PREVENTIVE MAINTENANCE PLAN
BLUE WATER RENEWABLES, LLC
SMITH'S CREEK, MI

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1.0 INTRODUCTION

1.1 Background

Blue Water Renewables, LLC (BWR) operates a landfill as treatment system and two spark ignited internal combustion engines, under authority received from Michigan Department of Environmental Quality – Air Quality Division, through Renewable Operating Permit MI-ROP-N6207-2018.

Section 2, IX.3 of the Renewable Operating Permit requires that the Preventive Maintenance Program for the operation of the landfill gas treatment system and engines be developed and implemented. The plan shall include a schedule of maintenance activities consistent with the equipment manufacturers' recommendations, and the operating variables that will be monitored to detect a malfunction or failure.

The landfill gas treatment system filters, dewaters and compresses the landfill gas prior to delivery to the engines.

1.2 Included Components

The following items are included in the requirements of the Preventive Maintenance Plan (PMP):

- The gas treatment system that receives landfill gas from the landfill gas collection system, and conditions it prior to use as fuel in the internal combustion engines; including, but not limited to, gas dewatering system, gas filtration system and gas compression system.
- The landfill gas control system including, but not limited to the open flare, blower and motor, compressors, solar flares, ignition and operation equipment, continuous recording devices.
- Any future gas treatment system components.
- Engine and supporting components.

1.3 Owner Contacts

Facility Contact: Blue Water Renewables, LLC

Smiths Creek Landfill

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Smiths Creek, MI 48074

Jeff Neumann, Facility Manager

Cell Phone: 734-216-6979

Owner Contact: DTE Biomass Energy

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Detroit, MI 48226

Doug Ayers, Director – Operations

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Corporate Environmental Contact: DTE Vantage

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Detroit, MI 48226

Maureen Bennett, Environmental Engineer

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2.0 SCHEDULED MAINTENANCE

The Blue Water Renewables, LLC (BWR) facility consists of a landfill gas treatment system that feeds two Caterpillar engines. The engines are utilized to turn generators to produce renewable electricity for sale to the grid.

2.1 Landfill Gas Treatment System

The landfill gas treatment system for the BWR facility, or engine plant gas skid, is a system that is standard in the industry. The system is manufactured by Perennial Energy, Inc. (PEI) and utilizes traditional technologies to provide treatment of the landfill gas. Accordingly, the system is low maintenance compared to systems that provide for things such as siloxanes removal and/or removal of sulfur containing gases. Additionally, the lifespan of the treatment system is long, due to the relative simplicity of the technology. Unless the composition of the landfill gas changes significantly, which is not expected, this equipment is expected to last for at least 15 years with nothing more than routine maintenance provided. However, it is expected that the compressor, or blower, will require more extensive maintenance than the other components of the system.

The PEI manual for the equipment provides a schedule of routine maintenance for the system. The schedule specifies tasks that should be conducted on a routine basis. BWR will perform routine maintenance in accordance with the PEI manual. The elements of the routine maintenance program are as follows:

Frequency	**Task**
Daily	Visually Inspect Unit – note problems in site log book
Daily	Test Lamps (push RUN Lamp & ALARM/SHUTDOWN Lamp)
Every Two Months	Lubricate Blower
Every Three Months	Check Blower
Every Three Months	Adjust ZERO, DELTA PRESSURE, VACUUM gauges
Every Three Months	Remove debris from Demister
Every Three Months	Clean Demister, if necessary
Annually	Check for loose bolts at all flanges

Specific procedures for each of the tasks are contained in the PEI manual. The schedule from the manual is presented in Appendix A.

2.2 Engine Generator Sets

The engines utilized at the BWR facility are Caterpillar 3520C spark ignition engines. These are used widely throughout the landfill gas to energy industry.

BWR maintains the engines at the site in accordance with manufacturer recommendations, and with the operating experience at several other DTE Biomass Energy facilities (DTEBE), where an identical model of engine is used. Extensions to maintenance beyond manufacturer's recommendations will be made if found to be operationally feasible while taking into account environmental requirements.

