



**Preventative Maintenance/Malfunction
Abatement Plan (PM/MAP)
Freedom Compressor Station
Compressor Engines
Unit 3-1, 3-2, 3-3, 3-4 & 3-5**

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1.0 PM/MAP Overview and Approval

Facility: Freedom Compressor Station

Physical Address: 12201 Pleasant Lake Rd
Manchester, MI 48158

Plan Adoption Date: January 2021

Previous Revisions: July 2019
May 2017
October 2016

Purpose of the PM/MAP:

The purpose of this PM/MAP is to describe the actions that will be taken at the Freedom Compressor Station Facility to prevent, detect, and correct malfunctions or equipment failures that could result in emissions exceeding any applicable limits. This plan is for the Plant 3 compressor engines.

This PM/MAP, and any revisions of this Plan, will be maintained for a period of five (5) years, and will be on file at the Freedom Compressor station. This PM/MAP does not contain proprietary information.

At Freedom Compressor Station, the field leader, or his designee is responsible for assuring that the most recent copy of this PM/MAP is made available to personnel involved with the affected operations. This individual is also responsible for ensuring that Station employees are aware of the procedures and requirements contained in this Plan.

All reports for the PM/MAP must be signed by a Responsible Official.

2.0 Equipment Covered by PM/MAP

This PM/MAP covers five (5) natural gas fired compressor engines. Each engine is a four stroke, lean burn, 3,750 HP, natural gas fired internal combustion engine with oxidation catalyst for emissions control. The gas compressor engines and related emission controls and monitoring equipment are included in Table 1.

Table 1.
RICE Covered by PM/MAP

| Emission Unit ID | Engine ID | Engine Description | | Site-Rated HP | Emission Controls (NSCR/AFRC or Oxy-Cat) | Initial Pressure Drop (in) | Subcategory & Compliance Date for MACT |
|------------------|--------------|--------------------|-----------|---------------|--|----------------------------|---|
| | | Manufacturer | Model | | | | |
| EUENGINE3-1 | COMP-3-01-01 | GE Waukesha | 12V275GL+ | 3,750 | Oxidation Catalyst | 1.3 | <input type="checkbox"/> 4SRB <input checked="" type="checkbox"/> 4SLB <input type="checkbox"/> 2SLB Compliance Date: 10/24/2016 |
| EUENGINE3-2 | COMP-3-01-02 | GE Waukesha | 12V275GL+ | 3,750 | Oxidation Catalyst | 1.8 | <input type="checkbox"/> 4SRB <input checked="" type="checkbox"/> 4SLB <input type="checkbox"/> 2SLB Compliance Date: 10/26/2016 |
| EUENGINE3-3 | COMP-3-01-03 | GE Waukesha | 12V275GL+ | 3,750 | Oxidation Catalyst | 2.1 | <input type="checkbox"/> 4SRB <input checked="" type="checkbox"/> 4SLB <input type="checkbox"/> 2SLB Compliance Date: 6/23/2020 |
| EUENGINE3-4 | COMP-3-01-04 | GE Waukesha | 12V275GL+ | 3,750 | Oxidation Catalyst | 2.0 | <input type="checkbox"/> 4SRB <input checked="" type="checkbox"/> 4SLB <input type="checkbox"/> 2SLB Compliance Date: 6/23/2020 |
| EUENGINE3-5 | COMP-3-01-05 | GE Waukesha | 12V275GL+ | 3,750 | Oxidation Catalyst | 2.0 | <input type="checkbox"/> 4SRB <input checked="" type="checkbox"/> 4SLB <input type="checkbox"/> 2SLB Compliance Date: 6/23/2020 |

3.0 Engine Operating Variables to be Monitored

The natural gas fired IC engines will be constantly monitored by the onboard Engine Control Unit (ECU). The Engine System Manager (ESM) and the NO_x Control Module (NCM) will control the engine such that the engine is performing per manufacturer specification. These controllers utilize various sensors to provide critical operating information to the ECU. If a sensor provides a signal outside of the normal range the ECU will flag either an alarm or a shutdown, depending on how great the value deviates from normal.

Engine maintenance will be performed in accordance with the manufacturers recommended schedule. SAP work orders will be issued in accordance with the engine maintenance plan. Engine maintenance logs will be kept in the SAP system.

