

TREATMENT SYSTEM MAINTENANCE PLAN

Energy Developments
Grand Blanc

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Prepared for:

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1 INTRODUCTION

Energy Developments of Grand Blanc, LLC (EDGB) owns and operates the landfill gas-to-energy facility at the Citizens Disposal Landfill (CDL), which is a landfill gas (LFG) powered electricity generation plant located in Grand Blanc, Michigan. The CDL is subject to the United States Environmental Protection Agency, (USEPA) New Source Performance Standards (NSPS) and has the potential to emit greater than 50 MG (mega grams) per year of non-methane organic compounds.

This LFG Treatment System Malfunction Abatement/Preventative Maintenance Plan (MAPMP) was prepared in accordance with Condition III(3) of the Emission Unit EUTREATMENTSYS (page 59) of Renewable Operating Permit (ROP) No. MI-ROP-N5991-2015 issued by Michigan Department of Environmental Quality Air Quality Division.

2 EQUIPMENT FUNCTION AND MONITORING

EDGB receives LFG collected from the CDL and processes it through a treatment system. After the treatment system the LFG is sent to one of three sources:

1. Two (2) Caterpillar (CAT) 3520 internal combustion engines, and Four (4) CAT 3516 internal combustion engines
2. Two (2) open flares

Below is a summary of the treatment equipment through which LFG is treated:

1. One (1) 2"Ø condensate/liquids knockout sump for dewatering purposes
2. One (1) 10" inline strainer
3. One (1) AMERCOOL 40-gallon aftercooler.
4. One (1) AMERCOOL 80-gallon aftercooler.
5. One (1) JENCO XX"Ø carbon steel scrubber tank with scrubber pad for gas dewatering.
6. One (1) CAMERON 5 micron coalescing filter for filtering gas.
7. One (1) RO-FLO air compressor with 200 horsepower blower.
8. Two (2) RO-FLO air compressors with 100 horsepower blower.
9. One (1) Glauber plate heat exchanger dryer for dewatering gas and temperature control for optimum combustion.
 - **One (1) 2"Ø condensate knockout sump** - Wet gas flows via headers pipes into this tank. Due to the diameter of the tank the gas slows down and as a result condensate droplets in the gas fall to the bottom of the tank. Collected condensate in the tank is pumped by one of two pneumatic pumps to the CDL leachate collection system. On a weekly basis EDGB staff observes that the regulators for the pumps are indicating that air pressure is available to the pumps. On a weekly basis EDGB staff observes the counters on the pneumatic pumps indicate that the pumps are cycling therefore noting that the condensate is being pumped from the knockout tank to the leachate collection system.
 - a. **One (1) 10" inline strainer** - The purpose of the inline strainer is to remove and trap solid debris. As wet gas flows through the strainer,

larger particles and debris are trapped on the internal screen. On a weekly basis EDGB staff check the strainer for build-up on the filter screen and possible rupture of the screen system.

- b. **One (1) AMERCOOL 40-gallon and 80-gallon aftercooler** - The purpose of the aftercooler is to cool the gas. The gas flows through the aftercoolers tubes, and while the gas is flowing through the tubes a fan blows air over the tubes. On a daily basis EDGB staff observes and documents the temperature and pressure drops across the aftercoolers. On a daily basis an operator observes the operation of the fan motor, fan and drive belts documenting abnormal sounds or operating conditions.
- c. **One (1) JENCO carbon steel scrubber tank with scrubber pad** - This vessel has the same function as the condensate knockout sump, liquid removal. Wet gas flows from the plant header pipe under vacuum into the scrubber vessel. Due to the diameter of the tank the gas slows down and as a result condensate droplets in the gas fall to the bottom of the tank. Additionally a random fiber mist pack is installed horizontally at approximately $\frac{3}{4}$ the height of the tank. As the wet gas flows through the random fiber mist pack smaller droplets are forced into contact with larger droplets, and eventually the droplets reach a size where they fall to the bottom of the tank. Condensate collected in the bottom of the tank is piped to the condensate knockout sump. On a daily basis EDGB staff observes the differential pressure across the scrubber tank. Additionally, on a daily basis an operator observes liquid levels in the scrubber tank via a site glass.
- **One (1) CAMERON 5-micron coalescing filter for filtering the gas** - The coalescing filter removes moisture from the gas. Gas enters the coalescing filter through one flange, then passes through filters and exits through a second flange. Liquids collect in the bottom of the coalescing filter and are piped from the bottom of the unit directly to a storage vessel outside the building which is pumped to the CDL leachate collection system. On a daily basis the EDGB staff will observe and document the differential pressure drop across the coalescing filter. Also daily the EDGB staff will observe liquid levels accumulated in the coalescing filter vessel via a site glass.
- **One (1) 200 horsepower RO-FLO compressor** - The compressor moves the LFG through the system. It applies a vacuum to the wellfield and it provides pressure for the landfill gas treatment system and end uses. The compressor is powered by an explosion proof 300 horsepower electric motor. The compressor has a lubricating device which is sheaved off the compressor shaft that lubricates the

