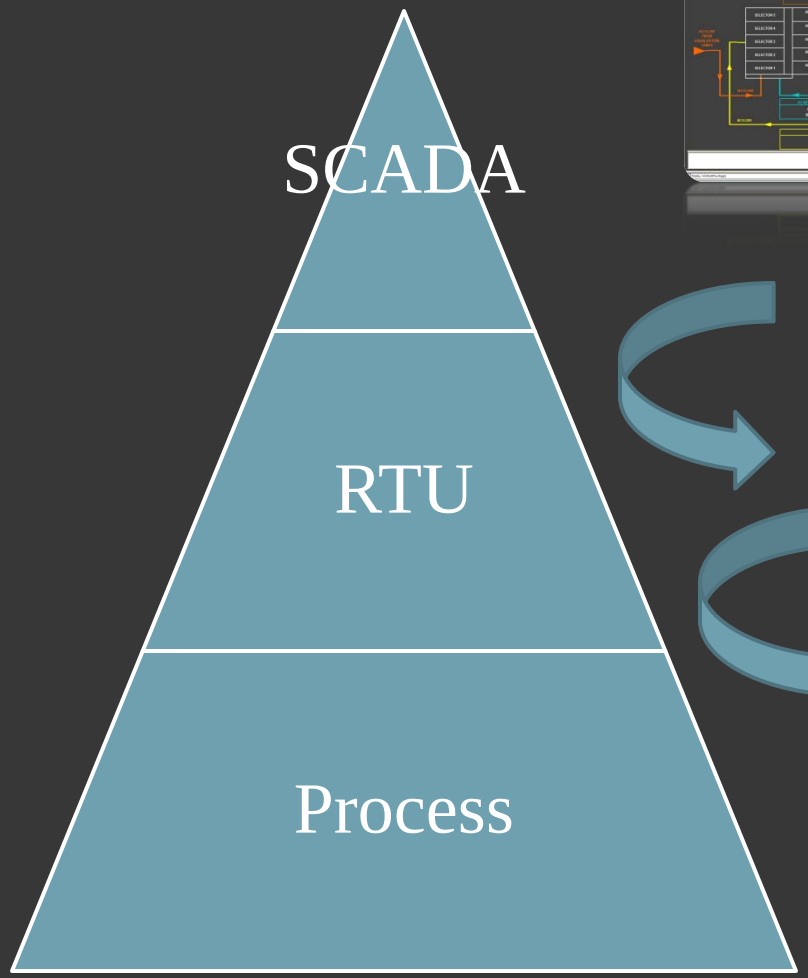
- Automate each process from a local PLC based “RTU”. Integrate all OEM controls including HMI screens into the local RTU.

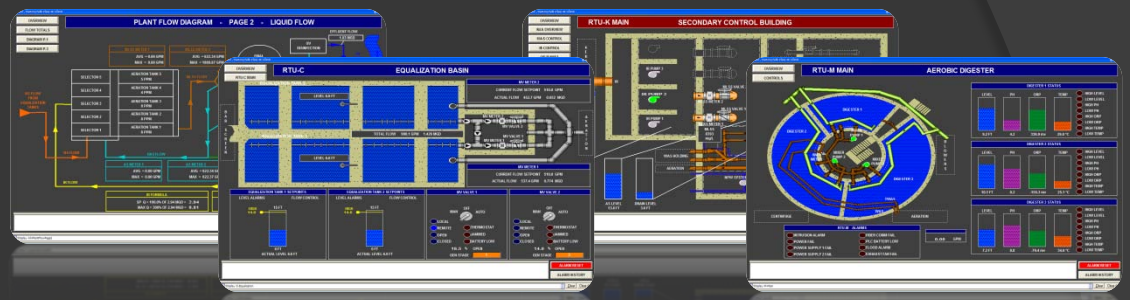
- Link all RTUs together with a high speed redundant communications network allowing operation and monitoring of any process from all locations.

- Provide a SCADA (Supervisory Control And Data Acquisition) system that includes detailed alarming, data collection, and automated reporting.

- Secure local and remote operation.

SCADA - RTU – Process Communications

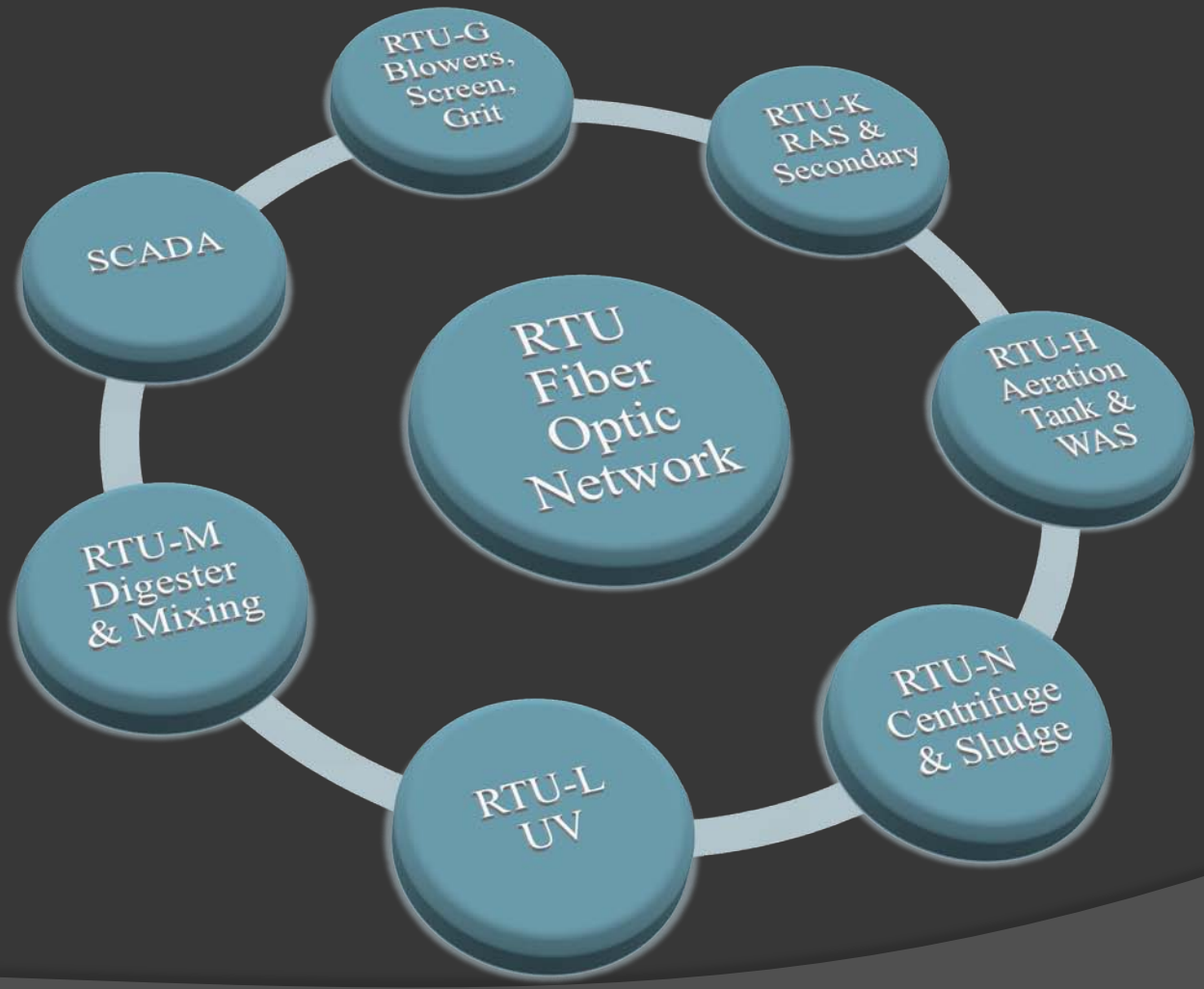




RTU with touch screen user interface

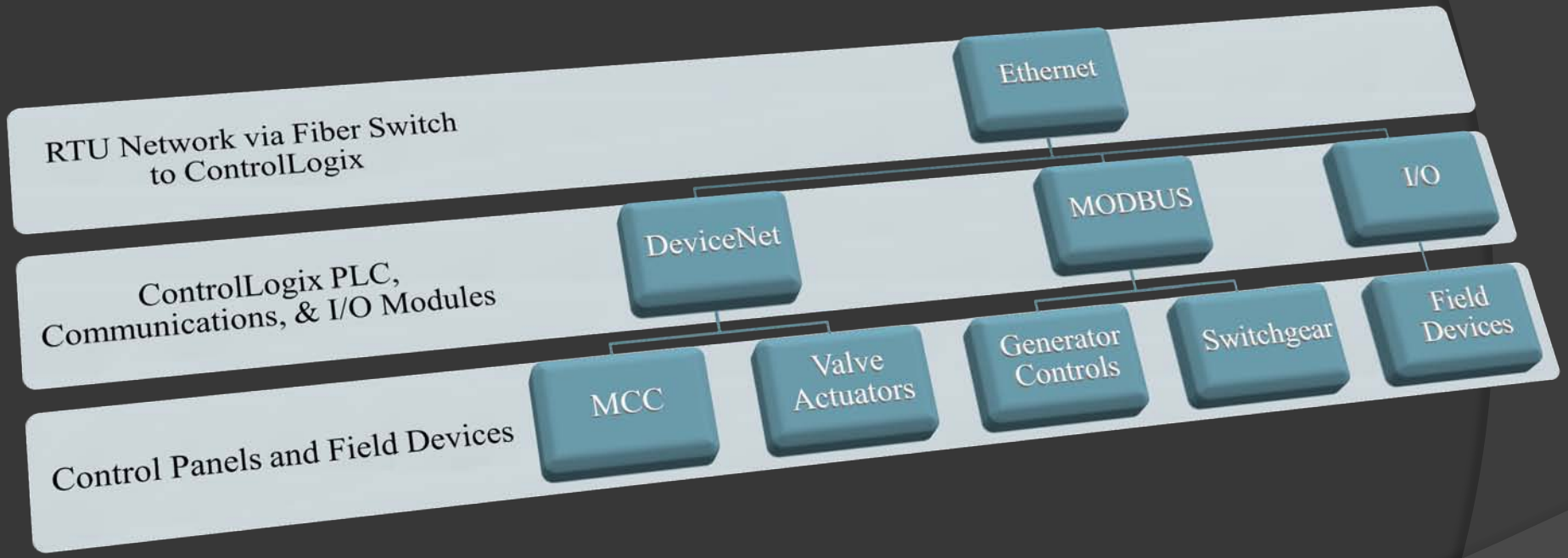
An Allen Bradley ControlLogix PLC system with redundant power supplies is the heart of each RTU. I/O , communication modules, and enclosure type varied depending on the location's requirements. UPS provides backup power. RTU network communications is via redundant fiber optics. Touch screen operation using an Allen Bradley VersaView with RSView FactoryTalk Station .

Redundant fiber optic ring for high speed RTU to RTU/ SCADA communications.



Each RTU contains a Phoenix fiber optic switch with redundant ports using Rapid Spanning Tree Protocol to ensure a reliable high speed connection. Multiple copper ports on each switch are for connection to the ControlLogix, VersaView, and any other local devices requiring an Ethernet connection.

RTU communicates to local devices and control systems using various protocols and methods.



DeviceNet, MODBUS, Ethernet, and others, in addition to discrete and analog I/O signals, are ways the RTU communicates and controls the process in its location.

RTU – L UV Disinfection

UV Building

RTU-L is in the UV Disinfection Building. It communicates with the UV system's control panel.

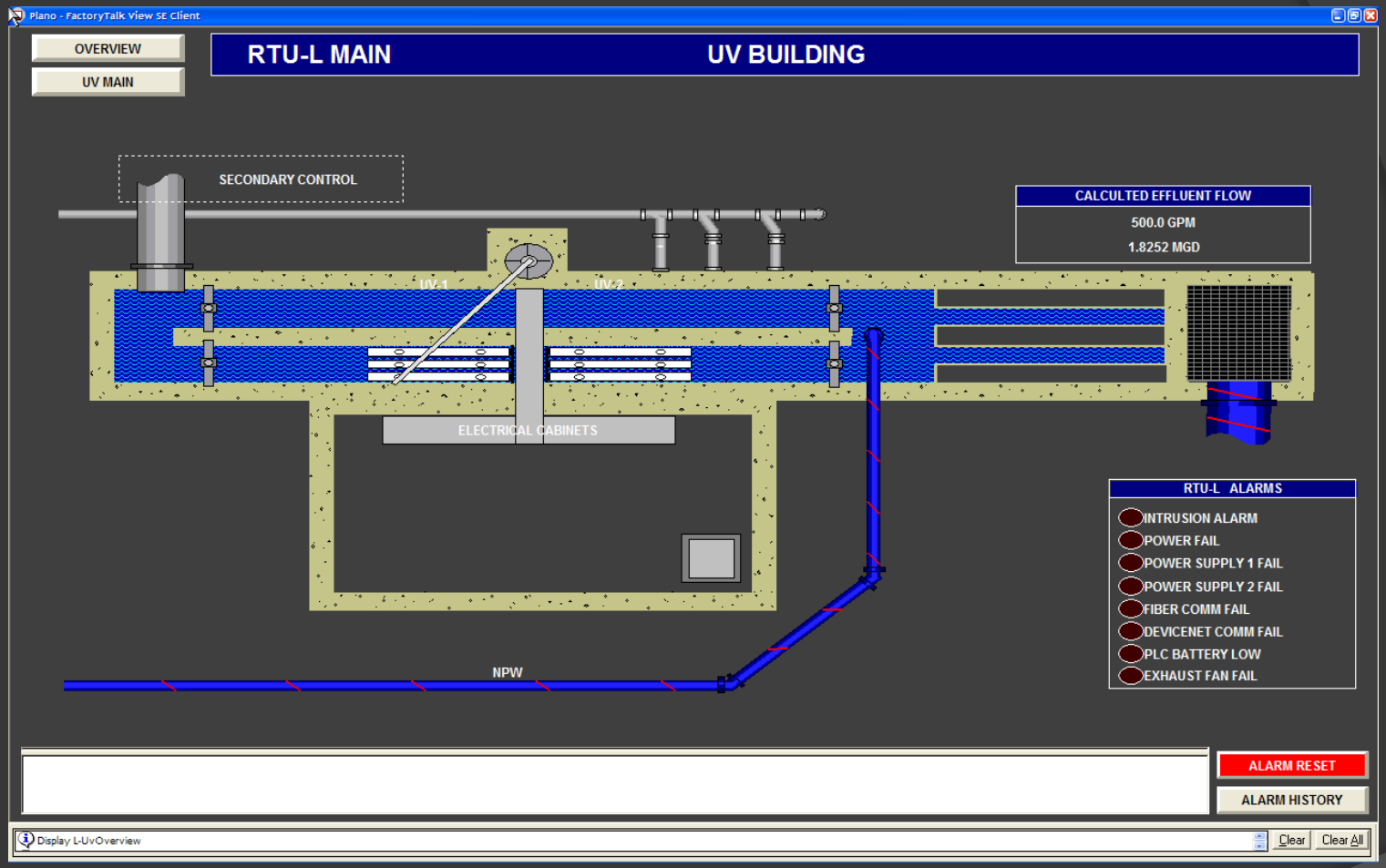
- UV HMI screens and alarms integrated into RTU HMI / SCADA
- Effluent Flow transmitted to UV
- Effluent Sampler
- Building Intrusion

OEM UV Control Panel

Ethernet

RTU-L and MCC

RTU – L UV Disinfection



The main screen for RTU-L displays an overview of the UV operation. Local alarm status is displayed along with a system wide alarm window at the bottom. This is typical of each RTU's main screen. The alarm window appears on all screens. Navigation is via on-screen selections. Pressing "UV MAIN" displays the OEM UV screens. "OVERVIEW" displays the Plant Overview screen. All RTU screens are available at each RTU location

RTU – M Digester & Mixing Pumps

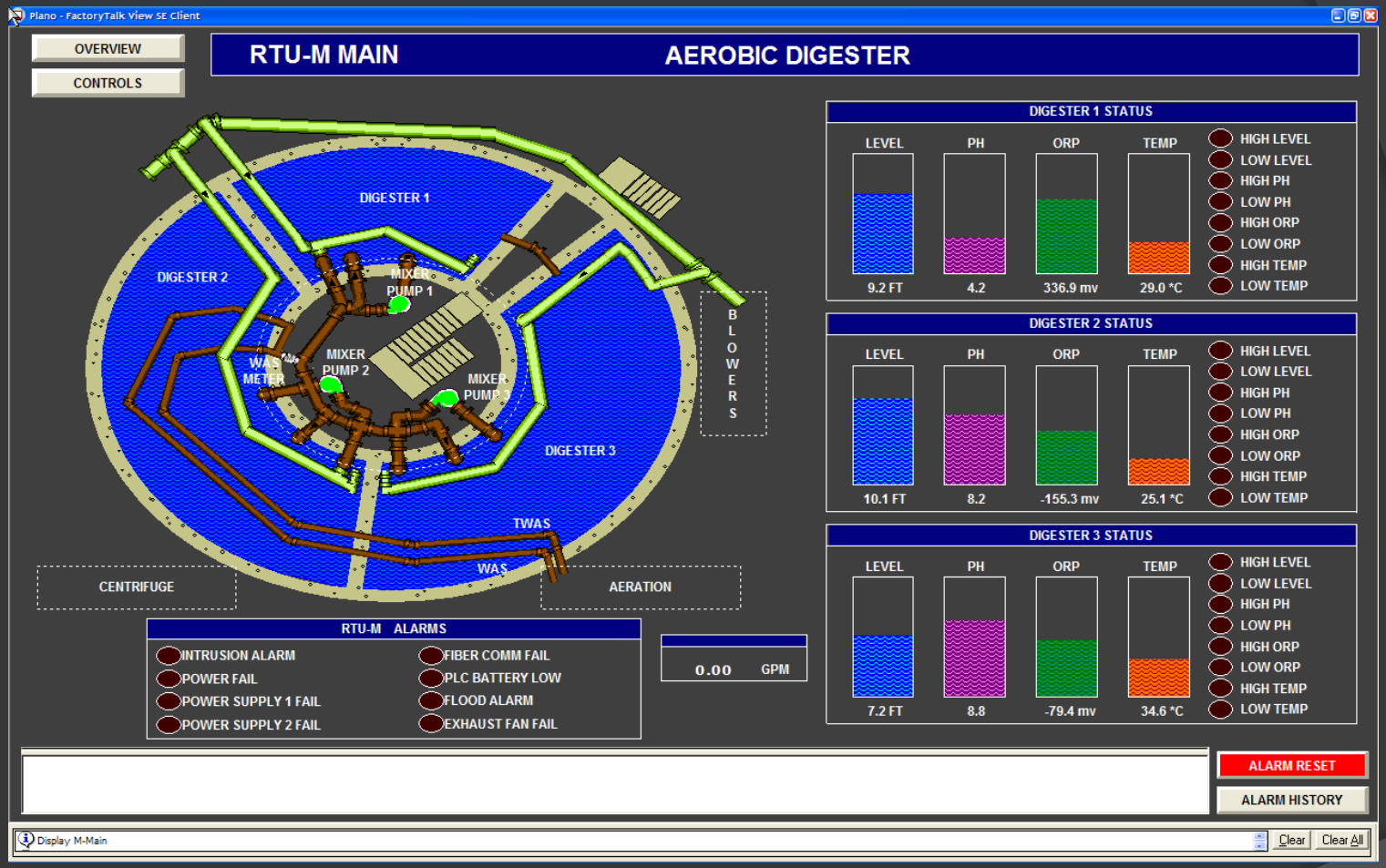
Digester and Mixing Pumps

Ultrasonic Level Transducer

RTU-M is located in the Digester building. It controls the Mixer Pump panels via hardwire connections.

