DEQ

RENEWABLE OPERATING PERMIT APPLICATION
AI-001: ADDITIONAL INFORMATION

This information is required by Article II, Chapter 1, Part 55 (Air Pollution Control) of P.A. 451 of 1994, as amended, and the Federal Clean Air Act of 1990. Failure to obtain a permit required by Part 55 may result in penalties and/or imprisonment. Please type or print clearly. Refer to instructions for additional information to complete this form.

	SRN: 5831	Section Number (if applicable): 1

1. Additional Information ID
AI-MAP

Additional Information

2. Is This Information Confidential? ☐ Yes ☒ No

Revised PM MAP to reflect the omission of EUENGINE5

Preventative Maintenance and Malfunction Abatement Plan

BreitBurn Operating, LP

Facility: Wilderness CO2pf
SRN: N5831

Revised to remove EUENGINE5 from ROP 6/27/18
Revised July 31, 2013
Submission date: August 20, 2012
Revised to reflect company names change
Effective Date 11/1/2007

	PM/MAP Content Checklist *Reference Appendices C,D, and E.*	Where included	
		Page	Section or Table
1	Contact Person		*Cover Letter*
	ENGINES		
2	Engine Identification: Include the engine make/model and type of engine (i.e. rich or lean burn). Identify engines with add on control and AFRC. If add on control is present, identify type of control.		*Appendix A & Appendix C*
3	Engine Operating Variables To Be Monitored. Include a copy of the normal engine maintenance log.	*4*	*Table 1 & Appendix B*
4	Corrective procedures or operational changes that will be taken in the event of a malfunction.	*2, 6*	*Table 2, Appendix D & Appendix E*
5	Major parts replacement inventory for engines.	*2*	
	Add On Controls		
6	Catalytic Converter & Oxidation Catalyst operating variables to be monitored. Include the method and frequency of monitoring these variables; provide the normal operating range of these variables.	*4-5*	*Table 1*
7	Corrective actions to be taken in event of malfunction of the catalytic converter.	*6*	*Table 2*
8	AFRC O_2 Sensor replacement schedule or operating variables to be monitored	*5*	*Table 1*
9	Corrective actions to be taken in event of malfunction of the AFRC	*6*	*Table 2*
10	Emission testing utilizing portable analyzer	*5*	*Table 1*
11	Scheduled maintenance of control equipment	*4-5*	*Table 1*
12	Major parts replacement inventory for add on control.	*2*	
13	Identify supervisory personnel responsible for overseeing inspection, maintenance and repair of add on controls.	*6*	*Table 2*
14	Recordkeeping and retention of records.	*2-3*	
15	Updates of PM/MAP as necessary.	*3*	

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

BreitBurn Operating, LP (BreitBurn) operates numerous natural gas central processing facilities (CPFs) in Michigan. The CPFs receive gas from natural gas wells and dehydrate (if necessary) and compress the gas prior to pipeline transport. All of these CPFs have natural gas fired internal combustion engines. BreitBurn uses both rich burn and lean burn engines. Some of the rich burn engines are equipped with 3-way catalytic control systems. Generally there is no add-on control for BreitBurn lean burn engines. However, a few of BreitBurn's lean burn engines are equipped with oxidation catalytic control systems. The text of this PM/MAP is uniform for all of BreitBurn's facilities. The cover page and the specific engine, catalyst and AFRC information shown in Appendix A will be unique to each facility.

2.0 ENGINES AND CATALYTIC CONTROL UNITS

2.1 Description

Three-way catalytic converters, used on rich-burn engines, provide an overall control efficiency of 90 percent for NO_x, 80 percent for CO and 50 percent for VOCs. Some of BreitBurn's rich burn engines operate with an air to fuel ratio controller (AFRC), others do not. Oxidation catalysts used on lean-burn engines reduce CO, VOC and trace organic toxic air contaminants (TACs), which include hazardous air pollutants (HAPs) and TACs emissions. Appendix A identifies the BreitBurn-operated engine(s) that are equipped with add-on control devices. This information is stored and updated on a BreitBurn database or spreadsheet. Appendix B also lists the operating variables of the engines.

