

**DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION
ACTIVITY REPORT: Scheduled Inspection**

B264445395

FACILITY: Hemlock Semiconductor Operations LLC		SRN / ID: B2644
LOCATION: 12334 Geddes Rd., HEMLOCK		DISTRICT: Saginaw Bay
CITY: HEMLOCK		COUNTY: SAGINAW
CONTACT: Annette Lucas , Associate Environmental Specialist		ACTIVITY DATE: 07/26/2018
STAFF: Gina McCann	COMPLIANCE STATUS: Compliance	SOURCE CLASS: MAJOR
SUBJECT: FCE of MI-ROP-B2644-2016a		
RESOLVED COMPLAINTS:		

I (glm) conducted a site inspection at the Hemlock Semiconductor (HSC) manufacturing facility located in Hemlock, Michigan. I was accompanied by HSC staff Annette Lucas, EH&S and Mr. Matthew Karl, MDEQ-AQD.

We viewed the control devices for emissions from silicon etching and washing, polycrystalline silicon manufacturing process and several FGRULE290 emission units used during harvesting of product and cleaning of reactors. Production engineers associated with each production area joined us.

HSC was issued ROP MI-B2644-2016a on April 4, 2018 with an administrative amendment change of ownership received April 20, 2017. No violation of the ROP or other air regulations were found during the inspection.

FACILITY DESCRIPTION:

HSC produces a variety of high purity polycrystalline silicon for semiconductor and photovoltaic manufacturers. Section 1 of the ROP covers the HSC operations in Hemlock, Michigan. Section 2 of the ROP was established for the Praxair Inc. operations located at the HSC Hemlock site. Praxair Inc. produces hydrogen and nitrogen for use at HSC.

The HSC site operates several chemical vapor deposition vessels where chlorosilanes are converted to polycrystalline silicon in a batch process operated under high temperature conditions. The polycrystalline silicon manufacturing process includes raw material storage, polycrystalline silicon production, and silane and chloride recovery. A majority of the process exhaust associated with the production of polycrystalline silicon is recovered for reuse or sale via vent vapor recovery systems. Process exhaust which cannot be recovered is vented to the caustic scrubber associated with each vapor recovery system.

HSC uses nitric acid and hydrofluoric acid for etching and washing of silicon. Caustic scrubbers are used to control emission from the etching and washing activities. Emissions from material handling of hydrofluoric acid are also controlled by a caustic scrubber.

HSC operates two natural gas fired boilers, each controlled by a low nitrogen oxide burner, that provide steam for process heat. Several smaller steam and hot water boilers and natural gas fired process heaters throughout the site provide additional process heat for a variety of production activities.

The HSC facility has hydrochloric acid (HCL) stored on-site. The chlorosilanes used at the HSC facility become hydrochloric acid (HCL) upon contact with air. Only small amounts of HCL are released during normal processing but there is the potential for larger releases due to leaks and upset conditions.

The following table lists stationary source emission information as reported to the Michigan Air Emissions Reporting System in the 2017 submittal.

TOTAL STATIONARY SOURCE EMISSIONS

Pollutant	Tons per Year
Carbon Monoxide (CO)	40.27
Lead (Pb)	0
Nitrogen Oxides (NO _x)	54.08
Particulate Matter (PM)	8.05
Sulfur Dioxide (SO ₂)	0.43

Pollutant	Tons per Year
Volatile Organic Compounds (VOCs)	3.80
Nitric Acid	0.02
Hydrochloric Acid	1.18
Hydrogen Fluoride	0.12
Methanol	0.67

The stationary source is subject to Title 40 of the Code of Federal Regulations (CFR), Part 70, because the potential to emit NOx exceeds 100 tons per year. The NOx emission potential of over 100 tons per year is generated from the combined emissions of multiple boilers, and, the etching, washing, and polycrystalline silicon manufacturing processes.