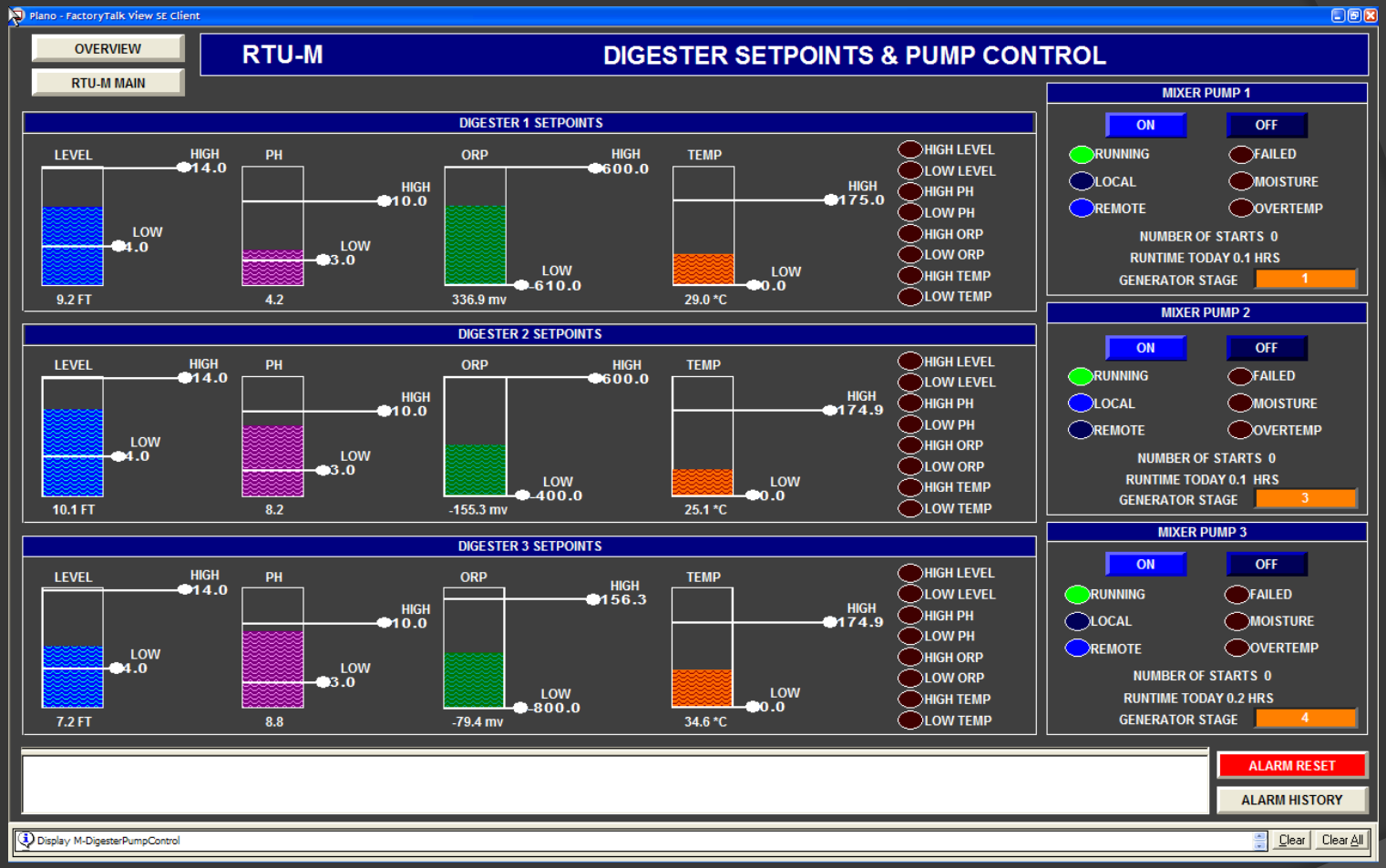
- Ultrasonic Levels
- ORP, PH, and Temperatures
- Mixing Pump Control
- Building Intrusion

RTU – M Digester & Mixing Pumps



This is the main screen for RTU-M displaying an overview of the Digester and Mixing Pump operations. Pressing “CONTROLS” displays the Digester Setpoint & Pump Control screen. Navagation to other areas is done by pressing the location name inside the dotted line box, such as “AREATION” shown above.

RTU – M Digester & Mixing Pumps



Digester setpoints are set on this screen, grouped by Digester. Setpoints are entered by either moving the slider on each level bargraph or by clicking on the value and entering the value using an on-screen keyboard. Next to the setpoints are alarms related to each Digester. On the right side of the screen are indicators and controls for each Mixing Pump.

RTU – G Blowers and Power

Blower Building

RTU-G is located in the Blower building. Standby generator and incoming power are also located here.

- Blower HMI screens and alarms integrated into RTU HMI / SCADA
- Generator Status
- Switchgear and Power Monitoring
- Building Intrusion

RTU-G

DeviceNet

Master Blower Control Panel

Ethernet

DeviceNet

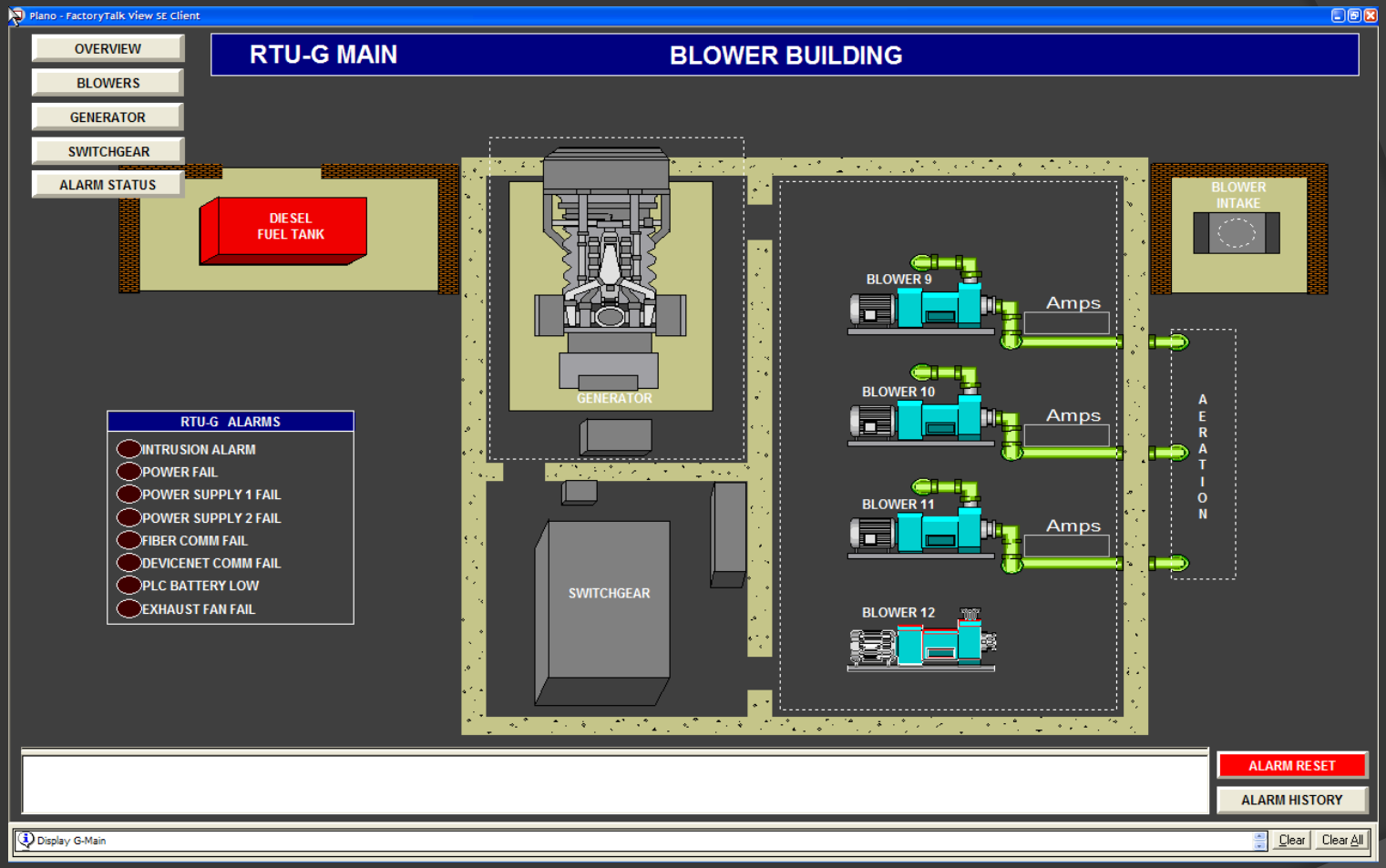
Motor Control Center

Valve Operator

Generator & Switchgear

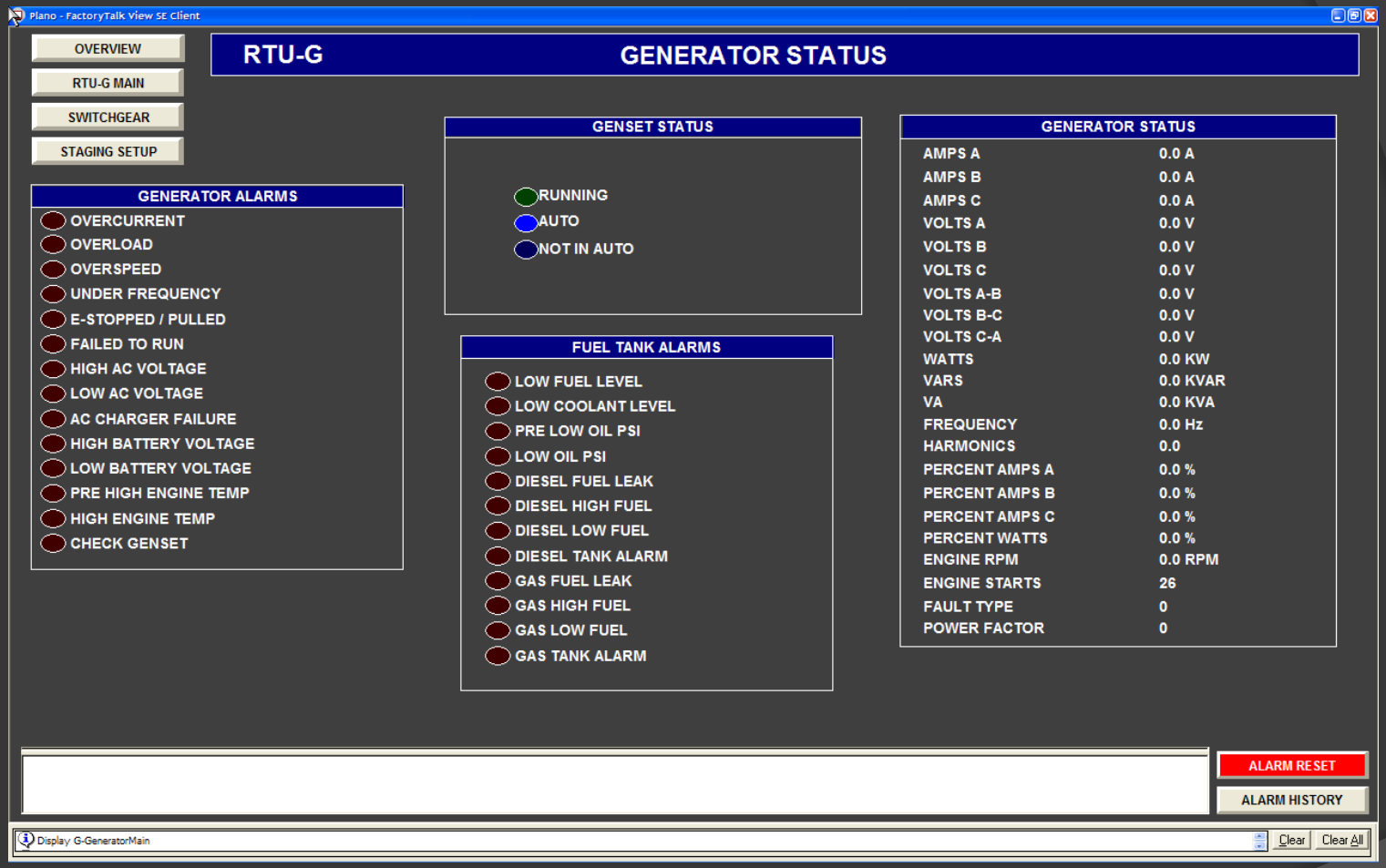
ModBus

RTU – G Blowers and Power



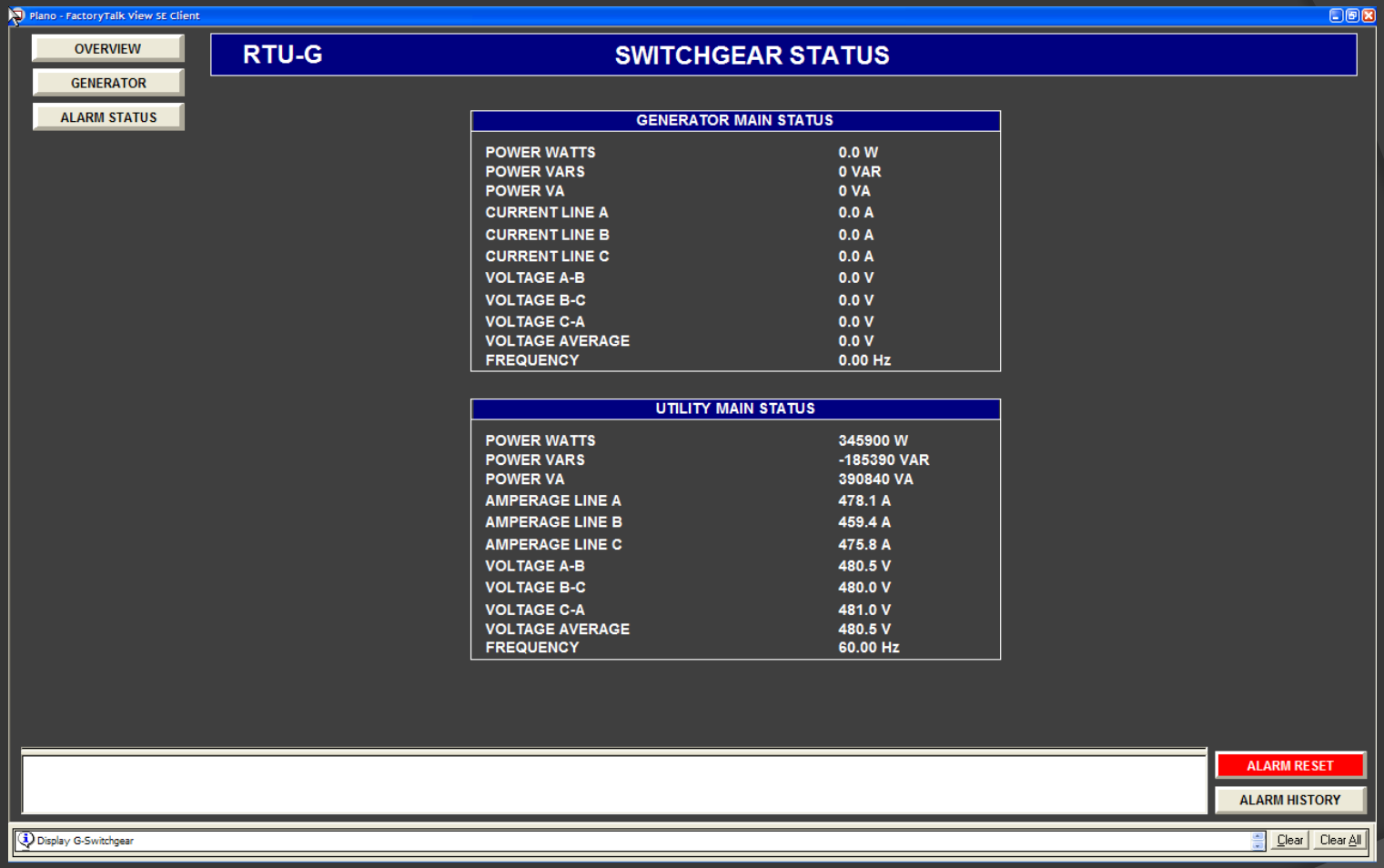
This is the main screen for RTU-G displaying an overview of the Blower operations. In the upper left corner is a series of navigation buttons. “BLOWERS” displays the first OEM Blower screen.

RTU – G Blowers and Power



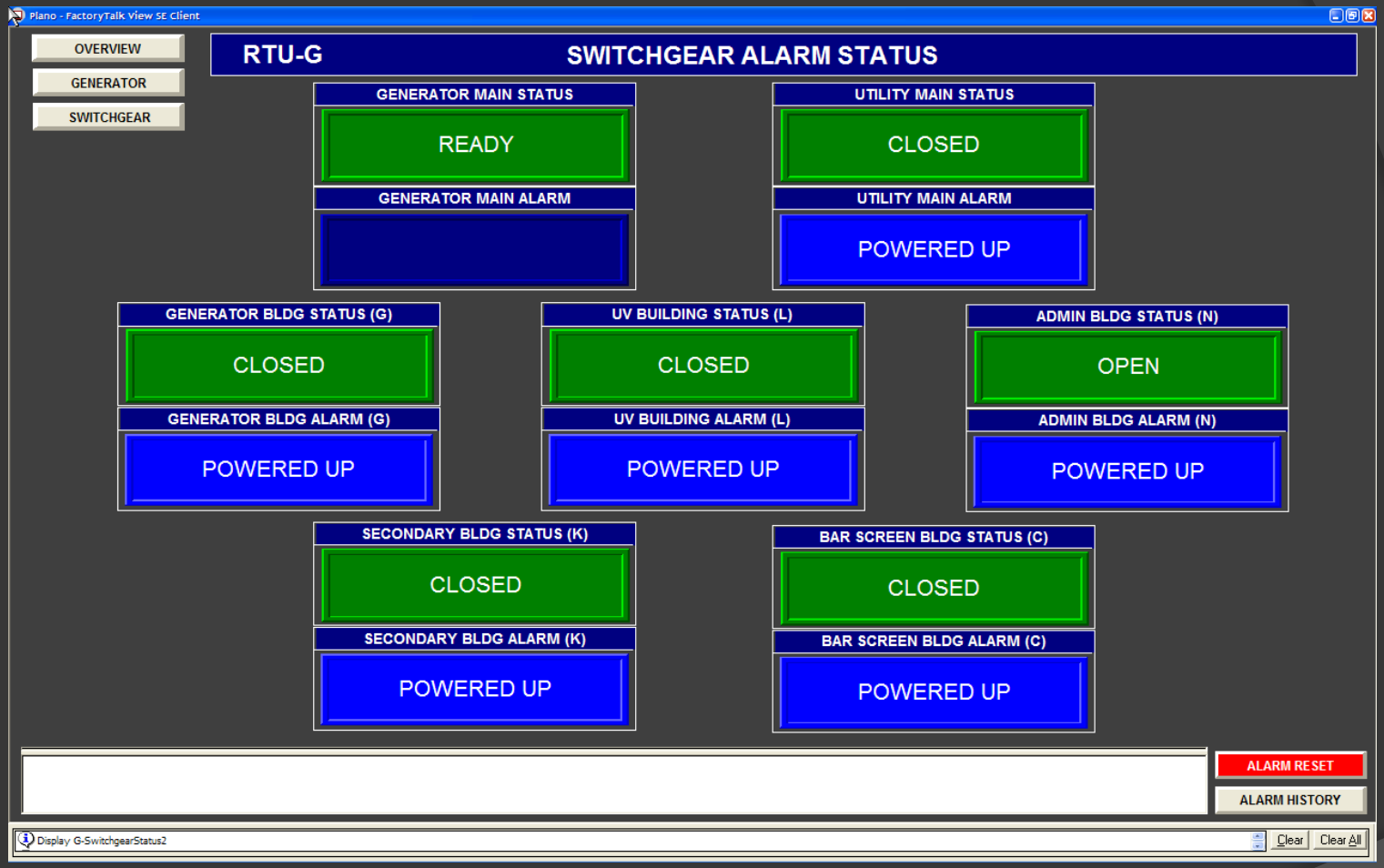
Pressing “GENERATOR” on RTU-G’s main screen displays the Generator Status screen. Generator alarms and status as well as fuel tank alarms are displayed here.

