DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION
ACTIVITY REPORT: On-site Inspection

P066868043

FACILITY: Marquette Board of Light and Power		**SRN / ID:** P0668
LOCATION: 2200 Wright Street, MARQUETTE		**DISTRICT:** Marquette
CITY: MARQUETTE		**COUNTY:** MARQUETTE
CONTACT: Tom Skewis , Environmental Compliance		**ACTIVITY DATE:** 06/09/2023
STAFF: Joe Scanlan	**COMPLIANCE STATUS:** Compliance	**SOURCE CLASS:** MAJOR
SUBJECT:		
RESOLVED COMPLAINTS:		

REGULATORY AUTHORITY

Under the Authority of Section 5526 of Part 55 of NREPA, the Department of Environment, Great Lakes, and Energy may upon the presentation of their card, and stating the authority and purpose of the investigation, enter and inspect any property at reasonable times for the purpose of investigating either an actual or suspected source of air pollution or ascertaining compliance or noncompliance with NREPA, Rules promulgated thereunder, and the federal Clean Air Act.

FACILITY DESCRIPTION

The Marquette Board of Light and Power (MBLP) Marquette Energy Center (MEC) consists of three dual fuel fired Wärtsilä 18V50DF Reciprocating Internal Combustion Engines (RICE), one 400 KW emergency diesel fired generator, and one natural gas/propane fired emergency generator. The Wärtsilä engines primarily operate on natural gas; diesel fuel as a backup fuel, for startup, and a small amount of diesel fuel is injected to aid in compression ignition when firing on natural gas during normal operations. SCR (urea injection) is used to control NOx emissions and an oxidation catalyst is used to control VOC and CO emissions.

PTI No. 204-15 was issued January 13, 2016, and installation of the Wärtsilä engines was completed on August 25, 2017. PTI No. 204-15A was issued March 28, 2019, to change the allowed operation of diesel from emergency-only to any reason for operation, emergency, or non -emergency. This is because the Wärtsilä engines can fire on natural gas, using diesel as a pilot fuel to start, or start and fire on strictly 100% diesel (fuel oil). The engines are not equipped with spark plugs, so to operate on natural gas, a small amount of diesel is required to provide the ignition from compression. Therefore, diesel could not be limited to emergency use only. PTI No. 204-15A was revised May 9, 2019, due to an administrative amendment to clarify conditions that are fundamental to the PSD opt-out. The facility submitted an initial Renewable Operating Permit (ROP) application on July 18, 2018, and MI-ROP-P0668-2019 was issued October 1, 2019.

PROCESS DESCRIPTION

The MEC generates electrical power through the operation of the three (3) dual fuel fired Wärtsilä engines (EUENGINE01, EUENGINE02, and EUENGINE03) which are shaft coupled to electric generators. The engines are housed inside a sound-proofed reciprocating engine hall and exhaust systems are routed outside of the building with silencers, air quality control systems, and stacks. Each of the three MEC Wärtsilä engines has its own 70-foot stack and is equipped with selective catalytic reduction (SCR) for NOx control, and oxidation catalysts for CO, VOC, and HAPs control.

The MEC Wärtsilä engines' primary operating mode is dual fuel firing, with natural gas as the primary fuel and a very small amount of fuel oil to aid in compression ignition. The engines are not equipped with spark plugs, so to operate on natural gas, a small amount of diesel is required to provide the ignition from compression. During dual fuel operation, the annual average ratio of diesel fuel to total fuel is less than 2 parts to 100 parts on a heat input basis (less than 2% of fuel is fuel oil/diesel). Therefore, in dual fuel operation where natural gas is the primary fuel the MEC Wärtsilä engines are classified as stationary spark ignition internal combustion engines, despite using compression ignition and not having spark plugs (FGNGOP). This meets the definition of Spark Ignition in NSPS Subparts IIII and JJJJ. When using diesel (fuel oil) as the primary fuel, the MEC Wärtsilä engines are classified as Compression Ignition internal combustion engines (FGDIESELOP).