Caterpillar has published a recommended preventive maintenance schedule for the Model 3520 engine. This schedule is attached as Appendix D in this document.

3.0 TROUBLESHOOTING

3.1 Landfill Gas Treatment System

The PEI manual provides a comprehensive table of troubleshooting actions in the event on system operating problems, or control system alarms. The table is included as Appendix B of this document

A list of manufacturers recommended spare parts is contained in Appendix C.

3.2 Engine Generator Sets

The CAT 3520 engine incorporates an Electronic Control Module (ECM) that continuously monitors several key operating parameters and adjusts operations at necessary to provide for most efficient combustion. The ECM is easily monitored by BWR staff when a malfunction does occur. The ECM programming includes the ability to set ‘trip points’ for key the key operating parameters. When the engine is not able to sufficiently adjust due to changing conditions and the trip point limit for one or more parameters is exceeded, the ECM automatically shuts down the engine. When a malfunction occurs, the ECM is accessed by BWR staff to identify the problem.

4.0 MODIFICATIONS, RECORDKEEPING, AND REPORTING

4.1 Modifications

The PMP must be periodically modified to reflect changes in treatment system equipment, or changes to the routine maintenance schedule that occur as a result of experience gained through operation on the system. The Plan should be modified if any of the following are true:

- PMP maintenance is required at intervals shorter than provided for in manufacturers' schedule.
- PMP does not address all maintenance tasks, as indicated through actual operations over time.
- Through experience it is determined that additional maintenance task can be introduced that prevent a recurring maintenance issue.

The PMP will be modified as appropriate.

4.2 Recordkeeping

The PMP will be kept on site, for reference by site operating personnel. The PMP will be made available to EGLE personnel, for review, as requested.

APPENDIX A

Routine Maintenance Schedule

MAINTENANCE SCHEDULE

FREQUENCY		CHECK
Daily	A.	Fill out the Gas Compression System Data Log.
	B	Visually inspect unit - repair any breaks, leaks, and loose wires.
	C.	Follow all Manufacturers' Recommendations in Section 7.
	D.	Test Lamps by pushing the RUN Lamp and the ALARM/SHUTDOWN Lamp.
Two Months	A.	Lubricate Blower(s) per Blower Manufacturer's instructions.
Three Months	Turn system off and perform the following procedures:	
	A.	Check Blower(s) - Turn the BLOWER switch to the "TEST" position. Verify that the selected blower starts smoothly and operates properly. After the blower has ramped to maximum speed, turn the BLOWER switch to the "AUTO" position and verify that the blower stops properly. Repeat test for all blowers.
	B.	Zero out the pressure, delta pressure, and vacuum gauges by closing off the valves in the gas lines to the gauges and opening the valves in the tees to atmosphere. Adjust the zeroing screw until the needle points to zero.
	C.	Remove the 8" blind flange inspection port on the demister and remove any debris that has collected.
	D.	If the pressure drop across the demister reaches two times it's original value, open up the top of the demister and pull out the element. There is a handle at the top that is attached to the demister element. Hose the element down opposite of landfill gas flow with high pressure water and put it back in the demister container.
Annually	Shut the System down and perform the following checks:	
	A.	Check for loose bolts on the structure and at the flanges.