RTU – G Blowers and Power



Pressing “SWITCHGEAR” on RTU-G’s main screen displays the Switchgear Status screen. Status of Generator and Utility Mains are displayed.

RTU – G Blowers and Power



Pressing “ALARM STATUS” on RTU-G’s Switchgear Status screen displays the Switchgear Alarm Status screen. Status of all switchgear alarms are displayed.

RTU – C Screening and Grit

Screening and Grit Building

Equalization Tank levels are measured and flow rates regulated. Bar Screen and Grit systems are monitored and controlled.

- Bar Screen Control Panels
- Grit Control Panel
- Blowers and Conveyors via MCC
- Ultrasonic and Radar Levels
- Modulating Flow Valves on DeviceNet
- Magnetic Flow Metering
- Sampler Pacing
- Combustible Gas Detection
- Building Intrusion

RTU-C

Radar Level

Ultrasonic Level

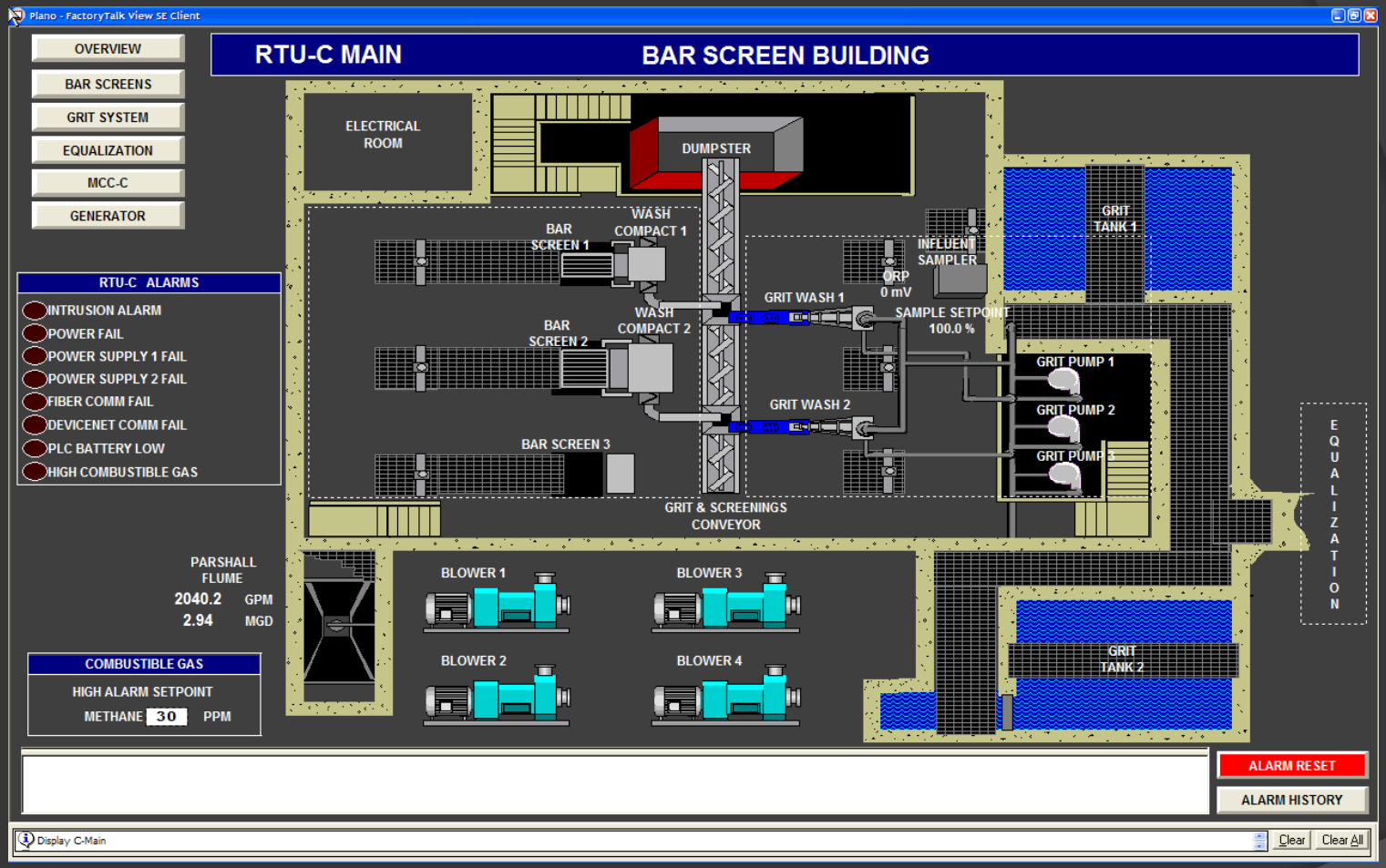
Motor Control Center

DeviceNet

Screening and Grit

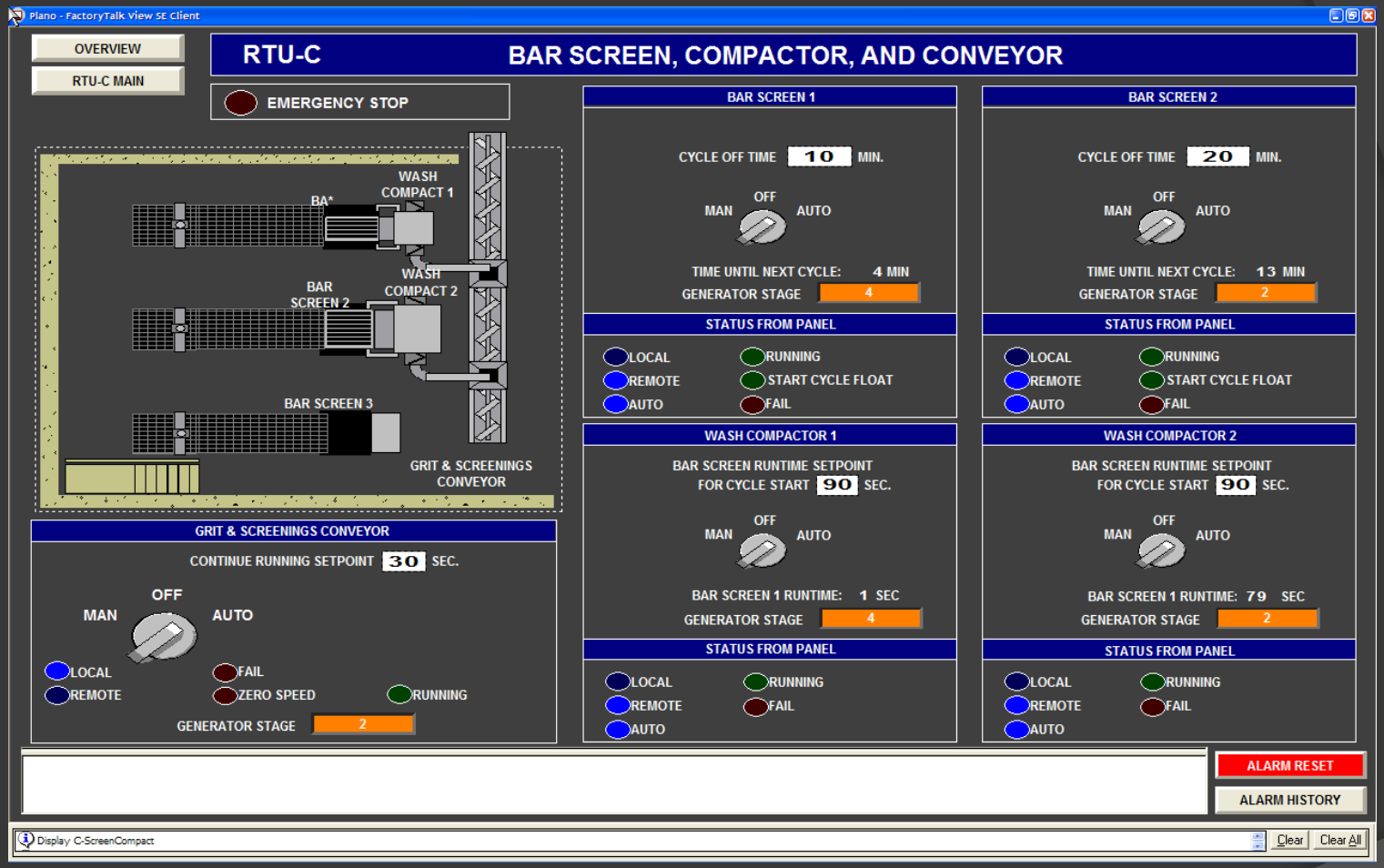
Hardwired

RTU – C Screening and Grit



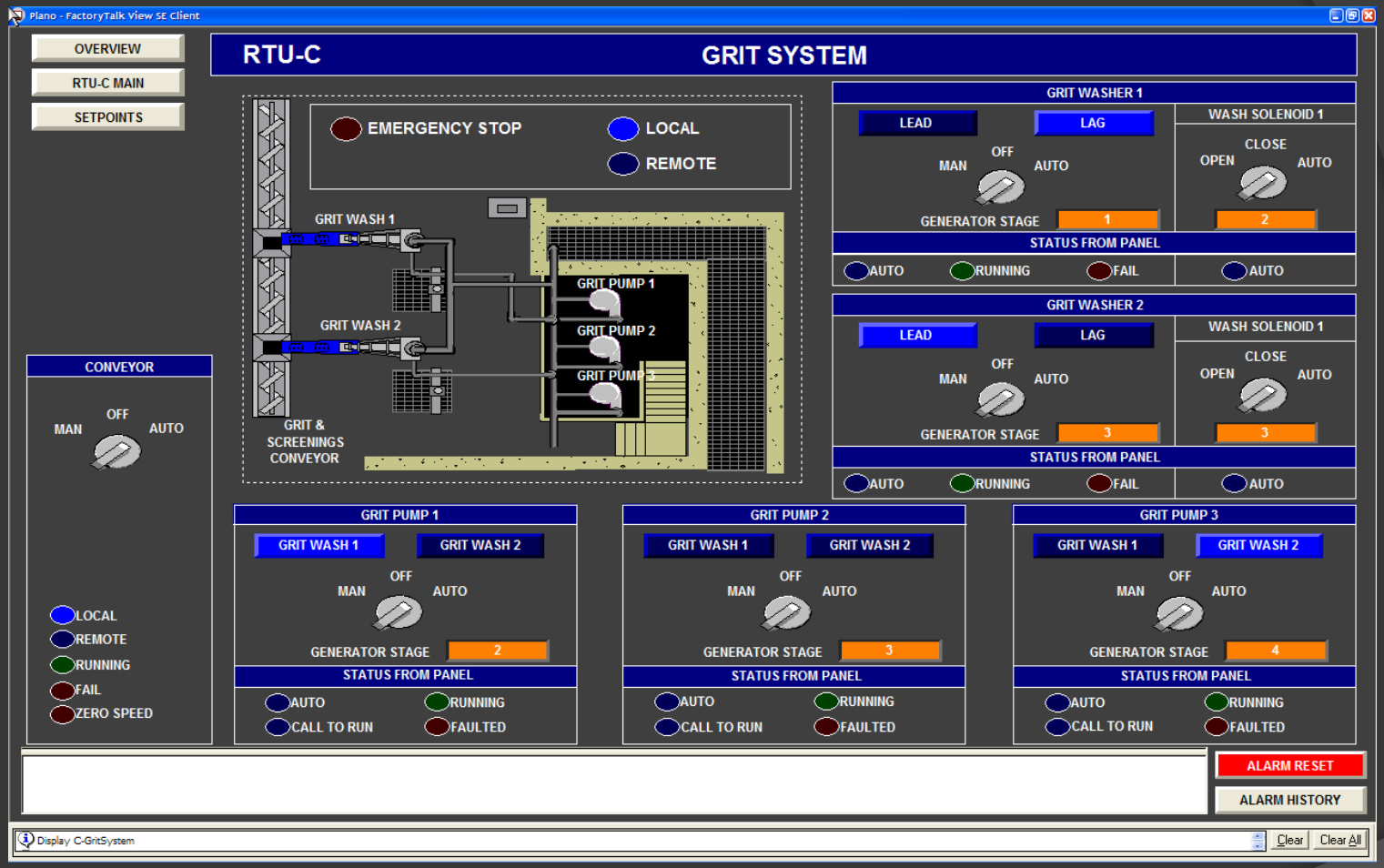
This is the main screen for RTU-C displaying an overview of the Bar Screen operations. In the upper left corner is a series of navigation buttons. Each button is used to navigate to that section of RTU-C's operation.

RTU – C Screening and Grit



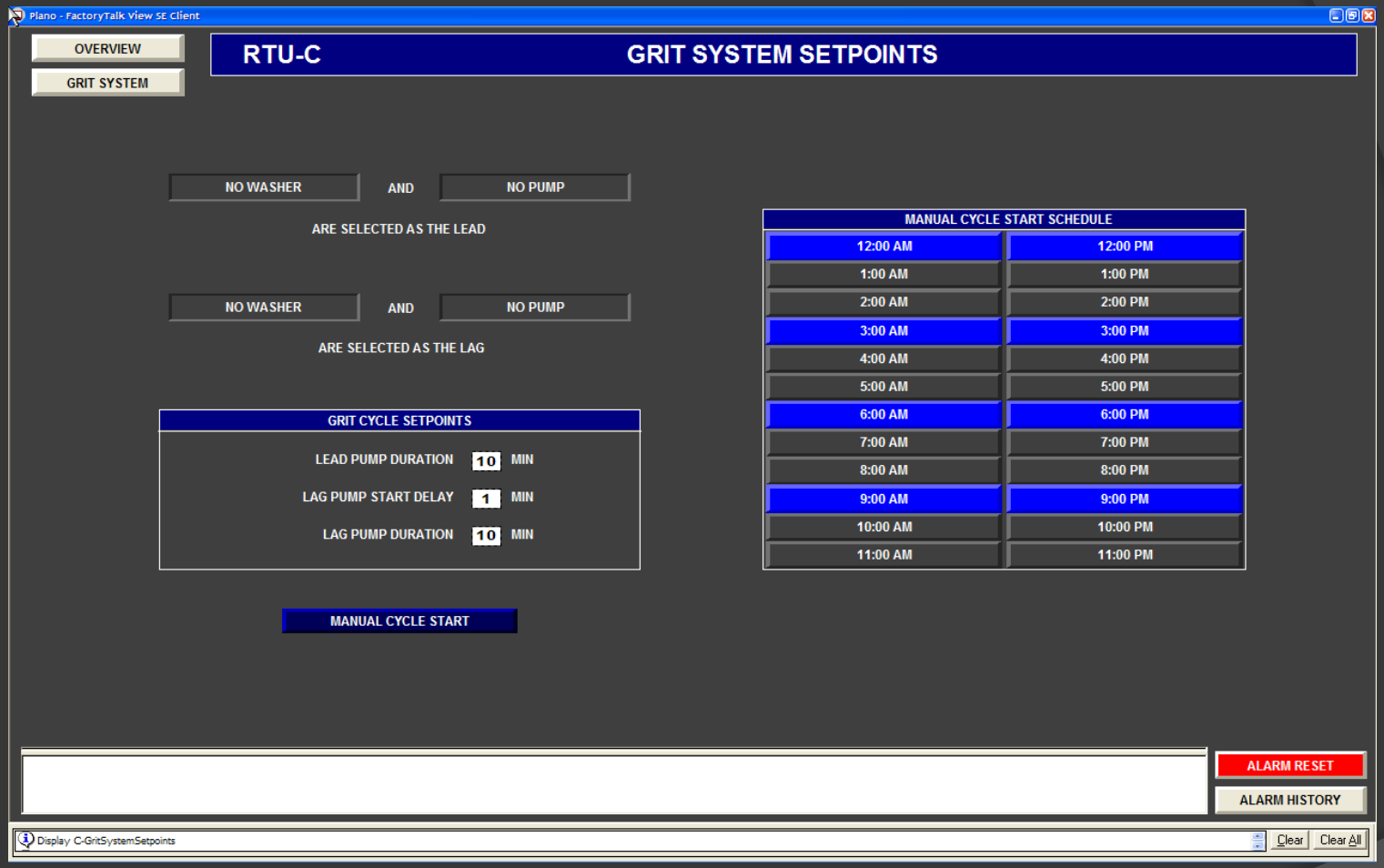
Pressing “BAR SCREENS” on the RTU-C main screen displays the Bar Screen, Compactor, and Conveyor screen. Controls and indicators are grouped together for each unit.

