



# Fuel Blending & Controls Upgrade

*Waukesha Digester Cogen Units*

# Project

## CHALLENGE

To meet the new permitting standards only allowing the 3 Waukesha Cogen units to run on no more than 50% natural gas.

## SOLUTION

To provide the customer with a turnkey solution to optimize efficiency & run time of the cogen units.

Blend the digester and natural gas to meet new permitting standards.



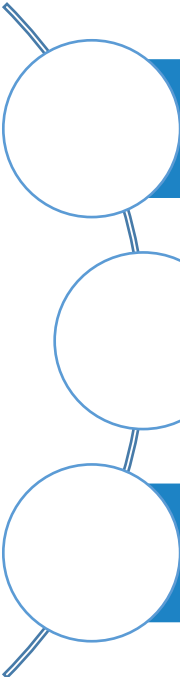
# Previous Operating Obstacles

To meet the new permit, previously, the units ran solely on digester gas and load levels had to be adjusted based on their digester gas production.

If production was low, then the generator was running at a low load (300kW), which substantially increases maintenance & oil consumption.

This low load also decreases efficiency & the heat production is insufficient in meeting the facilities needs.

# Overview

- 
1. Biogas production in wastewater plants changes daily
  2. Blending (substituting natural gas) can offset these issues
  3. Upgraded engine controls are required



