



Hello and welcome to the CybatiWorks™ Pipeline for the DOE Cyber Defense Competition. The CybatiWorks™ Pipeline is composed of an HMI, OPC server, engineering workstation and physical model. The HMI, OPC server and engineering workstation are located on the HMI Ubuntu workstation. The physical extraction and distribution model is operated by a Raspberry PI. This user manual will provide a brief introduction to system operations.

Some notes before we begin. The HMI software is a trial edition that operates with a two hour timeout and a 20 minute monitoring window. Upon the 20 minute monitoring closure, you can simply select Monitoring / Start from the file window. After the two hour termination you restart the CybatiWorks HMI from the desktop menu. The CybatiWorks™ pipeline HMI will automatically start. The engineering software and Raspberry PI controller are also operated as trial editions of the software with timeouts of 2 hours. The Raspberry PI service will need to be restarted after 2 hours of use. A restart script is available on the desktop. You input the IP address of your Raspberry PI and it will login and restart the service. Once the service is restarted you will need to reload the engineering logic using the engineering workstation software. The key applications and files are located on the desktop as shown in Figure 1.



Figure 1. CybatiWorks Pipeline Desktop

The desktop icons shown in Figure 2 provide the basis of the platform. The icons are used as follows:

- RexDraw: Engineering workstation software to review, load and monitor running control system logic
- RexView: Engineering workstation software to monitor and diagnose events in the running logic
- CybatiWorks HMI (PeakHMI): HMI and OPC server to provide operational control and monitoring of the pipeline process
- Link to CybatiWorks Pipeline Logic: direct folder link to the pipeline logic to load open via RexDraw and load to the Raspberry PI controller
- Restart RexCore on PI: Script to restart the RexCore daemon on the Raspberry PI after the two-hour trial timeout expires.

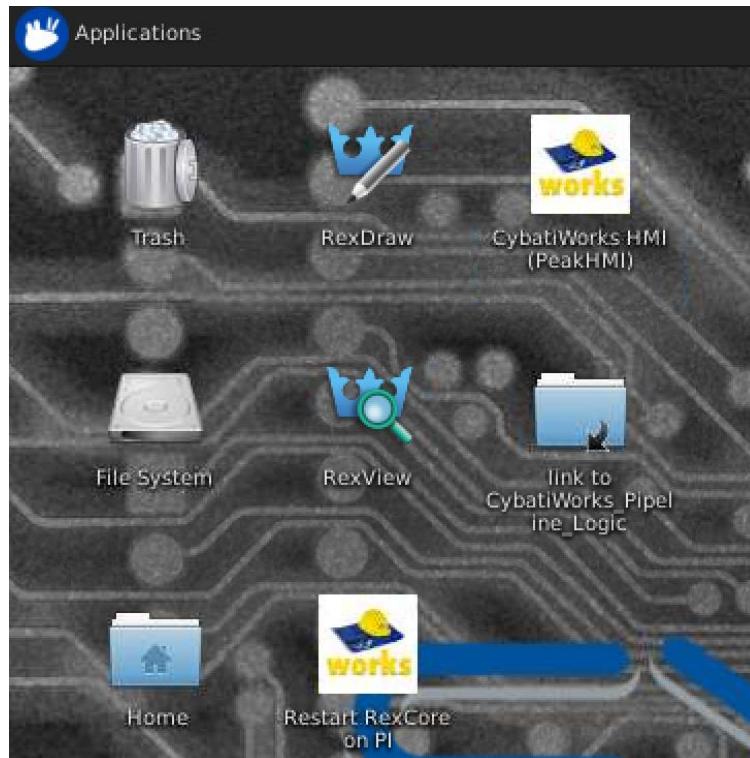


Figure 2. CybatiWorks Pipeline Desktop Icons

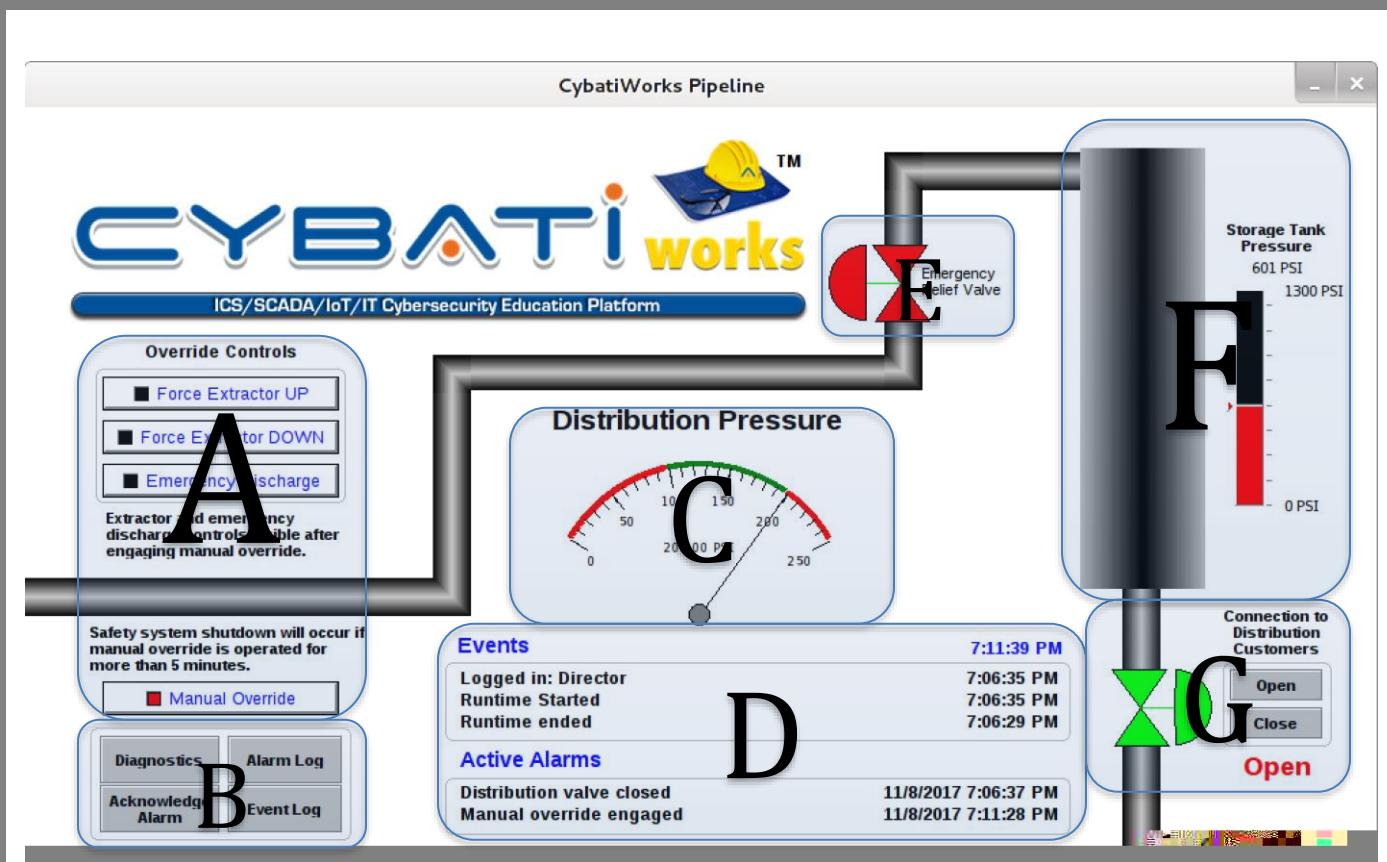


Figure 3. CybatiWorks Pipeline HMI

Clicking on the Desktop link CybatiWorks HMI (PeakHMI) launches the HMI / OPC software and further opens the Pipeline HMI screen automatically. The Human Machine Interface (HMI) has seven distinct elements. The elements are

- Override controls for the extractor and operating the emergency relief valve. Manual override must be engaged prior to operating any overrides.
- Control operations to diagnose tag reads and writes, view the Alarm log, view the Event log and acknowledge alarms.
- Gauge to review the operational pressure of the distribution system. The pressure must be kept within range to assure customer connections.
- Active Events and Alarm entries
- The operational state of the emergency relief valve. Red is closed, yellow is traveling and green is open.
- The current transmission storage tank pressure.
- The operational state of the distribution control valve.