RTU – C Screening and Grit



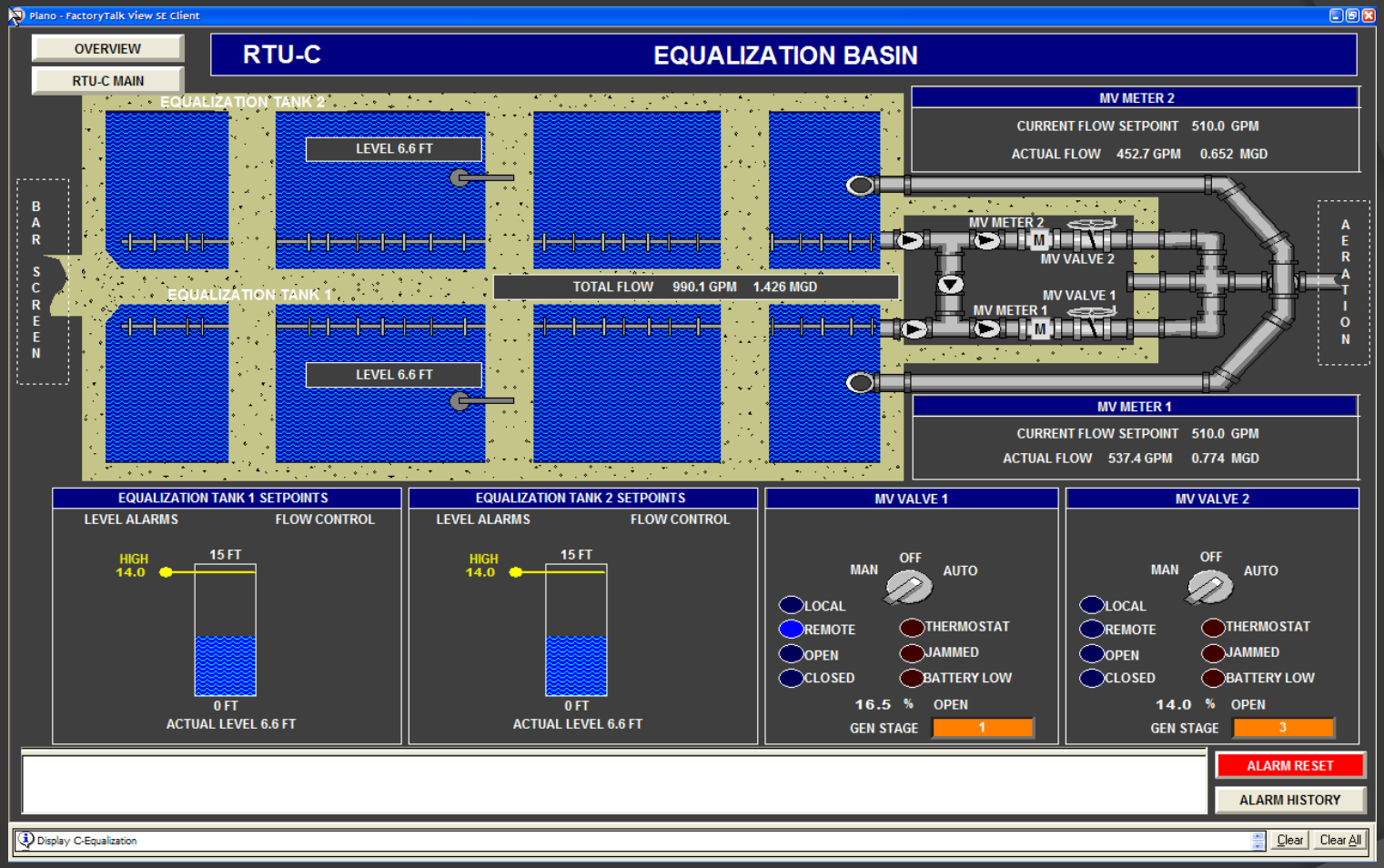
Pressing “GRIT SYSTEM” on the RTU-C main screen displays the Grit System screen. Controls and indicators are grouped together for each unit.

RTU – C Screening and Grit



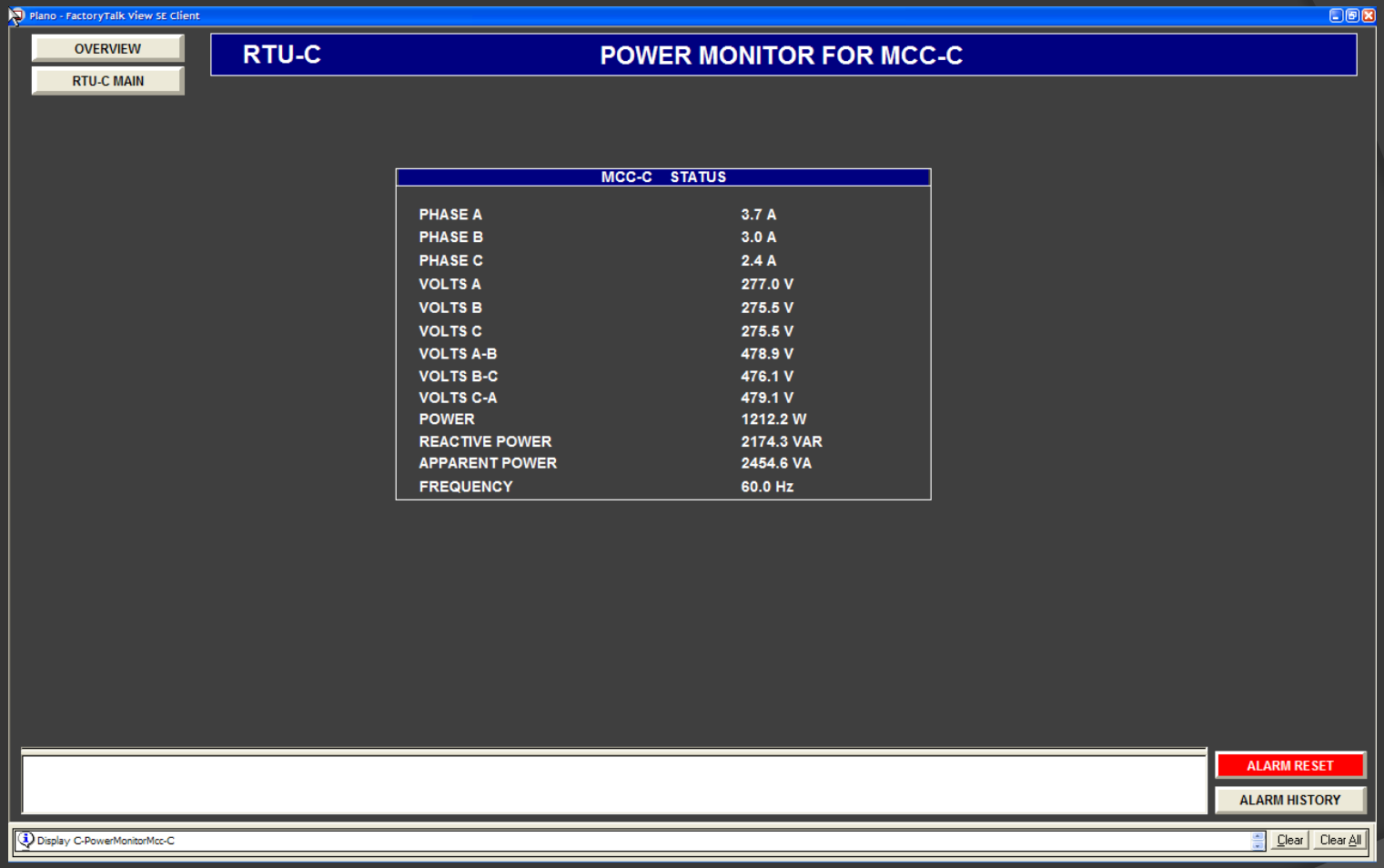
Pressing “SETPOINTS” on the RTU-C’s Grit System displays the Grit System Setpoints screen. Cycle start schedule and setpoints are entered on this screen.

RTU – C Screening and Grit



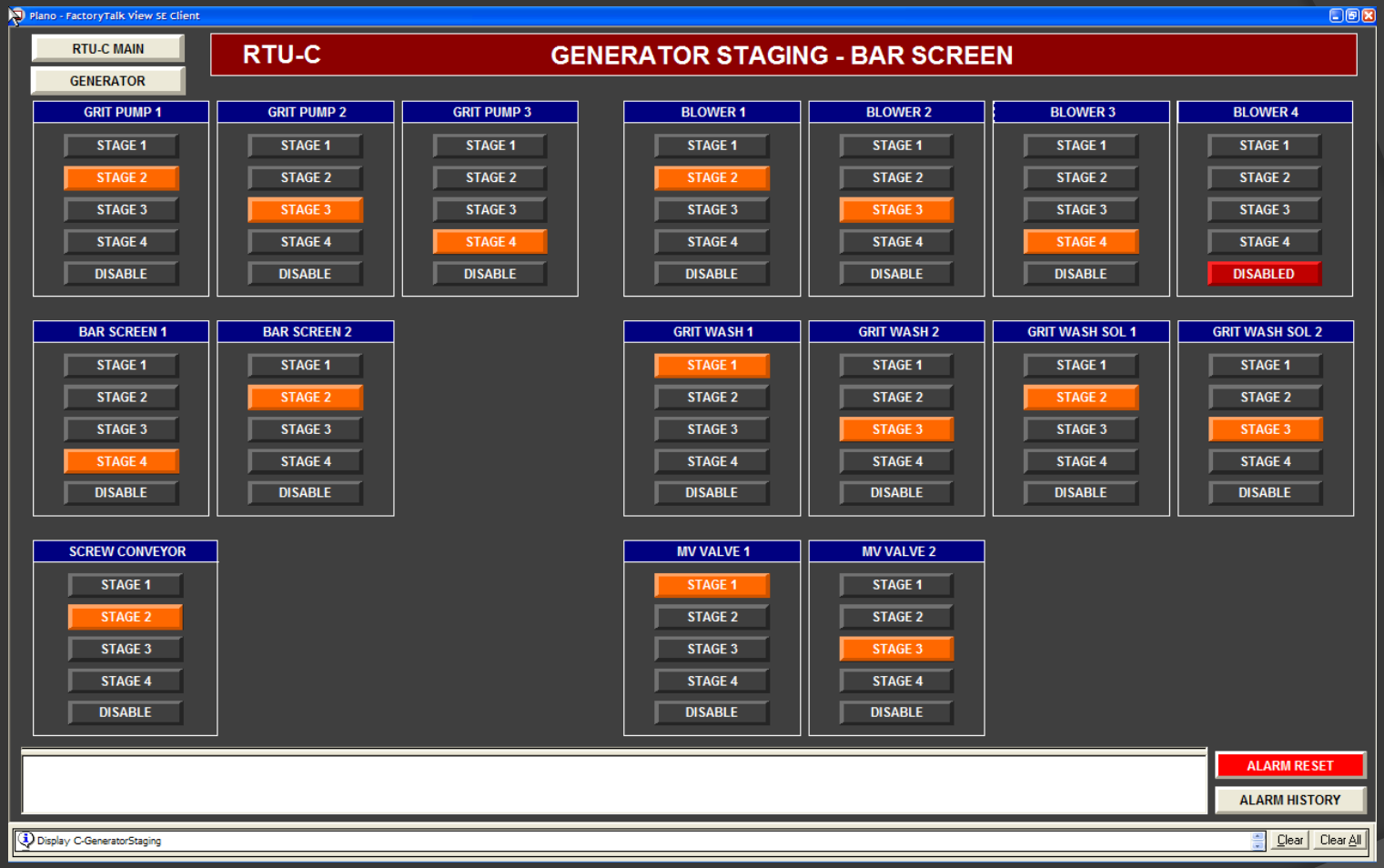
Pressing "EQUALIZATION" on the RTU-C main screen displays the Equalization Basin screen. Equalization levels are displayed along with their operational setpoints. Operators and indicators are grouped together for each modulating valve.

RTU – C Screening and Grit



Pressing “MCC-C” on the RTU-C main screen displays the Power Monitor MCC-C screen. Power status for MCC-C is displayed.

RTU – C Screening and Grit



Pressing “GENERATOR” on the RTU-C main screen displays the Generator Staging – Bar Screen screen. Each unit can be assigned to a start up stage or disabled when the plant is operating on generator power. This prevents overloading the generator by starting all the operating equipment at the same time.

RTU – K Secondary Control

Secondary Control Building

Secondary Control processes, such as RAS and MLSS flows, Non-Potable Water, and Clarifiers are controlled .

- Non-Potable Water Control Panel
- Motors and Pumps via MCC
- Ultrasonic Levels
- Modulating Flow Valves on DeviceNet
- Magnetic Flow Metering
- Pressures
- Building Intrusion