The stationary source is not considered a major source of Hazardous Air Pollutant (HAP) emissions because the potential to emit of any single HAP regulated by the federal Clean Air Act, Section 112, is less than 10 tons per year and/or the potential to emit of all HAPs combined is less than 25 tons per year.

No emissions units at the stationary source are currently subject to the Prevention of Significant Deterioration (PSD) regulations of Part 18, Prevention of Significant Deterioration of Air Quality of Act 451, because at the time of New Source Review permitting the potential to emit of was less than tons per year. However, modifications to this source may be subject to PSD regulations.

Emissions from the vapor deposition processes are monitored and controlled pursuant to Part 55, Air Pollution Control Rules, Rule 290 (R 336.1290) and the requirements contained in the ROP for Flexible Group FGRULE290.

Section 1: HSC

EUS11ETCH: Compliant

Silicon rods are etched using nitric acid and hydrofluoric acid prior to being placed in reactor vessels. Emissions from the etching process are captured and sent to a caustic scrubber. Emissions from on-site nitric acid tanks are also captured and sent to the scrubber.

ROP-MI-B2644-2016a limits NOx emission limits to 39 ton per year (tpy) on a 12-month rolling time period. I viewed NOx emissions data for the 12-month rolling time periods ending December 2016 through June 2018. NOx emissions were below 1 ton per year (tpy), see *attached*.

The scrubber recirculation liquid has continuous reading monitors that record pH, flow and temperature once per minute. A records request was sent on July 25, 2018 and records received on August 4, 2018. I reviewed a subset of electronic records for June 2016, June 2017 and June 2018. All required parameters were monitored and results indicate compliance with emission limits and operating restrictions in the ROP.

We viewed the caustic scrubber, recirculating pumps, flow & pH metering, and control panel read out. In order to demonstrate compliance with the emission unit limits for NOx and hydrogen fluoride the facility is required to maintain the scrubber flow at minimum of 150 gpm, and a minimum pH of 7. At the time of the site inspection the scrubber flow was 220 gpm with a pH of 7.0. There was no evidence of improper operation of the scrubber. The control and monitoring system has an audible and visual alarm for low flow conditions.

EUS30ETCH: Compliant

Post reaction silicon rods are broken into chunks. The chunks are etched and washed using nitric acid and/or hydrofluoric acid. Emissions from the etching process are captured and sent to a caustic scrubber. Wash was not performed at this emission unit during 2015. December 2014 was the last time etching was completed. Records are maintained for this unit even though it has not been in operation.

FG 130WASH: Compliant

This flexible group was formerly named FGS130ETCH. During the 2015 ROP renewal process the name was changed. Staff reviewed the associated permit issued for this group, PTI #324-07, and discovered the naming convention was incorrect. No etching takes place in this flexible group, only washing.

Post reaction silicon rods are broken into chunks. The chunks are etched and washed using nitric acid and/or hydrofluoric acid. Emissions from the etching process are captured and sent to a caustic scrubber. Emissions from the on-site hydrofluoric acid tank farm are also captured and sent to the scrubber.

The ROP has design/equipment parameters that restricts the facility from loading EUHFTank1 or EUHFTank2 or transfer hydrofluoric acid from either tank unless the vapor balance system and the caustic scrubber are installed, maintained, and operated in a satisfactory manner. The facility does not use these tanks. Instead they use 330 gallon totes. The tanks were used a few times when the process initially started up, but the hydrofluoric acid was not at the purity level it needed to be. At that time the facility switched to using totes. This condition should be addressed during the next ROP renewal cycle in 2020.

The facility is required to maintain the scrubber flow and pH in a satisfactory manner. I reviewed a subset of electronic records for June 2016, June 2017 and June 2018. All required parameters were monitored, and results indicate compliance with emission limits and operating restrictions in the ROP.

