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Grand River Generating Station Malfunction Abatement & Preventative Maintenance Plan

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1 BACKGROUND

This Malfunction Abatement and Preventative Maintenance Plan (Plan) was prepared in accordance with Renewable Operating Permit (ROP) number MI-ROP-N5996-2018, Section 2, Condition D, FGICE(III)(2) (page 41) for Grand River Generating Station (GRGS) issued by the Michigan Department of Environment, Great Lakes, and Energy Air Quality Division (EGLE-AQD). The ROP condition reads as follows:

The permittee shall submit to the AQD District Supervisor, for review and approval, a malfunction abatement/preventative maintenance plan (PM/MAP) for FGICE within 30 days of ROP issuance. After approval of the PM/MAP by the AQD District Supervisor, the permittee shall not operate FGICE unless the PM/MAP, or an alternate plan approved by the AQD District Supervisor, is implemented and maintained. The plan shall incorporate procedures recommended by the equipment manufacturer as well as incorporating standard industry practices. At a minimum the plan shall include:

- a. Identification of the equipment and, if applicable, air-cleaning device, and the supervisory personnel responsible for overseeing the inspection, maintenance, and repair.*
- b. Description of the items or conditions to be inspected and frequency of the inspections or repairs.*
- c. Identification of the equipment and, if applicable, air-cleaning device, operating parameters that shall be monitored to detect a malfunction or failure, the normal operating range of these parameters and a description of the method of monitoring or surveillance procedures.*
- d. Identification of the major replacement parts that shall be maintained in inventory for quick replacement.*
- e. A description of the corrective procedures or operational changes that shall be taken in the event of a malfunction or failure to achieve compliance with the applicable emission limits.*

If the plan fails to address or inadequately addresses an event that meets the characteristics of a malfunction at the time the plan is initially developed, the owner or operator shall revise the plan within 45 days after such an event occurs and submit the revised plan for approval to the AQD District Supervisor. Should the AQD determine the PM/MAP to be inadequate, the AQD District Supervisor may request modification of the plan to address those inadequacies. (R 336.1213(2), R 336.1911)

This Plan has been developed to satisfy the above requirements. As such, it provides procedures and elements of inspection, inspection frequencies, back up equipment inventories and general information used to prevent, detect, and correct malfunctions.

It is important to note that the regulations anticipated periodic shutdown of the individual control equipment at the landfill. Since periodic malfunctions, unforeseen circumstances or short duration maintenance activities are anticipated by the regulations, EDL Energy (EDL) believes they have implemented a program consistent with these requirements.

EDL understands that EGLE-AQD expects EDL to address any temporary break down of a control device or devices. While a plan has been written suggesting parts lists, inspections, inspection frequencies, etc. to comply with the above paragraph it is anticipated the short duration shutdown events will continue to occur which are beyond EDL's control.

2 AFFECTED EQUIPMENT

EDL operates three (3) internal combustion engines (ICE) (all Caterpillar model G3516 ICE) that are covered by this Plan. The engines are used for combusting treated landfill gas to produce electricity. These engines are identified as Emission Units EUICE1, EUICE3, and EUICE5 in ROP number MI-ROP-N5996-2018 issued by EGLE-AQD.

3 RESPONSIBLE PERSONNEL

All supervisory personnel responsible for overseeing the inspection, maintenance, and repair of the generating station are listed below:

Name	Title	Phone Number
Aron Gunn	General Manager, North America Reciprocating Engine Operations	517 730 5152
Mike Schaper	Michigan Operations Manager	989 313 1450
Rob Stewart	Operations Supervisor	517 896 9725
Meghan Stackhouse	Senior Environmental Manager	517 243 3676

4 MALFUNCTION ABATEMENT AND PREVENTATIVE MAINTENANCE PLAN

The following section of this Plan covers prevention of malfunctions, detection of malfunctions, and correction of malfunctions for each of the engines.

4.1 Description of the Equipment

EDL operates three (3) ICE (Caterpillar model G3516) for combusting treated landfill gas to produce electricity. These engines are identified as Emission Units EUICE1, EUICE3, and EUICE5 in ROP number MI-ROP-N5996-2018 issued by EGLE-AQD.

4.2 Equipment Inspection

Table 1 shows the generating station items or conditions that are inspected, the frequency of the inspections, and the procedures followed to aid in the prevention of a malfunction.

**Table 1
List of Generating Station Prevention / Detection Items**

Item or Conditions to be Inspected	Frequency of Inspection /Monitoring	Procedures to be Followed to Aid in the Prevention of Malfunctions
Engine Air Cleaner Element	*Performance based assessment	Visual inspection and scheduled PM
Engine Oil	*Performance based assessment	Establish baseline, use oil chemistry and performance as a guide (Change when necessary)
Engine Oil Sample	Establish Baseline for each engine (Performance/oil sample)	Once baseline is established verify frequency with oil chemistry sampling results
Engine Oil Level	Weekly	Check float & secondary autofill
Engine Oil Temperature	Weekly	Check temperature gauge
Oil Filter Differential Pressure	Weekly	Check Technician (ET) software
Engine Oil Filter	Establish Baseline for each engine (Performance/oil sample)	Check pressure differential, change engine oil filter as needed
Fuel Metering Valve	Performance based assessment	Verify correct pressure, Check codes
Throttle Control Valve	Performance based assessment	Check electronic valves in Technician (ET) software
Cooling System Coolant Level	Weekly	Check sight glass for level
Cooling System Coolant Temperature	Weekly	Check Technician (ET) software
Cooling System Coolant Pressure	Weekly	Check Technician (ET) software
Differential Pressure Crankcase Vent	Weekly	Check pressure, control vacuum (walk around)

