Peaker Services, Inc.

**Location**
Eastern Sanitary Landfill
Solid Waste Management
White Marsh, Maryland

**Type of Installation**
Landfill Merchant Power

**Power Source**
- (3) Waukesha L7042GLD engines

**Unique Obstacle**
Unreliable engine starting, low, unstable power production (30-40% variation)

**System/Product Used**
E6 system including:
- Ignition Module
- Knock Module
- easYgen Control

**Result**
Consistent, reliable engine starts with full, stable power output

**Installation Partner**
EPP Energy Partners

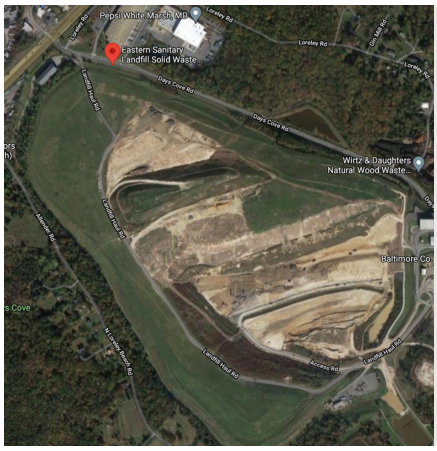
**Contact**

(248) 437-4147

WEBSITE: www.peaker.com
EMAIL: jlogue@peaker.com

**Peaker Services, Inc. Case Study**
**Primary Contact for Additional Information: Jim Logue**
**Email: jlogue@peaker.com**
**Phone: 248-921-5864**

# *Control System Upgrade Gives Inoperative Landfill Plant New Life*




*The site, located at an active north-east US municipal landfill.*

## Customer Goal & Challenge:

The former owners of the plant had difficulty keeping the plant online and producing revenue, causing the plant to be sold. Difficulties were attributed to the plant design, which would be expensive to remedy. The plant had three Waukesha L7042GLD landfill gas engines that took several days to start, requiring the landfill gas produced to be flared. This resulted in personnel opportunity cost and lost generation revenue. When the machines finally did start, power output was subject to swings of 30-40%. Generation output had to be substantially reduced to allow sufficient safety margin for the swings in kW output.

While the Waukesha engine is a solid engine, the variety of legacy controls prevented reliable starting and operation. The L7042GLD is "stereo" engine where each engine bank has independent dedicated turbos and fuel systems. This stereo configuration requires manual adjustment of several variables: starting main fuel supply regulator pressure; AFR regulator position; carburetor screw adjustment; and precombustion chamber (PCC) pressure. Except for PCC, these adjustments must be made for each bank and balanced for the stereo engine. The starting process required adjustment iterations and permutations, as well as a degree of luck. Significant operator knowledge and experience was necessary to get the engine started safely.

Peaker Services, Inc.