We viewed the caustic scrubber, flow & pH metering, and control panel read out. Compliance is demonstrated through proper operation of the caustic scrubber. The facility is required to monitor the pH of the solution circulating in the caustic scrubber and the flow rate of the scrubbing medium once each day that FG130WASH operates. At the time of the site inspection the scrubber flow was >220 gpm with a pH > 7.0. There was no evidence of improper operation of the scrubber. The control and monitoring system has an audible and visual alarm for low flow conditions.

FGBOILERS: Compliant

Boilers #8 and #9 with heat capacity of 98 MMBtu/hr are, FGBOILERS, are controlled by a low NOx burner. The ROP limits natural gas usage for the boilers to less than 1400 million standard cubic feet per 12-month rolling time period as determined at the end of each calendar month.

Compliance is maintained through proper operation and maintenance of the boilers and material usage limitations. The facility provided proper documentation for the last (2) two malfunctions the boilers had, which coincided with maintenance performed. Natural gas usage values are recorded at the end of each month by a Utilities Technician and entered into an electronic tracking system. Records received for 12-month rolling periods ending December 2016 through June 2018 showed usage between 627 MMcf and 325 MMcf.

Rule 290 emission units: Compliant

Plant vent 1 is no longer used for capture & treatment of reactor vessel emissions but is used a liquid neutralization vessel. All former Plant 1 vent emissions now go to Plant Vent2. There are GC calibration alarms sent to the Process Control Operator if calibration is out of range. The emission calculations include each chloride group (HCL, and mono/di/tri/siltec) measured by the GC. The scrubber has 99.8 % removal efficiency.

During the inspection the following emission units and their associated control devices were viewed.

- S-301 (EUPLTVENT1 through EUPLTVENT5)
- S-401 (EUPLTVENT1 through EUPLTVENT5)
- S-450 (EUPLTVENT1 through EUPLTVENT5)
- S-292
- S-292VacNorth
- S-292VacSouth
- EU S292VacX

Vent scrubbers control HCl and particulate emissions. All records from the on-site instrumentation are maintained in the Process Information System ("PI"). Alarms are set around scrubber recirculation flows. Action is taken if emissions reach 450 lbs/month.

For each emission unit that emits non-carcinogenic particulate air contaminants the facility performs a monthly visible emission observation of each stack or vent. I viewed records for the FGRULE290 emission units viewed during the inspection from 2016 through current, 2018. The facility appears to be in compliance with R290 exemption.

FGCOLDCLEANERS: Compliant

The facility currently operates and maintains 3 cold cleaners. Safety Kleen is contracted to dispose and replenish solvent. The facility also tracks the amount of solvent, pounds in minus pounds shipped out, used for MAERS reporting.

FG287(c): Compliant

The facility uses the paint booth to maintain the appearance of their facility. I reviewed usage records for 2016, 2017 and 2018. Usage was less than 40 gallons per month for any given month during that time period. The facility maintains records of maintenance and provided records for date filters were changed. It appears to be maintained and operated according to the ROP standards. The facility was in compliance with the ROP requirements for this emission unit.

FG-GasDispGACT: Compliant

This flexible group includes existing and new/reconstructed stationary gasoline dispensing facilities (GDFs). GDF means any stationary source which dispenses gasoline into the fuel tank of a motor vehicle, motor vehicle engine, nonroad vehicle, or nonroad engine, including a nonroad engine use solely for competition. These facilities include but are not limited to facilities that dispense gasoline into on and off road street, or highway motor vehicles, lawn equipment, boats, test engines, landscaping equipment, generators, pumps, and other gasoline-fueled engines and equipment.

The GACT limits the gasoline throughput to less than 10,000 gallons per month. I reviewed the last 12 months of gasoline throughput records and the facility was in compliance with this requirement.

FGMACTEMER: Compliant

Four emission units make up this flexible group; EUFPSO69P1, EUFPSO69P2, EUGENSO42 and EUGNESO82. I reviewed records for 2016, 2017 and 2018. Records of run time are recorded for each unit. The facility does monthly maintenance checks, which require the generators to operate. The overall operating hours were below the allowed 100 hours.