Each Wärtsilä engine provides approximately 17 MW of gross electrical output. The RICE units fire pipeline quality natural gas and fuel oil when operating dual fuel, with a fuel consumption rate of up to 173 MMBtu/hr at full load (FGNGOP), and 154 MMBtu/hr when firing strictly fuel oil (FGDIESELOP) during emergency natural gas curtailments. Fuel oil storage tanks have capacity to supply fuel for up to seven days of emergency power generation when natural gas supplies are limited or interrupted.

The MEC has a black start emergency diesel generator (EUEDG) that provides up to 400 kW of power to the Wärtsilä engine auxiliary equipment during interruptions of electrical power supply to the site. The emergency diesel generator fires on ultra-low sulfur diesel fuel. The auxiliary power generated provides necessary service loads to equipment required for startup of the Wärtsilä engines, including the fuel supply system, lube oil pumps, radiators, and reagent pumps for the SCR system. EUEDG is designed to meet applicable NSPS emissions requirements, has an operational limit of 500 hours per year based on a 12-month rolling time-period, and is used only in case of emergency and for periodic testing.

Additional emission units at the source include the emergency generator that fires natural gas or propane (EUNGENGINE), miscellaneous space heaters, and storage tanks for fuel oil and urea. EUNGENGINE is subject to 40 CFR Part 60, Subpart JJJJ.

EMISSIONS

The Wärtsilä engines emissions vary according to the air-to-fuel ratio, ignition timing, torque, speed, ambient temperature, humidity, and other factors. Pollutants emitted from the combustion process of dual fuel fired units include nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO2), volatile organic compounds (VOCs), and particulate matter (PM). Sulfur dioxides emissions are primarily from firing diesel; during normal operation SO2 is lowest, due to firing natural gas as the primary fuel (sulfur compounds are removed from pipeline-quality natural gas at processing plants). The formation of nitrogen oxides is related to the combustion temperature in the engine cylinder, and CO and VOC emissions are primarily a result of incomplete combustion. Post-combustion control systems include the SCR for NOx control and catalytic oxidizers for CO and VOC control.

The primary function of the SCR system is reducing NOx to N2 and H2O. The SCR system is equipped with a 31,000 gallon urea storage tank, feeding unit, dosing unit, reactor with catalyst, along with a NOx monitor and SCR control system. The reducing agent, urea, is injected

downstream of the engine and upstream of the reactor to mix with flue gas before entering the reactor containing the catalyst. Inside the reactor, the urea selectively reacts with NOx in the presence of the catalyst and oxygen within a specific temperature range. The SCR system includes an automated process control that automatically adjusts the amount of urea injected into the flue gas stream.

The catalytic oxidation system is fitted into the same housing as the SCR. In a catalytic oxidation system, CO and VOCs in the flue gas are oxidized to CO2 and H2O as they pass over the catalyst. The oxidation catalyst efficiency varies with inlet gas concentrations, inlet gas temperature, and flue gas residence time.

During startup, uncontrolled emissions from the Wärtsilä engine are somewhat higher than emissions during normal steady state operation. This is due to exhaust gas temperatures being too low for the SCR and oxidation catalysts to function. When an engine is started for normal operation in natural gas mode, diesel is used as a pilot fuel to start the engine. Natural gas is then introduced after combustion has been stabilized in every cylinder. The engines are capable of reaching minimum load operation within 3 minutes, and full load operation within 5 to 15 minutes. The SCR and oxidation catalyst temperatures reach operating temperatures within 30 minutes of startup. To limit uncontrolled emissions, each Wärtsilä RICE unit at MEC has annual startup and shutdown limits.

PM emissions may include trace amounts of metals and condensable, semi-volatile organics which result from incomplete combustion, volatized lubricating oil, and engine wear. Incomplete combustion is normally restricted to startups while firing diesel, but PM will typically increase during baseload operation when firing 100% diesel.