Figure 3. CybatiWorks HMI Diagnostics Window

The diagnostics provide active information about the connectivity to the Raspberry PI port. If the watchdog times out it may be because the trial edition has expired. If this is the case, use the Restart RexCore on the Raspberry PI link on the desktop. You will need to reload the logic using RexDraw once RexCore is restarted.

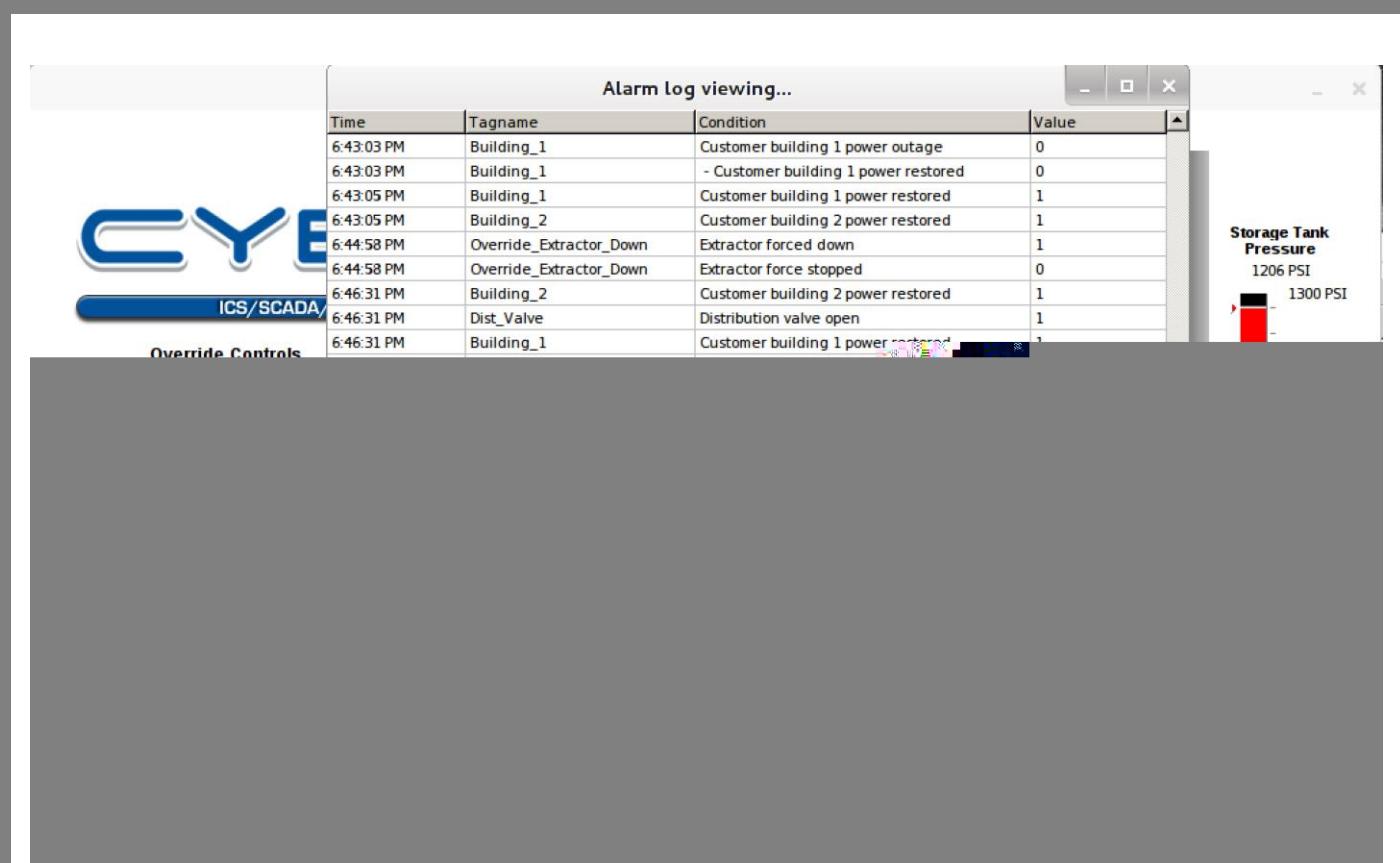


Figure 4. CybatiWorks HMI Alarm Log

The alarm log provides an active review of the alarms within the environment. You can use the alarm log to keep track of what has occurred and to help with troubleshooting events.

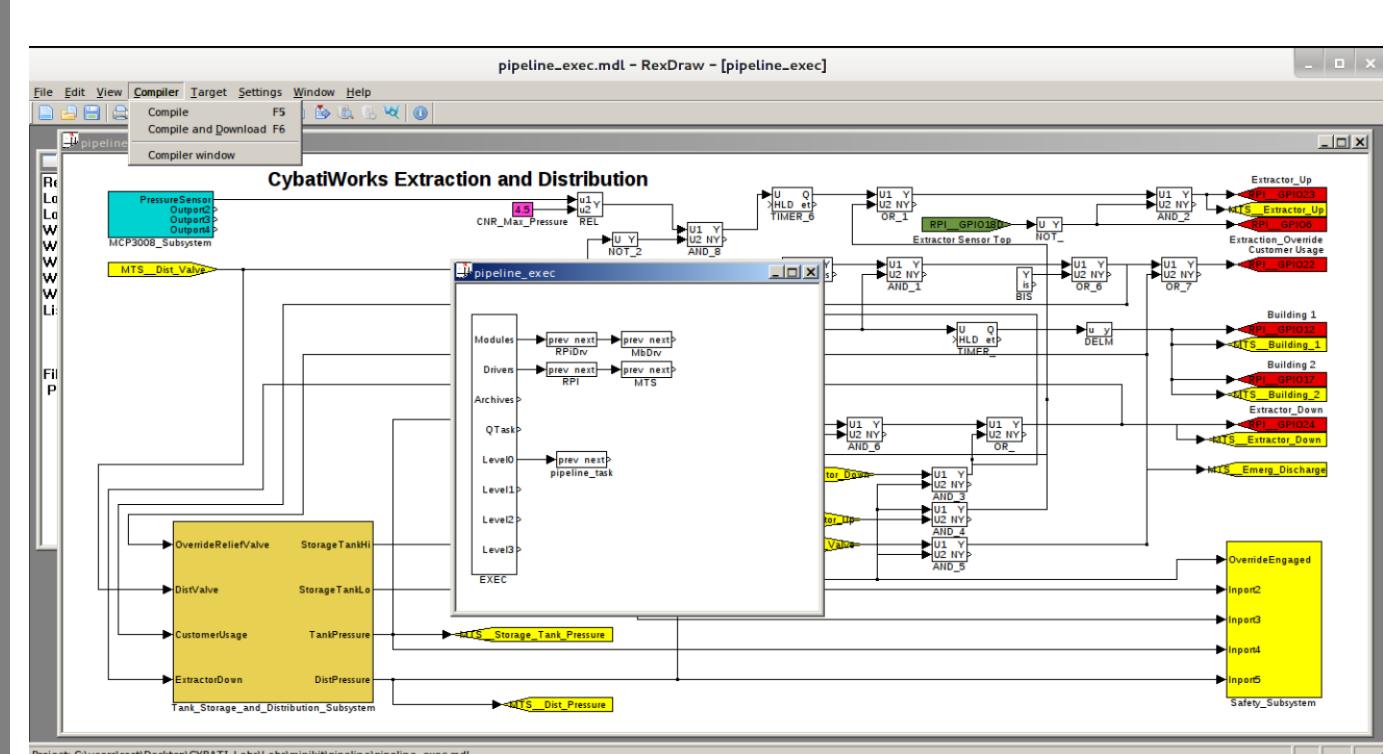


Figure 5. RexDraw Pipeline Logic

The RexDraw pipeline logic can be opened using the “link to the CybatiWorks Pipeline logic” folder on the desktop. Open the folder and double-click on the pipeline_exec.mdl file. Make sure to select the correct file. The exec file will also open the pipeline_task.mdl file within RexDraw. The exec file provides the drivers the engineering logic will use.