RTU-K

Magnetic Flow Meter

Motor Control Center

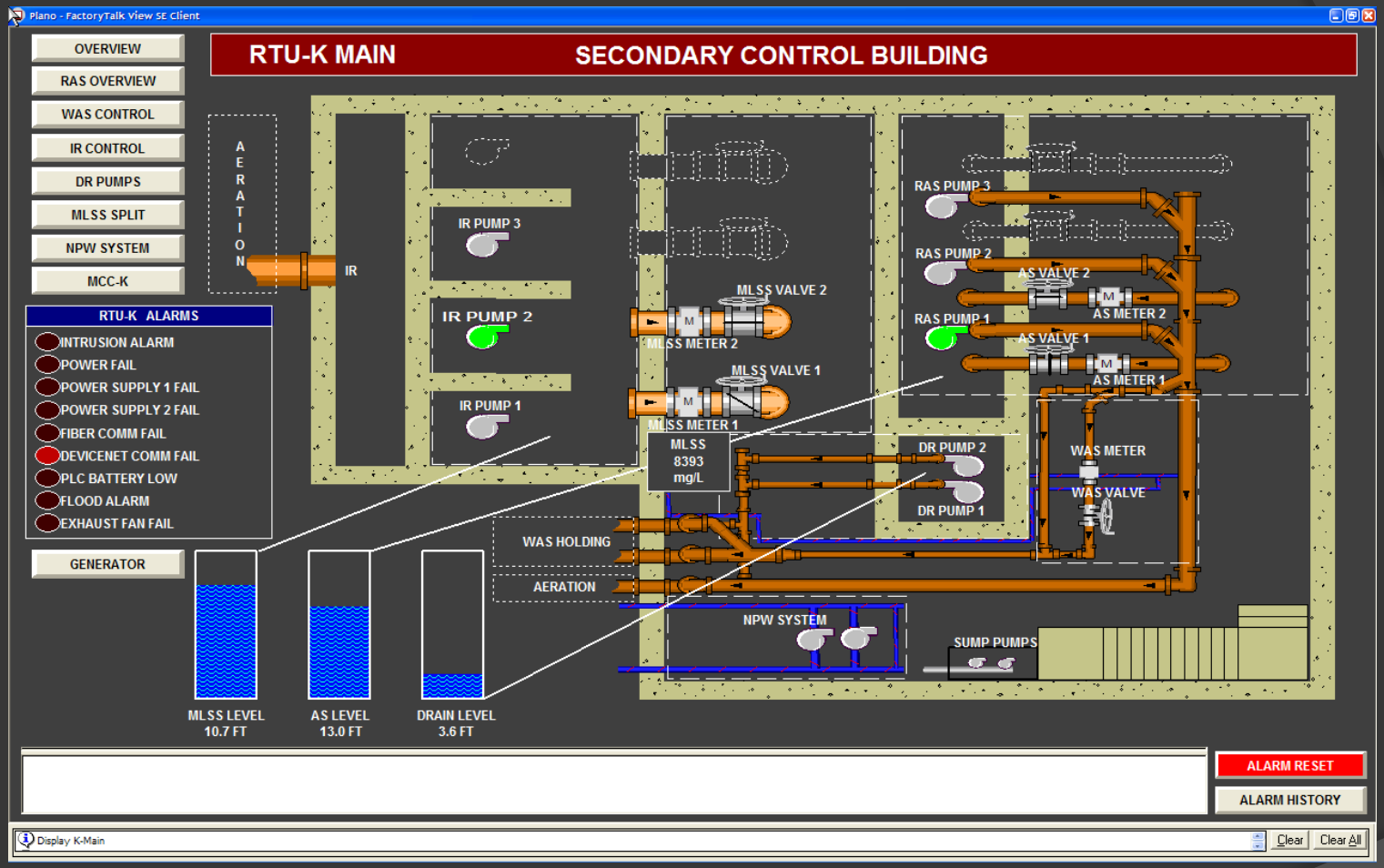
DeviceNet

Modulating Flow Valves

Non-Potable Water

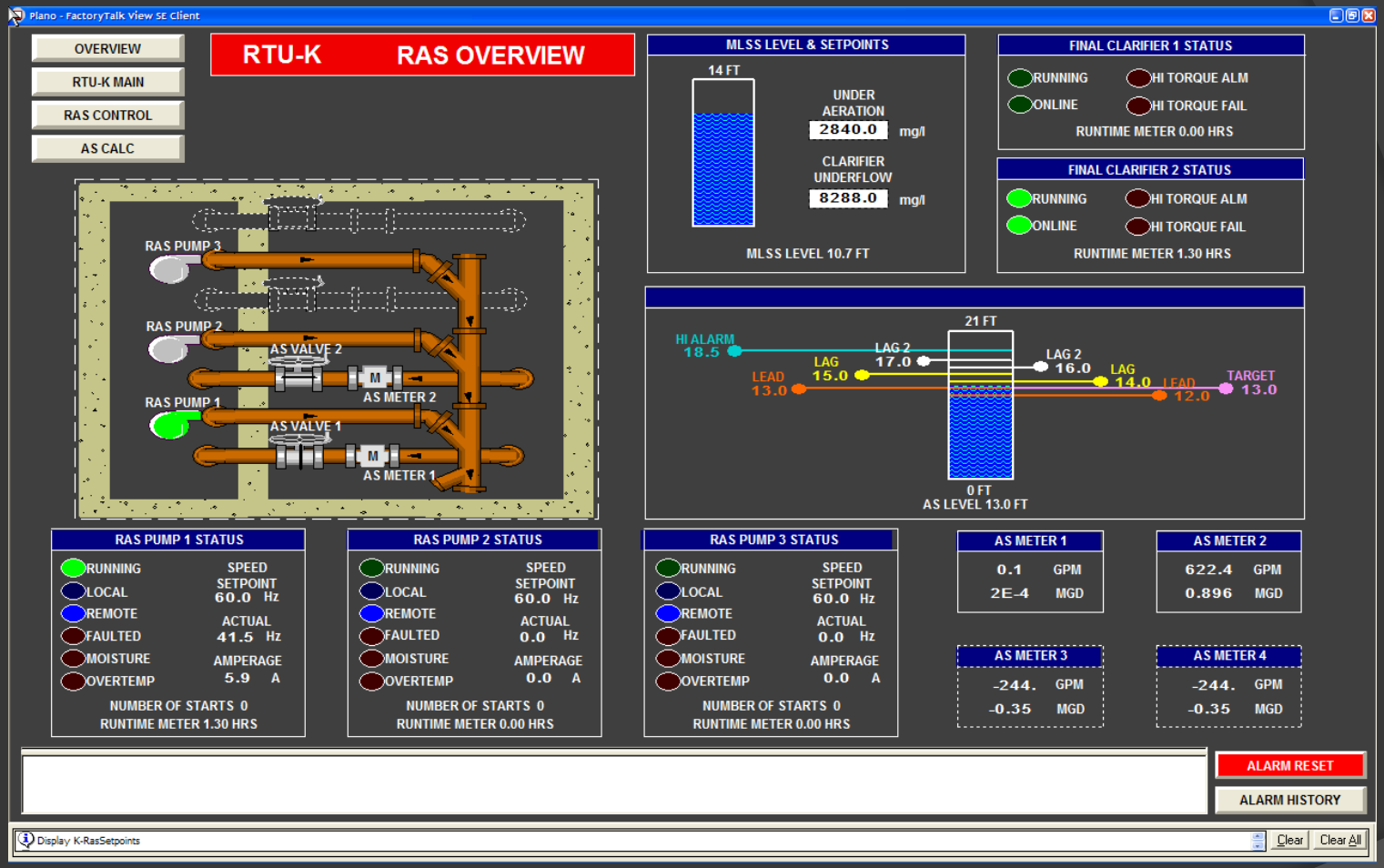
Hardwired

RTU – K Secondary Control



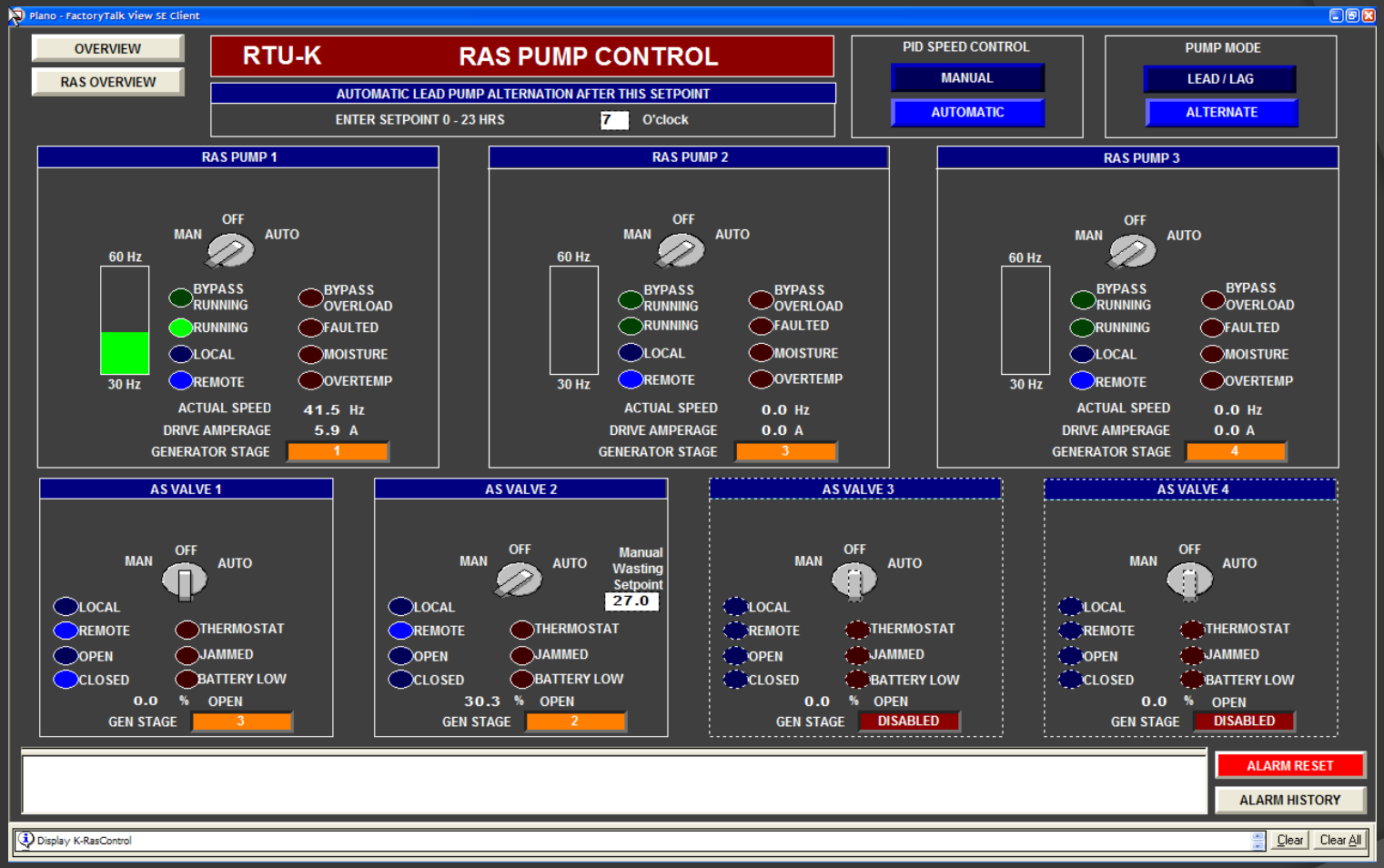
This is the main screen for RTU-K displaying an overview of the Secondary Control operations. In the upper left corner is a series of navigation buttons. Each button is used to navigate to that section of RTU-K's operation.

RTU – K Secondary Control



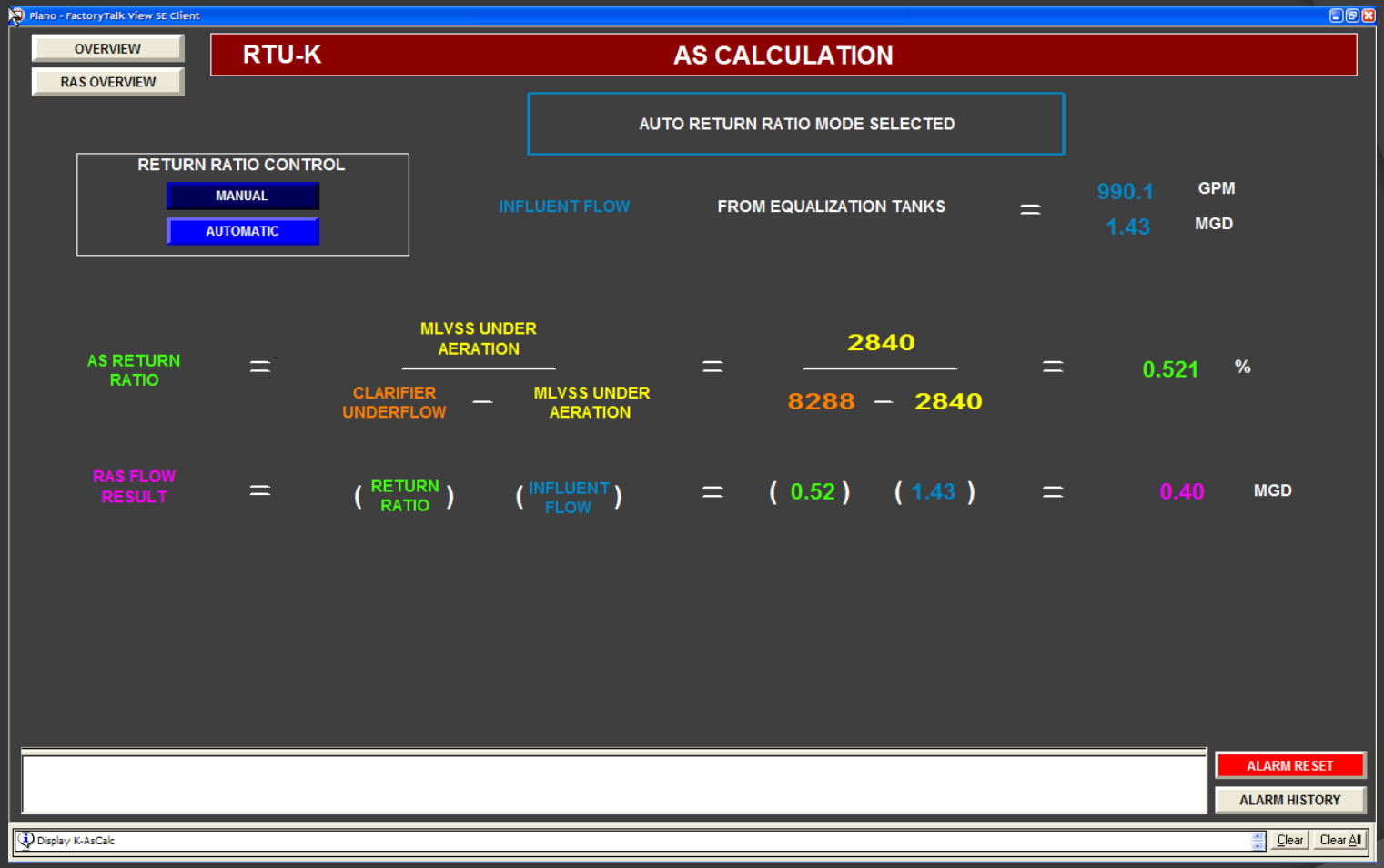
Pressing “RAS OVERVIEW” on the RTU-K main screen displays the RAS Overview screen. Levels, controls, and indicators are grouped together for each item.

RTU – K Secondary Control



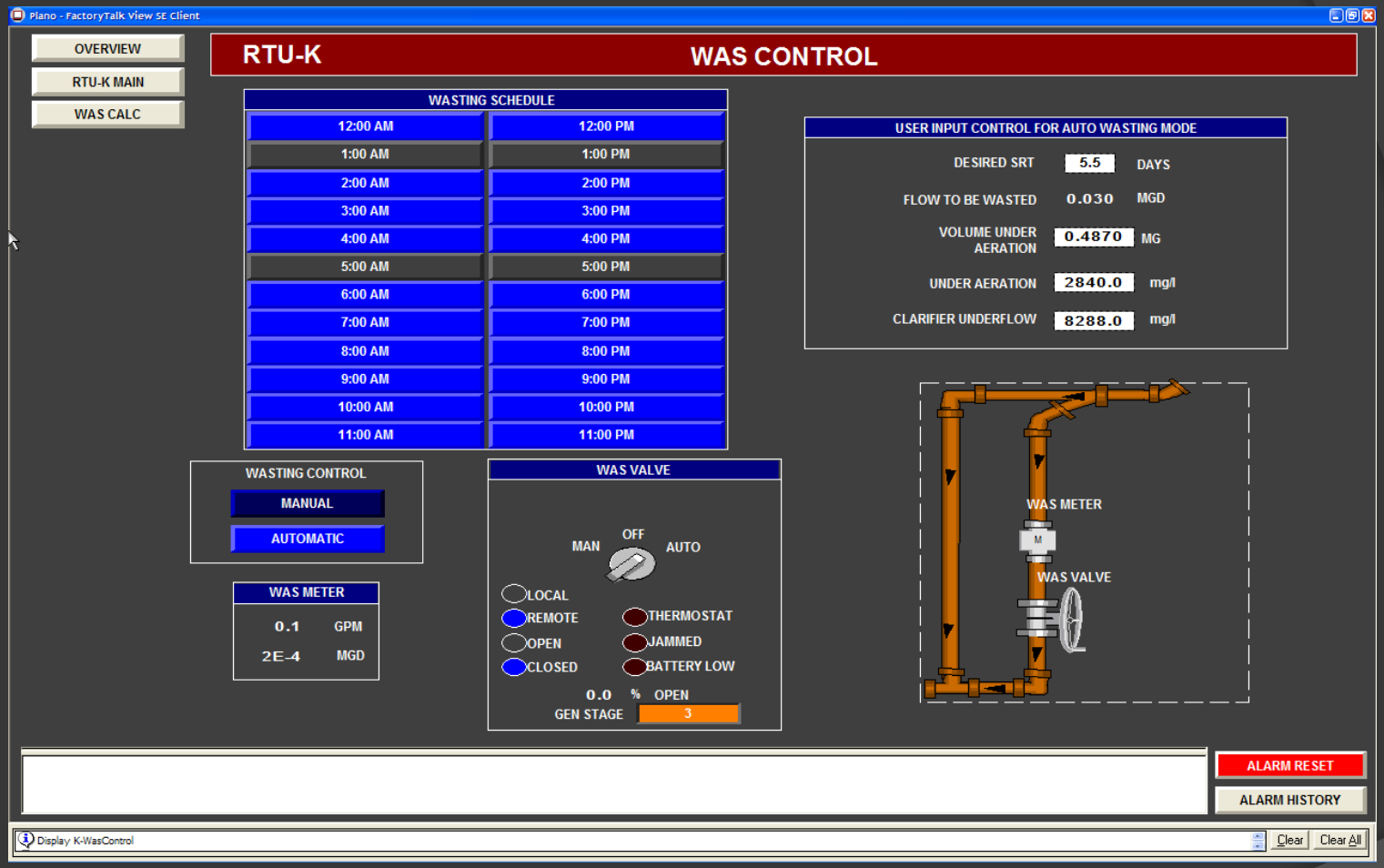
Pressing "RAS CONTROL" on the RAS Overview screen displays the RAS Control screen. Levels, controls, and status are grouped together for each pump and valve.

RTU – K Secondary Control



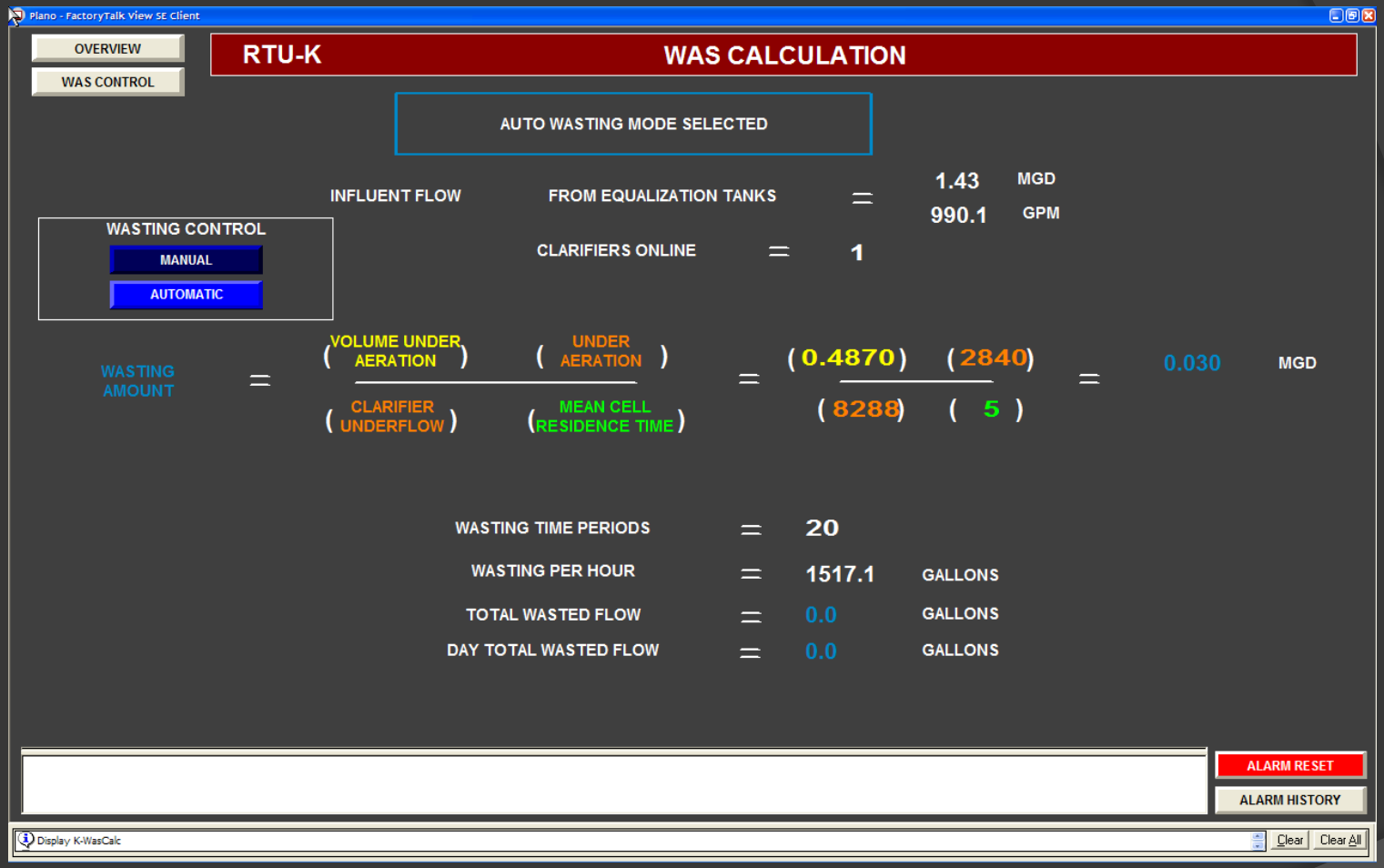
Pressing “AS CALC” on the RAS Overview screen displays the AS Calculation screen. Values for setpoints can be entered directly into the equation and the flow recalculated.

RTU – K Secondary Control



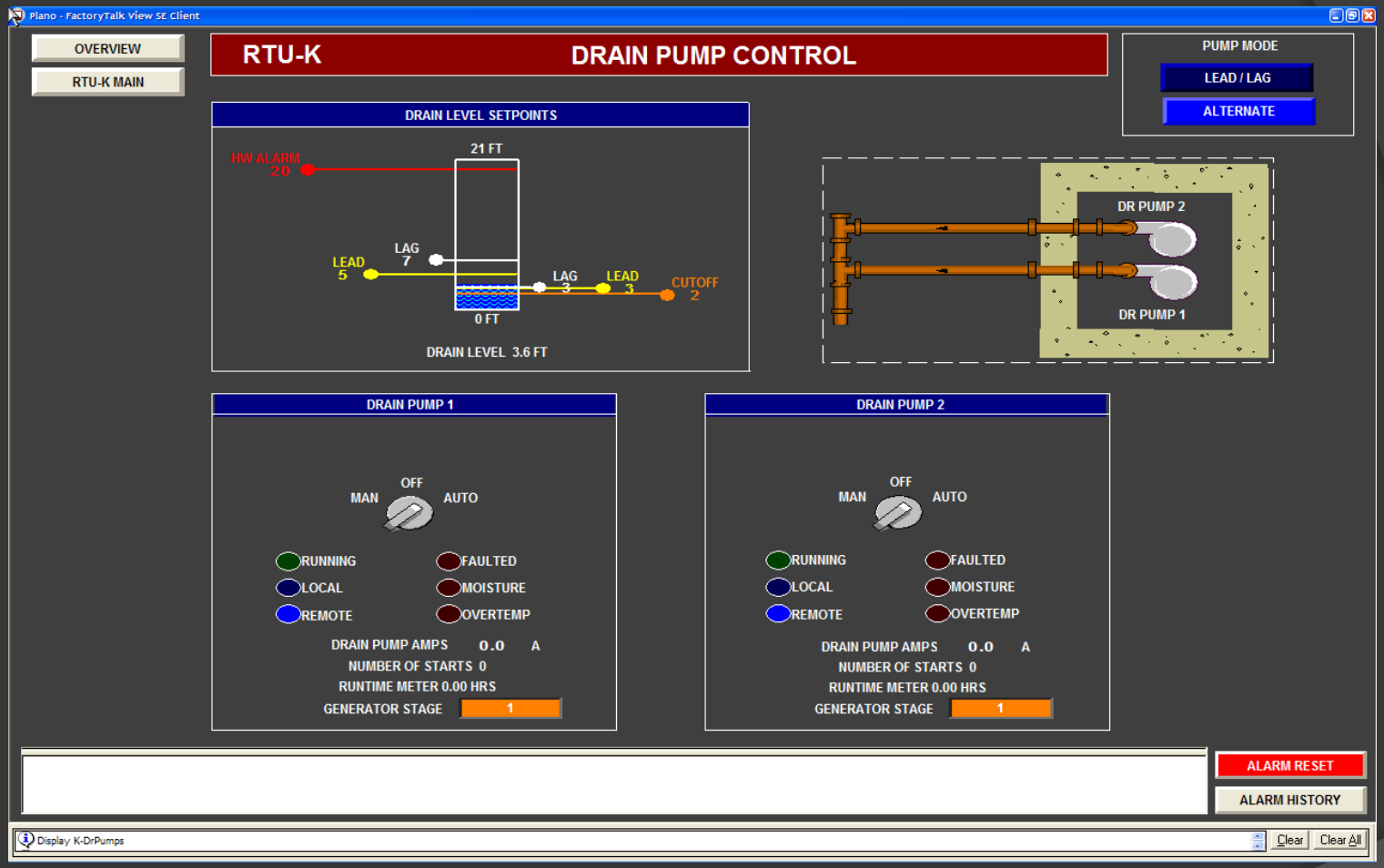
Pressing “WAS CONTROL” on the RTU-K main screen displays the WAS Control screen. Levels, controls, and indicators are grouped together for each item. Wasting schedule and auto wasting setpoints are entered here.

