Peaker Services Inc.

Location
Hoffer Plastics
Elgin, Illinois

Type of Installation
Island-Mode On-site Power

Power Source
- (9) CAT 3516 Engines
- Battery Pack

Unique Obstacle
Mechanical governor engines with older ignition system and obsolete switchgear

System/Product Used
E6 system including:
- Ignition Module (9)
- Ignition Coils (144)
- Knock Module (9)
- F-Series Trim Valve (9)
- easYgen Control (9)
- Knock Sensors (144)
- Wire Harness (9)

Result
Modern powerplant with improved performance

CONTACT

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Peaker Services, Inc. Case Study
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Extensive Digitization Controls Upgrade Gives Power Plant New Life

Hoffer Plastics installed nine CAT 3516A natural gas engines in 1994 for onsite power and cogeneration. The power plant had a number of reliability and safety problems including: obsolete and outdated switchgear and ignition systems, older mechanical governed engines, brittle wire-harnesses, and a knock system that could only detect major events. The goal of the upgrade was to provide facilities with unmanned reliable island-mode power that could start in minutes.

Mechanical Governor and Fuel Valve

Pre-Upgrade

Fig. 1 Engine Gensets

Fig. 2.1 Switchgear

Fig. 2.2 Engine Control Panel

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Unique Improvement
Mechanical governor replaced with electronic actuator

System/Product Used
- ProAct Electric Actuator
- F-Series Trim Valve

Results
- Less maintenance
- Better fuel control
- Better air control
- Improved monitoring capabilities
- Better diagnostics

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The engine throttle was controlled with an engine driven and engine oil supplied hydraulic actuator through multiple bar linkages (Fig. 3, 4 and 5):

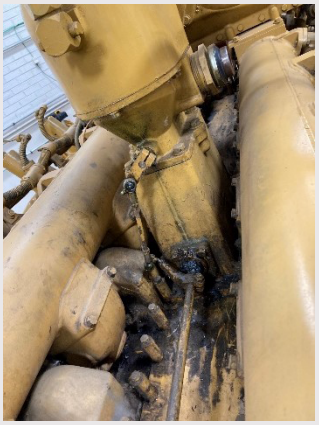

Fig. 3

Fig. 4

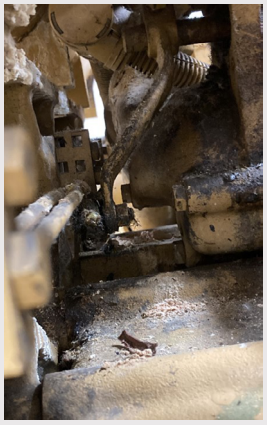

Fig. 5

Each of these non-linear throttle linkages, couplings, and bearings were difficult to set up, needing regular greasing. Compared to modern electronic throttles, these governors were limited in adjusting for changes in load or environment.

Post-upgrade

The throttle control was upgraded to a ProAct™ electonic actuator, and the air fuel ratio trim valve was replaced with an F-Series electronic trim valve (Fig. 6 and 7).

Fig. 6

Fig. 7

The new ProAct™ throttle and F-Series fuel trim valve (Fig. 6 and 7) result in exceptional air/fuel ratio control, providing the contoller with the ability to continuously adjust for fuel and environmental changes. These actuators are controlled by LAT (limited angle torque) motor actuators. These brushless torque motors include on-board software and digital intelligence to monitor and diagnose problems while the engine is running.

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Unique Improvement
Ignition and electrical engine upgrade

System/Product Used
- Wire Harness
- Ignition Module
- Ignition Coils

Results
- Robust wire-harness
- Higher energy ignition
- Continuous monitoring of combustion system
- Better diagnostics
- Automatic spark adjustments for peak engine performance

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Engine Ignition and Electrical System

Pre-Upgrade

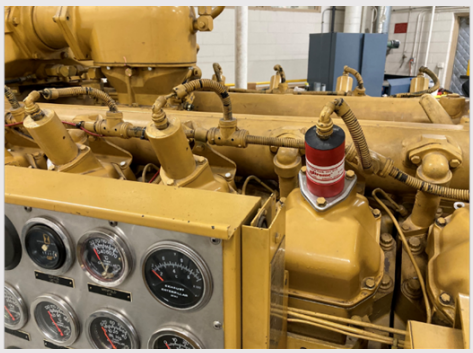

Fig. 8

The ignition system was an Altronic magneto system (Fig. 8). A number of coils were replaced over the years, and the ignition wire harness was brittle and cracked. In addition, the low energy capacity discharge ignition system required a time-based spark plug replacement strategy.

Post-Upgrade

The ignition system was replaced with Woodward coils and high energy PWM Digital Ignition system (Fig. 9).

Fig. 9

The brittle harnesses were replaced with robust, custom-fit wire harnesses. These harnesses were fabricated and tested on the Peaker Services test stand before shipment to the site. This resulted in a simple, reliable installation.

The high energy Woodward Ignition system is the latest PWM technology, which allows the amount of energy supplied to the spark plugs and the spark profile to be optimized. The new ignition system is calibrated on the Hoffer engines for optimal combustion performance. The ignition system will automatically modify the spark duration when required for peak performance. Additionally, misfire detection and indication of spark plug condition are included in the engine control, with an alarm visible from the control room.

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Unique Improvement
Installation of cylinder knock system

System/Product Used
- Knock Sensors

Results
- Cylinder by cylinder knock detection
- Engine timing continuously adjusted for optimal engine control
- Control room visible misfire

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Cylinder Knock System

Pre-upgrade

The OEM engine included one knock sensor on each bank of 8 cylinders (Fig. 10).