# Overview

---

## Biogas production in wastewater plants changes daily

---

Generator loads are adjusted to reflect production

---

Heat from the cogen is required for production

---

---

## Blending (substituting natural gas) can offset these issues

---

We can blend while the engine is at full load

---

When biogas production is low, system will blend to maintain full engine load

---

System will turn on and off automatically based on the production of bio gas

---



# Overview

## Upgraded Engine Controls

Provides more insight to engine/generator parameters

Automatic start/stop, loading/unloading & blending

Allows for trending, more engine/generator protection & remote monitoring

Faster reactions to engine load & emission changes

Lower maintenance cost & predictive maintenance forecasting



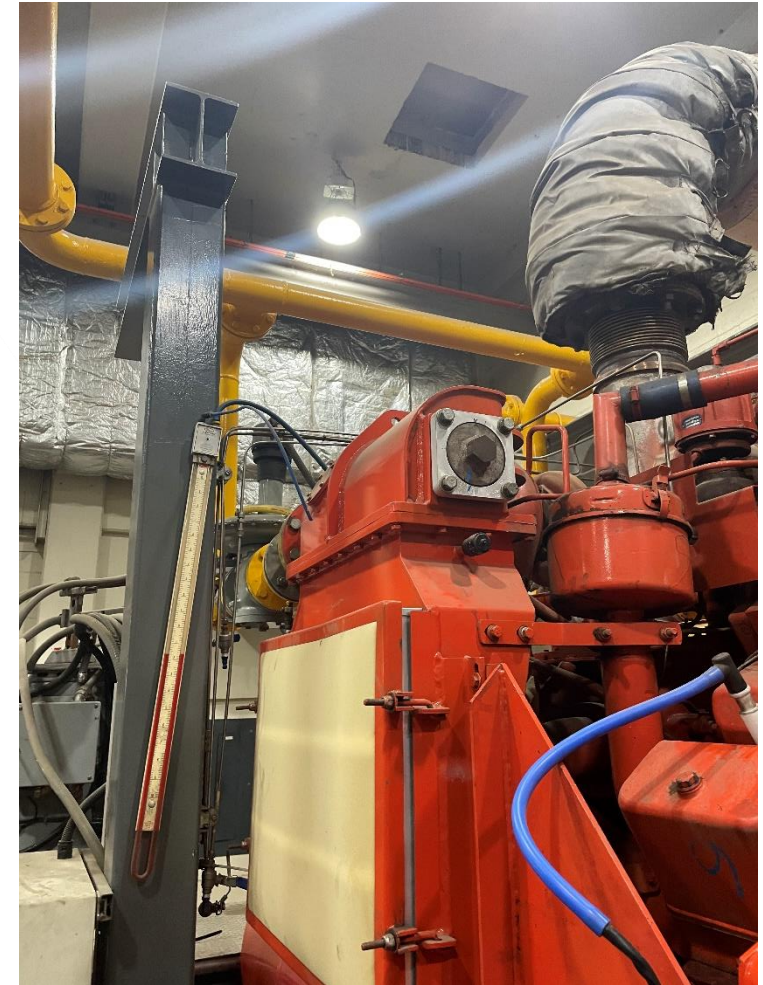


# Existing System

The onsite Waukesha generators had old AFM modules with barrel valves. They required significant component travel to maintain correct emissions.

This made tuning the engine very tedious, time consuming & labor intensive due to the continuous adjustment of the barrel valves and programming of the AFM.

These AFM modules received information from the oxygen sensors to make the required change in engine emissions. Inconsistent readings from the sensors caused large variances in engine emissions.



# New: Air Cleaner & Motortech Varifuel AFR Installed



## The Motortech Varifuel

- Minimal adjustments required
- Automated and incredibly fast response
- Automatic adjustments are based off of combustion temperature as well as kW reading from the controller
- It has a range from 0-100%
- At high idle & no load the Varifuel is at the 45% position
- At 95% engine load the Varifuel is at 46.5% position





# New: Throttle Body

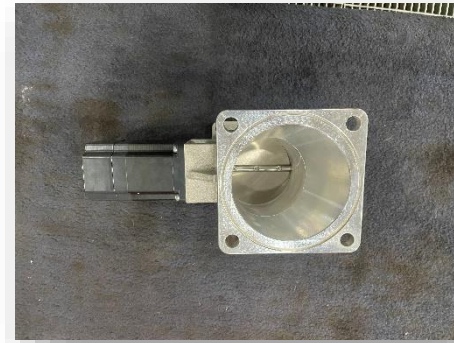
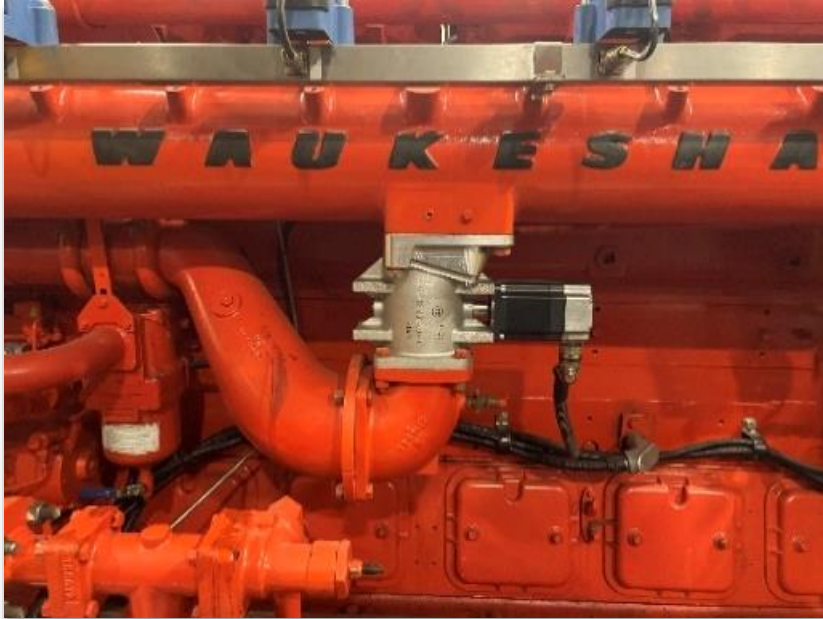


Old throttle body with a shaft through the block to sync the throttles



New throttle body

# New: Throttle Body



- New independent electronic throttle bodies installed.
- Eliminated the shaft that pins the throttles to operate simultaneously, allowing both throttle bodies to stay at the same angle.
- Using one stepper motor card that drives both throttles.



