Malfunction Abatement Plan
(MAP)
And
Start-up/Shutdown Malfunction Plan
(SSMP)
for

Milford Compressor Station
Natural Gas-Fired Combustion Turbines

3515 Childs Lake Road
Milford, Michigan

October 12, 2018

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1 Background

The development of a Malfunction Abatement Plan ("MAP") is required by Rule 911 (R 336.1911) of the state of Michigan's Air Pollution Control Rules. In Rule 911, MDEQ states that all sources of air contaminants must prepare a MAP to prevent, detect, and correct malfunctions or failures resulting in excess emissions. The development of a Start-up/Shut down Malfunction Plan (SSMP) is required by PTI 185-15A Special Condition FGTURBINES III.2. The MAP and SSMP are also used to describe the documentation and reporting requirements when a malfunction occurs. This MAP and SSMP have been developed, in accordance with Rule 911 and PTI 185-15A Special Condition FGTURBINES III.2, for the Milford's Compressor Station's three natural gas-fired turbines.

2 Description of System

Milford Station's equipment includes three (3) natural gas-fired 10,504 horsepower (ISO) combustion turbines (EUTURBINE1, EUTURBINE2, & EUTURBINE3) which started normal operation in July of 2018. The turbines are responsible for generating line pressure to assist the transmission of natural gas in the pipeline transmission system in southeastern Michigan. The turbines are equipped with dry ultra-low NOx burners and a combustion air inlet filter NOx emission controls. All the turbines exhaust directly to the atmosphere through separate rectangular exhaust ducts.

The Station is permitted to install and operate an additional two (2) 10,504 horsepower (ISO) combustion turbines (EUTURBINE4 & EUTURBINE5). Both permitted turbines are designed for low NOx emissions.

3 Preventive Maintenance Program

3.1 Responsible Personnel

The Station Manager is responsible for ensuring that Milford Compressor Station operates in compliance with all environmental and safety requirements and regulations. The Station Manager delegates day to day responsibilities for gas compressor station operations and maintenance to the Station Supervisor.

The Station Supervisor is responsible for overseeing the inspection, maintenance, and repair of the turbines and is responsible for all operations at the plant, as well as on call 24 hours a day, every day to the operators (i.e. nights and weekends) when plant management is not on site.

Critical phone numbers are:

Station Manager (Transmission & Storage Operations)	(248) 249-4332
Station Supervisor	(248) 308-9967
Control Room	(248) 685-0966

3.2 Maintenance Inspections

Maintenance for the turbines is contracted with the turbine manufacturer. The preventative maintenance inspections are completed semi-annually. The turbine manufacturer is also contracted to handle any abnormalities or malfunctions in the turbine operation.

3.2.1 *Semi-annual inspection* (tasks may change based on turbine condition and operation)

1. Visually inspect all package gages and indicators, verify proper operation.
2. Check condition of T5 thermocouple harnesses. Check integrity of support grommets.
3. Remove and inspect igniter torch housing for cracks, excessive erosion; inspect discharge tube for chafing wear. Remove and inspect igniter cable. Inspect igniter plug for erosion for proper gap. Replace customer-supplied plug as necessary.
4. Check batteries for proper voltages, cell electrolyte levels, and perform an 8-hour equalizing battery charge. (High Rate)
5. Test and calibrate backup over speed devices
6. Verify K values of High T5 and T7 alarms and shutdown devices.
7. Assist customer with testing and calibration, as necessary all safety, warning, and package shutdown devices. (required semi-annually)
8. External visual inspection of intake and exhaust systems for damage, leaks and debris.
9. Inspect bleed valve and IGV's for full-open and full-close signals.
10. Check and calibrate IGV (Inlet Guide Vane) activation system.
11. Check oil cooler system for cleanliness and proper operation.
12. Record lube oil filter differential pressures, Inspect and replace lubricating oil filter elements, as necessary.
13. Inspect and test pre/post lube oil pump and backup lube oil pump.
14. Inspect starter clutch to ensure lock-up in one direction and free rotation in the other.
15. Assist customer in exchanging compressor bundle.

3.2.2 *Annual Inspection* (tasks may change based on turbine condition and operation)

1. Perform all tasks required in the semi-annual maintenance/inspection.
2. Assist in checking and calibrating switches, transmitters and shutdown devices.
3. Test and calibrate, as necessary, all safety, warning, and shutdown devices.
4. Replace customer-supplied lithium battery in processor (PLC). Adhere to supplier recommendations.
5. Check PT to Compressor alignment; realign as necessary. (If vibration data dictates alignment check is necessary).
6. Inspect accessory drive through inspection covers and borescope, as applicable.
7. Perform borescope inspection of the Gas Producer.
8. Coordinate cleaning of entire package following maintenance inspection
9. Perform detergent wash of the Gas Turbine with detergent and DI water supplied by customer
10. Start and run turbine. Note any discrepancies and make any on-site adjustments or repairs to ensure normal performance and operation.
11. Using Testo record emissions levels (Tune Gas Producer as required).
12. Sample lube oil sump, ship to Analysts, Inc for laboratory analysis.
13. Assist in exchanging compressor bundle

4 Monitoring Requirements

Daily inspections of the system include an inspection of the control panel to check for failed or alarm conditions. The system is equipped with the following alarms:

1. Fuel system temperature and pressure
2. System Vibration
3. Shaft bearing temperature
4. Solonox system monitoring
5. Lube system temperature and level
6. Compressor seals flow
7. System startup terminated before sequence completed