Items to explore (Additional guidance is provided later in the manual).

- Double-click on the MTS block in the pipeline_exec window. Click the Special Edit button. These are the Modbus TCP server values that are interacted with by the HMI.
- Select Compile, Compile and Download. You will be prompted for the IP address of the Raspberry PI. Enter it and select download. You will be prompted that this is a demo license. Click OK. The logic is now loaded on the Raspberry PI. Click the watch button. If you receive a socket error you may need to restart the RexCore daemon on the Raspberry PI using the link on the desktop.
- After downloading the logic, click on the pipeline_task window. Then select Edit, and “Select All”. Next click on Target, Monitor selection. You can use this method to monitor the logic live.

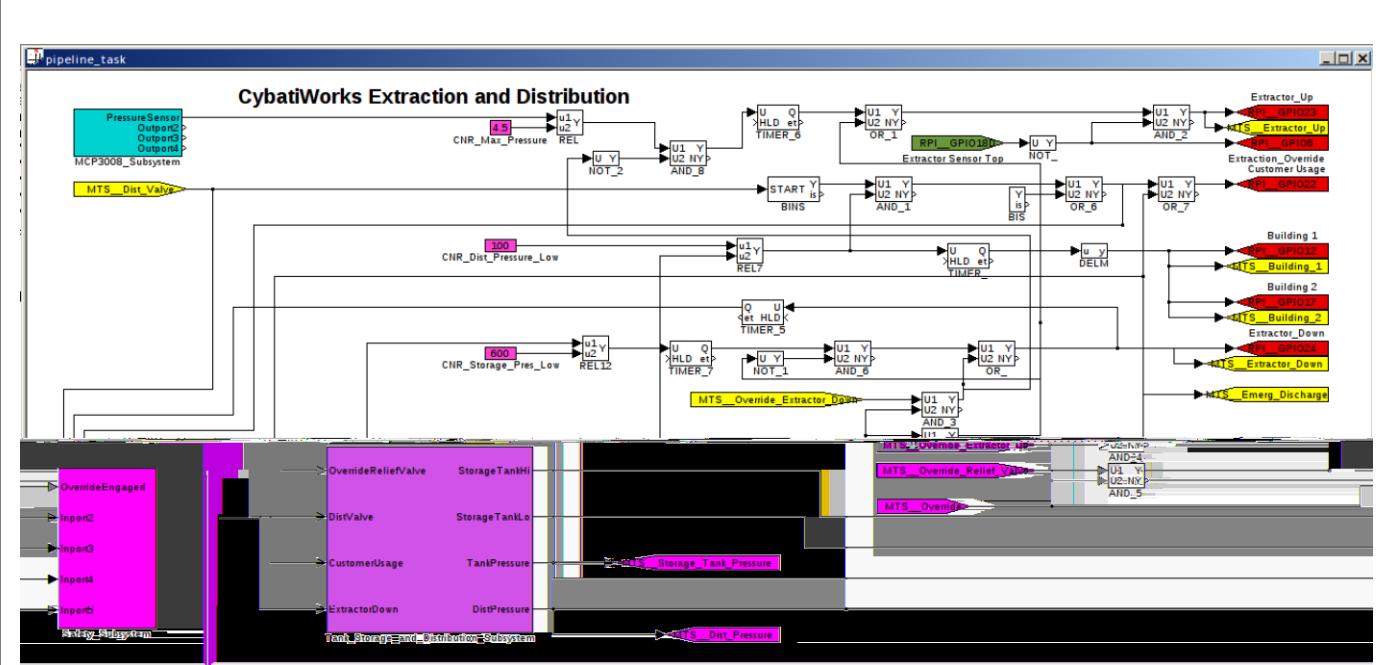


Figure 6. RexDraw Pipeline Logic

The CybatiWorks pipeline logic is located in four files.

- Pipeline_task: The main logic file that manages the extractor, storage tank, distribution tank, valves, pressure sensor and safety system.
- MCP3008_Subsystem: The analog input for the pressure sensor.
- Tank_Storage_and_Distribution_Subsystem: The logic to simulate the operation of tank storage and distribution with valves.
- Safety_Subsystem: An automated safety to provide safety to the people around and operating the process.

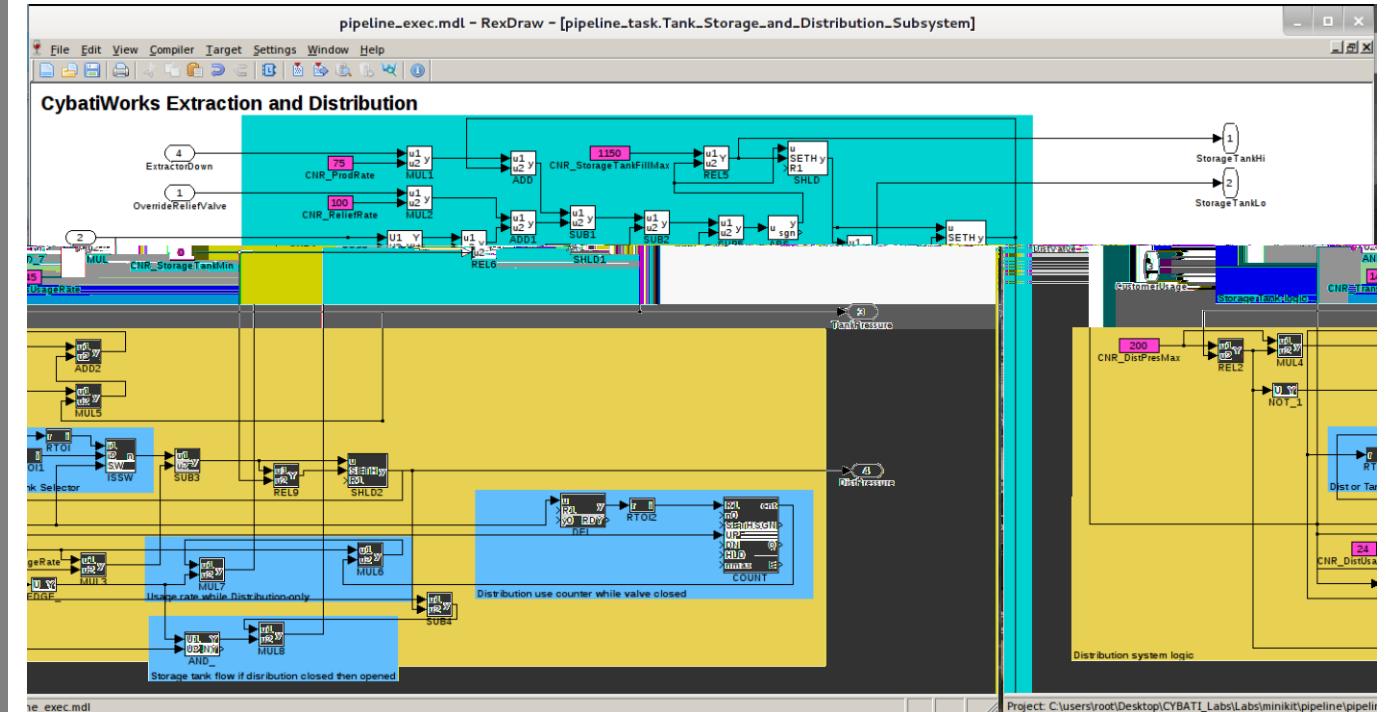


Figure 7. Tank Storage and Distribution Subsystem

This logic provides the ability to simulate a larger pipeline storage, transmission and distribution system.