RTU – K Secondary Control



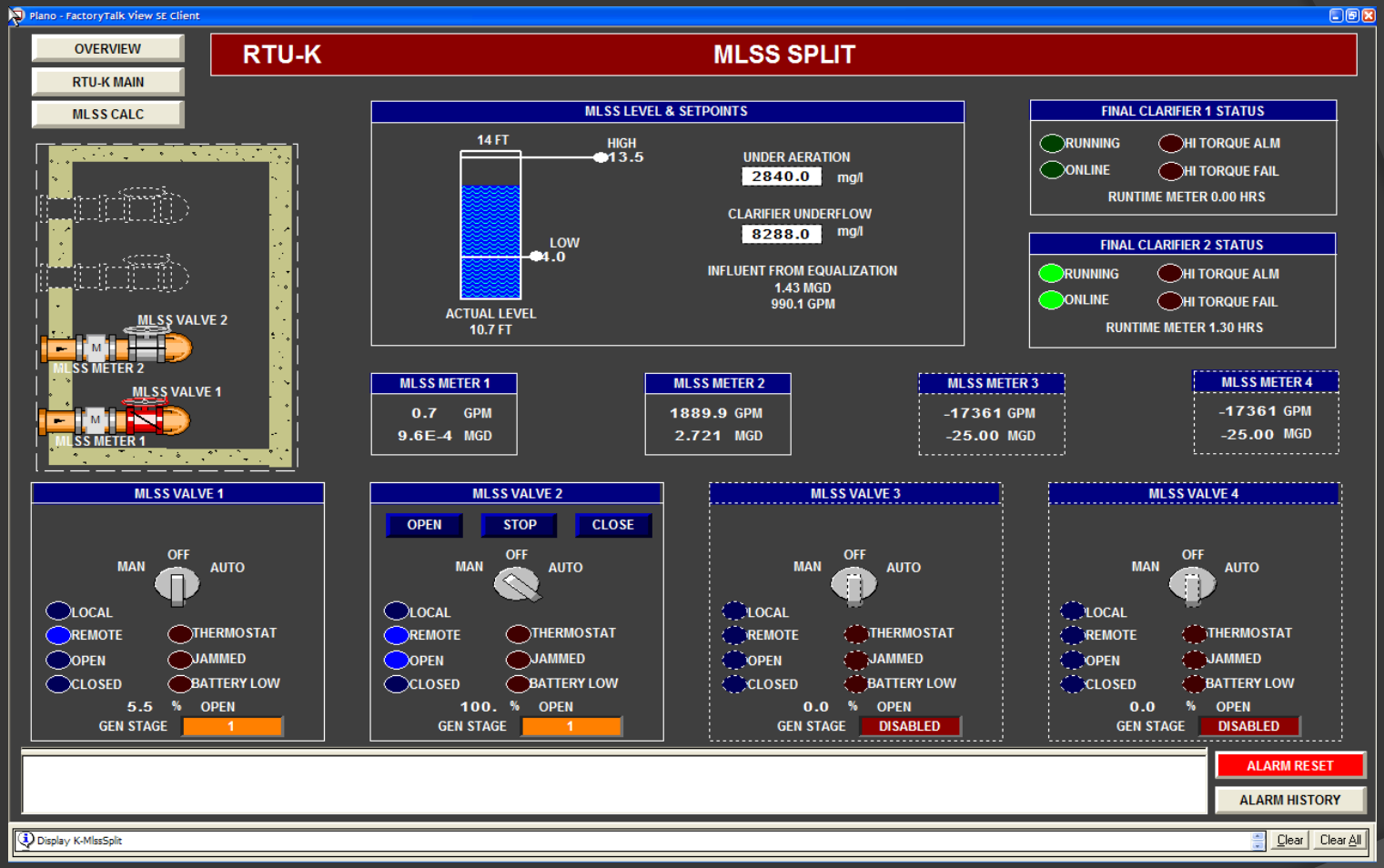
Pressing “WAS CALC” on the RAS Overview screen displays the WAS Calculation screen. Values for setpoints can be entered directly into the equation and the flow recalculated.

RTU – K Secondary Control



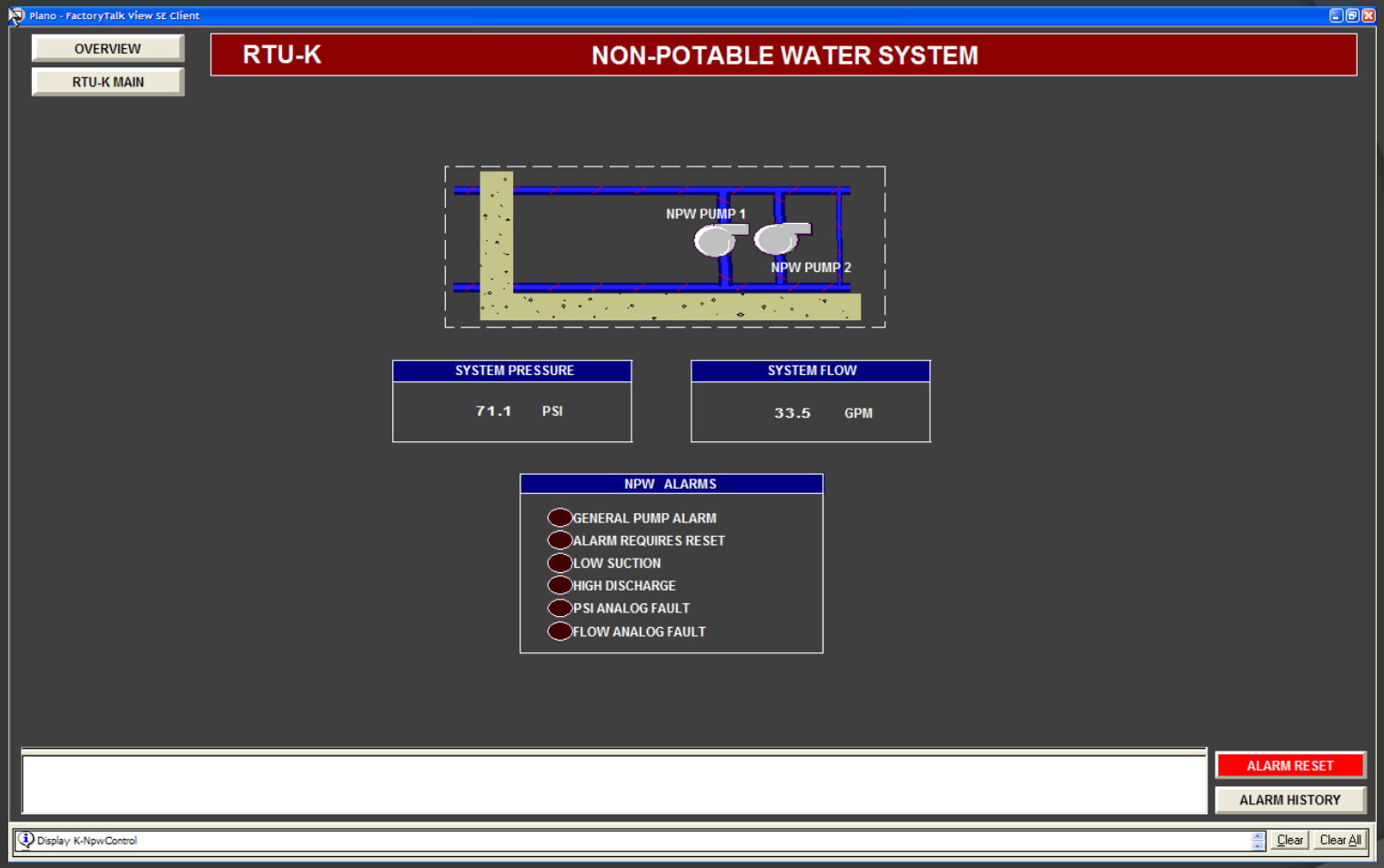
Pressing “DR PUMPS” on the RTU-K main screen displays the Drain Pump Control screen. Levels, controls, and indicators are grouped together for each item.

RTU – K Secondary Control



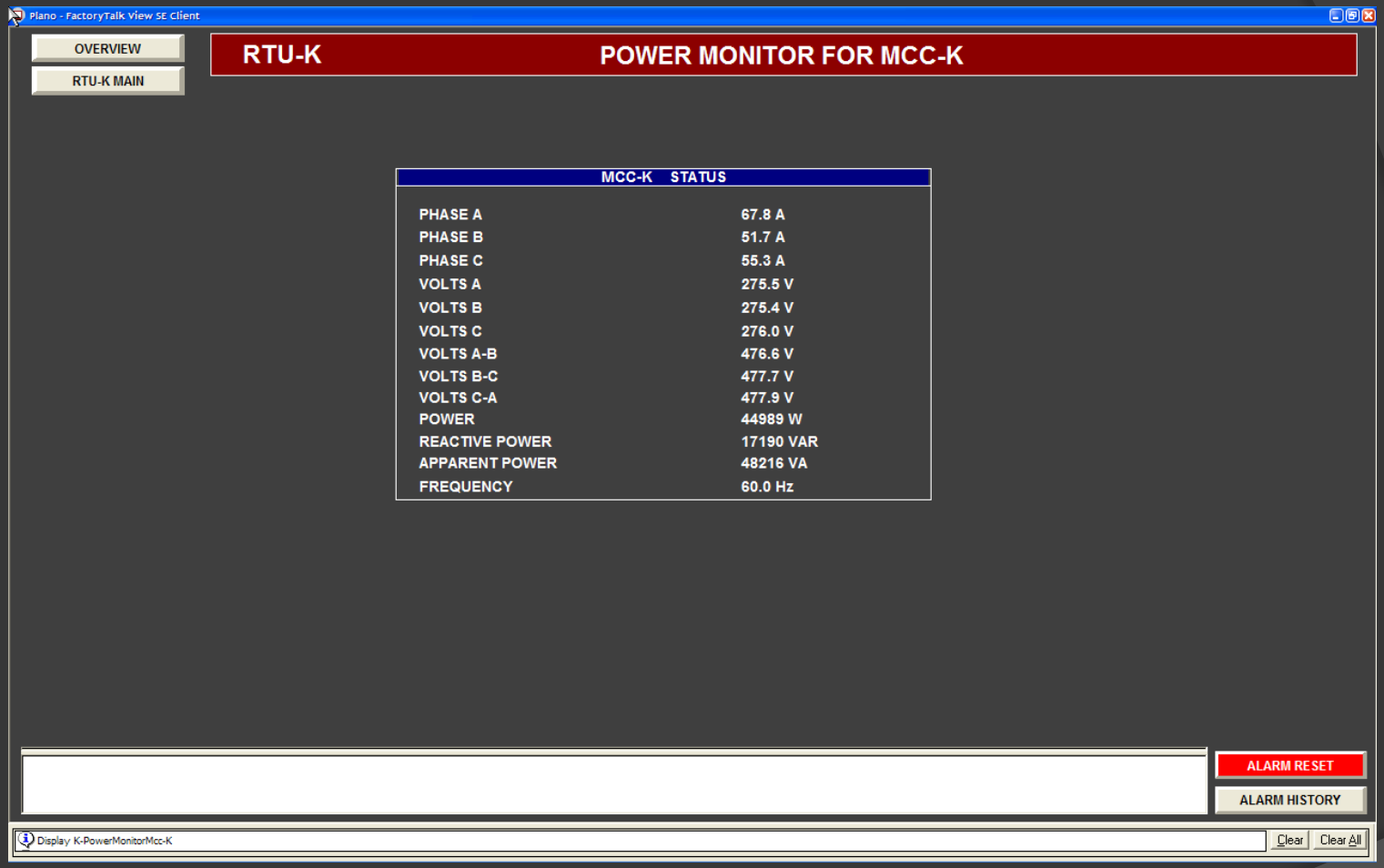
Pressing “MLSS SPLIT” on the RTU-K main screen displays the MLSS Split screen. Levels, controls, and indicators are grouped together for each item.

RTU – K Secondary Control



Pressing “NPW SYSTEM” on the RTU-K main screen displays the Non-Potable Water System screen. Levels, controls, and indicators are grouped together for each item.

RTU – K Secondary Control



Pressing “MCC-K” on the RTU-K main screen displays the Power Monitor MCC-K screen. Power status for MCC-K is displayed.

RTU – H Aeration Gallery

Aeration Building and Tanks

Aeration Gallery process control, such as WAS and MLSS flows, and Dissolved Oxygen content.

- Selector Pump Control Panels
- WAS Pump Control Panel
- Modulating Flow Valves on DeviceNet
- Magnetic Flow Metering
- Thermal Mass Flow Metering
- Temperature
- Building Intrusion