**Location**

Eastern Sanitary Landfill
Solid Waste Management
White Marsh, Maryland

**Type of Installation**

Landfill Merchant Power

**Power Source**

- (3) Waukesha L7042GLD engines

**Unique Improvement**

Fuel train split and new, smaller compressor for main fuel provides better flow

**System/Product Used**

- Fuel Supply Piping
- Air Compressor

**Installation Partner**

EPP Energy Partners

**Contact**

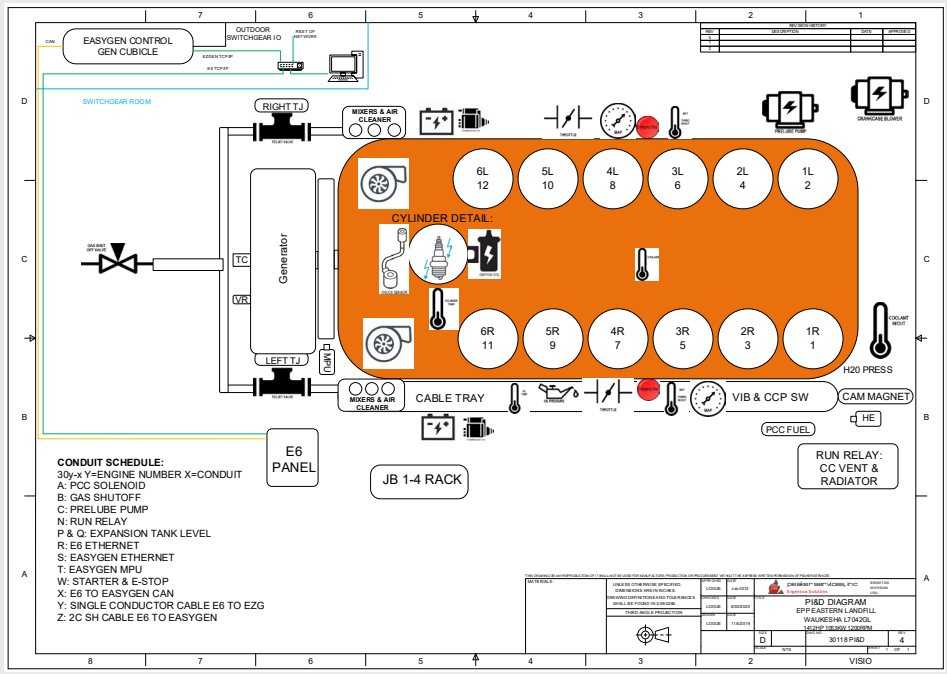
(248) 437-4147

WEBSITE: www.peaker.com
EMAIL: jlogue@peaker.com

The old control system was based on an amalgamation of 1990s controls. The knock detonation system was identified as a Murphy vibration switch, including one sensor for all 8 cylinders. The knock system was limited, designed only to detect major events and shut down the system. The Waukesha air/fuel ratio module used oxygen sensors and a motorized final cut fuel gas pressure regulator. Reliability of such an approach is compromised in such an application, as $O_2$ sensors can be fouled by contaminants in the landfill gas. All of the discrete components required extensive and complex wiring for system operation. The Waukesha CEC ignition and 2301D governor were OEM supplied components that required replacement.

The landfill operates on varying BTU gas content, and the independent control systems were unable to operate in unison to compensate for changes in landfill gas energy content.

Due to the complexities involved in modernization, the new owners contacted Peaker Services for advice. Several areas of system improvement were recommended and implemented.




***System Diagram***

## Solutions provided:

The fuel gas supply piping was enlarged to allow for better flow characteristics. The L7042GLD engine is a "draw through" suction design, requiring 4.5 PSI for main fuel gas supply pressure. The PCC fuel delivery system requires 35 PSI of fuel pressure. Rather than increase the higher flow, low pressure main fuel gas supply to 35 PSI, the fuel train was split and the PCC has fuel supplied by a smaller, more efficient compressor, thereby reducing the plant's parasitic electrical load.

Each of the three engines were fitted with a new Woodward

Peaker Services, Inc.

**Location**
Eastern Sanitary Landfill
Solid Waste Management
White Marsh, Maryland

**Type of Installation**
Landfill Merchant Power

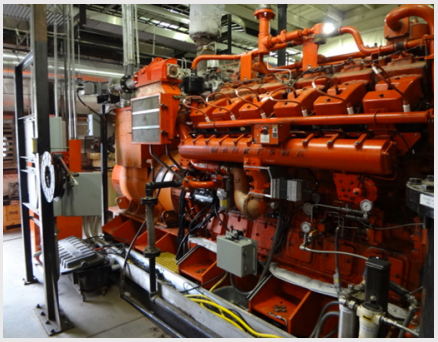
**Power Source**
- (3) Waukesha L7042GLD engines

**Unique Improvement**
Simplified wiring, improved control system and components

**System/Product Used**
E6 system

**Installation Partner**
EPP Energy Partners

E6 triple stack control system. All engine wiring was removed, except for thermocouples. This control unification has dramatically reduced the wire count, interconnection points, complexity, and failure modes between reduced function obsolete control components. All engine wiring now terminates inside the E6 panel.

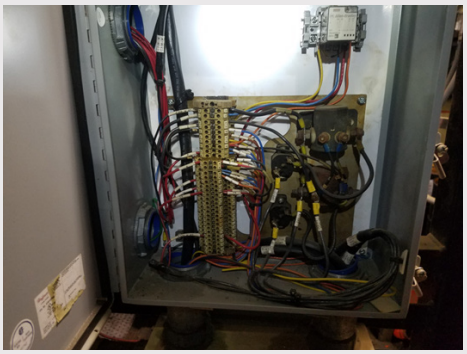


***One of three Waukesha L7042GLD engines on-site.***

The single E6 system control manages start sequencing, governing, air fuel ratio, ignition, engine fault annunciation, cylinder and engine temperature monitoring, and knock avoidance functions. This is contained within one integrated control unit whose inputs are shared at a single point.

Each E6 manages start sequencing variables, including the pre-lube pump, radiator fan, starter motor, ignition timing, air/fuel ratio, throttle limiting, and fuel gas sequencing. All process functions have adjustable timers and permissives for start optimization.

The starting issue was resolved by installing TecJet mass flow



***Above, left to right: Previous panel wiring and interconnections, one of four interconnected junction boxes. Below: New, simplified wiring after Woodward E6 triple stack installation.***


## Contact

(248) 437-4147

WEBSITE: www.peaker.com
EMAIL: jlogue@peaker.com

Peaker Services, Inc.