# Old Engine Controller

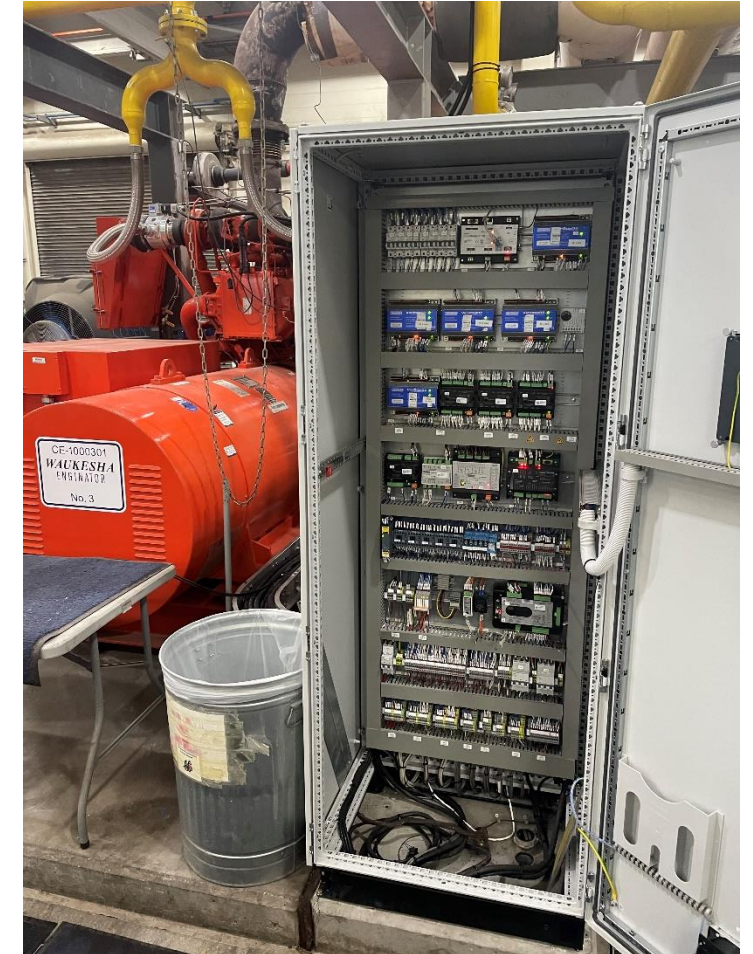


- Any new programmed parameters would need to be written or burned into EPROM.
- The memory is limited to only 5 writes before replacing the EPROM.
- The old engine controller is limited to 5 sensors with alarms/shutdowns with vague data annotation issues.

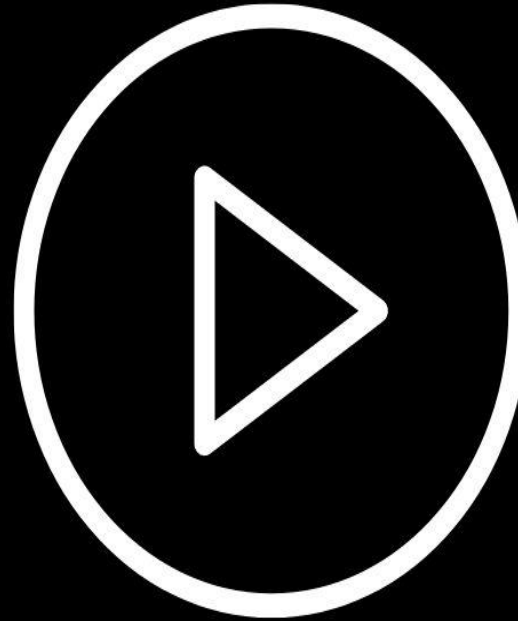
Old AFM model, antiquated system with chips and EPROMs.

# New: Updated Controller

Upgraded controller with unlimited programming and hundreds of monitoring capabilities with recording.