compressor vanes and the bearings. EDGB uses rotary vane compressors because they are mechanically simple and extremely reliable. If the electric motor is running and the lubricator is working the compressor operates. On a daily basis EDGB staff observes that the compressor lubricator is pumping oil. On a daily basis an operator observes the operation of the electric motor and compressor, listens for out of the ordinary sounds and feels bearings for significant changes in vibration or temperature. On a daily basis an operator records vacuum and pressure readings on both sides of the compressor.

- d. **One (1) 100 horsepower RO-FLO compressor** - The compressor moves the LFG through the system. It applies a vacuum to the wellfield and it provides pressure for the landfill gas treatment system and end uses. The compressor is powered by an explosion proof 250 horsepower electric motor. The compressor has a lubricating device which is sheaved off the compressor shaft that lubricates the compressor vanes and the bearings. EDGB uses rotary vane compressors because they are mechanically simple and extremely reliable. If the electric motor is running and the lubricator is working the compressor operates. On a daily basis EDGB staff observes that the compressor lubricator is pumping oil. On a daily basis an operator observes the operation of the electric motor and compressor, listens for out of the ordinary sounds and feels bearings for significant changes in vibration or temperature. On a daily basis an operator records vacuum and pressure readings on both sides of the compressor.
- e. **One (1) Glauber Plate Heat Exchanger** - The plate heat exchanger uses metal plates to transfer heat from the LFG as it passes through the drying system. On a daily basis EDGB staff observes and documents the temperature drops across the exchanges. On a daily basis an operator observes the operation of the fan motor, fan and drive belts documenting abnormal sounds or operating conditions.
- f. **One (1) XXXX Equipment 40-gallon aftercooler** - The purpose of the aftercooler is to cool the gas. The gas flows through the aftercoolers tubes, and while the gas is flowing through the tubes a fan blows air over the tubes. On a daily basis EDGB staff observes and documents the temperature and pressure drops across the aftercoolers. On a daily basis an operator observes the operation of the fan motor, fan and drive belts documenting abnormal sounds or operating conditions.
- g. **Two (2) XXXX gas dryer** - The dryer is the most technically elaborate piece of equipment in the treatment process. The purpose of the

dryer is to cool the landfill gas below the dew point of any moisture carried in the gas and then return the gas approximately to its original temperature. Like most cooling systems the dryer has compressed refrigerant that needs to be operating within pressure and temperature ranges. On a daily basis EDGB staff monitors and documents refrigerant temperature and pressure in the dryer and well as gas temperature and pressure prior to and after the dryer. Additionally, an operator visually observes and listens to the dryer compressors documenting abnormal sounds and vibration.

3 MAINTENANCE ACTIVITIES

As discussed in previous sections EDGB personnel observe and document the operation of the treatment system on regular intervals. If an operator observes equipment operating abnormally and/or observes/ documents an operating parameter from Appendix A is outside the recommended range, than a maintenance action will be taken. Below is a summary of anticipated maintenance activities which might be expected to occur during normal operation of the EDGB treatment system.

We do not anticipate this list is entirely comprehensive, and at all time EDGB reserves the right to conduct additional preventative maintenance activities in order to ensure the treatment system functions in accordance with its designed intent. In general, if any part of the treatment system is out of service, or operating outside of the tolerable ranges, EDGB immediately take steps to bring the equipment back to operation within the tolerable ranges within 24-72 hours. If a piece of equipment in the treatment system was observed to be operating within tolerable ranges but in need of preventative maintenance EDGB will schedule maintenance activities within 60 days. Documentation of all maintenance activities on the treatment system will be kept on-site including at a minimum, the equipment description, the type of maintenance performed and the duration of time required to complete the maintenance.