5 Corrective Action Procedures

Precautionary measures to minimize excess emissions from the turbines will be implemented when they are experiencing a malfunction. These precautionary measures may include the following:

- If the malfunction results in turbine shutdown, determine the cause of the malfunction using the Control Panel or the Operators Manual located in the Control Room to diagnose the malfunction and identify the appropriate corrective action.
- If the malfunction does not result in turbine shutdown, determine the cause of the malfunction. If there is a potential for excess emissions, call the Environmental Contact (EM&R Matrix personnel) for the Compressor Station to determine if the turbine should be shutdown for environmental purposes.
- Notify the appropriate responsible station manager or supervisor of the malfunction so manufacturer/service representative may be contacted as necessary.
- Table 1 outlines Startup/Shutdown/Malfunction activities and actions to take depending on the situation. In most cases when there is a malfunction, the turbine will automatically shut down.

All malfunctions must be fully documented by completion of the Startup, Shutdown, & Malfunction ("SSM") Event Form contained in **Appendix A**. If prompted by the Event Form, the operator must also notify the EM&R Matrix personnel.

ATTACHMENT
TABLE 1

Table 1
Startup, Shutdown and Malfunctions Events
MILFORD COMPRESSOR STATION

	Action	Response	Documentation (form in AppendixA)
Nexus Turbines			
Start-up - Automated or manual startup procedure	**Successful Operation** • Turbines follow start up sequence. Start up is obtained when unit reaches 400 degrees, • Display on operator screen will show unit is in SOLONox mode		
	Unsuccessful Operation • Turbine stops before reaching start up temperature • SOLONOx system is not operating properly (after unit reaches 500 degrees operator display screen does not indicate SOLONox mode operating).	• Shut down turbine and determine cause of problem using the Operators Manual in the Control Room • Notify site manager or supervisors on site of potential problem • Contact Solar to have rep. come out and fix the problem. (Call should be made by site manager or supervisor).	Startup, Shutdown, and Malfunction Event Form
Shutdown - Automated or manual shutdown procedure	**Successful Operation** • Manual - turbine stops • Automatic - turbine stops		
	Unsuccessful Operation • Turbine does not follow shutdown procedure provided by the manufacture	• Cutoff gas to turbine. Determine cause of problem using the Operators Manual in the Control Room • Notify site manager or supervisors on site of potential problem	Startup, Shutdown, and Malfunction Event Form
Malfunction	• Control Room alarm will sound, or fire, lightening, weather, and other Acts of God	• If the malfunction results in turbine shutdown, determine the cause of the malfunction using the Control Panel or the Operators Manual located in the Control Room to diagnose the malfunction and identify the appropriate corrective action. • If the malfunction does not result in turbine shutdown, determine the cause of the malfunction. If there is a potential for excess emissions, call the Environmental Contact for the Compressor Station to determine if the turbine should be shut down for environmental purposes. • Notify the appropriate responsible official at the facility of the SSM event	Startup, Shutdown, and Malfunction Event Form
Malfunction	• Alarm code for low inlet air temperature (T1 alarm code) indicates that unit is out of SOLNox mode due to low inlet air temperatures.	• Shut down turbine and determine cause of problem using the Operators Manual in the Control Room • Notify site manager or supervisors on site of potential	Startup, Shutdown and Malfunction Event Form

Table 1 Startup, Shutdown and Malfunctions Events MILFORD COMPRESSOR STATION			
	Action	**Response**	**Documentation (form in AppendixA)**
		problem • Contact Solar to have rep. come out and fix the problem. (Call should be made by site manager or supervisor).	

APPENDIX A
BLANK FORMS

STARTUP, SHUTDOWN, AND MALFUNCTION EVENT FORM

To be completed for each SSM Event and retained for a period of five (5) years

Completed By: _____

Completion Date: _____

Location and Unit _____

Type of Event: check appropriate box

- ☐ Startup
- ☐ Shutdown
- ☐ Malfunction, describe: _____

_____

_____

Time/Duration of Event:

Date & Start Time of Event: _____

Date & End Time of Event: _____

Duration of Event: _____

Actions Taken to Minimize Event:

Were steps taken to immediately correct malfunction?	☐ Yes	☐ No*
Were steps taken to minimize emissions from event?	☐ Yes	☐ No*
Were monitoring and control systems in operation?	☐ Yes	☐ No*
Were actions taken consistent with the SSM Plan / MAP? (If no, complete the SSM Report Form)	☐ Yes	☐ No*

Please describe actions taken during SSM event and all reasons for answering **No** below:

_____

_____

_____

_____

_____

_____

Evaluation of Malfunction Event:

Did SSM Plan / MAP provide adequate procedures to address event? ☐ Yes ☐ No*

If **No**, provide recommendations for revision of SSM Plan / MAP in the spaces provided below.

_____

_____

_____

If **No**, was an evaluation of the root cause of the malfunction made? ☐ Yes ☐ No*

If **Yes**, describe results of evaluation in space provided below.

_____

_____

_____

If **No**, provide reasons for not performing evaluation in space provided below:

_____

_____

_____

*** IF YOU ANSWERED NO TO ANY OF THESE QUESTIONS, NOTIFY DTE ENVIRONMENTAL CONTACT IMMEDIATELY.**

APPENDIX B
COMPLETED FORMS