# Updated Controller Page Views





# Old Switch Gear

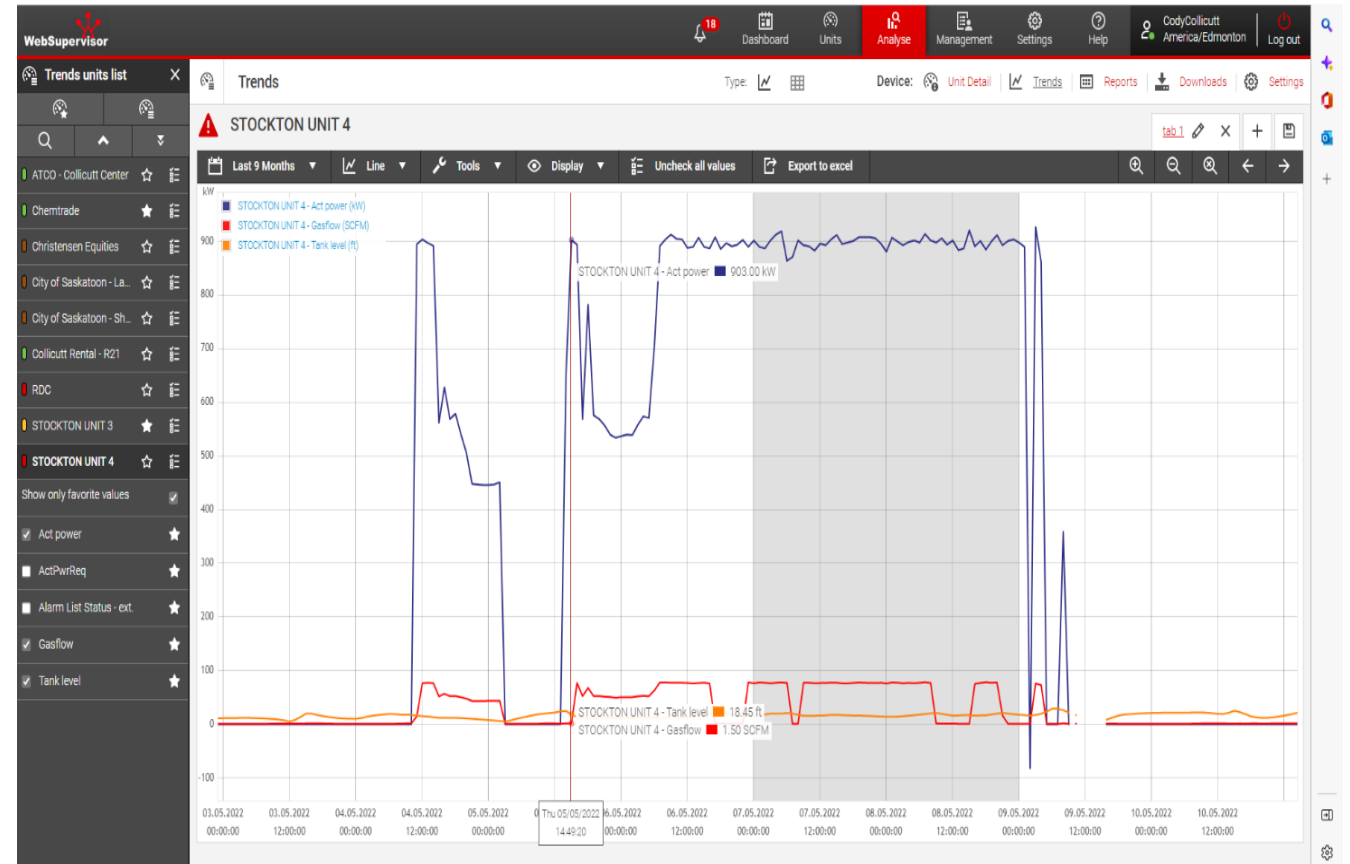
This is the old switch gear that was used for paralleling the generator to utility.

Our controller in the previous slide has now taken over the breaker control & syncing, thus making these controls almost irrelevant.



# Blending

- The digester tank is equipped with a tank level sensor.
- When the tank level is below 16', we start the blending process.
- When the tank level increases to 21', we begin to reduce the natural gas and stop blending.
- We installed an electronic butterfly valve that controls the flow of natural gas for the blending process.