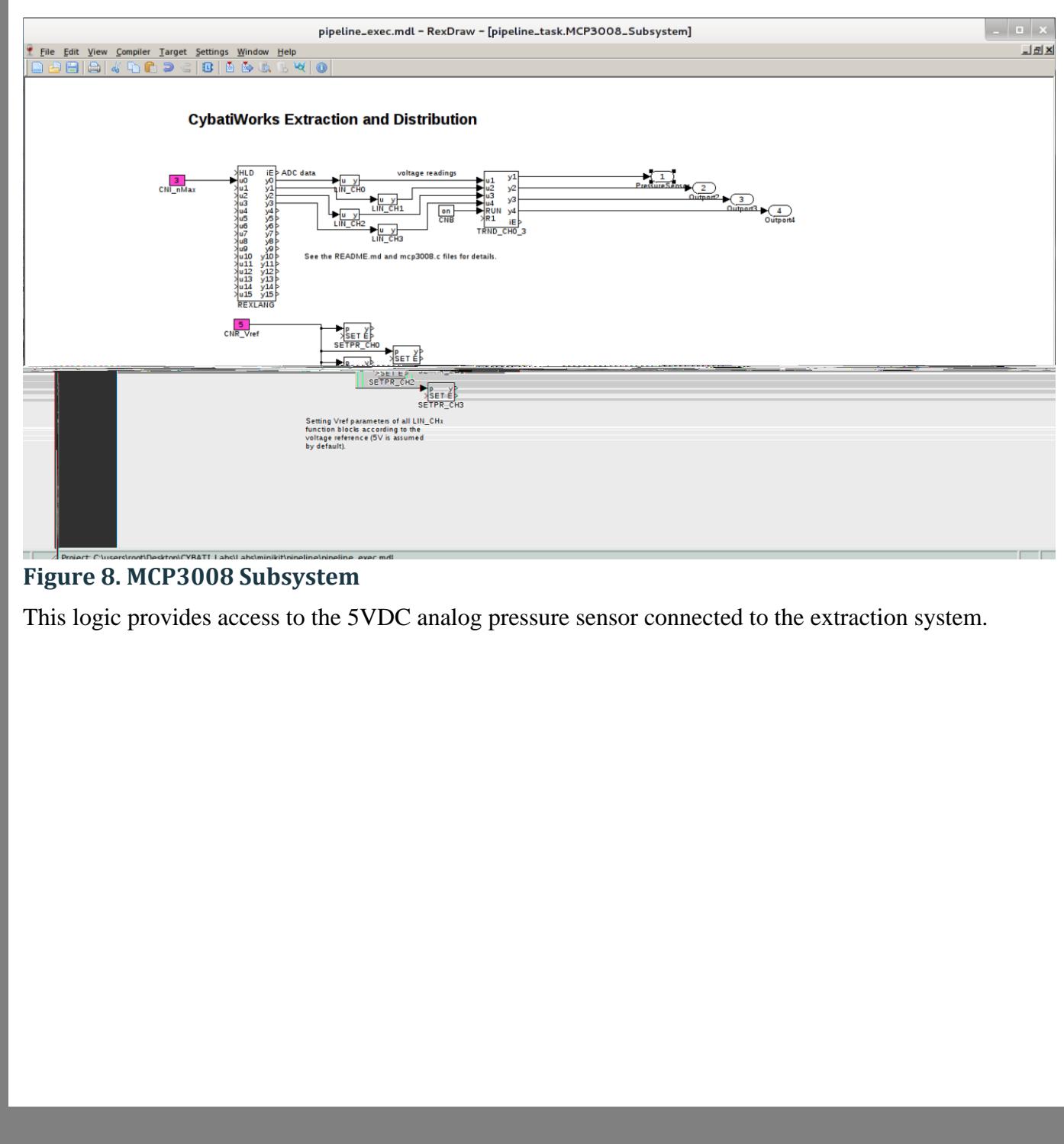


Figure 8. MCP3008 Subsystem

This logic provides access to the 5VDC analog pressure sensor connected to the extraction system.

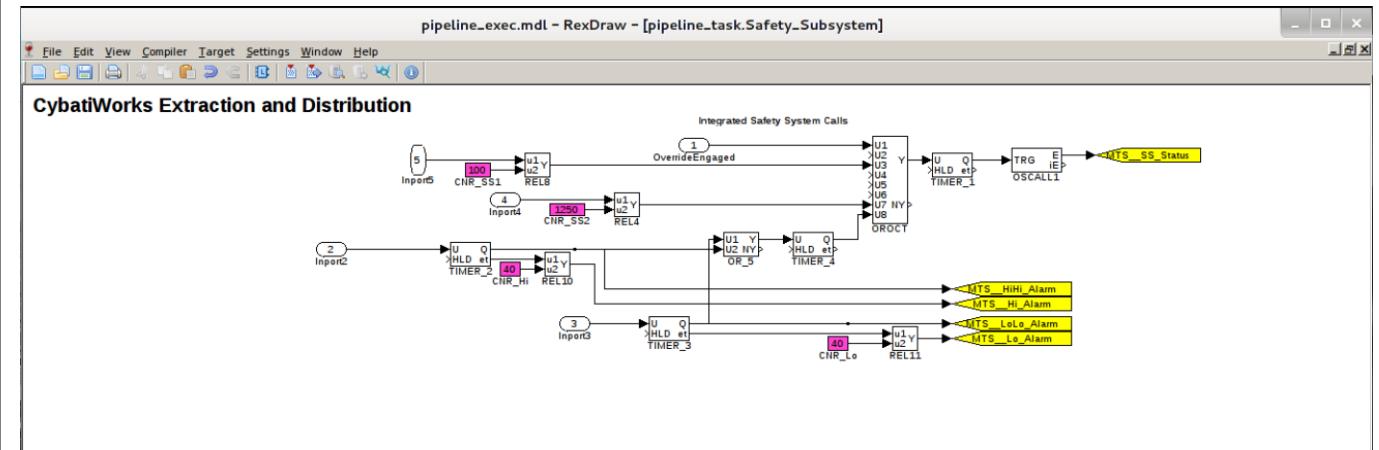


Figure 9. Safety Subsystem

This logic provides automated safety system support to protect the people and process.



Figure 10. RexDraw Logic Compile and Download

Use Compile, Compile and Download to convert the logic to a binary file and transfer it to the RexCore process running on the Raspberry PI.

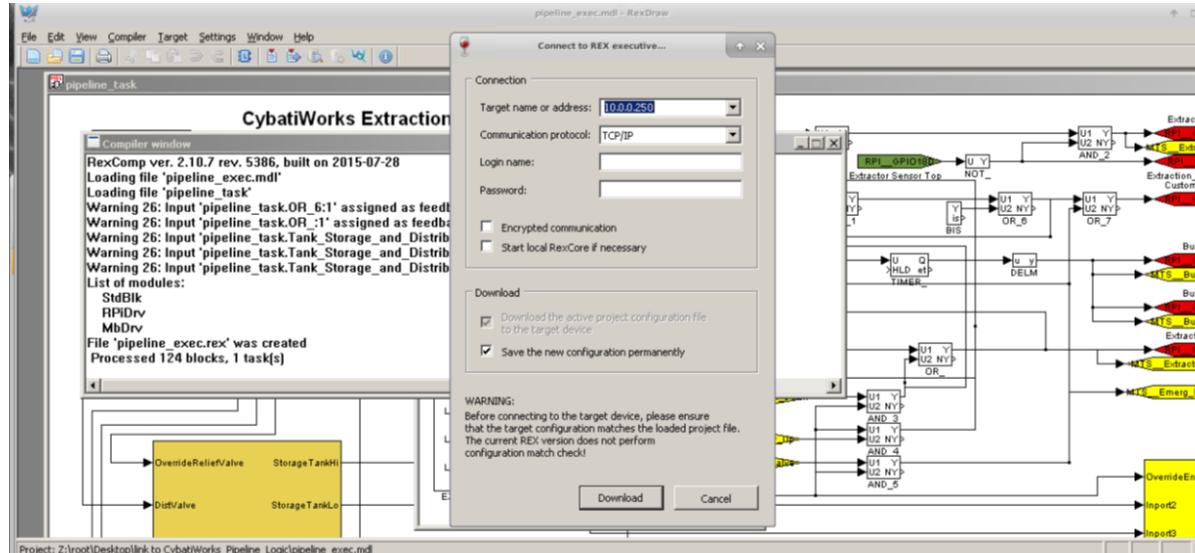


Figure 11. Download Logic to Raspberry PI

Enter the Raspberry PI IP address and select Download.