Emissions from the space heaters, fuel oil tanks, and urea storage tank, are negligible.

EMISSIONS REPORTING

The facility is required to report its annual emissions to Michigan Air Emissions Reporting System (MAERS). The following table lists the source total emissions for the reporting year 2022:

Pollutant	Emissions (TPY)
CO	2.77
NOx	16.7
PM10, PRIMARY	20.6
PM2.5, PRIMARY	20.6
SO2	0.84

VOC	**46.9**
Formaldehyde	**1.25**

REGULATORY ANALYSIS

The MEC is subject to Permit to Install (PTI) No. 204-15A and MI-ROP-P0668-2019. The facility is subject to Title 40 of the Code of Federal Regulations (CFR) Part 70 because it is a major source for NOx, CO, and VOCs and is subject to Part 60 Subparts A, IIII, and JJJJ, and Part 63 Subparts A and ZZZZ. The MEC is a minor source of HAPs.

EUENGINE01, EUENGINE02, and EUENGINE03 have emission limitations or standards that are subject to the federal Compliance Assurance Monitoring rule pursuant to 40 CFR Part 64, because the units have potential pre-control emissions over the major source thresholds. While EUENGINE01, EUENGINE02, and EUENGINE03 are subject to CAM, none of the engines are defined as "large pollutant specific emission units" (PSEU), therefor a CAM plan is not required with the initial application. Part 64.5(b) states the facility must supply a CAM Plan with the ROP renewal; at that time CAM language will be added to the ROP.

An administratively complete ROP renewal application for the MEC is due between April 1, 2023, and April 1, 2024. A pre-application ROP renewal reminder letter was sent from AQD to MBLP on April 5, 2023.

COMPLIANCE HISTORY

The facility was last inspected in December of 2020 and found to be in compliance with all applicable air quality rules and federal regulations at that time. No violation notices have been issued since the last inspection date.

INSPECTION

A targeted inspection was scheduled for 06/09/2023 at the MEC to determine compliance with MI-ROP-P0668-2019 and PTI No. 204-15A. The contact for the facility is Tom Skewis, Utility Compliance.

SOURCE-WIDE

SC I, VI.6:

Pollutant	Emission Limit	12-Month Rolling Emissions Through July 2023
NOx	**222 tpy**	**18.4 tpy**
VOC	**218 tpy**	**36.7 tpy**

Individual HAP	**8.9 tpy**	**0.77 tpy**
Aggregate HAP	**22.4 tpy**	**3.90 tpy**

SC III.1-3: MEC shall not operate EUENGINE01, EUENGINE02, and EUENGINE03 while firing fuel oil for more than 6,000 total hours combined per year on a 12-month rolling time period as determined at the end of each calendar month. The 12-month rolling sum of hours of operation for EUENGINE01, EUENGINE02, and EUENGINE03 while firing fuel oil was 13 hours through July 2023.

Total startups for all units in FGNGOP and FGDIESELOP combined is limited to 4,380 startup events per year on a 12-month rolling time period as determined at the end of each calendar month. The facility had 861 starts for the previous 12-month rolling period through July 2023.

Startup for EUENGINE01, EUENGINE02, and EUENGINE03 combined is limited to 825 startup events while firing fuel oil per year on a 12-month rolling time period as determined at the end of each calendar month. Of the 825 events, the cold startups while firing fuel oil for EUENGINE01, EUENGINE02, and EUENGINE03 combined shall not exceed 375 cold startup events while firing fuel oil per year on a 12-month rolling time period as determined at the end of each calendar month, where a cold startup is defined as a startup following a minimum of 24 hours of non-operation of the engine. The 12-month rolling sum for cold and standard fuel oil starts were 20 standard startups and zero cold starts through July 2023.