APPENDIX B

Troubleshooting Guide

TROUBLESHOOTING ALARM AND SHUTDOWN ANNUNCIATION

Problem	Cause	Solution
VFD 1..3 Fault Shutdown.	**1).** Variable Frequency Drive in fault state.	**1).** Refer to Section 7-40 in this manual under troubleshooting faults.
FLT-301 & 302 High Condensate Level Alarm & Shutdown.	**1).** Condensate is at or above these levels. **2).** Faulty level switches.	**1).** Blockage. Clean out bottom of demister or piping. **2).** Replace faulty level switches.
Low Flare Flow Alarm and Shutdown.	**1).** Flare flow rate below system's "Low Flow Setpoints". **2).** Restriction of flow.	**1).** Adjust flow to higher flow rate or lower "Low Flow Setpoints. (Do not operate below manufacturer's designed flow rate.) **2).** Check valving for proper positioning or condensate blockage.
No Flow Condition Shutdown.	**1).** No flow to end users **2).** No flow signal from transmitter.	**1).** Verify valves are open on system and pipeline **2).** Verify transmitter valves are correct. Verify current signal from transmitter. Faulty analog input module
Engine 1 & 2 Fail Alarm.	**1).** No flow to engines **2).** No flow signal from transmitter.	**1).** Verify valves are open on GHS and pipeline **2).** Verify transmitter valves are correct. Verify current signal from transmitter. Faulty analog input module.
Flare Shutdown Valve Fail to Close Shutdown.	**1).** Shutdown valve not closing properly. **2).** Limit switches out of range. **3).** Actuator linkage failed.	**1).** Valve sticking or blocked open. **2).** Adjust limit switches. **3).** Replace if adjustment doesn't work.
High Inlet Vacuum Alarm and Shutdown.	**1).** Landfill wells not opened sufficiently. **2).** Condensation blocking inlet. **3).** Operating system out of designed range.	**1).** Open wells. **2).** Pump out remote knockout vessels. **3).** Adjust flowrate or vacuum setpoint within ranges for proper landfill tuning.

Low Control Panel Temperature Alarm	1). Breaker is off or tripped. 2). Heater is faulty.	1). Reset breaker. Turn on. 2). Replace heater.
High Control Panel Temperature Alarm	1). Heater setting is too high. 2). Air conditioner thermostat setting too high. 3). Breaker is off or tripped	1). Setting needs to be turned down during summer months. 2). Setting needs to be turned down during summer months. 3). Reset breaker. Turn on.
Specific Gravity Calculation Error Alarm.	1). Operator input value out of range.	1). Check your input selections. The total of all inputs cannot exceed 100%.
VFD-1..3 Run Signal Fail Shutdown.	1). VFD Input selection. 2). VFD is Off.	1). Make sure that VFD is set to remote input, not direct. 2). Close VFD Disconnect.
Blower 301 & 302 High Vibration Alarm and Shutdown.	1). Blower/Motor Coupling Alignment. 2). Blower/Motor Bearings. 3). Blower/Motor.	1). Check alignment, correct as necessary. 2). Refer to Section 7-41 in this manual for Manufacturer's troubleshooting literature. 3). Make sure that devices are mounted securely to base frame.
High LFG % Oxygen Alarm & Shutdown	1). Alarm & Shutdown setpoint set too low. 2). Broken pipe/Loose flanges. 3). Overdrawing well field.	1). Adjust setpoints. 2). Repair piping, tighten flanges. 3). Adjust wells.
High Inlet Temperature Alarm & Shutdown	1). Faulty T/C or module. 2). Alarm & Shutdown setpoint set too high.	1). Replace T/C or module. 2). Adjust setpoints.
Low LFG % Methane Alarm	1). Alarm & Shutdown setpoint set too low. 2). Broken pipe/Loose flanges. 3). Overdrawing well field.	1). Adjust setpoints. 2). Repair piping, tighten flanges. 3). Adjust wells.
High Pipeline Flow Rate Alarm & Shutdown	1). Alarm & Shutdown setpoints set too high.	1). Adjust setpoints.