# Blending



- We use a natural gas flow meter to determine the butterfly valve position when the unit is blending.
- Over the course of 4 minutes, we will substitute up to 49% of the natural gas into the engine.
- During the blending process we will also start to retard the engine timing to compensate for the higher BTU of the natural gas.
- This is all completed when the engine is at 95% load and still maintaining emissions, therefore the unit doesn't skip a beat.

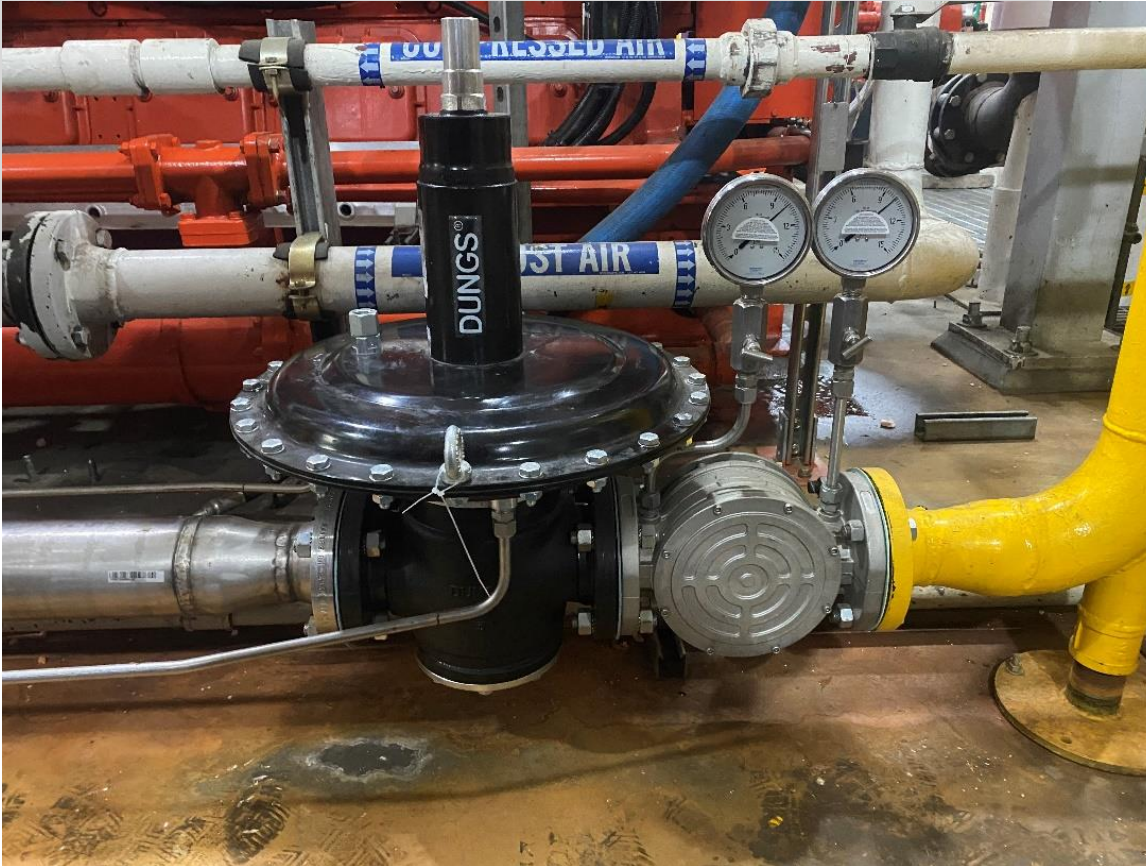
# Blending – Mixing Valves & Shut Off Valves Fuel Regulator



If tank level continues to decrease below 12' while the engine is still blending, the engine load will automatically derate to 40% load on a linear bias.



