North American-Central, LLC

a Kinder Morgan company

MALFUNCTION ABATEMENT / PREVENTATIVE MAINTENANCE PLAN

North American-Central, LLC – Central Generating Station
Montcalm County, Michigan
SRN: N2804
Permit No.: MI-ROP-N2804-2020a, Section 2

North American-Central, LLC (North American) is submitting the following Preventive Maintenance Plan pursuant to the requirement of the Renewable Operating Permit for the Central Generating Station. The Preventive Maintenance Plan is and has been North American's standard operating procedure for the Plant.

1. Responsible Personnel

The personnel responsible for overseeing the inspection, maintenance, and repair of the Plant and related facilities are:

Justin Boone
Plant Supervisor
Central Generating Station
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Operations Manager
Central Generating Station
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2. Purpose

The purpose of this Malfunction Abatement/Preventative Maintenance Plan is to establish appropriate process monitoring, malfunction response and preventative maintenance procedures to maintain compliance with applicable air pollutant emission limits for the three (3) landfill gas (LFG) fueled engines that will be operated at the Central Generating Station.

This plan has been developed in accordance with the requirements of Renewable Operating Permit No. MI-ROP-N2804-2020a (Section 2), Condition D.III.2. that specifies:

No later than 30 days after startup of EUENGINE3, the permittee shall submit to the AQD District Supervisor, for review and approval, a malfunction abatement/operation and preventative maintenance plan (PM/MAP) for FGRICEENG. After approval of the malfunction abatement/operation and preventative maintenance plan by the AQD District Supervisor, the permittee shall not operate FGRICEENG unless the malfunction abatement /operation and preventative maintenance plan, 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.

A copy of the most recent Engine Malfunction Abatement/ Preventative Maintenance Plan will be kept on file at the facility.

3. Facility and General Process Information

North American has been permitted to install and operate two (2) Caterpillar (CAT®) G3520C and one (1) Caterpillar (CAT®) G3516 reciprocating internal combustion (IC) engines that are fueled with LFG and connected to electricity generators (IC engine/generator). The emission units are identified in the permit as flexible group FGRICEENG.

The LFG generated at the Central Sanitary Landfill is collected using a system of wells, gas headers and blowers, which have been installed and are operated by the landfill owner. The LFG is dewatered, filtered, and compressed by the on-site treatment system before being supplied as fuel to the IC engine/generator sets. The electricity generated is distributed to the local grid.

4. IC Engine / Generator Malfunction Abatement

The CAT® engines are designed to fire low-pressure, lean fuel mixtures (e.g., LFG). The engines are equipped with an air-to-fuel ratio controller that monitors engine performance parameters and automatically adjusts the air-to-fuel ratio and ignition timing to maintain efficient fuel combustion. This is performed through software provided by Caterpillar.

The engine/generator sets are not equipped with add-on emission control devices. Therefore, the units maintain compliance with applicable air pollutant emission limits through the proper operation of the engine and efficient fuel combustion, which:

- Reduces the formation of carbon monoxide (CO) and nitrogen oxide (NOx) emissions.
- Destroys methane and nonmethane organic compounds (NMOC) in the LFG fuel (nonmethane hydrocarbons may be classified as volatile organic compounds and/or hazardous air pollutants).

Malfunction Abatement for the CAT® engines consists of monitoring critical engine parameters to ensure proper operation. Each engine is equipped with numerous sensors that monitor critical operation parameters. An engine control module (ECM) processes the data and adjusts operating variables (ignition timing, air/fuel ratio, engine speed), activate alarms to warn of an out-of-range variable or shuts down the engine.

4.1 Engine Oil / Engine Coolant Temperature

Engine oil and engine coolant conditions do not directly influence air pollutant emissions. However, maintaining proper engine oil/coolant temperature and pressure is critical to the operation of the engine and preventing early or catastrophic mechanical failure.

The engine is equipped with sensors to monitor the engine oil temperature and oil pressure before and after the oil filter. Notification alarms are activated based on out-of-range conditions (e.g., high oil temperature, low or high oil pressure). An automatic shutdown will occur if the variable exceeds a critical setpoint.

Engine coolant temperature is monitored to assure proper circulation of coolant and cooling of the engine block. Notification alarms are activated based on out-of-range conditions (high or low coolant temperature). An automatic shutdown will occur if the coolant temperature exceeds its critical setpoint temperature.

Abnormal engine operations or shutdowns are logged by the ECM. The cause of the problem is investigated and corrected by the operators and the engine is restarted.

4.2 Air / Fuel Ratio Control

Maintaining proper air/fuel ratio results in efficient fuel combustion and limits the formation of CO and NOx. The engine is equipped with an inlet gas quality monitor that continuously monitors the inlet LFG fuel for methane (fuel value) and oxygen content. The Engine Control Module (ECM) software monitors the fuel gas conditions, engine load and engine speed and automatically adjusts the air/fuel mix valve (raptor valve position) to achieve the desired air/fuel mix setting. This programming is set by the manufacturer.

If the monitored LFG oxygen level increases, or the methane content decreases, beyond preset values the engine automatically shuts down if the desired air/fuel mix ratio cannot be obtained. This prevents excess emissions.

Abnormal fuel conditions and/or engine shutdown is logged by the ECM. The cause of the excess oxygen or decreased methane is investigated (this is typically caused from landfill wellfield maintenance or adjustments) and corrected by the operators and the engines are restarted.