2.2 Operation of Catalytic Converters

For both 3-way and oxidation catalysts, the hot exhaust gases from the engine pass through a catalytic reduction bed, where the reduction and oxidation occur. An oxidation catalyst requires higher oxygen levels to allow the converter bed to oxidize the CO, VOC and trace organic TACs/HAPs. The exhaust gases then pass out a stack.

2.3 Critical Criteria

The preventative maintenance of the engines is primarily done to keep the engine operating properly and to extend its useful life. Any major malfunction of the engine will lead to its being taken out of service for repair. Each engine has a control panel that will indicate critical malfunctions, and will initiate an engine shutdown if necessary. In the event of a shutdown, a third party mechanic is called out to repair the engine and a record of the event is made.

The critical criteria for the operation of the catalytic converter are the oxygen content of the incoming gases, the pressure drop across the catalyst bed and the inlet and outlet temperature. If the oxygen content is too high for a 3-way catalytic converter, the NO_x reduction reaction will not yield the desired 90 percent decrease in concentration. Similarly, for oxidation catalysts, if the oxygen level drops too low, the proper oxidation of CO, VOC and trace TACs/HAPs will decrease. For lean burn engines, the oxygen level should be enough to ensure that the oxygen content of the exhaust gases will remain adequate to allow proper oxidation. A high pressure drop may be an indication of plugging of the catalyst, and a very

low one may indicate the catalyst bed has leakage around or through it. A high outlet temperature may also be an indication of the need to shut down the unit to prevent burnout of the catalyst. Typical operating temperature ranges for 3-way catalysts are 750 deg. F to 1350 deg. F.

2.4 Catalyst Inspections and Maintenance

In order to reduce the chance of fouling problems with either 3-way and oxidation catalysts, if an engine is new or major maintenance is performed, the engine may run for up to 100 hours without the catalyst installed. The engine may run without the catalytic converter a maximum of 200 hours per year. Records will be maintained of the engine hours of operation without the catalyst insert installed. All catalysts will be equipped with pre- and post-catalyst temperature sensors. All engines equipped with catalysts will automatically shut down in the event that the sensors indicate that the post-catalyst temperature exceeds 1350 degrees F. If the post-catalyst temperature on a 3-way catalyst is less than the pre-catalyst temperature, a mechanic will be called out to investigate. Temperature rise will not be used as a measure of oxidation catalyst performance. The preventative maintenance schedule for BreitBurn engines and catalysts is included as Table 1. A log of all inspections and maintenance work will be maintained in a BreitBurn database or spreadsheet. A schedule is maintained for each engine and its add-on control devices.

2.5 Spare Parts

Spare washed catalyst elements and engine parts will be maintained in a third party warehouse for use when a catalyst has been removed for maintenance. Each spare insert will be washed in accordance with the Table 2 schedule. Catalyst insert kits, oxygen sensors for air fuel ratio controllers, and extra temperature probes, stepper motor as well as a harness will be supplied by a third party.

2.6 Key Operating Variables and Corrective Procedures in the Event of a Malfunction

See Table 2 for a summary of the key operating variables and corrective actions for each malfunction.

3.0 RECORDKEEPING

Records of engine operating hours and maintenance are maintained and updated on BreitBurn's data server in a database or in spreadsheet form.

BreitBurn will keep all records necessary for demonstrating compliance with this PM/MAP. Records will be made available within two weeks from the date of request by the MDEQ.

4.0 UPDATES

If BreitBurn experiences a malfunction that is not properly addressed in this Preventative Maintenance and Malfunction Abatement Plan, it will be updated and submitted to the AQD District Supervisor for review and approval.