SC VI. 1-6: MEC monitors and records the total hours of operation when firing fuel oil in EUENGINE01, EUENGINE02, and EUENGINE03 monthly. The facility calculates the total hours of operation when firing fuel oil for EUENGINE01, EUENGINE02, and EUENGINE03 combined on a monthly and 12-month rolling time period. The facility monitors and records the number of total startup events when firing fuel oil and the number of total cold startup events when firing fuel oil in EUENGINE01, EUENGINE02, and EUENGINE03 on a monthly basis. MEC calculates the total number of startup events for EUENGINE01, EUENGINE02, and EUENGINE03 combined and the total number of cold startup events for EUENGINE01, EUENGINE02, and EUENGINE03 combined on a monthly and 12-month rolling time period basis. The facility calculates source-wide NOx, VOC, and individual and aggregate HAP calculations on a monthly and 12 month rolling basis (see attached records).

SC VIII.1-3: The permittee has reported deviations as required and submitted semiannual and annual monitoring and certification of compliance records in a timely manner.

EUEDG

This emission unit (EU) is a 400-kW diesel-fired emergency generator. The engine is used to supply power to the Wärtsilä engine auxiliary equipment during an interruption of the electrical power supply.

SC I, III.4, V.1: The EU is an EPA certified engine that meets the emission limits in SC I.

SC II.1: The engine only fires ultra-low sulfur diesel fuel. MEC maintains fuel supplier certification record and fuel sample test results for each delivery. Records from the most recent delivery is attached to the hard copy of this report.

SC III.1-5, IV.1: The engine is operated in a certified manner and is only used for emergency purposes or for maintenance and readiness testing. Records provided showed a 12-month rolling total of 7.4 hours through July of 2023. During the inspection, an hour meter was seen through the control screen and listed 24 hours of total use. Records provided show preventative maintenance is done monthly, every 6 months, and annually.

SC VII.1-4: The permittee has reported deviations as required and submitted semiannual and annual monitoring and certification of compliance records in a timely manner. No testing has been required for EUEDG.

SC VIII.1: SV-EUEDG is vertical and verified to be 20 feet above the ground using a 3-point measurement on a Range Finder, measured from the building grade to the top of the stack. Diameter appeared to be no more than 8 inches.

SC IX.1-2: EUEDG appears to be in compliance with all provisions of NSPS Subpart JJJJ and MACT ZZZZ.

EUNGENGINE

This emission unit (EU) is an existing emergency generator firing natural gas or propane. The engine is used to supply power to MBLP offices during an interruption of the electrical power supply.

SC III.1, IV.1, VI.1: The engine is operated in a certified manner and is only used for emergency purposes, or 100 hours for maintenance and readiness testing. Records provided showed a 12-month rolling total of 35.5 hours in July of 2023. During the inspection, a non-resettable hour meter was seen through the control screen and listed 175 hours of total use. Records provided show a total of 20.2 hours of total operation for 2023, all of which were non-emergency hours for maintenance/readiness testing. Records also show preventative maintenance is done monthly, every 6 months, and annually.

SC VII.1-4: The permittee has reported deviations as required and submitted semiannual and annual monitoring and certification of compliance records in a timely manner.

SC IX.1-2: EUEDG appears to be in compliance with all provisions of NSPS Subpart JJJJ and MACT ZZZZ.

FGNGOP

This flexible group consists of three (3) Wärtsilä 18V50DF dual fuel-fired RICE units that are shaft coupled to electric generators. Each engine is rated at approximately 17 MW and 173 MMBtu/hr when firing natural gas, or 154 MMBtu when firing fuel oil (diesel fuel). The terms and conditions of FGNGOP are triggered only when less than 2 % of the fuel fired in each engine in FGNGOP on an annual average is fuel oil, such that the engines meet the definition of a spark ignition engine. Each engine is equipped with a SCR and oxidation catalytic system. Each engine emits out its own vertical stack.

