System Overview

This system is an Auxiliary Fluid System (AFS) that supplies the main chemical industrial processes with Arsenic Trioxide (As_2O_3). The system consists of a large tank with a capacity of 65.5m^3, supplied by <PUMP A> and drained by <PUMP B>. The flow rate of <PUMP A> is fixed, and the flow rate of <PUMP B> is limited by <VALVE B>. If <VALVE B> is closed (0%) then <PUMP B> is automatically shut off. Pressure Operated Relief Valves (PORV) exist to relieve tank of fluid if system is overfilled. This is dangerous – see ***Safety***.

System Limits

Tank Volume	65.5m^3	*PORV triggered (see **Safety**)*
High Level Alarm	62.3m^3	*Pump A auto-shutoff initiated*
Low Level Alarm	06.6m^3	*Pump B auto-shutoff initiated*
Valve B Position	100%	-

Control and Monitoring

The system is controlled by a Phoenix Contact AXC F 2152 PLC. The PLC hosts several Modbus servers to enable HMI control, data acquisition, and manual overrides. The Modbus servers are found on the following ports:

HMI_MB_SERVER	TCP:502	*Dedicated HMI connection*
HIST_MB_SERVER	TCP:1502	*Dedicated Historian connection*
DebugOverrideSERVER	UDP:420	*Multi-connect, for development only*

Content in <HMI_MB_SERVER> and <HIST_MB_SERVER> are identical:

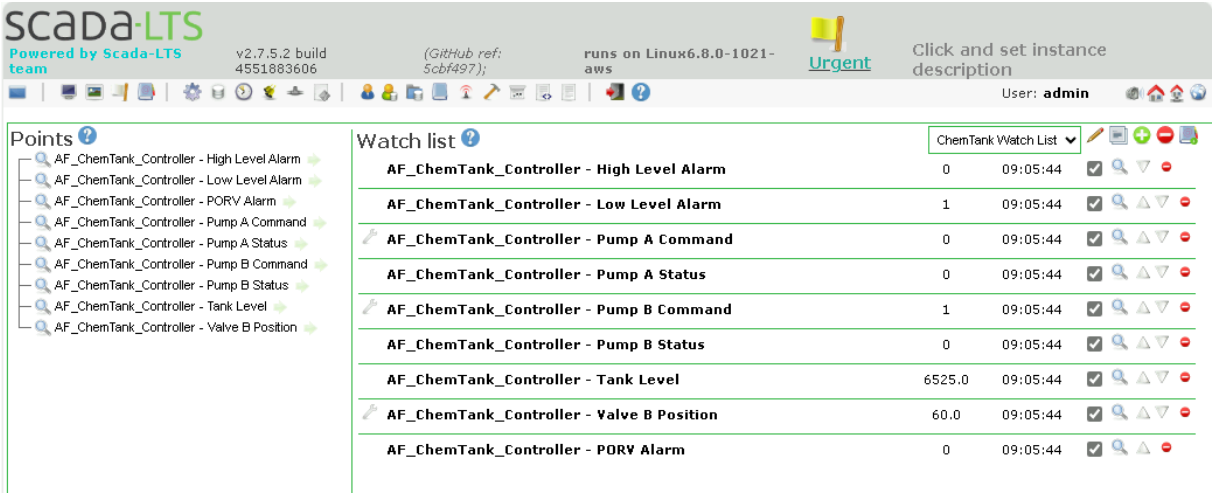
DIGITAL INPUTS (DI) / INPUTS			
DI 0	High_Level_Alarm	*Binary, read-only*	*High level alarm*
DI 1	Low_Level_Alarm	*Binary, read-only*	*Low level alarm*
DI 2	Pump_A_Status	*Binary, read-only*	*Status of Pump A*
DI 3	Pump_B_Status	*Binary, read-only*	*Status of Pump B*
DI 4	-	-	-
DI 5	PORV_ENGAGED	*Binary, read-only*	*True if PORV engaged*
ANALOG INPUTS (AI) / INPUT REGISTERS			
AI 0	Tank_Level	*0-65535, read-only*	*Tank level, m^3*
DIGITAL OUTPUTS (DO) / OUTPUT COILS			
DO 0	Pump_A_Cmd	*Binary, read-write*	*Command for Pump A*
DO 1	Pump_B_Cmd	*Binary, read-write*	*Command for Pump B*
ANALOG OUTPUTS (AO) / HOLDING REGISTERS			
AI 0	Valve_B_Pstn	*0-65535, read-write*	*Position of Valve B, max 100*