Table 1 – BreitBurn Engine and Catalysts Preventative Maintenance Schedule			
Item	**Activity**	**Equipment Status**	**Frequency**
Engine	Mini Service ✓Check and adjust valves ✓Check engine compression ✓Check timing ✓Check fuel pressure ✓Check air filter ✓Change pre air filter ✓Check all kill devices ✓Inspect hoses and belts ✓ Inspect spark plugs	Off line	Every 60-90 days
Engine	Major Service ✓Perform mini service as listed above, and ✓Change motor oil and filter, as necessary, by sampling oil every 30 days, and submitting for an oil analysis	Off line	Approximately every 2,160 hours of engine operation, or if oil analysis indicates need.
Engine	Swing/overhaul ✓Replace existing engine with new/refurbished engine. ☞When new/rebuilt engine is installed or major maintenance is performed, the unit will be run without the catalyst, if applicable, for up to 100 hours per event. This prevents the catalyst from becoming damaged due to lubricants left in the engine and gives the valves and piston rings time to seat and seal.	Off line	Approximately every 75,000 hours of engine operation, or as needed.
Catalyst	Check differential pressure across catalyst. Establish baseline ΔP each time a new or cleaned CC insert is installed at normal operating conditions (rpm's). Check monthly. If greater than baseline ΔP by 2" WC @80-100percent max rpm, then inspect catalyst and take actions based on findings.	On line	Monthly
Catalyst	Check inlet and outlet temperatures across catalyst. ☞ If the pre-catalyst temperature is less than 750°F, or other minimum temperature established through testing, a mechanic will be called out to investigate. ☞ If the post-catalyst temperature exceeds 1350°F, the engine will be shut down. ☞ If the ΔT across CC is negative, mechanic will evaluate cause and determine a resolution, based on history and degree of change. May	On line	Daily

Table 1 – BreitBurn Engine and Catalysts Preventative Maintenance Schedule			
Item	**Activity**	**Equipment Status**	**Frequency**
	establish engine specific ΔT through testing. Must document conclusions, and actions.		
Catalyst	The catalytic converter shall be removed, inspected and cleaned at least once per 12-18 months. Cleaning will consist of vacuuming or blowing clean the catalyst face and clearing fouling and built-up ash. If the catalyst does not respond to the annual vacuum or blowing treatment, the catalyst will be removed, shipped to the manufacturer, and washed. A "washed swing" catalyst insert shall be used until a new or refurbished catalyst is installed. The used catalyst will not be returned to service unless it can be rejuvenated. Replace the gaskets (typically at the same time the catalyst is washed or serviced).	Off line	Every 12 -18 months of catalyst operating time, or in the event of an engine malfunction where foreign fluids cause engine shutdown.
Catalyst	Remove catalyst insert and wash in chemical solution to remove surface contamination. ☞Replace with clean or fresh "swing" insert during cleaning process.	Off line	Every 18-24 months of operation.
Catalyst	Replace catalyst insert.	Off line	If not functioning properly after vendor cleaning, or in lieu of vendor cleaning.
AFRC	Replace oxygen sensor.	On or off line	After 90-110 days of operation or if AFRC unit or lifetime sensor indicates need.
Emission Reduction Testing	For CO and NO_x. BreitBurn will do one of the following: a) inlet and outlet testing and estimate destruction efficiency; b) outlet testing and check for gm/hp-hr compared to levels used for permitting; or c) outlet testing and use the uncontrolled vendor data to establish a destruction efficiency.	On line	Whenever new or refurbished catalyst inserted. Typically every 12-18 months when insert is serviced. Also as needed to identify alternate operating conditions.
Portable Emission Analyzer	Maintenance and calibration.	On or off line	As required by mfg'r manuals.

Table 2 – BreitBurn Operating Variables and Remedial Actions

Device Description	Operating Variable	Monitoring Method	Frequency	Normal Operating Range	Corrective Procedure or Operational Change in the Event of a Malfunction	Responsible Supervisor
AFRC Oxygen Sensor	Oxygen content of exhaust gases	Gauge or digital reading	Monthly	0-1 percent O_2	Re-synchronize the engine and the AFRC. If O_2 level does not come into line, replace oxygen sensor within 5 days and readjust engine.	Third Party Mechanic
Catalyst	2.5" WC Change in ΔP @ normal operating conditions	Gauge or manometer	Monthly	Established with installation of new or cleaned CC insert that a 2.5" WC Change in ΔP @ normal operating conditions. Varies by engine. Recorded in database	Remove and inspect catalyst insert within 3 days. Clean or replace if necessary.	Third Party Mechanic
Catalyst	Inlet and Outlet temperatures	Thermocouple	Daily	Must be below 1350 degrees F. For 3-way catalysts only: Outlet temperature must be equal to or greater than the catalytic inlet temperature	Engine will automatically shut down at 1350 degrees F. For 3-way catalysts: If outlet temperature is less than inlet temperature, a mechanic will investigate and make appropriate repairs.	Third Party Mechanic
Thermocouple	Temperature	Temperature read-outs. Check with independent thermocouple.	As needed	0 to 1400 °F	Inspect thermocouple. Clean, recheck, or replace if not functioning.	Third Party Mechanic