SC I, V: The three engines most recently underwent performance testing in August 2023 for compliance with MI-ROP-P0668-2019, and 40 CFR Part 60 Subpart JJJJ, primarily NOx, CO, Formaldehyde, and VOC emissions. Test results were not available at the time of this writing. Performance testing conducted in July 2021 for each engine shows compliance with the emissions limits in SC I:

	EUENGINE01	EUENGINE02	EUENGINE03	Emission Limit
NOx	1.60 lb/hr	2.90 lb/hr	0.47 lb/hr	3.3 lb/hr
	0.03 g/HP-hr, 3.0 ppmvd @ 15% O2	0.06 g/HP-hr, 5.5 ppmvd @ 15% O2	0.009 g/HP-hr, 0.9 ppmvd @ 15% O2	1.0 g/HP-hr, 82 ppmvd@ 15%
CO	0.32 lb/hr	0.22 lb/hr	0.28 lb/hr	5.0 lb/hr
	0.01 g/HP-hr, 1.0 ppmvd @ 15% O2	0.004 g/HP-hr, 0.7 ppmvd @ 15% O2	0.006 g/HP-hr, 0.9 ppmvd @ 15% O2	2.0 g/HP-hr, 270 ppmvd @ 15% O2
VOC	9.96 lb/hr	8.24 lb/hr	6.28 lb/hr	16.5 lb/hr
	0.2 g/HP-hr, 19.5 ppmvd @ 15% O2	0.16 g/HP-hr, 16.3 ppmvd @ 15% O2	0.12 g/HP-hr, 12.2 ppmvd @ 15% O2	0.7 g/HP-hr, 60 ppmvd @ 15% O2
Formaldehyde	0.25 lb/hr	0.26 lb/hr	0.18 lb/hr	0.648 lb/hr

SC III.1-4, V.1-3, VI.1-3: MEC maintains a malfunction abatement plan for EUENGINE1, EUENGINE2, and EUENGINE3. The MAP provides the equipment operating parameters, ranges, and frequency, along with a list of inspection items, frequency of maintenance, major parts replacement list, and responsible personnel. The four monitoring parameters for FGNGOP representative of air quality performance are reactor inlet temperature, urea injection rate, reactor pressure drop, and reactor outlet temperature. The normal operating ranges for these parameters in the MAP are 570 - 850 F for reactor inlet temperature, urea injection rate is 0 -14 gallons/hr for natural gas, 0 - 53 psi for reactor pressure drop, and 570 – 850 F for the reactor outlet temperature.

During the inspection, EUENGINE1 was undergoing a maintenance overhaul and not operational; EUENGINE2 and EUENGINE3 were operating and reporting the following performance parameters via the control software at 11:20 AM EST on 6/09/23:

Engine	EUENGINE2	EUENGINE3
Power Output (KW)	15708	15634
Outlet NOx (ppm)	9	7
Outlet CO (ppm)	236	213
Urea (gal/hr)	5.9	11.4
Reactor Inlet Temp (F)	784	784
Reactor Outlet Temp (F)	788	792
Reactor Pressure Drop (psi)	19	19

During the inspection, both engines appeared to be operating properly. During performance testing in August, all three engines appeared to be operating properly. The air pollution control equipment appeared to be operating within the normal operating ranges and no malfunctioning equipment was observed. All duct work appeared in good shape with no leaks.

Examples of continuous monitoring data records were provided during performance testing on 8/24/2023. On this date, all three engines were operating at greater than 90% load. The monitoring data records provide natural gas usage (lb/hr), power output (MW), engine load (%), urea flow rate to SCR (gal/hr), reactor inlet temperature (F), reactor outlet temperature (F), differential pressure across the reactor (lbf/ft2). The data for these parameters are recorded every 60 seconds for each engine. From records reviewed, all performance parameters are within the normal operating range during full operation on all three engines.