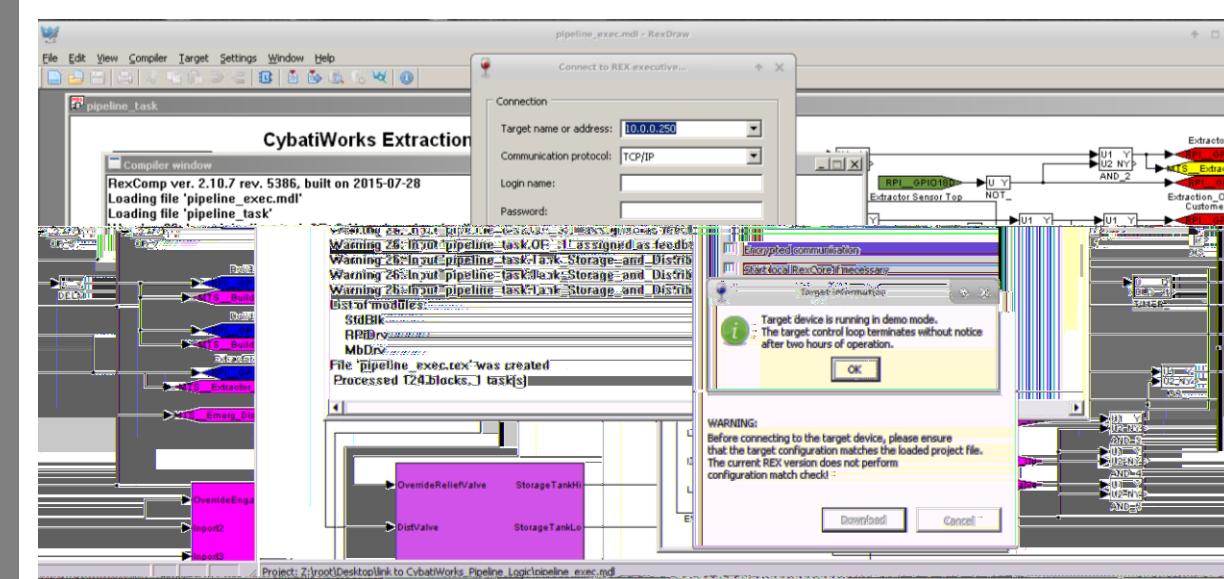


Figure 12. RexCore Demo Mode

The RexCore process operates in demo mode. Click OK. Remember that will restart the RexCore process using the Desktop script. You will also receive a watchdog alert in the HMI when the service stops.

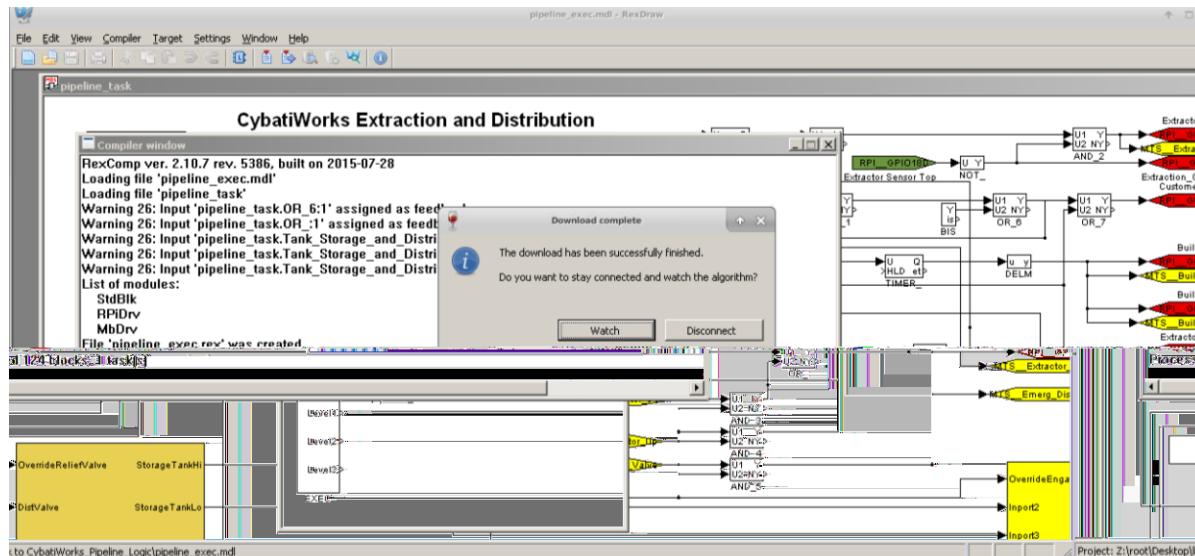


Figure 13. Monitor Active Logic with RexDraw

You can select to watch the active state tables using RexDraw.

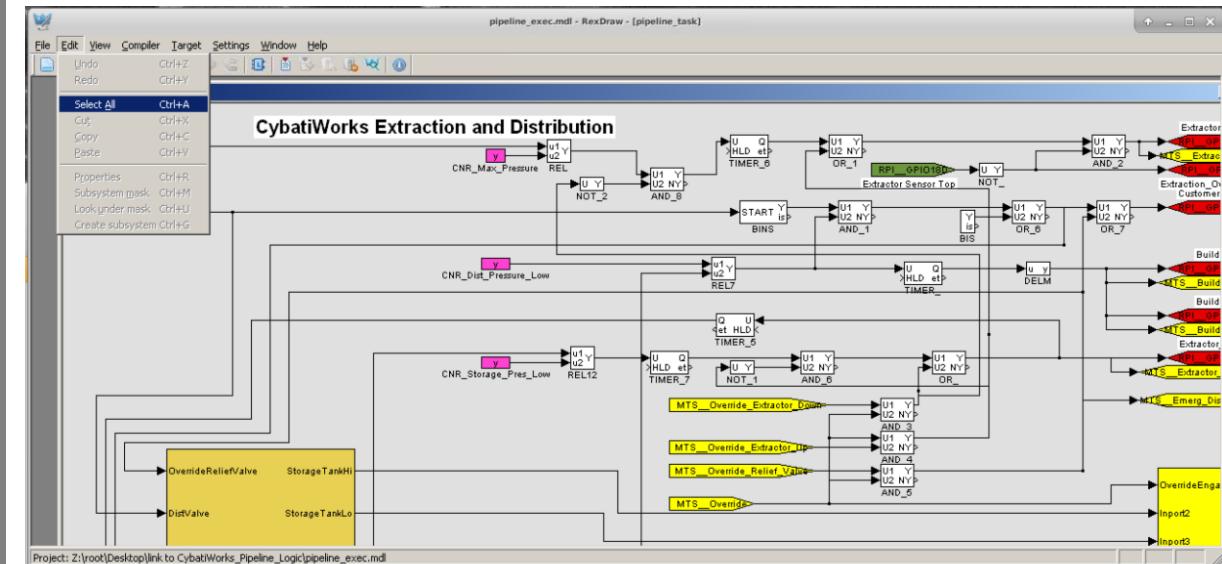


Figure 14. Select all items to Watch

If you selected “Watch” mode then you can use Edit, Select All to monitor all state changes.