Appendix A
Wilderness CO2 Equipment Information

Facility	PTI	SRN	AQD ID	BB Unit Number	Type of Control	AFRC (yes/no)	Baseline DP	Engine Model		Rich or Lean Burn
WILDERNESS CO2	86-05A	N5831	EUENGINE6	CO2 - 1	CC	YES	2.3	Waukesha	L-7042 GSI	RB
WILDERNESS CO2	86-05A	N5831	EUENGINE1	831	NA	YES	NA	Caterpillar	3516	LB
WILDERNESS CO2	86-05A	N5831	EUENGINE2	856	OC	YES	NA	Caterpillar	3516	LB
WILDERNESS CO2	86-05A	N5831	EUENGINE3	885	OC	YES	NA	Caterpillar	3516	LB
WILDERNESS CO2	86-05A	N5831	EUENGINE4	907	OC	YES	NA	Caterpillar	3516	LB

EUENGINE6 BASELINE DP CHANGE (HISTORICAL)

3/3/2014	5.7
8/8/2014	2.1
2/6/2015	VACCUMMED & INSPECTED
2/9/2015	2.5
7/27/2015	3.0
3/29/2016	Tested & DP is the same (3.0), no revision sent
10/30/2017	2.3
6/27/2018	Remove EUENGINE5 from MAP

EUENGINE5
SHUT IN 11/10/14

Appendix B

BreitBurn Operating L.P.

Preventative Maintenance and Malfunction Abatement Plan

Field Report

Location:_____ Month & Year:_____

Unit #: _____ Location: _____ Equipment: _____

Engine Model & S.N.:_____ Comp. Model & S.N.:

/	Engine:							Compressor												
Date:	RPM	Oil Press	Oil Temp	Oil Level	Water Temp	Water Level	Suct Press	#1 int Press	#2 int Press	#3 int Press	Disch Press	#1 int Temp	#2 int Temp	#3 int Temp	Disch Temp	Oil Press	Oil Temp	Oil Level	Mech Initial	Exhaust Temp
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
16																				
17																				
18																				
19																				
20																				

Field Report Continued on Other Side

Appendix B

BreitBurn Operating Company, LP/Terra Energy, Ltd.

Preventative Maintenance and Malfunction
Abatement Plan

Date:	RPM	Oil Press	Oil Temp	Oil Level	Water Temp	Water Level	Suct Press	#1 int Press	#2 int Press	#3 int Press	Disch Press	#1 int Temp	#2 int Temp	#3 int Temp	Disch Temp	Oil Press	Oil Temp	Oil Level	Mech Initial	Exhaust Temp
21																				
22																				
23																				
24																				
25																				
26																				
27																				
28																				
29																				
30																				
31																				

Hours Down Time

Date	BB	Reason For Downtime

Appendix C

BreitBurn Operating Company, L.P.

Preventative Maintenance and Malfunction Abatement Plan

COMPRESSOR SPECIFICATION SHEET

Facility/Unit #:	Packager:	Year Built:

Engine		
Manufacturer:	Model:	Serial Number:
Horsepower:	RPM:	Spec/Arrangement:
Ignition/Make?:	Starter/Make?:	Governor/Make?:
Low Emission (LE)?	AFRC/Make-Model?	Catalytic Converter-Make/Model?
Stack Height:	Exhaust Diameter:	

Compressor		
Manufacturer:	Model:	Serial Number:
Throws:	Stages:	Stroke:
RPM:	Horsepower:	Rod Load Rating:

Cylinders						
Stage/Cyl#	Bore	Class	MAWP	Serial Number	VVP/Plug/Plain	VVP S/N

Cooler					
Manufacturer:		Model:		Serial Number:	
Section	MAWP	Number of Tubes	Number of Rows	Louvers?	Year
EJW					
TAW					
IC-1					
IC-2					
IC-3					
AC					

Appendix C

BreitBurn Operating Company, L.P.