FGNGOP were purchased as non-certified EPA engines. For non-certified engines, the facility is required to conduct performance tests, create a maintenance plan, and keep records of conducted maintenance performed. The maintenance plan is included in the MAP. Records were provided on all three engines for all of 2022 through August 2023. Maintenance occurred on all engines and the SCR/oxidation catalyst systems.

Per SC VI.3 of FGNGOP, the facility keeps track of the percentage of fuel oil/diesel to total parts fuel on an energy equivalent basis. The annual average ratio of diesel fuel to total fuel is less than 2 parts to 100 parts on a heat input basis (less than 2% of fuel is fuel oil/diesel). As defined in NSPS Subparts IIII and JJJJ, all engines have been operating as Spark Ignition (SI) engines while operating in dual fuel operation where natural gas is the primary fuel.

Parts Fuel Oil (Diesel) to Parts Total Fuel by Engine			
2021			
	EUENGINE01	**EUENGINE02**	**EUENGINE03**
Annual Fuel Oil/Diesel (gal)	**36,054**	**53,693**	**50,063**
Annual Natural Gas (MMCF)	**431**	**445**	**504**
Fuel Oil/Diesel MMBtu	**4,975**	**7,409**	**6,909**
Natural Gas MMBtu	**439,832**	**453,660**	**513,748**
Total MMBtu	**444,807**	**461,069**	**520,657**
Percent Fuel Oil/Diesel	**1.12%**	**1.61%**	**1.33%**
2022			
Annual Fuel Oil/Diesel (gal)	**8,952**	**33,636**	**2,771**
Annual Natural Gas (MMCF)	**514**	**261**	**503**
Fuel Oil/Diesel MMBtu	**1,235**	**4,641**	**382**
Natural Gas MMBtu	**524,930**	**266,569**	**513,118**

Total MMBtu	**526,166**	**271,211**	**513,501**
Percent Fuel Oil/Diesel	**0.23%**	**1.71%**	**0.07%**
2023 (through Sept 18)			
Annual Fuel Oil/Diesel (gal)	**5,422**	**14,497**	**5,090**
Annual Natural Gas (MMCF)	**262**	**276**	**290**
Fuel Oil/Diesel MMBtu	**748**	**2000**	**702**
Natural Gas MMBtu	**267,814**	**281,770**	**296,594**
Total MMBtu	**268,563**	**283,771**	**297,297**
Percent Fuel Oil/Diesel	**0.28%**	**0.71%**	**0.24%**

SC VII: MEC has reported deviations as required and submitted semiannual and annual monitoring and certification of compliance records in a timely manner.

SC VIII: All three stacks for FGNGOP were verified to be 70' in height using a 3-point measure with a Range Finder, from the base to the top of the stacks. The diameter appeared to be no more than 64 inches in diameter. No visible emissions were observed.

FGDIESELOP

This flexible group also consists of the three (3) Wärtsilä 18V50DF dual fuel-fired RICE units; however, the terms and conditions of FGDIESELOP are triggered only when equal to or greater than 2% of the fuel fired in each engine in FGDIESELOP on an annual average is fuel oil, such that the engines meet the NSPS definition of a compression ignition (CI) engine. Fuel data for each individual engine was reviewed for 2021, 2022, and through August of 2023. The annual average ratio of diesel fuel to total fuel is less than 2 parts to 100 parts on a heat input basis (less than 2% of fuel is fuel oil/diesel). As defined in NSPS Subparts IIII and JJJJ, all three engines have been operating as Spark Ignition (SI) engines while operating in dual fuel operation where natural gas is the primary fuel and are subject to FGNGOP and not FGDIESELOP.

CONCLUSION

Based on the inspection performed and the records reviewed, the Marquette Board of Light and Power Marquette Energy Center is currently in compliance with MI-ROP-P0668-2019 and PTI No. 204-15A.

NAME _____ DATE 9-20-2023 SUPERVISOR _____