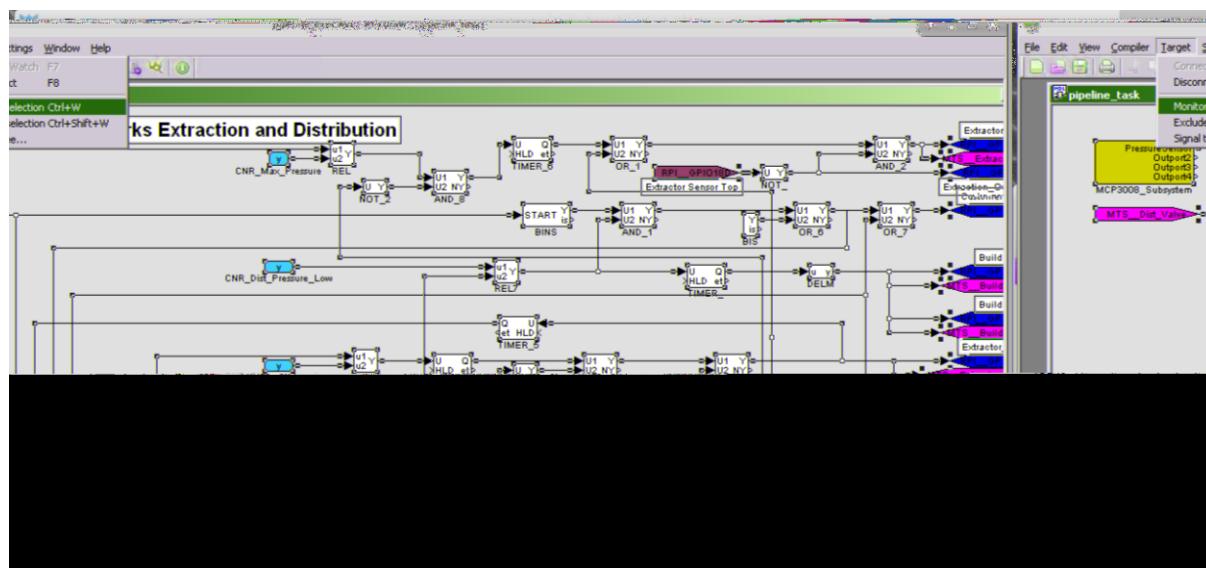


Figure 15. Target Monitor Selection

After selecting all, you choose Target, Monitor Selection to watch the state changes.

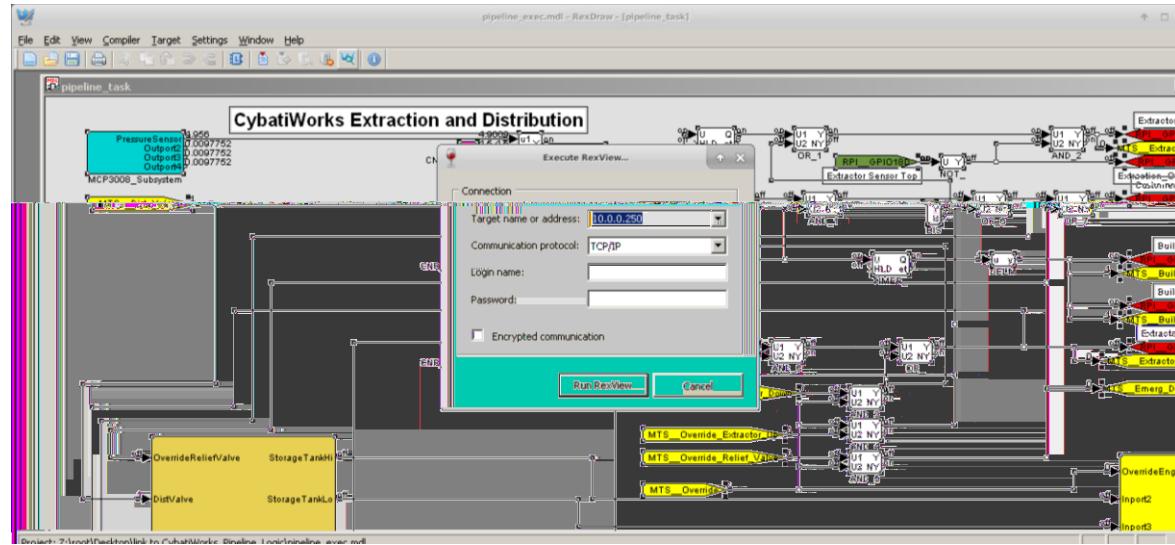


Figure 16. RexView Diagnostics

RexView provides a more feature rich diagnostic program. You can find it within RexDraw or on the desktop. After opening you will be prompted for the Raspberry PI IP address and click “Run RexView”.

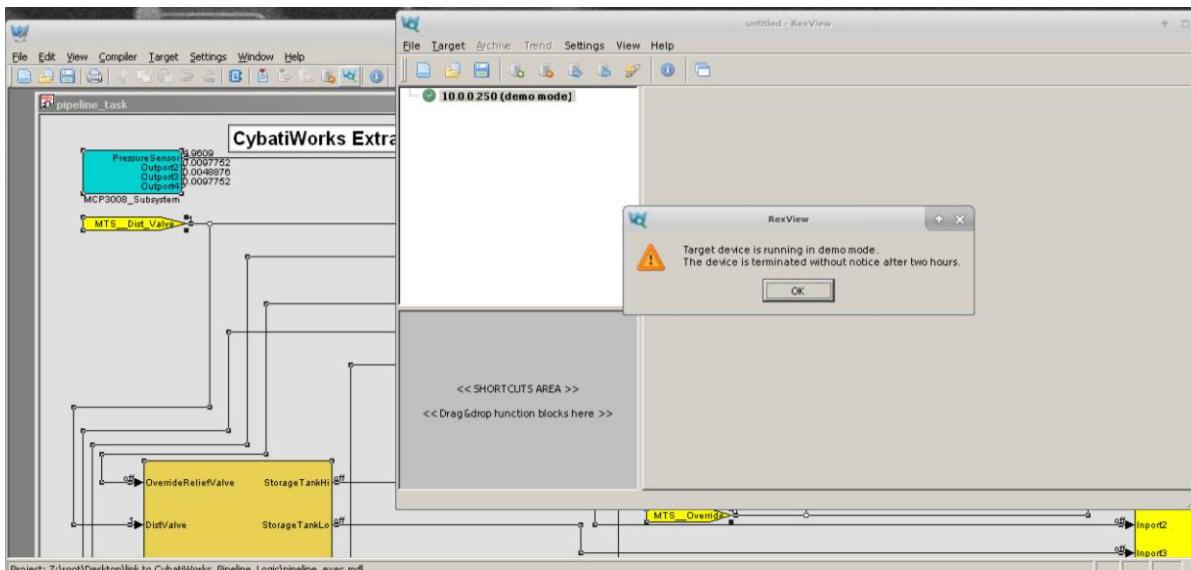


Figure 17. RexView Demo Mode Prompt

Click OK to accept demo mode.