4.0 Engine Malfunction Events & Procedures

Malfunction Events for Engines in Table 1

Engine System Manager (ESM) and Unit Control Panel (UCP):

- High Exhaust Temperature
 - Alarm and Shutdown
- High Engine Exhaust Post-Turbo Temperature
 - Alarm
- High Intake Manifold Temperature
 - Alarm and Shutdown

5.0 Major Engine Parts Replacement Inventory

Spare parts that will be maintained in inventory for quick replacement will be determined after the equipment has been operated and life cycle duration can be determined.

6.0 Oxidation Catalyst Operating Parameters

The following variables will be constantly monitored using pressure and temperature transmitters feeding data into a PLC data collection system. Normal Operating ranges will be established during the initial performance test:

Pressure Drop Across Catalyst

Maintain the catalyst such that the pressure drop across the catalyst does not change by more ± 2 inches from the initial pressure drop measured at the time of the initial compliance demonstration. The pressure drop across the catalyst will be monitored by an electronic pressure sensitive device and is required to be recorded at least once per month.

If the catalyst is changed, a performance test will be conducted as soon as possible to demonstrate that the RICE is still in compliance with the standard.

Catalyst Temperature

Maintain the engine exhaust temperature such that the catalyst inlet temperature is greater than or equal to 450 °F and less than or equal to 1350 °F. The catalyst inlet temperature will be continuously monitored.

7.0 Oxidation Catalyst Malfunction Events & Procedures

Malfunction Events for oxidation Catalyst Included in Table 1:

- High/Low Catalyst Backpressure
 - Alarm control room @ Initial test backpressure ± 2 in H₂O
- High Catalyst Inlet Temperature
 - Alarm control room
- Low Catalyst Inlet Temperature
 - After engine cold start & warm-up: Alarm control room @ 450°F

Malfunction Procedures

In the event of a malfunction of the catalyst, signified by monitoring equipment alarms, the catalyst and/or monitoring equipment will be inspected to determine the cause. The engine will shut down automatically or manually, as necessary, to maintain prescribed emission quality.

Diagnosis, troubleshooting, cleaning, or replacement will be performed in accordance with the manufacturer's specifications. The engine will be returned to normal service once the catalyst and/or monitoring equipment are repaired and functioning per the manufacturer's specifications.

8.0 Emissions Checks

Following major maintenance of the engine or control device, exhaust emissions will be checked following the procedure below:

The CO and O₂ will be measure at the inlet and outlet of the oxidation catalyst with an exhaust gas analyzer using ASTM D6522.00 (incorporated by reference, according to § 63.14). Measurements will be made to determine O₂ at the same time as the measurement for CO concentration. The CO concentration will be corrected to 15% O₂, dry basis.

9.0 Scheduled Oxidation Catalyst Maintenance

Oxidation catalyst maintenance will be performed in accordance with the manufacturer suggested maintenance. Given that the oxidation catalyst may require maintenance for a variety of reasons, any malfunction that may arise during the operation of this equipment will be approached utilizing the manufacturer recommended steps for troubleshooting and maintaining the equipment.

At a minimum the Preventative Maintenance schedule for the catalyst will be as follows:

Preventative Maintenance – Oxidation Catalyst

1. Physical inspection per the manufacturer's specification.
2. Vacuuming as needed to reduce ash build up and associated increased backpressure.
3. Approved washing procedure (Low pH) will be used to improve performance.

10.0 Major Oxidation Catalyst Replacement Parts Inventory

The replacement parts that will be maintained in inventory for quick replacement will be determined after the equipment has been operated and life cycle duration can be determined.

11.0 Supervisory Personal Responsible for Maintenance of Control Equipment

Name: Vince Hittie
Title: Field Leader
Location: Freedom Compressor Station
12201 E Pleasant Lake Road
Manchester, MI 48158
Phone: (734) 428-2051 (Office)
(570) 412-6564 (Cell)
Email: Vincent.Hittie@cmsenergy.com

12.0 Retention of Records

Records shall be maintained on file for a period of five years.

13.0 Updates/Revisions of PM/MAP

Periodically this PM/MAP may need to be revised. Copies of all PM/MAP revisions will be retained for a period of five years.

Revisions must be completed within 45 days if the PM/MAP does not address – or inadequately addresses – an event that occurs and meets the characteristics of a malfunction. The revisions must include procedures to operate and maintain the source during similar malfunction events and a program of corrective action for similar malfunctions of the compressor engines or associated controls and monitoring equipment. The revised plan shall be submitted to the AQD District Supervisor may request modification of the plan to address those inadequacies. MDEQ recommends the PM/MAP be reviewed annually.