Thermal Mass Flow Meter

Dissolved Oxygen

MODBUS

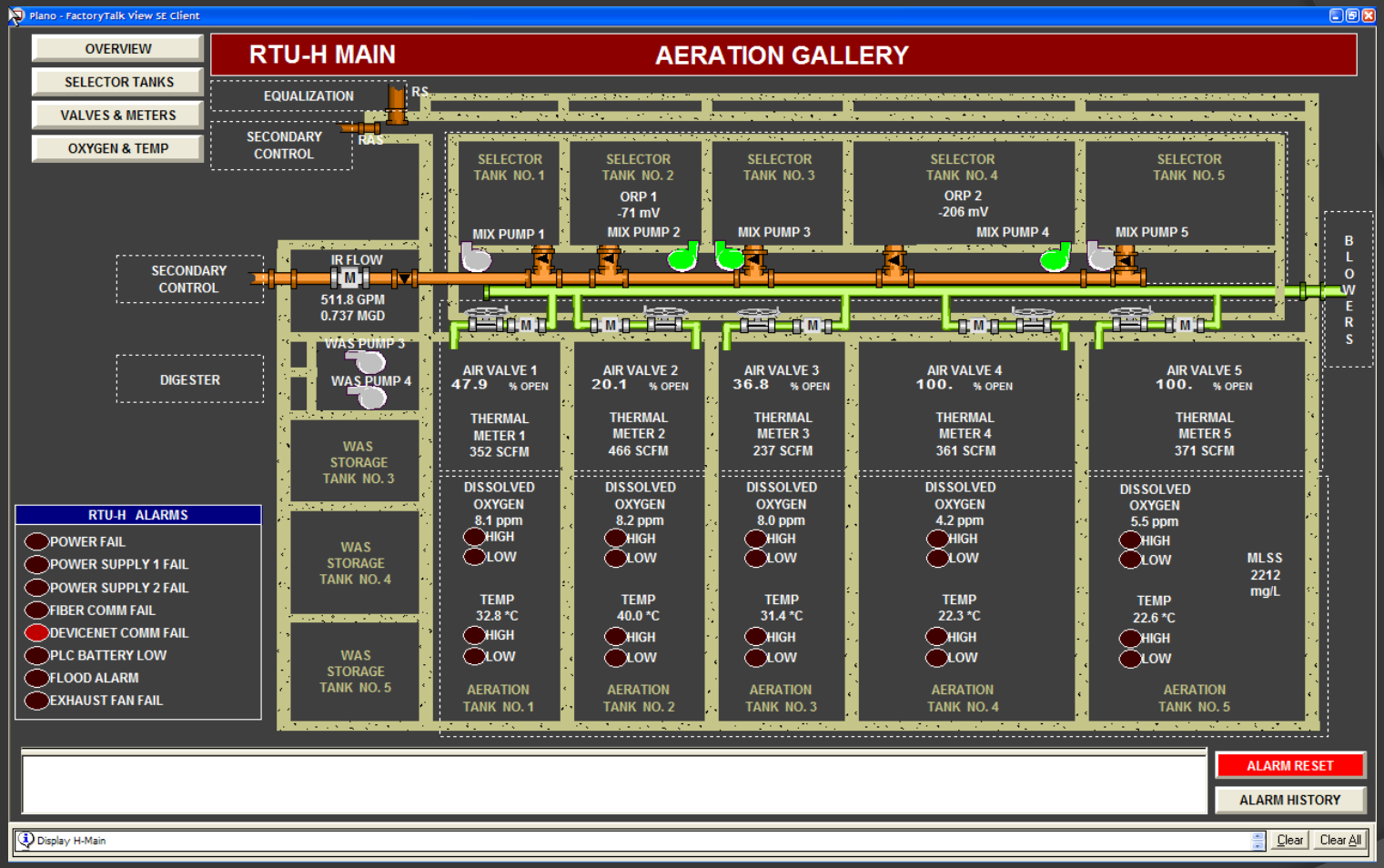
RTU-K

Modulating Flow Valves

Aeration and Pump Control Panels

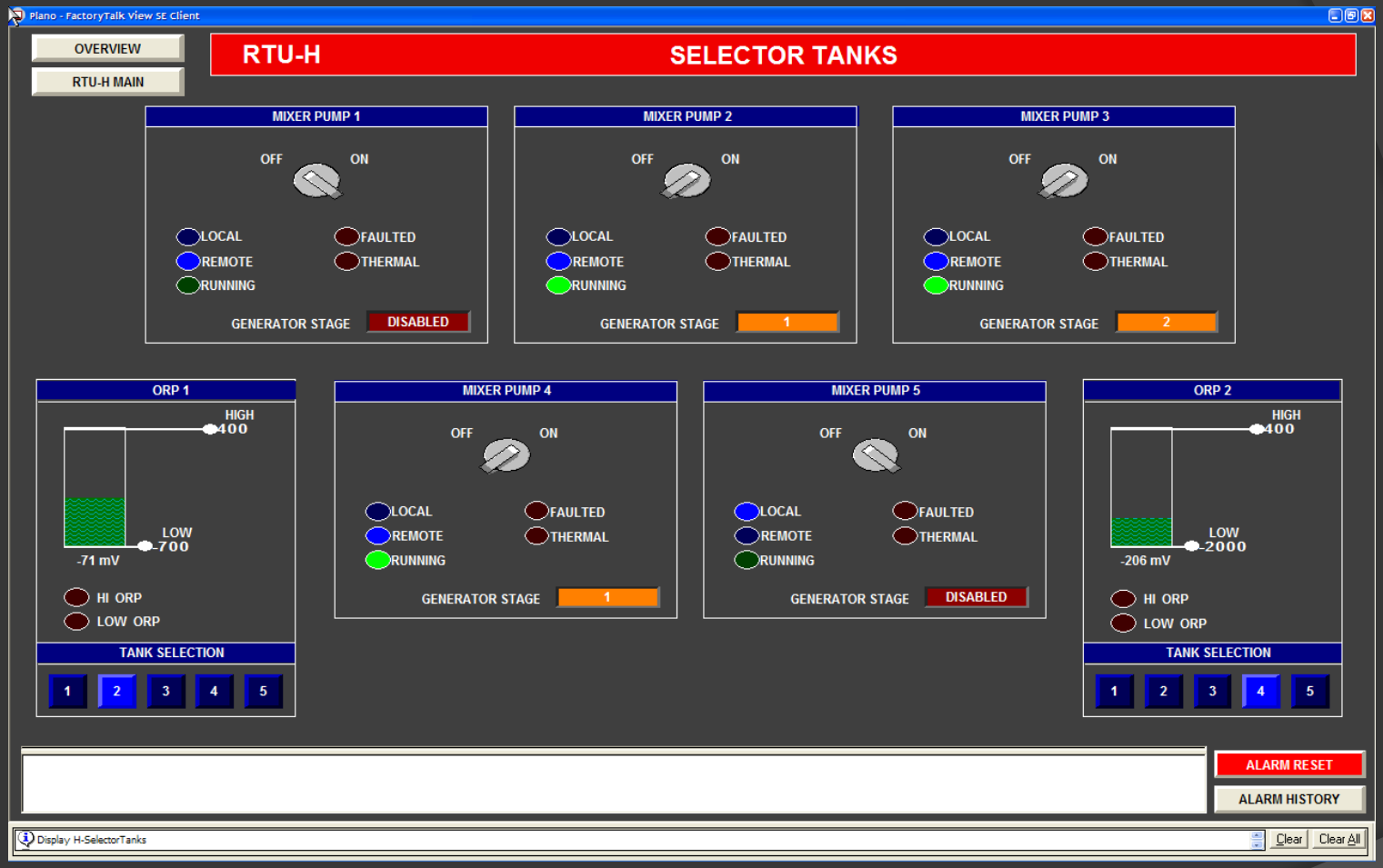
Hardwired

RTU – H Aeration Gallery



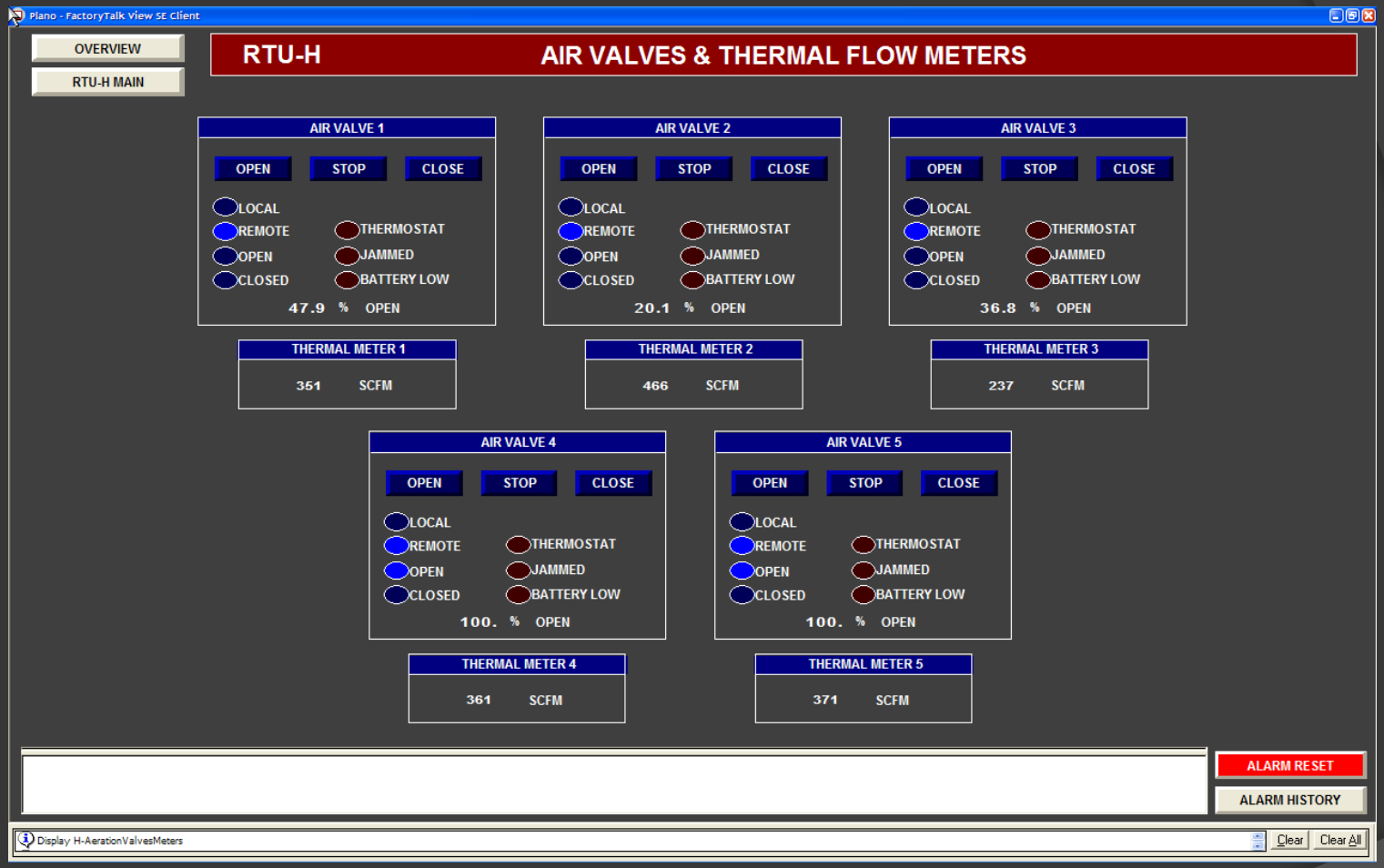
This is the main screen for RTU-H displaying an overview of the Aeration Gallery operations. In the upper left corner is a series of navigation buttons. Each button is used to navigate to that section of RTU-H's operation.

RTU – H Aeration Gallery



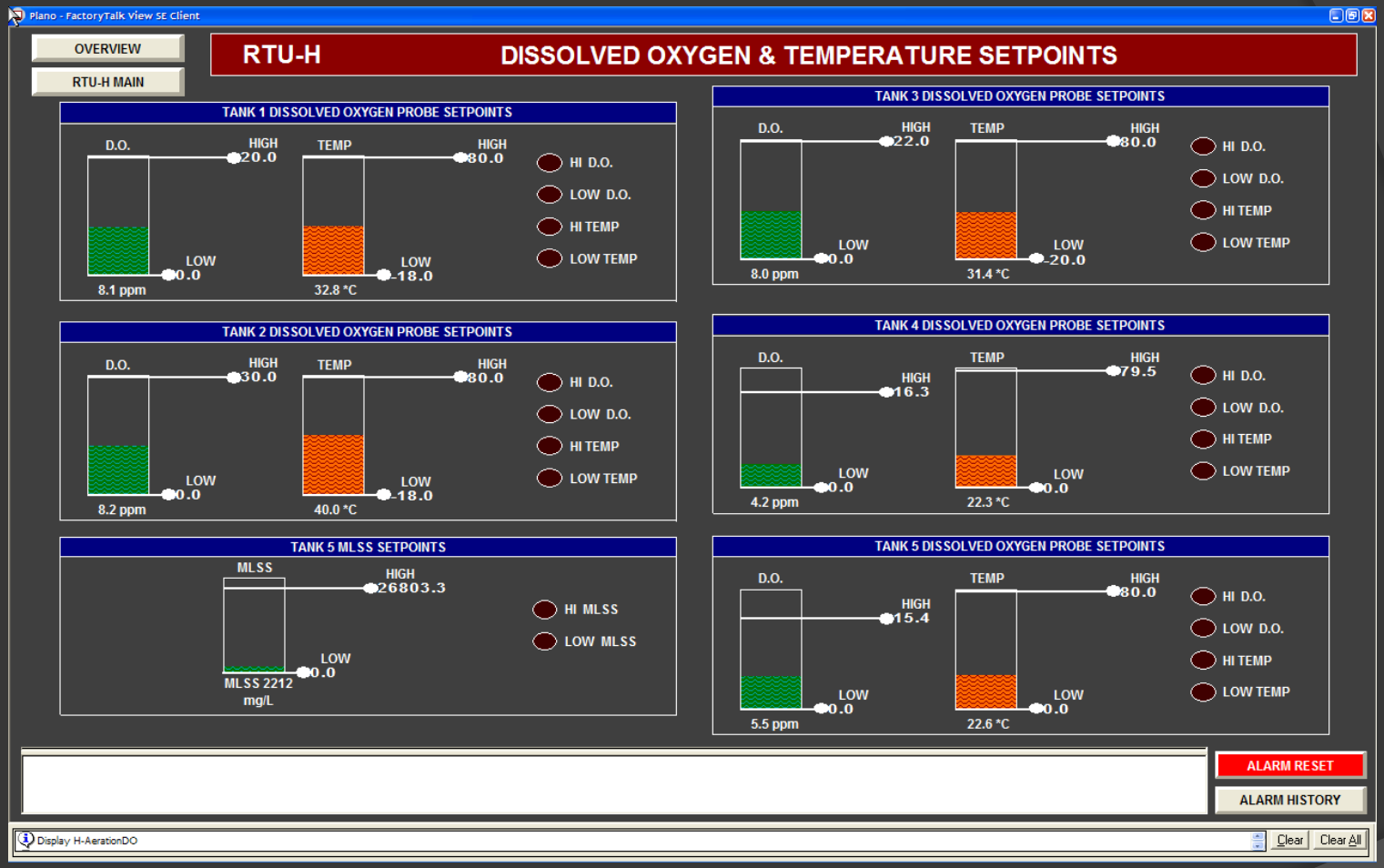
Pressing “SELECTOR TANKS” on the RTU-H main screen displays the Selector Tanks screen. Levels, controls, and indicators are grouped together for each item.

RTU – H Aeration Gallery



Pressing “VALVES & METERS” on the RTU-H main screen displays the Air Valves & Thermal Flow Meters screen. Levels, controls, and indicators are grouped together for each item.

RTU – H Aeration Gallery



Pressing "OXYGEN & TEMP" on the RTU-H main screen displays the Dissolved Oxygen & Temperature Setpoints screen. Levels, controls, and indicators are grouped together for each item.

RTU – N Administration

Administration

RTU-N is located in the Administration building. It coordinates date and time settings as well as alarm operations for all the RTUs. Operates autodialer for announcing plant alarms for on call personnel.

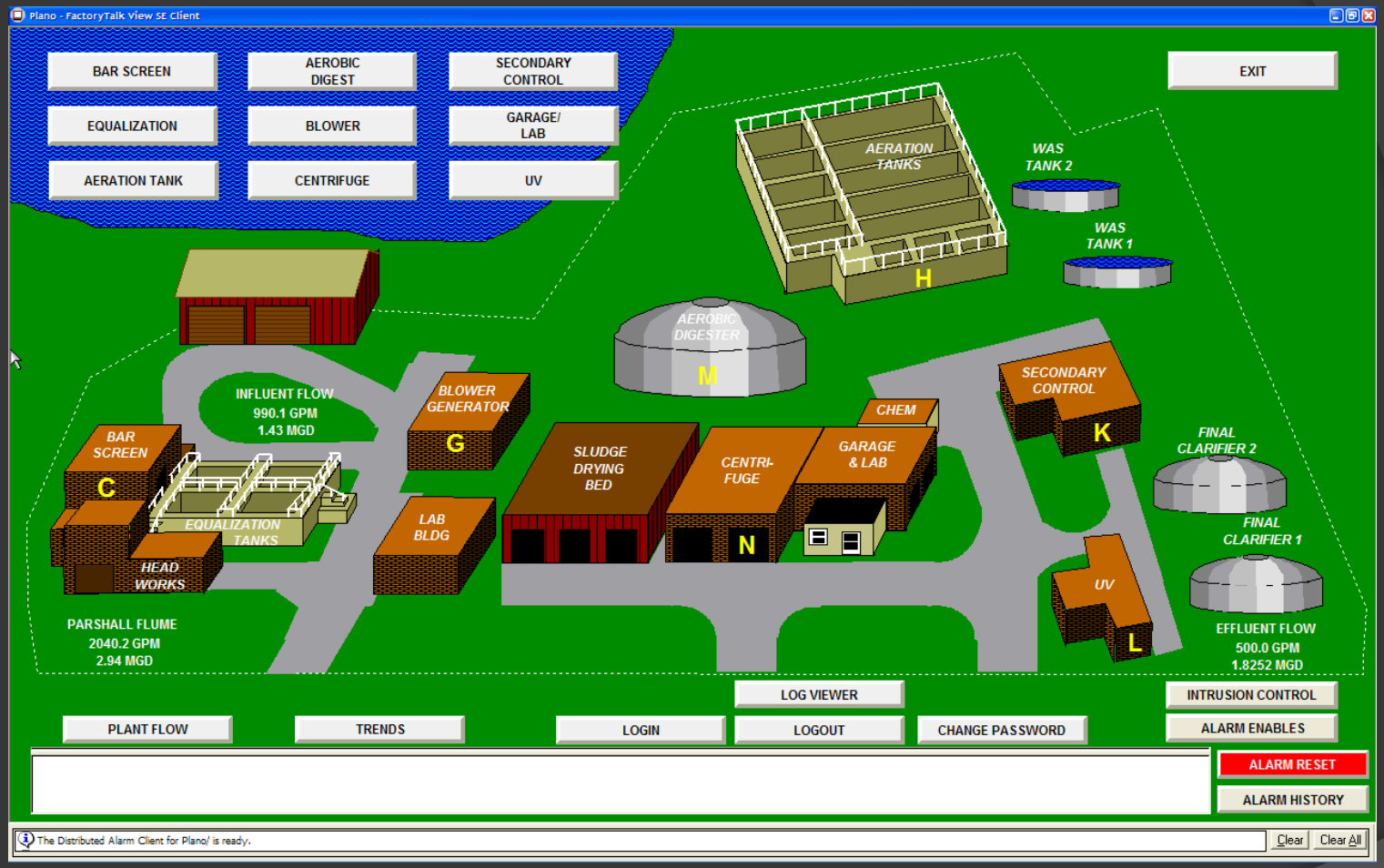
- Centrifuge Control Panel
- Chemical Storage
- Sludge Storage
- Coordinated Date / Time
- Coordinated Alarm Acknowledge / Reset
- Building Intrusion
- Autodialer

Centrifuge Control

Ethernet

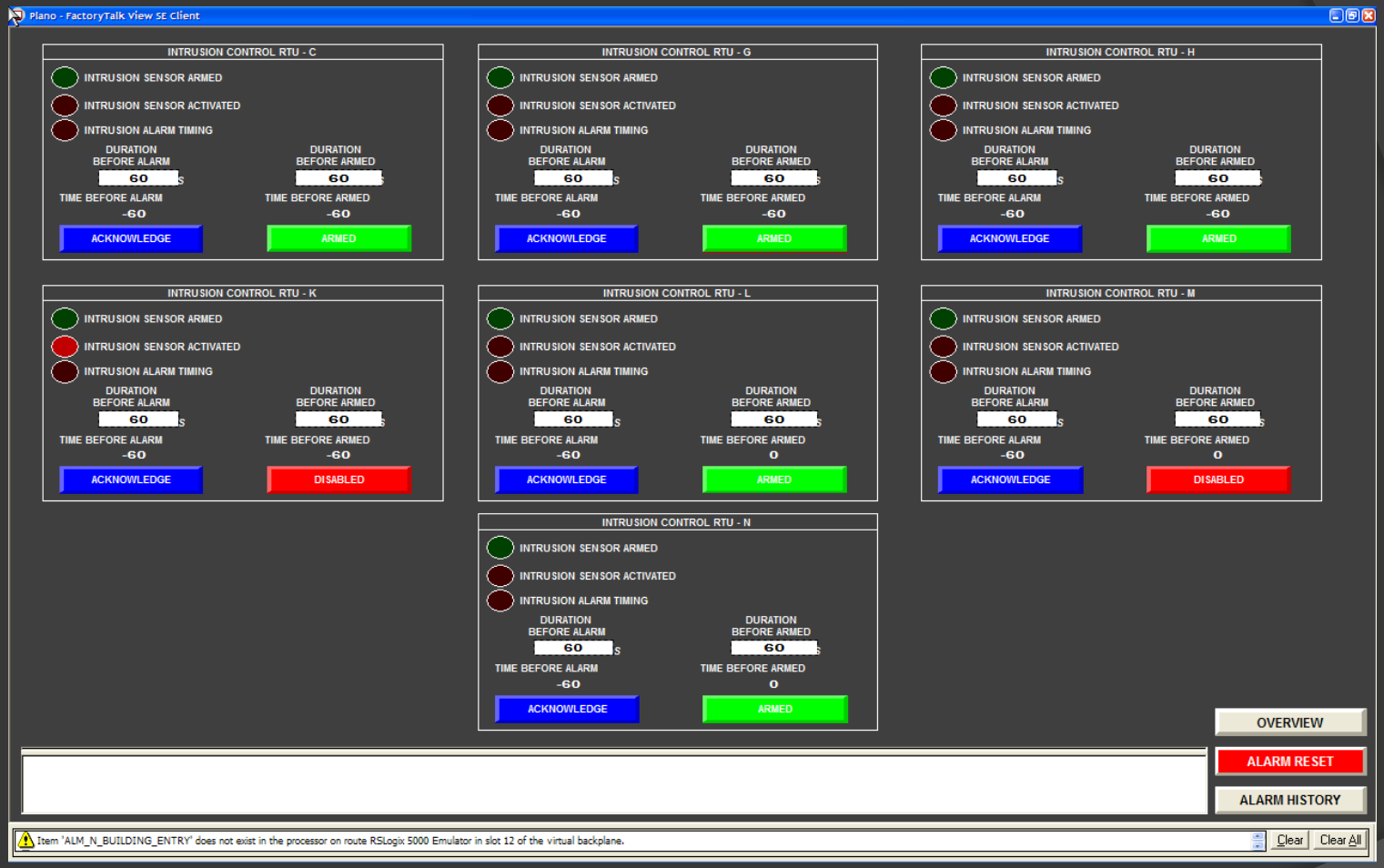
RTU-N

SCADA Overview screen



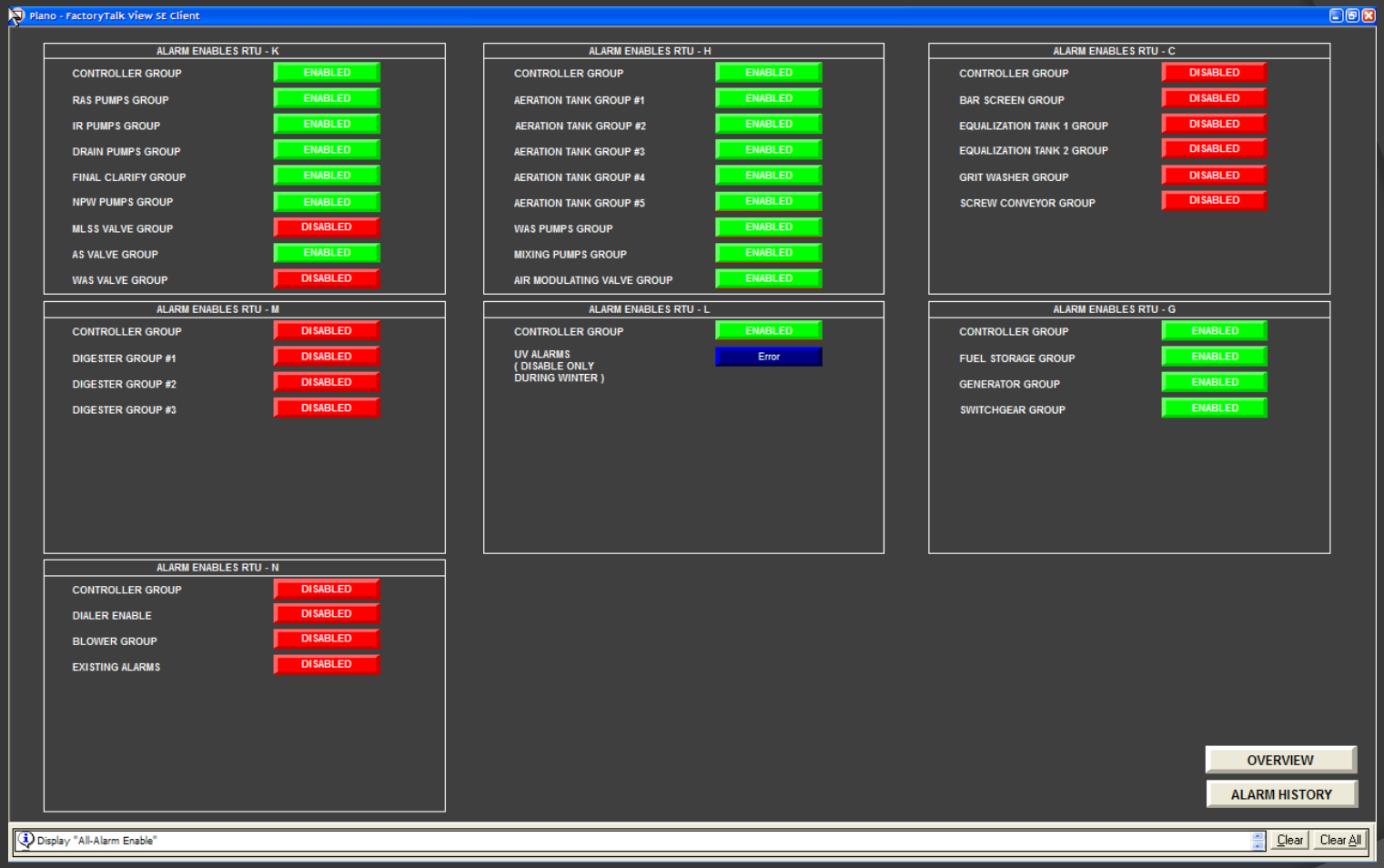
This is the main Overview screen for the SCADA system. In the upper left corner is a series of navigation buttons. Each button is used to navigate to a section of the plant. In addition, touching the screen on a location will navigate to that RTU's main screen.