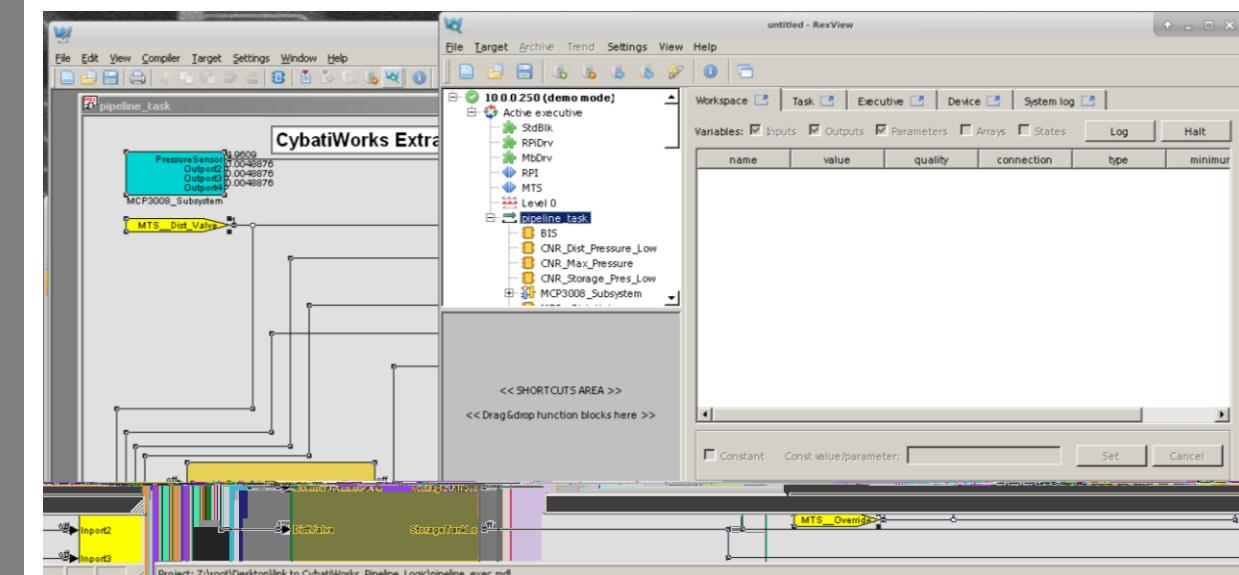


Figure 18. RexView Active Monitoring and Diagnostics

The RexView application provides active monitoring and state diagnostics.

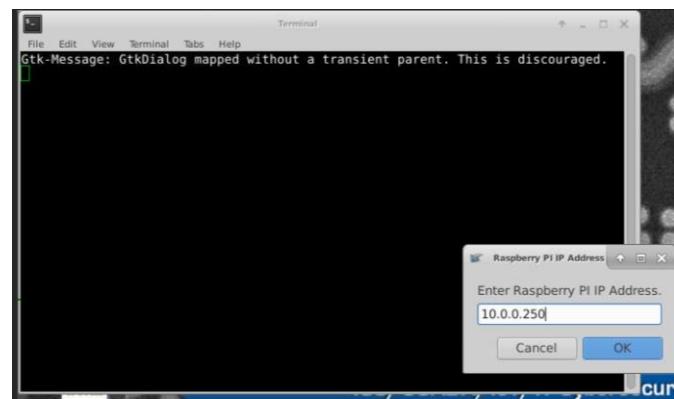


Figure 19. Restart RexCore on the PI

You can select restart RexCore on the PI from the desktop to restart the RexCore daemon once the trial period has expired. The logic needs to be reloaded upon restarting.

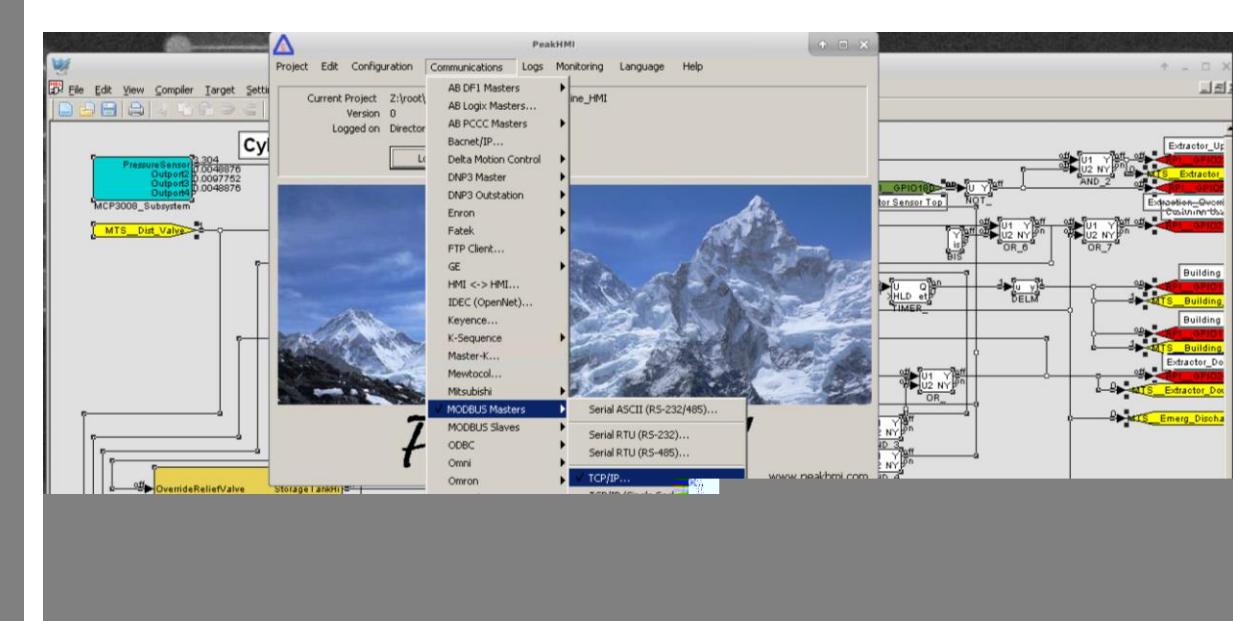


Figure 20. Setting the Raspberry PI IP address in the HMI/OPC Server

The Raspberry PI IP address can be set in the HMI/OPC server by selecting Communications, Modbus Masters, TCP/IP.