- (1) 2"Ø condensate knockout sump – If condensate is accumulated in the tank beyond the inlet gas pipe, the treatment system is taken down and the pump air lines, condensate discharge pumps, pipes and valves are inspected for possible blockages. EDGB will document when maintenance is conducted on this piece of equipment. Typical maintenance activities would take no more than 48 hours.
- (1) 10" inline strainer – Build-up of debris and particles can hinder the performance of the downstream gas process. EDGB will document when maintenance is conducted on this piece of equipment. Typical maintenance activities would take no more than 48 hours.
- (1) AMERCOOL 40-gallon and 80-gallon aftercooler – Two things can occur to impede the performance of the aftercooler: (1) The tubes can get dirty on the inside from the gas, or (2) something can occur to stop the fan. If the temperatures fall out of normal operating ranges, and the fan and fan motor are working properly, an operator cleans the inside of the aftercooler tubes. If the fans or fan motors are not operating properly, an operator coordinates the replacement of the belts, motors, bearings or electrical systems required to return the aftercooler to normal operations. EDGB will document when maintenance is conducted on this piece of equipment. Typical maintenance activities would take no more than 48 hours.

- (1) JENCO carbon steel scrubber tank with scrubber pad – If the differential pressure loss exceeds 2.5 inches of water column the treatment system is taken down and the scrubber pad is replaced. EDGB will document when maintenance is conducted on this piece of equipment. Typical maintenance activities would take no more than 48 hours.
- (1) CAMERON 5-micron coalescing filter for filtering the gas - If liquid levels do not drain from the coalescing filter EDGB checks condensate valves and piping to ensure no blockage exists. If differential pressure across the coalescing filter exceeds 2.5 psig an operator bypasses landfill gas around the coalescing filter and changes the coalescing filters. Typically changing the coalescing filters takes less than 60 minutes. In a typical year the filters are not replaced more than four times. EDGB will document when maintenance is conducted on this piece of equipment.
- (1) 200 horsepower and (1) 100 horsepower RO-FLO compressors – If a compressor is not able to make enough pressure to supply the end uses or if it is not applying a vacuum to the wellfield, EDGB mechanical maintenance staff are involved to troubleshoot and repair the compressor. Compressor bearings, compressor motor bearings and compressor vanes are replaced on an as needed basis in order maintain compressor performance. EDGB will document when maintenance is conducted on this piece of equipment. Typical maintenance activities would take no more than 72 hours.
- One (1) Glauber Plate Heat Exchanger – If the temperatures are noted to be outside of typical operating ranges or the heat exchangers are not operating properly, EDGB bypasses gas around the exchanger back through the refrigerant dryer skid and schedules immediate maintenance activities to diagnose and repair the exchanger. EDGB will document when maintenance is conducted on this piece of equipment. Typical maintenance activities would take no more than 72 hours.
- (1) XXXX Equipment 40-gallon aftercooler – Two things can occur to impede the performance of the aftercooler: (1) The tubes can get dirty on the inside from the gas, or (2) something can occur to stop the fan. If the temperatures fall out of normal operating ranges, and the fan and fan motor are working properly, an operator cleans the inside of the aftercooler tubes. If the fans or fan motors are not operating properly, an operator coordinates the replacement of the belts, motors, bearings or electrical systems required to return the aftercooler to normal operations. EDGB will document when maintenance is conducted on this piece of equipment. Typical maintenance activities would take no more than 48 hours
- One (1) XXXX Gas Dryer – If the gas or refrigerant temperatures or pressure are noted to be outside of typical operating ranges or the dryer compressors are not operating properly, EDGB bypasses gas around the dryer and contacts a refrigerant dryer service contractor and schedules immediate maintenance activities to diagnose and repair the dryer. EDGB will document when maintenance is conducted on this

piece of equipment. Typical maintenance activities would take no more than 72 hours.

4 SUMMARY

This Treatment System Maintenance Plan has been prepared by EDGB for the LFG treatment system at the EDGB facility located at the CDL. This plan is not intended to comprehensively address every possible maintenance activity that could be conducted on the maintenance system, but rather to establish the following:

- A general understanding of the function of each piece of equipment in the treatment system.
- Operational parameters that will be observed and documented throughout the treatment system
- Typical ranges for operational parameters that are observed and documented throughout the treatment system
- Mechanisms for documenting and reporting maintenance activities.

The overall goal of this plan is to provide assurance to the Michigan Department of Environmental Quality - Air Quality Division (MDEQ-AQD) the treatment system is operated and maintained in a manner that complies with New Source Performance Standards (NSPS), while allowing EDGB the operational flexibility to maximize combustion of the landfill gas.

LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

APPENDIX A
COMPRESSOR LOG

APPENDIX D

MALFUNCTION ABATEMENT AND PREVENTATIVE MAINTENANCE PLAN – EUENGINES