SCADA Intrusion Control



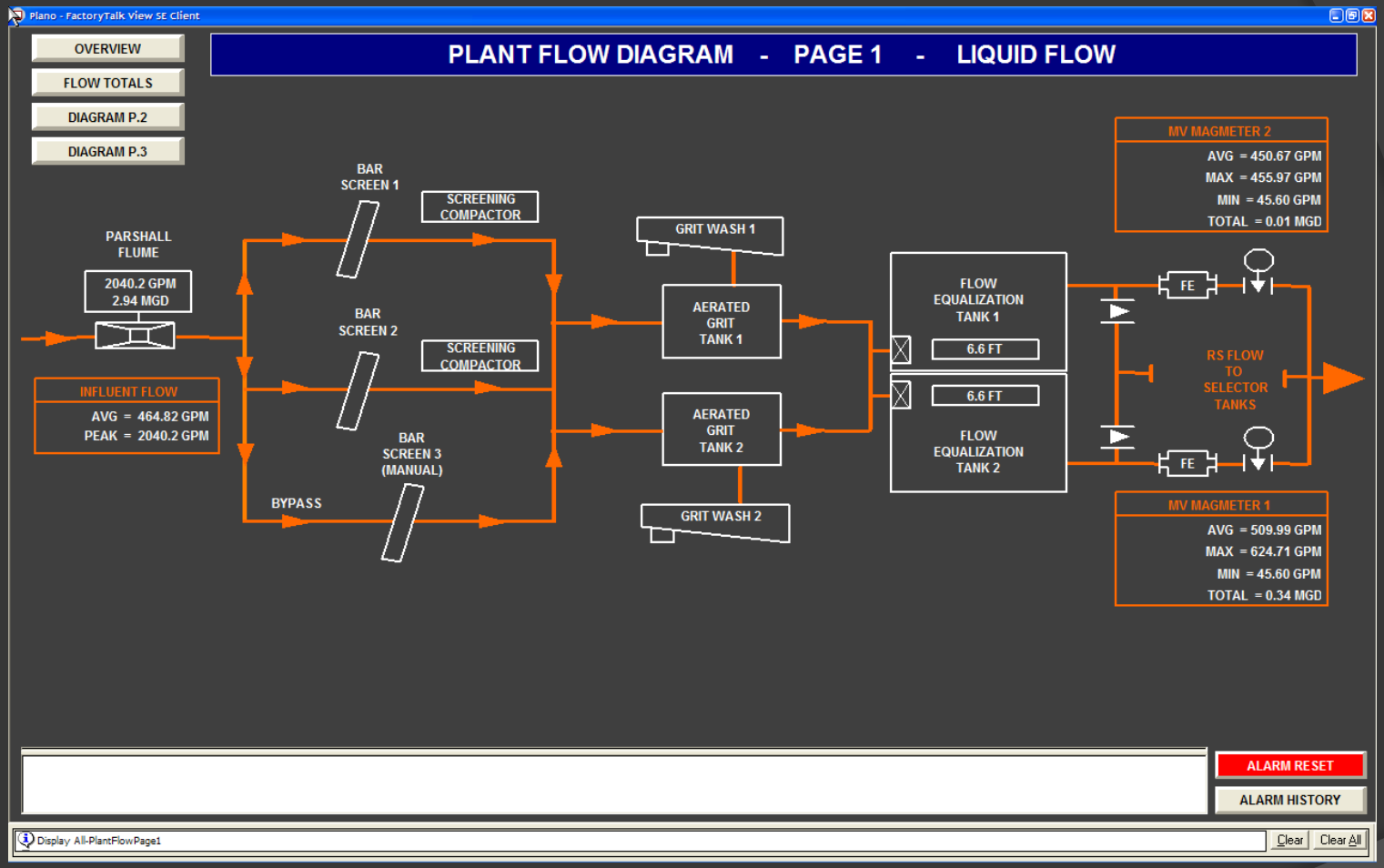
Pressing “INTRUSION CONTROL” on the SCADA Overview screen will display the Intrusion Control screen. All setpoints and selections related to intrusion monitoring at each RTU location is available here.

SCADA Alarm Enables



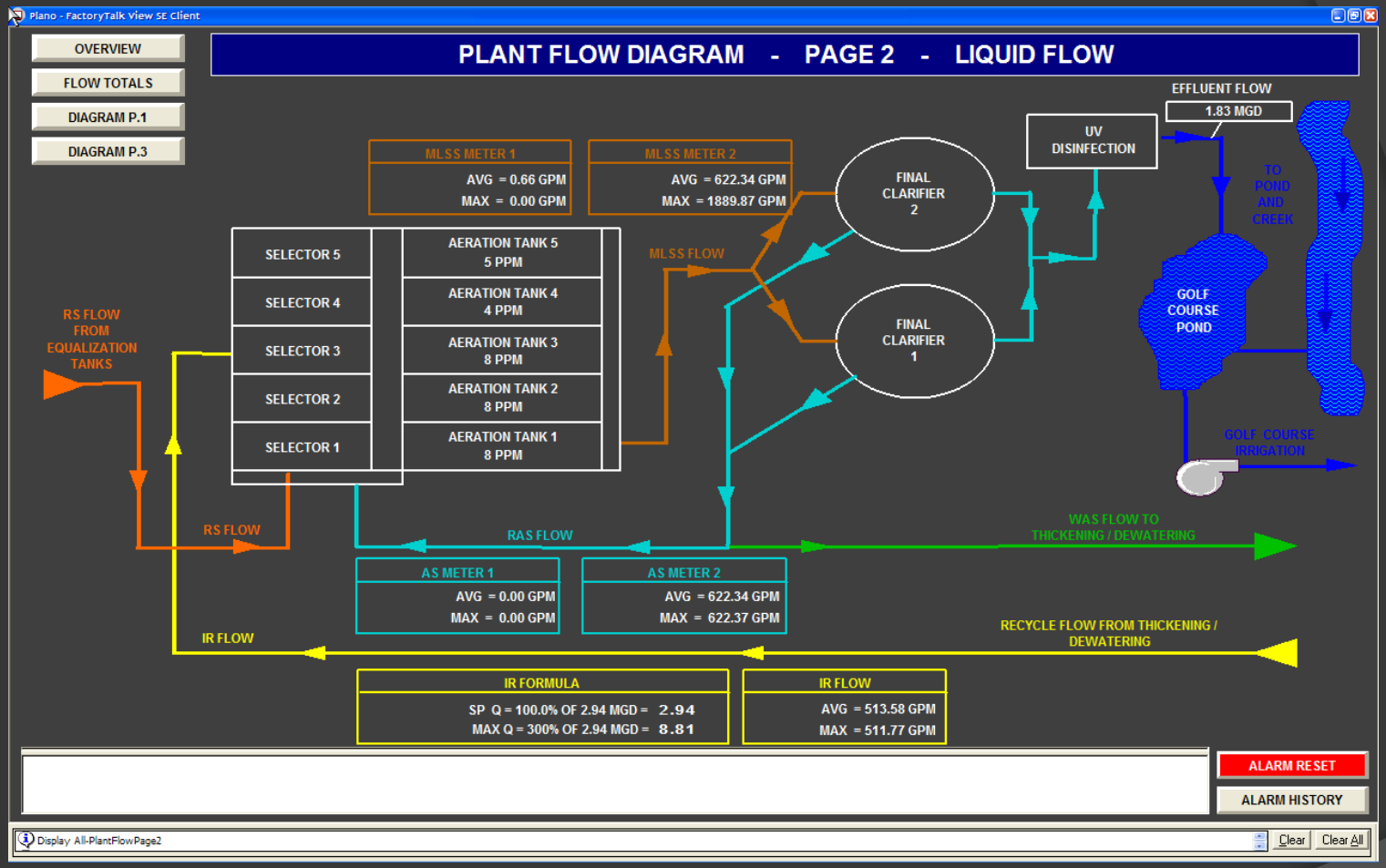
Pressing “ALARM ENABLES” on the SCADA Overview screen will display the Alarm Enable screen. All selections related to alarm monitoring at each RTU location is available here.

SCADA Plant Flow



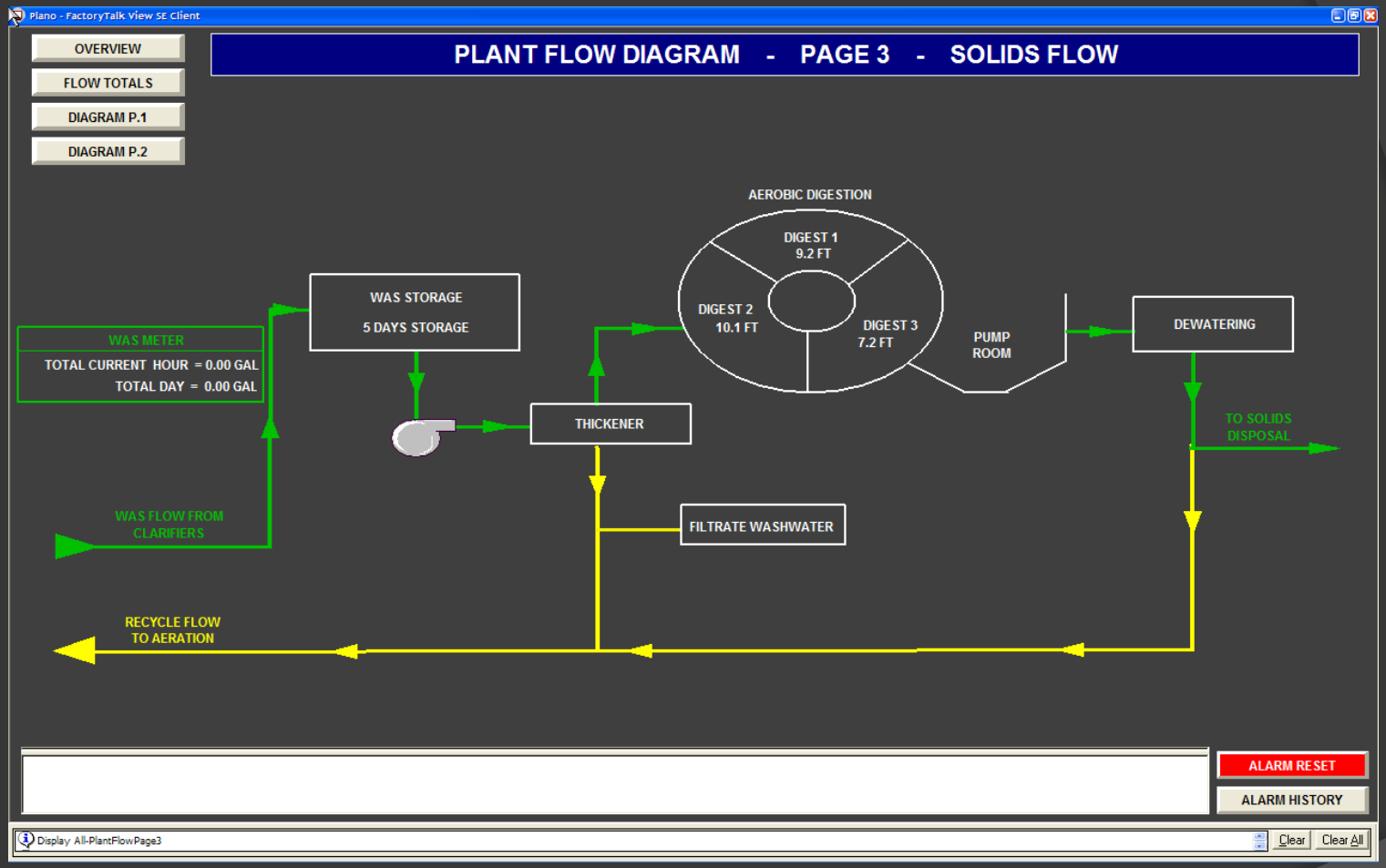
Pressing “PLANT FLOW” on the SCADA Overview screen will display the first Plant Flow screen. Realtime flows and statistics are shown on the flow diagram. Buttons in the upper left corner navigate to the two other flow diagrams. Pressing the large arrows on the sides of the screen can also be used to access the other diagrams.

SCADA Plant Flow



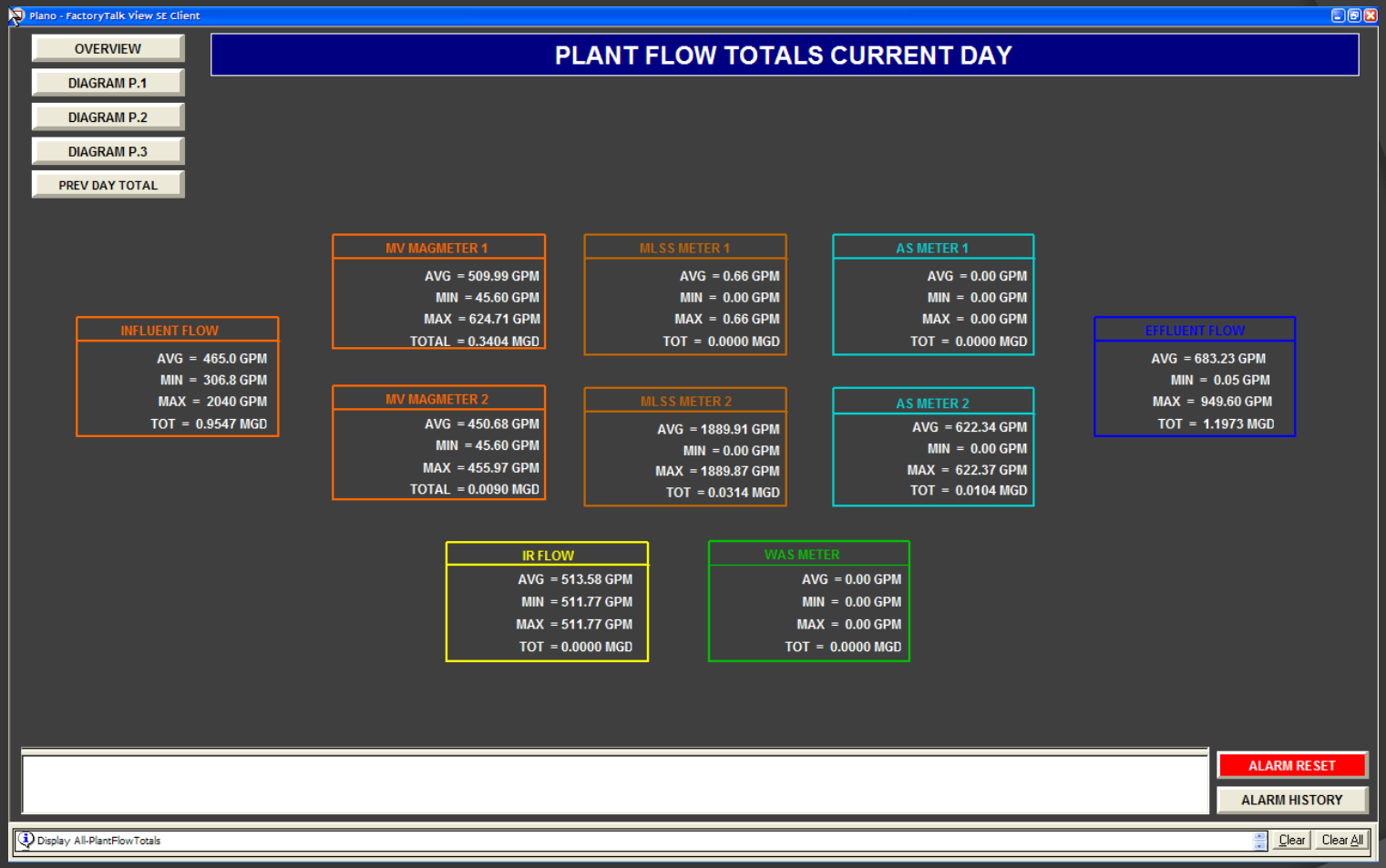
Pressing “DIAGRAM P.2” on one of the Plant Flow Diagram screens will display the second Plant Flow screen. Realtime flows and statistics are shown on the flow diagram. Buttons in the upper left corner navigate to the two other flow diagrams. Pressing the large arrows on the sides of the screen can also be used to access the other diagrams.

SCADA Plant Flow



Pressing “DIAGRAM P.3” on one of the Plant Flow Diagram screens will display the second Plant Flow screen. Realtime flows and statistics are shown on the flow diagram. Buttons in the upper left corner navigate to the two other flow diagrams. Pressing the large arrows on the sides of the screen can also be used to access the other diagrams.

SCADA Plant Flow



Pressing “FLOW TOTALS” on one of the Plant Flow Diagram screens will display the Plant Flow Totals Current screen. Realtime flow statistics for all flows on the current day are shown here. Buttons in the upper left corner navigate to the flow diagrams and previous day totals.

PROJECT OBJECTIVES ACHIEVED and RESULTING BENEFITS

- *Replace existing control systems with modern controls during a major plant expansion.*

  New controls and communication networks provide the foundation for the sophisticated monitoring and control features of this system. Service and parts are now readily available.

- *New motor controls, instruments, and valve actuators, use networked communications whenever possible.*

  New motor control centers, instruments, and actuators all take advantage of the enhanced communications provided by DeviceNet , MODBUS, and Ethernet networks.

- *Automate each process from a local PLC based "RTU". Integrate all OEM controls including HMI screens into the local RTU.*

  In each part of the plant, a PLC based RTU supervises and controls all the elements associated with the process at that location. If an OEM control panel is one of the elements, any HMI screens present are integrated into the RTU's screens and shared throughout the facility.

PROJECT OBJECTIVES ACHIEVED and RESULTING BENEFITS

- *Link all RTUs together with a high speed redundant communications network allowing operation and monitoring of any process from all locations.*

  A redundant fiber optic network provides high speed communications between RTUs and the SCADA system. All RTUs have the full complement of process screens so that any operation can be monitored from any location.

- *Provide a SCADA (Supervisory Control And Data Acquisition) system that includes detailed alarming, data collection, and automated reporting.*

  Monitored data, alarms, and other runtime information is collected and recorded for analysis and reporting. Automated report generation eliminates the need for the operator to record the data and create the report by hand while minimizing errors. Preventative maintenance schedules automatically generate daily reports of items to be serviced.

- *Secure local and remote operation.*

  All access to the system from the SCADA and RTU screens is password protected. Operator activties are logged. Remote operation is by secure dial-up connection.

This presentation of a case study in
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