Fig. 10

The original knock system could only detect major events—i.e. events that result in a system shutdown.

Post-Upgrade

The upgraded system included one knock sensor per cylinder for a total of 16 knock sensors per engine (Fig. 11).

Fig. 11

The knock sensors on each cylinder are monitored by the advanced Woodward engine controller. Feedback from the knock sensors allows the engine timing to be continuously adjusted for optimal control, with load derating or engine shutdown triggering in the case of severe knock.

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Unique Improvement
New cabinets, controller, operating parameters visible from Control Room

System/Product Used
- Large Engine Control Module

Results
- Operating conditions visibly from control room
- All operational data continuously monitored by LECM
- Engine control continuously optimized

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Engine Monitoring System

Pre-Upgrade

The majority of the original engine monitoring was on a gauge panel located on each engine (Fig. 12).

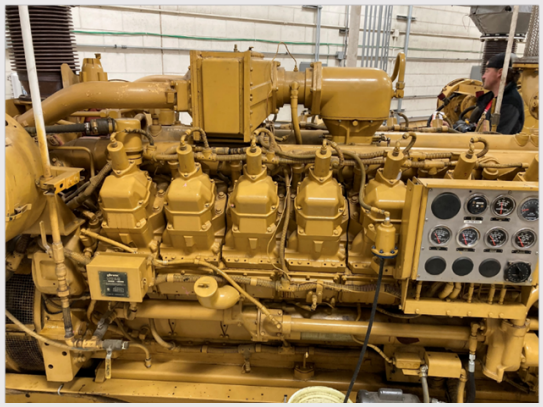

Fig. 12

For many engine operating conditions, operators had to physically walk to each engine and read the gauge displays. In addition, the original displays blocked access to engine service areas.

Post-Upgrade

The upgraded engines include cabinets housing the Large Engine Controller, and all operating conditions and metrics can be seen at the control panel in the Control Room (Fig. 13, 14 and 15).

Fig. 13

Fig. 14

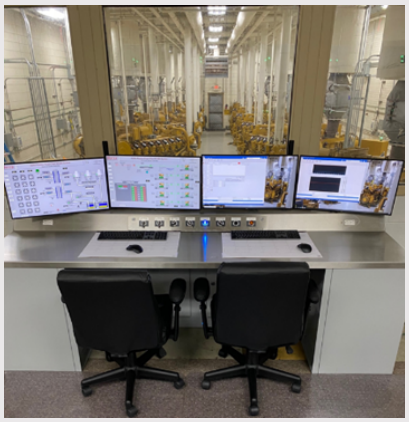

Fig. 15

All operating conditions and metrics are easily visible at the control panel in the Control Room. Operators no longer need to walk to the gauge panels in the engine room to understand the operating parameters of the engine. Engine components are all more accessible due to removal of gauge panels.

The key operation features (temperature, pressure, power, etc.) are all monitored by the LECM (Large Engine Control Module), which optimizes operating conditions.

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Unique Improvement
Modern control room and switchgear

System/Product Used
- Door and Back Panels
- easYgen System
- SCADA Control Panel

Results
- Improved Generator Protection
- Simplified Controls
- Modern Equipment

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Control Room and Switch Gear

Pre-Upgrade

The original control room was outfitted with simple engine monitoring and an obsolete analog switchgear (Fig.16 and 17).

Fig. 16

Fig. 17

The control room SCADA had very little feedback or control of the engines, and the switchgear included analog controls that needed to be "tweaked" to maintain control.

Post-Upgrade

The switchgear panels were replaced with door and back panels fabricated at Peaker Services' Brighton facility. The panels were installed with the latest digital easYgen control and generator protection systems. A new SCADA control panel with integrated Balance of Plant PLC was fabricated for the control room to monitor and control the entire power plant (Fig. 18, 19 and 20).

Fig. 18

Fig. 19

Fig. 20

The upgraded digital power management controls provide automation, power protection, synchronization, load control, and other key monitoring parameters.

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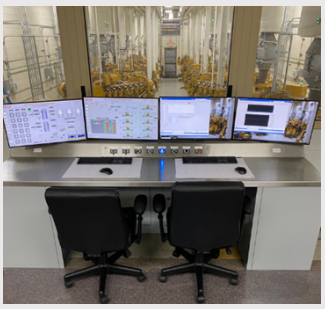
Updates to the Control Room allow direct management of the Engines, Battery Packs, and Generator controls in a simplified manner.



Upgrade Overview

The Hoffer facility can operate seamlessly in island-mode or synced with the grid.

Customer Feedback

The Peaker Services, Inc. installation team for the project were talented, professional, and followed all company safety rules. They performed quality work that is very visible when entering the cogen plant. The project itself went well despite some unexpected non-Peaker supplied equipment failures that extended the length of the project.

Peaker Services anticipates a 50% reduction in operational issues in the future compared to the old system. Currently, the plant is running way better than before! The plant starts and runs automatically and operates unattended. The engines are more stable when islanded from the utility and easily handle large block plant loads. With the new engine and power management digital controls tied into the newly supplied SCADA system, issues associated with the engine, gas, and electric utility are caught earlier than before. This keeps the production plant running and available for electric utility curtailment revenue. Overall, from all the benefits seen so far, Peaker Services anticipate seeing a project payback within the next 2-4 years.

Safety in the plant has been dramatically improved through early warnings from engine knock detection and other systems protection settings, lowering operational safety risks considerably.