4.3 Crankcase Vents

The crankcase exhaust is a necessary component of any reciprocating engine. A very small amount of combustion gases can slip past the piston rings ("blow-by") and collect in the upper portion of the engine crankcase. Therefore, the engines are equipped with a system that exhausts the upper portion of the crankcase to remove any of these gases, as this would eventually result in engine failure. Because the exhaust system pulls on the crankcase where oil is present, the crankcase exhaust is routed through an oil mist removal and filtration system for particulate control before being discharged to an exhaust pipe.

North American maintains this equipment by inspecting the filter (mist eliminator) on a scheduled basis, cleaning or replacing the filter as necessary. If emissions are observed from the vent stack, the filter is inspected as soon as possible.

4.4 Daily Inspections

North American personnel keep Daily Logs recording the status of operations for each of the generating unit. Any shutdowns, likely cause of the shutdown, and the down time period are recorded and the records maintained at the Plant.

The operator performs daily visual inspections of the engines and logs the following information in a daily log:

- Coolant system level;
- Engine air cleaner service indicator;
- Engine oil level;
- Fuel system fuel filter differential pressure; and
- Generator load.

4.5 Engine Operating Parameter Ranges

The following table presents operating ranges (or maximum values) for parameters that have been determined to be critical for proper engine operation.

Engine Parameter	Minimum	Maximum
Engine Coolant Pressure (psi)	38	60
Engine Coolant Temperature (°F)	---	248
Engine Oil Pressure (psi)	> 0	---
Engine Oil Temperature (°F)	---	219
Combustion Air Temperature (°F)	---	167
Gas (Fuel) Pressure (psi)	---	19.6

4.6 On-Call Dial-Out System

The facility is not staffed around the clock. Therefore, the ECM is connected to a dial-out system that notifies the on-call operator of any engine shutdowns and certain faults and warnings during evening/weekend/holiday hours when the facility is not staffed.

At any time, if one of the generating units shuts down, the plant operator is paged immediately, this operator is on call twenty-four (24) hours a day, seven (7) days a week and returns to the plant to investigate the nature of the shutdown. A rotation system is in place with operators from near-by locations covering for each other. Whenever a shutdown occurs, the flare immediately picks up the extra gas. As such, the flare is a backup to the engine plant.

Corrective actions/procedures in the event of a malfunction of Treatment System: (i) evaluate problem; (ii) correct problem with replacement part needed; (iii) if cannot be repaired in timely manner, turn flare on.

5. Preventative Maintenance

FGRICEENG are maintained per the guidelines in the Caterpillar Operation and Maintenance Manual. The actual maintenance schedule is dependent on actual fuel gas conditions and observations of engine performance.

Proper maintenance of the fuel train ensures good fuel mixing and combustion, which limits CO and NOx formation. The monitoring and regular replacement of worn engine parts (such as cylinder seals) reduces particulate matter (PM10/PM2.5) emissions (primarily engine oil).

The crankcase ventilation filters are inspected at least every 6-months and whenever emissions are observed.

5.1 Parts Inventory

North American maintains a stock of long-lead time or hard to obtain replacement parts for the electric generating units and for the gas compressor at the Central Generating Station. The part list is balanced against the requirement given North American's long-term engine maintenance program following practices in the industry.

Michigan Caterpillar also stocks a list of parts as required by the various landfill gas to energy power producers in the state of Michigan. Additionally, North American works in concert at the operator level to network with other likely situated companies to exchange parts when required. Typical items maintained on-site for the generators are engine oil, spark plugs, filters, and sensors.

The following parts are kept on-site for the Treatment System: Site glass gauges for the water separator and oil separator; spare gauges for coalescing filters; coalescing filters; spare compressor belt, spare vanes for the compressor and 200 gallons of oil for the compressor.

Spare filters are typically maintained on-site for the crankcase ventilation system.

5.2 Oil Sampling Program

When engine oil is changed per the preventative maintenance schedule (typically monthly), a sample of the oil is sent for analysis of several properties. The oil analysis results are used to determine fuel condition, the level of engine wear or parts that may need attention (inspection or replacement). Depending upon the results, the maintenance schedule may be adjusted from the manufacturer's guidelines.

6. Recordkeeping

The following information will be maintained to verify proper operation and maintenance of the CAT® engines and that proper procedures were implemented in response to malfunction requirements:

1. Daily records of the equipment monitoring parameters that are presented in this document (Section 4.3 Daily Inspections).
2. Equipment maintenance records for those systems that affect the operation of the engine.
3. Engine faults, alarms and shutdowns are recorded and logged by the ECM.

4. Records of process malfunctions or equipment failures if such events are different from those covered in this Plan.

7. Plan Revisions

ROP No. MI-ROP-N2804-2020a (Section 2), Condition D.III.2 specifies that:

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 malfunction abatement/preventative maintenance plan to be inadequate, the AQD District Supervisor may request modification of the plan to address those inadequacies. This Malfunction Abatement/Preventative Maintenance plan will be:

1. Amended or modified if equipment or processes are added that are not covered under the plan; or
2. Revised within 45 days of an event if the procedures described in this document do not adequately address any malfunction event that occurs at the facility.

Plan revisions will be documented using the revision history log (Appendix A) and submitted to the AQD District Supervisor as required by the Permit.

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Appendix A
Plan Revision History

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Date	Actions / Reasons for Revision
8/17/2020	Initial Draft of MAP/PMP
9/11/2024	Updated personnel, standardization with similar facility plans, addition of crankcase vents, and other minor edits