Preventative Maintenance and Malfunction Abatement Plan

COMPRESSOR SPECIFICATION SHEET

Pressure Vessels-Scrubber, Pulsatiion & Fuel Bottles					
Stage / Type *	MAWP	National Board Number	Serial Number	Diameter/Length	Year Built

*S=Scrubber SP=Suction Pulsation DP=Discharge Pulsation FB=Fuel Bottle

Panel Board		
Manufacturer:	Model:	Serial Number/Part Number:
Tachometer:	Annuciator:	Division II?

Comments		
Printed Name:	Signature:	Date:

Archrock	North America Operations Services	Ticket Number:
	General Service Ticket	

Employee Name:			W.O. Number:		
Employee ID:			W.O. Type:		
Unit Number:			Business Unit:		
Date:			Asset Group:		
Customer Name:				Engine	Compressor
Lease Name:			Make		
Service Billable to Customer? (Y/N)	No		Model		
			Serial Number		
			Hour Meter		

Time Clock				
Activity Start Time		**Note**: Select Asset Group first, then Exterran or Customer Downtime Code and Event	Customer Downtime Code	Hrs Down
Activity Finish Time	12:00 AM			
			Exterran Downtime Code	Hrs Down
Direct Time				
Work (hours)				
Travel (hours)		Activity No.	Event - Code Description	Worked Hrs or Blowdown Events
Standby (hours)		1		
Total Miles Traveled		2		
Weather Condition		3		
Total Direct Hours	0.00	4		
Others Operations Activities (MOB, DEMOB, etc)		Activity No.	Description	Worked Hrs
		1		
		2		

Indirect Time			
Description/Code	Hours	Explanation of Work Performed	ABC Spelling
		(Enter your comments here.)	
Total Indirect Hours	0.00		

Meal Hours	
Description	Hours
Total Meal Hours	0.00

Qty	Part Number	Description	Warehouse	Qty	Part Number	Description	Warehouse
0				0			
0				0			
0				0			
0				0			
0				0			
0				0			

0	Days at	$ -	Per Diem =	$ -	0	Nights at	$ -	Per Night = $ -
Is Job Complete? (Y/N)			Yes	Customer acknowledges and agrees all travel and living expenses shall be invoiced with labor charges per Exterran's Published Rate Sheet unless other terms are agreed to prior to commencement of service				
Employee Signature:				Employee Name: (print)				
Customer Signature:				Customer Name: (print)				

BREITBURN OPERATING LP
APPENDIX E
EMISSIONS TESTING EXAMPLE

Archrock

ENGINE EMISSIONS ANALYSIS

Customer:	BreitBurn	Engine CID:	0
Location:	0	Engine RPM:	0
Unit:	0	BMEP Calc:	#DIV/0!
Serial Number:	0	Amb Temp F:	0
Engine Model:	0	Date of Test:	01/00/00
		Engine Timing:	0

DATA OBSERVED

ENGINE		CONVERTER	
NOx Observed - PPM	0	NOx Observed - PPM	0
CO Observed - PPM	0	CO Observed - PPM	0
O2 Observed - %	0.0		
Engine Horsepower	0		
Fuel Used - cu-ft/hr	0		
Fuel Analysis - BTU/cu-ft	0		

CALCULATED RESULTS

	g/BHP-Hr	lbs/hr	TPY
ENGINE NOx	#DIV/0!	0.00	0.00
ENGINE CO	#DIV/0!	0.00	0.00
CONVERTER NOx	#DIV/0!	0.00	0.00
CONVERTER CO	#DIV/0!	0.00	0.00

NOx CONVERSION	CO CONVERSION
#DIV/0!	#DIV/0!

RATIO: NO / NO2
#DIV/0! / #DIV/0!

Calculated results are derived from a series of emissions readings from the identified engine at the conditions listed. Test instrument reads NO and NO2 separately with NOx based on the combined total and calculated as NO2. Concentrations in PPMv are given at the observed O2 levels with no correction factor made. Engine loading is confirmed using WPI proprietary software and / or driven equipment loading. Test instrument is spanned with known gas concentrations before each series of tests. Printout of the raw data is attached. Test instrument is an electro-chemical cell type. Method of calculation is per EPA Method 19 based on fuel usage and analysis.

Dan Kwapis