**Location**
Eastern Sanitary Landfill
Solid Waste Management
White Marsh, Maryland

**Type of Installation**
Landfill Merchant Power

**Power Source**
- (3) Waukesha L7042GLD engines

**Unique Improvement**
Consistent, reliable engine starts with combustion stability

**System/Product Used**
E6 system including:
- ProAct ISC
- Knock Module
- easYgen Control

**Installation Partner**
EPP Energy Partners

**Contact**

(248) 437-4147

WEBSITE: www.peaker.com
EMAIL: jlogue@peaker.com

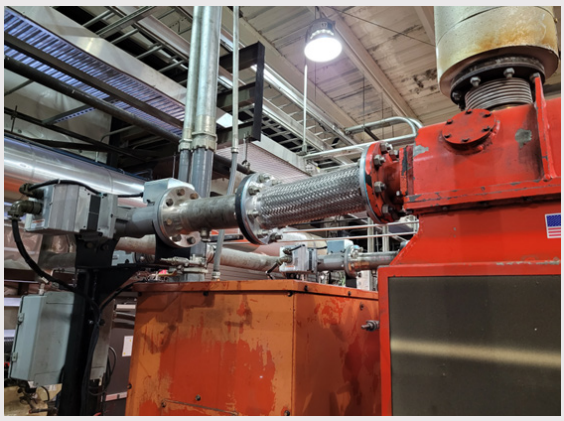
fuel valves to ensure delivery of the correct amount of fuel for each bank. The TecJet valves deliver precisely the same amount of fuel mass to each cylinder bank, automatically compensating for the varying gas BTU content. The engine now starts reliably, with cylinder temperatures and combustion stability between banks also ensured.

The engine driven electro-hydraulic actuator and throttle were removed, along with the cross-bank linkage. Two direct coupled ProAct ISCs now control each bank's throttle assembly, producing stable speed and load control. The complicated throttle position matching procedure has been eliminated. The E6 has an engine "bank balancing" function that allows the throttles to move independently of each other to maintain equal intake manifold pressures and prevent single bank overloading.

The knock detection system was updated to include knock sensors on each individual cylinder. By monitoring detonation on each cylinder, the E6 continually adjusts to optimize engine parameters like ignition timing. This system results in an engine running optimally throughout different operating conditions and parameters expected during the engine's life.

The PCC system runs at 9% $O_2$ exhaust levels and very low

*Old AFR valve*



*New TecJet valve*

$NO_x$ exhaust emissions. The TecJet valves, coupled with the E6's Gas Quality Closed Loop (GQCL) algorithm, ensure compliance with long-term emissions despite varying BTU fuel content. The system anchors a target manifold air pressure to kW level. The GQCL algorithm is able to maintain stable combustion and exhaust emissions, while eliminating the need for oxygen sensors.

Generator control functions are managed by an easYgen 3500-XT P1. The easYgen automatically synchronizes each 1 MW generator to the utility, closes the circuit breaker, and ramps the generator to its base load setpoint. The engines consistently run at steady full power. The E6 control is connected to the easYgen via a CAN communications

Peaker Services, Inc.

**Location**
Eastern Sanitary Landfill
Solid Waste Management
White Marsh, Maryland

**Type of Installation**
Landfill Merchant Power

**Power Source**
- (3) Waukesha L7042GLD engines

**Unique Obstacle**
Unreliable engine starting & low and unstable power production (30-40% variation)

**System/Product Used**
E6 system including:
- Ignition Module
- Knock Module
- easYgen Control

**Result**
Consistent, reliable engine starts with full stable power output

**Installation Partner**
EPP Energy Partners

## Contact

(248) 437-4147

WEBSITE: www.peaker.com
EMAIL: jlogue@peaker.com

network. The E6 engine data is also exchanged over a CAN network, allowing data to be viewed from the switchgear room on the easYgen display.

The E6 and easYgen comply with the latest communications protocols. Modbus TCP/IP is used to connect the controls to the plants SCADA control system. A custom Toolkit screen was developed to view all the engine critical parameters on a single page "at a glance."

The E6 has a complete library of diagnostic messages to aid in fast troubleshooting. All engine and generator functions can be trended with 0.1 second accuracy. The first trip can be readily identified and a solution can be found quickly.

## Results:

The engine has been digitized. Engine capacity has effectively been increased by 30-40% by elimination of the need for output safety margin. The customer now has an easy starting, more efficient, emissions compliant, reliable and financially viable renewable energy plant. Future plans are to add another Waukesha engine genset with the E6/ easYgen solution.