Flare Start Frequency Alarm	**1).** Alarm & Shutdown setpoint set too close to available flow. **2).** Low flare temp setpoint too low.	**1).** Adjust setpoints. **2).** Adjust setpoint.
GAC Fault Alarm	**1).** GAC has fault condition **2).** No power to GAC	**1).** Reset fault at GAC (See manufacturer's literature section 7-10) **2).** Restore GAC power.
High Blower or Pipeline Discharge Temperature Alarm and Shutdown	**1).** Excessive temperature at thermocouple **2).** Setpoints set too low.	**1).** Check manual valves on blower discharge. **2).** Adjust setpoints. Faulty thermocouple module.
Condensate Pump Motor Overload Alarm.	**1).** Incoming amps exceed heater pak setting. **2).** Faulty Motor/Pump.	**1).** Adjust amp. Setting on heater pak. **2).** Replace.
Cooler Low Discharge Temperature Alarm	**1).** VFD is in manual mode. **2).** Alarm & Shutdown setpoints set too high.	**1).** Change Man/Auto control to "AUTO". Check "Start Auto Control Below Setpoint". Adjust setpoint to a greater value. **2).** Adjust setpoints.
Cooler High Discharge Temperature Alarm	**1).** Alarm & Shutdown setpoints set too low. **2).** Cooler VFD setpoint out of range.	**1).** Adjust setpoints. **2).** Change Man/Auto control to "AUTO". Check "Start Auto Control Below Setpoint". Adjust setpoint to a greater value.
Blower Surge Control Valve Failed Open Alarm & Shutdown	**1).** When flow drops at or below the open surge control setpoint and limit switches do not close.	**1).** Limit switches need adjustment or faulty actuator.
Run Clock Off Alarm	**1).** System Start/Stop parameters set to operate on a timed schedule.	**1).** System Start/Stop parameters have been modified for ON/OFF operations. Refer to the Touchscreen (Help menu under Run Clock operations) or Section 4 in this manual under System Operation Information, Section F.

Condensate Pump Run Signal Fail Alarm	**1).** Overload Tripped. **2).** Breaker Open.	**1).** Reset Overload/Check current setting on overload. **2).** Reset breaker.

APPENDIX C

Manufacturers Recommended Spare Parts List

RECOMMENDED SPARE PARTS LIST FOR FLARE STATION

JOB #1634 Davidson

Device	Part Number	Reference Designator
CPU	3592	CP-PLC-1
Analog Input Module	969	CP-AI-1..2
Thermocouple Input Module	439	CP-AI-3..4
Analog Output Module	3583	CP-AO-1
Digital Input Module	446	CP-DI-1..2
Digital Input Module	4712	CP-DI-3
Power Supply	1702	CP-E/E-1
Relay Module	468	CP-RM-1
Relay Module	3102	CP-RM-2
Surge Arrester	129	CP-SSR-1
Surge Arrester	469	CP-SSR-2
Surge Arrester	470	CP-SSR-3
Surge Arrester	471	CP-SSR-4

APPENDIX D

CAT Maintenance Schedule

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Maintenance Interval Schedule (Landfill)

SMCS Code: 1000; 4450; 7500

S/N: MAD1-Up; JBX1-Up

S/N: HAT1-Up; JBZ1-Up

Ensure that all safety information, warnings and instructions are read and understood before any operation or any maintenance procedures are performed.

The user is responsible for the performance of maintenance, including all adjustments, the use of proper lubricants, fluids, filters, and the replacement of components due to normal wear and aging. Failure to adhere to proper maintenance intervals and procedures may result in diminished performance of the product and/or accelerated wear of components.

Use mileage, fuel consumption, service hours, or calendar time, WHICHEVER OCCURS FIRST, in order to determine the maintenance intervals. Products that operate in severe operating conditions may require more frequent maintenance.

Note: Before each consecutive interval is performed, all maintenance from the previous interval must be performed.

When Required

Daily

Initial 250 Service Hours

Every 250 Service Hours

Initial 1000 Service Hours

Every 1000 Service Hours

Every 2000 Service Hours

Every Year

Every 4000 Service Hours

Between 7500 and 8000 Service Hours

Every 8000 Service Hours

Between 22 500 and 24 000 Service Hours

Every 24 000 Service Hours or 3 Years

Between 37 500 and 40 000 Service Hours

Between 50 000 and 100 000 Service Hours