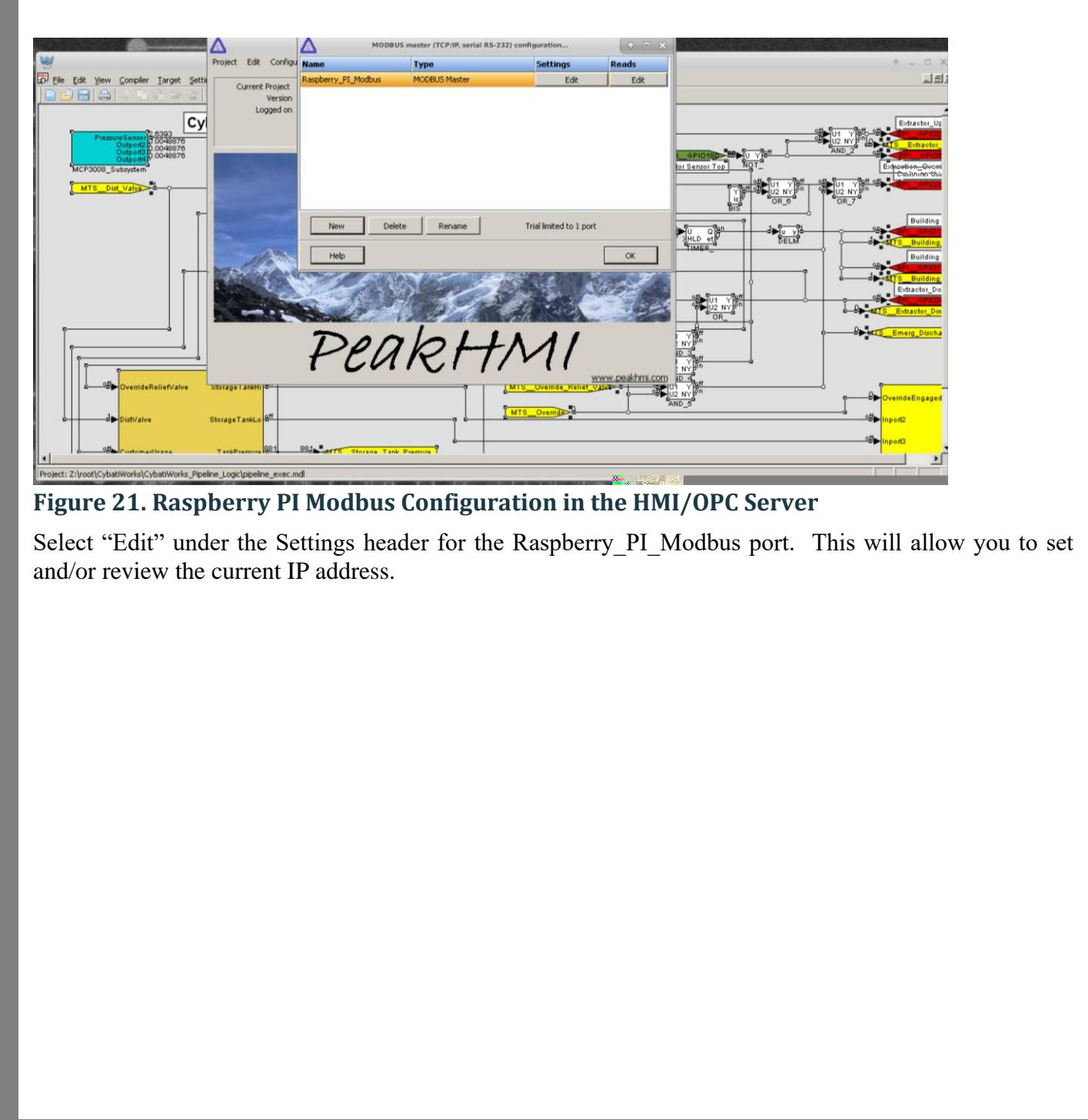


Figure 21. Raspberry PI Modbus Configuration in the HMI/OPC Server

Select “Edit” under the Settings header for the Raspberry_PI_Modbus port. This will allow you to set and/or review the current IP address.

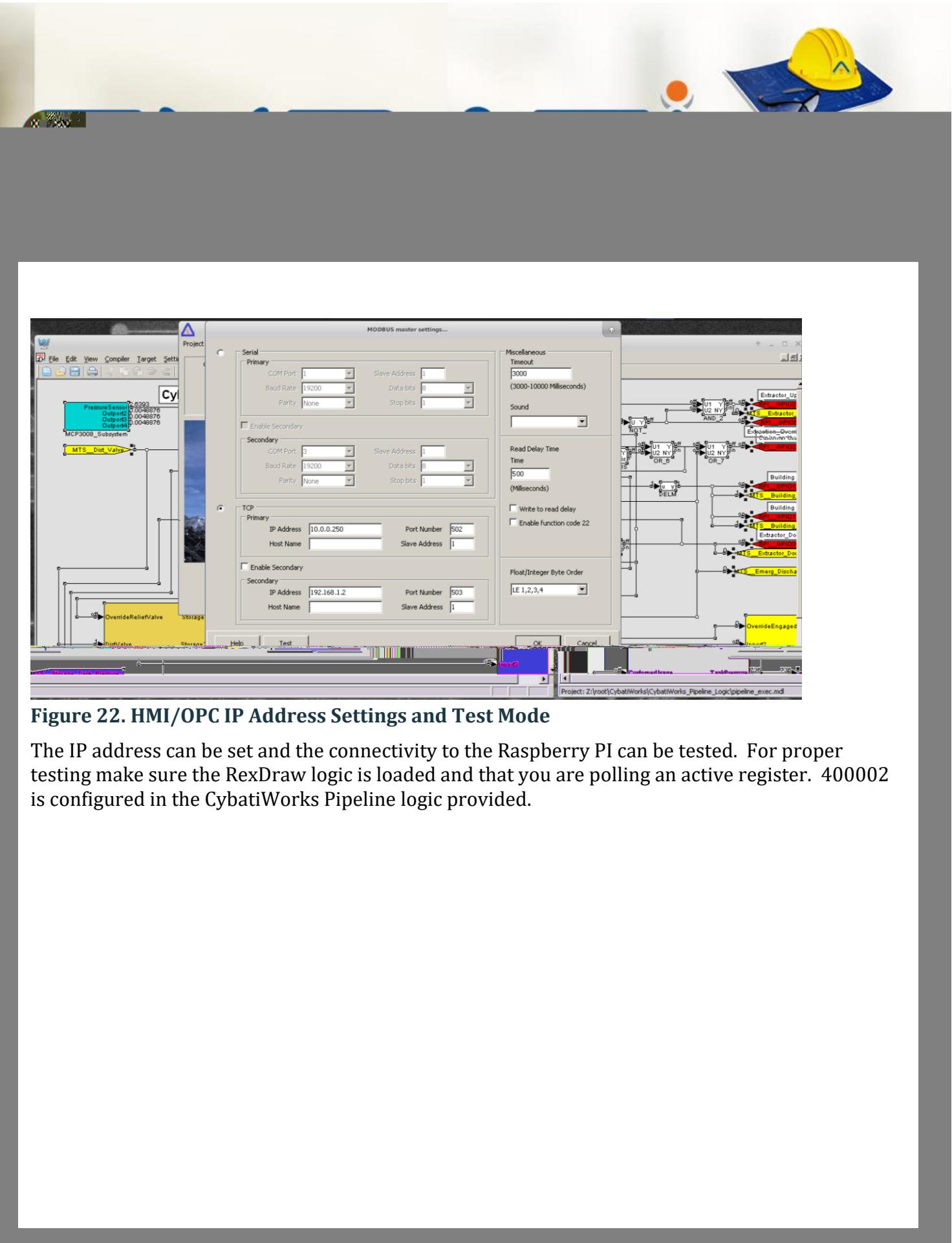


Figure 22. HMI/OPC IP Address Settings and Test Mode

The IP address can be set and the connectivity to the Raspberry PI can be tested. For proper testing make sure the RexDraw logic is loaded and that you are polling an active register. 400002 is configured in the CybatiWorks Pipeline logic provided.

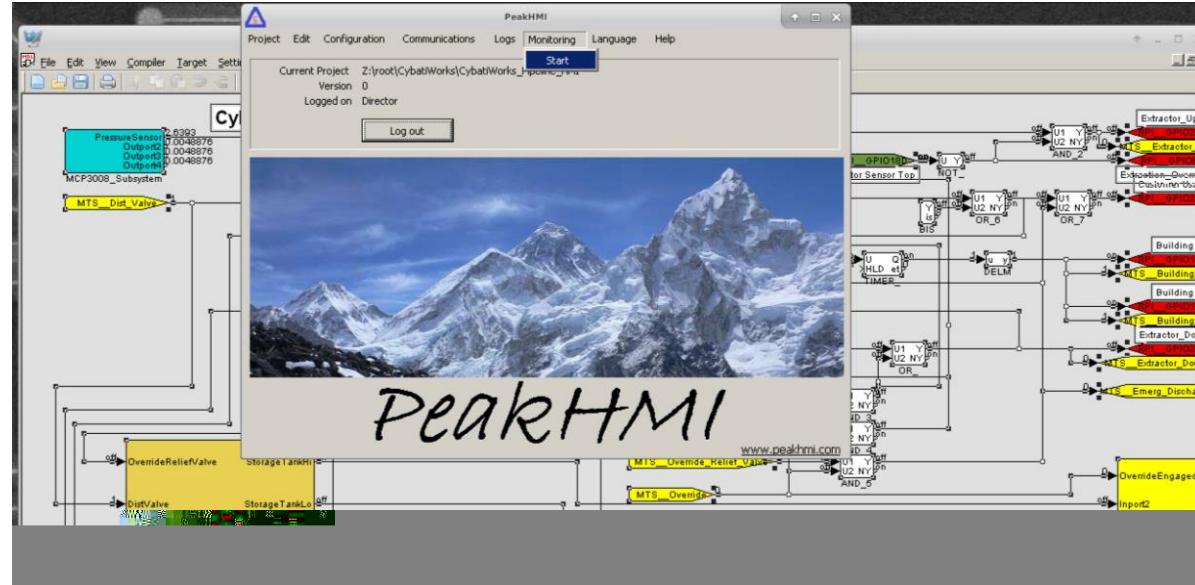


Figure 23. Restarting Monitor Mode in the HMI

The HMI is set to stop monitoring in twenty-minute intervals while using demonstration software. Simply click Monitoring then Start to launch the HMI again. Every two hours the HMI will stop entirely and you will need to launch it from the Desktop.