# Blending

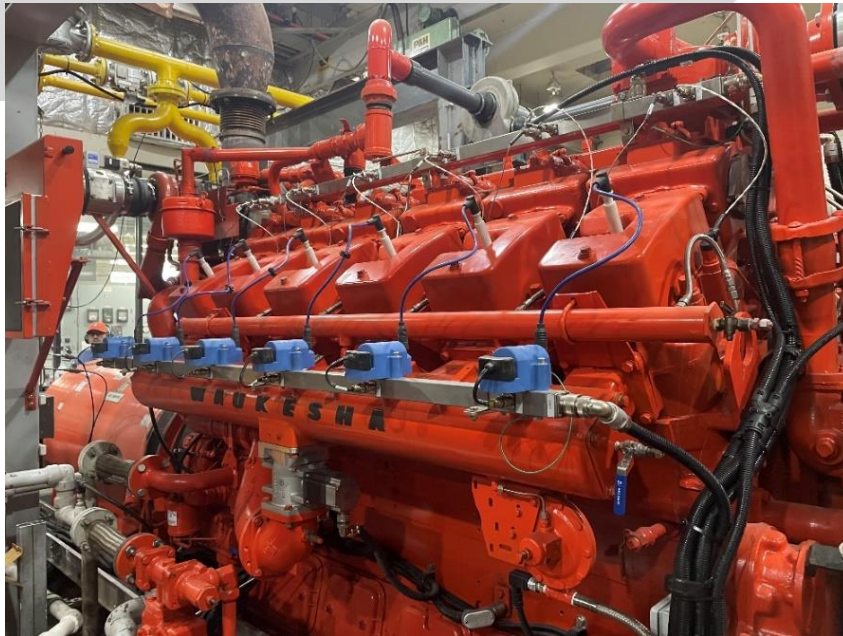


The upgraded digester fuel regulator maintains specific downstream fuel pressure no matter what the incoming pressure is.



# Fuel Rail Upgrade

These are the Motortech alpha rails, combining detonation sensors with thermocouples. Twelve (12) detonation sensors are mounted on each cylinder head bolt.