FG-NSPSEMER: Compliant

This flexible group is for the following compression ignition internal combustion engines:

ID	Manufacturer	ID/Serial Number	Manufactured	KW
EUFPS369P1	Clarke (John Deere)	RG6081A177677	11/2006	205.07
EUFPS369P2	Clarke (John Deere)	RG6081A177686	11/2006	205.07
EUFPS569P1	Clarke (John Deere)	PE6068L101871	12/ 2009	236
EUFPS569P2	Clarke (John Deere)	PE6068L101870	12/ 2009	236

The NSPS restricts the sulfur content of diesel fuel to less than 15 ppm per gallon and a minimum centane index of 40; or a maximum aromatic content of 35 percent by volume. HSC requested the sulfur content of the diesel purchased from the MPLX terminal in Bay City. The sample taken on 8/6/2018 had a sulfur content of 6.59 ppm per gallon. Per Marathon, all pipeline shipments to terminals must meet the minimum sulfur content specification. They conduct sampling tests at the tank tanks as well, but with multiple sources and deliveries, they do not have refinery certification results specific to Bay City.

Section 2: Praxair

The Praxair, Inc., plant produces gaseous hydrogen from natural gas feedstock by the steam methane reforming process. A cryogenic air separation plant produces gaseous nitrogen. The site treats city water to remove metals, prevent scaling, & de-aerates prior to going to a boiler. Natural gas is used for heating and treated gas is used for production.

The Praxair methane reformer EUH2PLANT was subject to the Maximum Achievable Control Technology Standards for Chemical Manufacturing Area Sources promulgated in 40 CFR, Part 63, Subparts A and VVVVVV. Based on a negative applicability determination by the US EPA, Praxair requested to remove the

federal applicability of 40 CFR, Part 63, Subpart VVVVVV, Chemical Manufacturing Area Sources Rule (CMAS rule), covered in FGMACTVVVVV during the ROP renewal process in 2015.

Praxair will have potential emissions of the applicable metal HAPS only during maintenance catalyst change-outs, which occur when the facility is shut down. According to the US EPA letter to Air Products and Chemicals, Inc., dated June 24, 2013, during catalyst change out, the chemical manufacturing process unit (CMPU) would be out of service and would not meet the rule requirements for HAP use or generation during production. In the case of the steam-methane-reforming (SMR) facilities, the CMAS rule would not apply during the catalyst change out process since the CMPU would not be in use for hydrogen production at the time of loading and unloading. Based on the above determination, FGMACTVVVVV was removed from the ROP during the 2015 renewal.

Compliance was not reviewed for FGMACTVVVVV during this inspection due to the negative applicability determination by the US EPA.

EUH2PLANT: Compliant

Equipment to produce hydrogen by steam methane reforming, including a steam methane reformer, a shift reactor, a deaerator, and a pressure-swing adsorption purification unit.

There are no emission limits or material limits. S. C. VI requires Praxair to monitor the steam reformer combustion chamber temperature and the feedstock natural gas flow rate during each startup event. The site must also keep a log for each start up event with the date & time, duration, steam methane reformer combustion chamber temperature immediately before feedstock introduction, feedstock NG flow rate at the time feedstock flow rate is established, & the feedstock NG flow rate immediately before the operator initiates the venting downstream of the PSA unit.

The facility uses remote monitoring at times other than Monday – Friday 7AM to 3 PM. I reviewed a subset of on-site electronic records for 2018, see attached. The facility had records for startup dates & times, methane reformer combustion chamber temperature, and natural gas feedstock flow rates. All required parameters were monitored, and results indicate compliance with emission limits and operating restrictions in the ROP.

At the time of the inspection the facility was in compliance with ROP-MI-B2644 and all applicable state and federal regulations.

NAME *Glenn L. McCann* DATE *8/14/2018* SUPERVISOR *C. Hare*