Content in <DebugOverrideSERVER> is as follows:

DIGITAL INPUTS (DI) / INPUTS			
DI 5	PORV_ENGAGED	*Binary, read-only*	*True if PORV engaged*
DIGITAL OUTPUTS (DO) / OUTPUT COILS			
DO 5	DisableSafetyLimits	*Binary, read-write*	*If true, pump shutoffs are disabled. Only for testing during maintenance activities* *DO NOT ENGAGE DURING NOMINAL OPERATIONS*

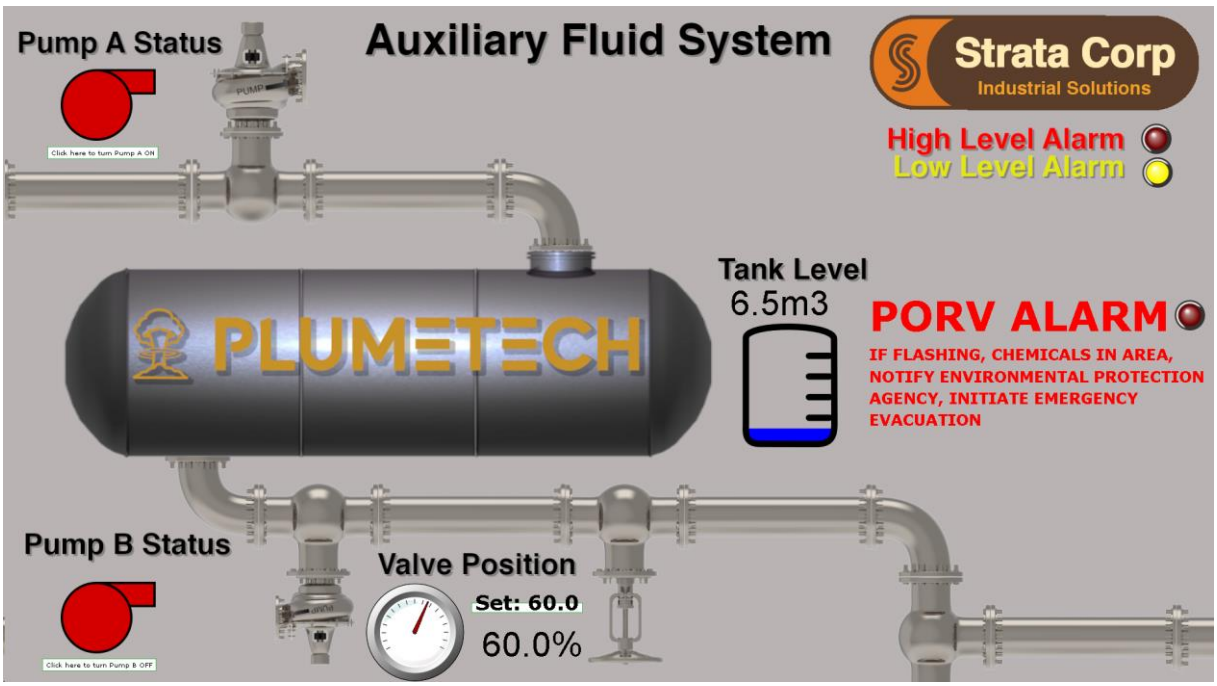
HMI Variable Watch List

The Human-Machine Interface (HMI) is implemented using Scada-LTS to monitor and control the system. The *ChemTank Watch List* contains the variables and their values, as well as the last-update time.