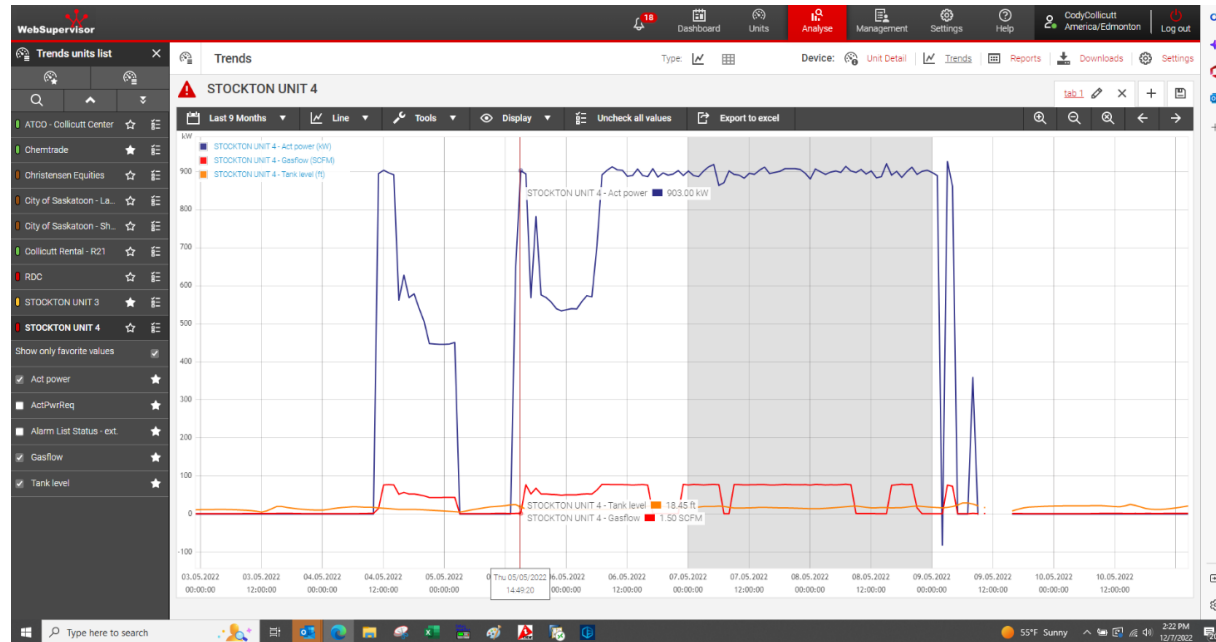


They provide accurate measurements of cylinder detonation & a more precise reading for each cylinder. This also cleans up the electrical & reduces wire chafing from vibration.

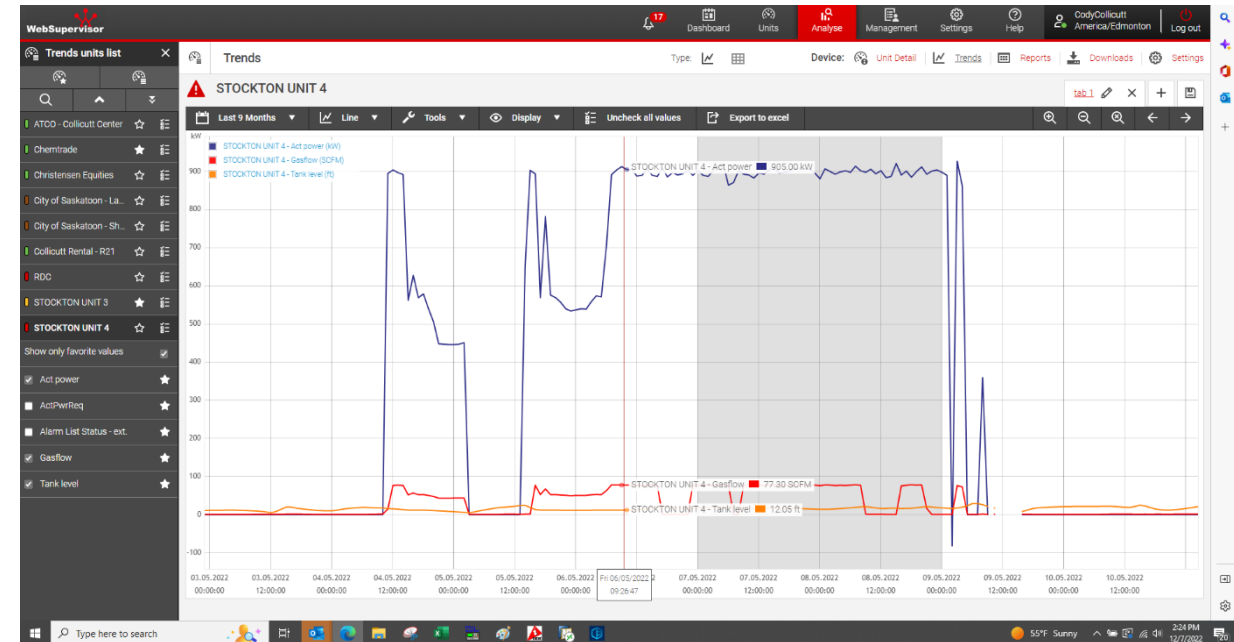
# Remote Monitoring

- The remote monitoring system allows you to access the site/equipment from anywhere through a secure internet connection.
- You can start & stop equipment, tune engine and check history; all remotely.
- You get real-time updates and alarm notifications.
- Alarms/Shutdowns will be sent via email or text.
- Remote monitoring is available via mobile app.

# Remote Monitoring



Engine at 900kW tank level is 21' feet with 0 natural gas flow.



Engine at 905kW tank level at 12' below the 16'.  
Natural gas starts flowing at 77 CFM.



888.682.6888 | [info@collicutt.com](mailto:info@collicutt.com) | [collicutt.com](http://collicutt.com)





☎ 888.682.6888

✉ [info@collicutt.com](mailto:info@collicutt.com)

[collicutt.com](http://collicutt.com)