Item or Conditions to be Inspected	Frequency of Inspection /Monitoring	Procedures to be Followed to Aid in the Prevention of Malfunctions
Generator Load	Weekly	Check load conditions (Kilowatts)
Generator	*Performance based assessment (assess at approximately 8,000 hours of use)	Visually inspect system for loose wires/fittings, vibration damage etc.
Walk-Around Inspection	Weekly	Check for any unusual conditions, leaks, broken gauges, pinched wires/tubing etc.
Battery Charge	*Every 6 months of service	Check battery voltage
Belts (Radiator)	*Every 12 months	Inspect/Adjust/Replace
Engine Valve	Performance based assessment	Adjust as needed
Radiator	Performance based assessment	Check inlet & outlet temperatures, clean/wash exterior surfaces as needed
Water Pump	Performance based assessment	Inspect for leaks during walk-around inspection
Ignition System Spark Plugs	Performance based assessment	Inspect/Replace
Turbocharger	*Performance based assessment (assess at approximately 8,000 hours of use)	Establish baseline to use as a guide (Change when necessary)
Overhaul- Top End	*Performance based assessment (assess at approximately 50,000 hours of use)	Top end overhaul is performed on site and is based on performance assessment
Overhaul- In-Frame	Performance based assessment	In-Frame overhaul is performed on site and is based on performance assessment
Overhaul- Major	*Performance based assessment (assess at approximately 80,000-100,000 hours of use)	Engine is removed and replaced with identical/like kind unit and is based on performance assessment

Engine performance supersedes frequency of maintenance activities. Approximate values used in this table **should only be used as a guideline in your evaluation of each parameter to be inspected, maintained, and replaced.*

Based on facility records and EDL personnel, a preventative maintenance program is conducted. Routine maintenance is conducted on the engines in accordance with manufacturer and company specifications which include replacing engine spark plugs, oil, and lubrication. Maintenance is also conducted on an as needed basis. In addition, a "top-end" overhaul, which includes replacing/cleaning cylinder heads, turbochargers, and valves, is conducted on each engine. This is typically completed on site.

A "Major" overhaul includes all of the work of a top-end overhaul plus disassembling all of the bearings, seals, gaskets, and components that wear and may even include replacing the crankshaft. When an engine is due for a major overhaul, it is swapped out with another engine. When the engine is swapped, it is removed from the facility and either replaced with an engine

with a different serial number and manufacture date or the same unit is brought back after being rebuilt and will have the same serial number and manufacture date. Swapping engines in this manner is an industry standard for maintaining the engines.

Table 2 provides the operating parameters that are used to detect and aid in the prevention of a malfunction or equipment failure and the normal range of these parameters as they relate to the FGICE Flexible Group. The status of operating parameters included in Table 2 are checked daily by plant operators via gauge, meter, or a visual inspection of liquid level, and recorded in a weekly operations log. Records of monitoring data are kept on file for a minimum of five years.

**Table 2
Monitored Equipment Parameters**

Equipment	Operating Parameters	Typical Range of Operation
FGICE	Manifold Pressure	2 - 25 PSI
FGICE	Engine Oil Pressure	30 - 90 PSI
FGICE	Oil Filter Differential Pressure	0 - 20 PSI
FGICE	Jacket Water Temperature	160 - 240 F
FGICE	Cooling System Coolant Pressure	2 - 45 PSI
FGICE	Differential Pressure Crankcase Vent	<5 PSI
FGICE	Regulated Gas Pressure	2 - 15 inches/water column
FGICE	Oil Level	Full mark (visual check)
FGICE	Generator Load	200 - 850 KW

4.3 Replacement Parts

To facilitate quick replacement, the spare or replacement parts necessary for proper engine operation and routine maintenance will be located on site at the generation facility or at EDL's central maintenance facility if the part is a large or specialty item. Most specialty parts will be ordered on an as needed basis.

Each engine is made up of hundreds of parts. Having each part in the inventory is not feasible or necessary. Below is a list of frequently used major replacement parts that may be available at the facility for quick replacement.

Temperature Regulators
Oil Filters
Fans – various types
Regulators – various types
Motors – various types
Sensors – various types

EDL utilizes an inventory management system that is used to ensure sufficient stock of parts is maintained. Actual inventory at GRGS at any given time will vary based on planned and unplanned part replacements occurring during operations, as well as supplier part availability. EDL also maintains a spare part inventory at a maintenance facility located in Michigan. GRGS is able to obtain spare parts from the maintenance facility as needed.

4.4 Corrective Procedures

Corrective procedures or operational changes shall be undertaken in the event of a malfunction or failure of the generation facility. EDL will expeditiously implement the appropriate procedures to correct the event. Though the corrective actions taken to correct a malfunction or failure will vary based on the cause, the general steps for facility personnel to take to address a malfunction event are outlined below.

1. If equipment is operating, initiate shutdown of the engine unit(s) and any affected process equipment.
2. Before approaching the equipment, ensure there are no unsafe conditions present, including any venting of landfill gas to the atmosphere. If landfill gas is venting and cannot be controlled, contact the Senior Environmental Manager.
3. Evaluate the cause of the malfunction.
4. Initiate corrective actions to fix the malfunction as soon as practicable.
5. After equipment has re-started following downtime, record the date, time, duration, and reason the engine was not operating in the facility downtime log.

5 IMPLEMENTATION OF AND UPDATES TO PLAN

5.1 Implementation of the Plan

If the plan fails to address or inadequately addresses an event that meets the characteristics of a malfunction at the time the Plan is initially developed, the owner or operator shall revise the Plan within 45 days after such an event occurs.

5.2 Updates to the Plan

This Plan will be updated within 60 days of replacing or expanding the components of the generating station with components not described herein. If no components of the generating station are replaced or expanded with components described herein, the Plan will be updated at least once every 5 years or as needed.