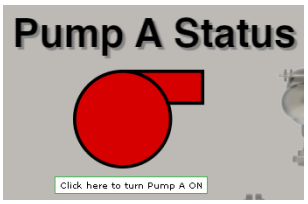
HMI Graphical View

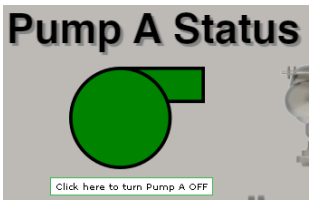
The main graphical view of the HMI enables the user to control the process using the buttons and setpoints on the screen. The HMI Graphical View looks like the following:



Pump Control

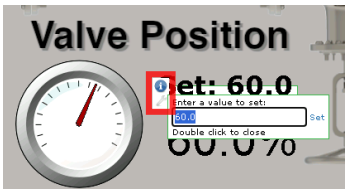
To turn a pump on, click the button below the pump status indicator. To turn the pump off, click the same button below the status indicator. **NOTE: <PUMP_B> will only turn on if the position of <VALVE_B> is greater than ZERO.**





Valve Control

To control the valve position, hover the cursor over the "Set:" input, and click the spanner icon (see red square, right). Enter in a value in the field and hit the enter key on the keyboard. Double-click the tooltip to close it.



Standard Alarms

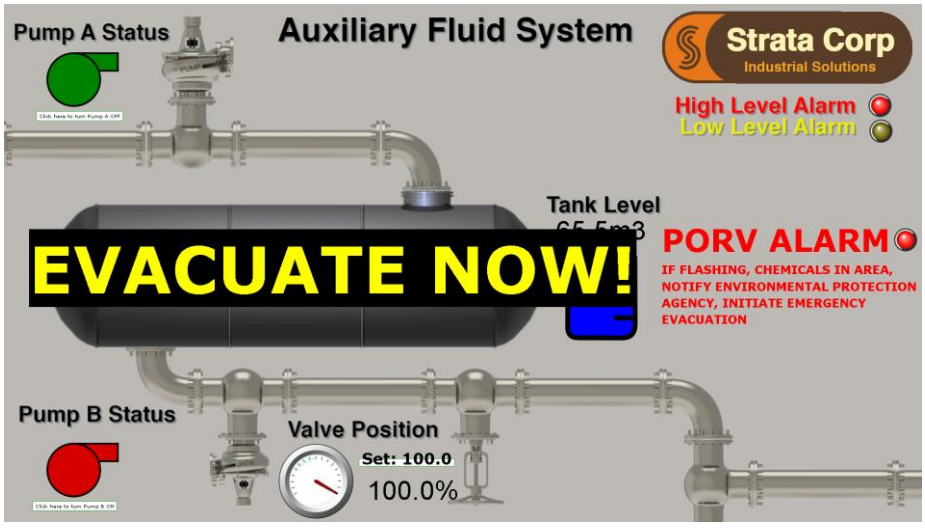
There are two visible standard alarms. These alarms will flash with the high and low limits of the process are reached. If the level of the tank reaches a high of 62.3m^3, the high level alarm will flash and the system will shut off <PUMP_A>. If the level of the system reaches a low of 6.6m^3, the system will shut off <PUMP_B>.

SAFETY – PORV ALARMS

The Pressure Operated Relief Valves (PORV) have their own alarm for when the chemical liquid level reaches the maximum 65.5m^3.

IF THE PORV ALARM IS FLASHING RED, THERE ARE CHEMICALS IN THE ATMOSPHERE - EMERGENCY EVACUATION MUST BE INITIATED.

You will see the following HMI Graphical View state:



Historical Data View

A process historian – a data archiving machine – has been integrated. After navigating to the historian and logging into the interface, the “AF Chem Tank Monitoring System” will show batch historical data from the last 6 hours of operation: