SMAQMD BACT CLEARINGHOUSE

ACTIVE

CATEGORY Type: **APC - MISCELLANEOUS**

BACT Category: Small Emitter BACT (PTE <10lb/day)

BACT Determination Number:	391	**BACT Determination Date:**	02/10/2025

Equipment Information

Permit Number: N/A - Generic BACT Determination

Equipment Description: Dry Etch emission control used for Semiconductor manufacturing

Unit Size/Rating/Capacity: <1 MMBTU/hr

Equipment Location: N/A - Generic BACT Determination

BACT Determination Information

District Contact: Venk Reddy **Phone No.:** 279-207-1146 **Email:** vreddy@airquality.org

ROCs	**Standard:**	No Standard
	Technology Description:	
	Basis:	Achieved in Practice
NOx	**Standard:**	No Standard
	Technology Description:	
	Basis:	Achieved in Practice
SOx	**Standard:**	No Standard
	Technology Description:	
	Basis:	Achieved in Practice
PM10	**Standard:**	Control efficiency >=99% of process emissions
	Technology Description:	
	Basis:	Achieved in Practice
PM2.5	**Standard:**	No Standard
	Technology Description:	
	Basis:	Achieved in Practice
CO	**Standard:**	No Standard
	Technology Description:	

		Basis:	Achieved in Practice
	LEAD	**Standard:**	No Standard
		Technology Description:	
		Basis:	Achieved in Practice

Comments:	This is a generic BACT determination based on BACT determinations made, and published, by other air agencies in California and/or other States.

Printed: 02/10/2025

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

DETERMINATION NOS.: 391

DATE: 12/18/2024

ENGINEER: Venk Reddy

Category/General Equip Description: Dry etch process emission control

Equipment Specific Description: Air pollution control device consisting of multiple combustion chambers and a water scrubber.

Equipment Size/Rating:
Minor Source BACT
Minor source of HAPs, both individually or facility wide.
Less than 10 lbs/day of VOC, NOx, SOx, PM10, PM2.5
Less than 550 lbs/day of CO
Total rating of less than 1 MMBTU/hr

Previous BACT Det. No.: None

The BACT will be applied to control equipment designed specifically for the treatment of dry etch semiconductor processing tool exhaust. The control equipment consists of a series of combustion chambers and a wet scrubber, housed in a single unit.

The dry etch process uses halogenated fluoride gasses such as CLF3, and CHF3. In the presence of a plasma field generated from an electric arc, the gasses react (etch) with the surface of the silicon wafer. At the end of the process cycle, the equipment will exhaust the gasses that are remaining which includes unreacted gasses, HF, HCl, and smaller fluorinated compounds to the control device. There are no VOC emissions from the process equipment, only non-organic compounds are found in the exhaust of this process.

The first stage of the exhaust control is a series of combustion chambers that convert any remaining fluorinated compounds to HF and HCl. The next stage is the water scrubber that removes the acids from the exhaust stream and traps them in the water. The water is then treated with NaOH. HF & HCl are Federal Toxic Air Contaminant (HAPs) and the water scrubber is expected to be 99% efficient in treating the acids in the exhaust stream.

Per Sac Metro Air District policy titled “Small Emitter and “Otherwise-Exempt Equipment” BACT Determinations” (5/16/19) technologically feasible analysis will not be conducted since the criteria pollutant emissions do not exceed 10 lbs/day of VOC, NOx, SOx, PM10 or PM2.5 and less than 550 lbs/day of CO. The control device is small enough that the products of combustion do not exceed this threshold.

BACT/T-BACT ANALYSIS

A. ACHIEVED IN PRACTICE (Rule 202, §205.1a):

The following control technologies are currently employed as BACT/T-BACT by the following agencies and air pollution control districts:

US EPA

Projects entered in the EPA RACT/BACT LAER clearinghouse between the period of 1/1/2014 and 12/18/2024 were reviewed for this BACT determination. There were no projects involved with semiconductor or dry etch processes.

RULE REQUIREMENTS:

40 CFR 63 Subpart BBBBB National Emission Standards for Hazardous Air Pollutants for Semiconductor Manufacturing.

This would be applicable for a source that is a major source of HAPs that is defined as 10 tons per year or more of a single HAP or any combination of HAP at a rate of 25 tpy or more. Though not subject to this standard it will be reviewed for achieved in practice requirements to control HAPs as part of the T-BACT applicability.

Per section 62.7184 (c) (1) & (2) the operation would be required to reduce inorganic HAP emissions by 95% and reduce or maintain the concentration of emitted inorganic HAP to less than or equal to 0.42 PPMV.

This rule does not cover the control device specifically, but it covers the entire semiconductor operation that this is a part of. This Air Pollution Control Device would help control the inorganic HAP emissions down to the 95% emitted from the dry etch process.

California Air Resource Board (CARB)

BACT

No projects were found in the BACT determinations, one project was found under BACT guidelines that references a dry etch process. The referenced BACT is for the process that this air pollution control device is controlling. This BACT is also referenced in the BAAQMD BACT clearinghouse published on their website.

Semiconductor Fabrication – Siliconizing Reactors, Furnace Chambers, and Chemical Vapor Deposition Reactors Document 149A.3.1 1/10/92	
Pollutant	**Standard**
VOC	No standard
NOx	No standard

Semiconductor Fabrication – Siliconizing Reactors, Furnace Chambers, and Chemical Vapor Deposition Reactors Document 149A.3.1 1/10/92	
SOx	No standard
PM10	Exhaust vented to a combustion chamber followed by wet scrubber w/ particulate control efficiency ≥ 99% (of the process emissions)
PM2.5	No standard
CO	No standard

Source: ARB BACT Clearinghouse

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
There are no rule standards for this source category.

Sacramento Metropolitan AQMD

BACT

No applicable BACT reviews were identified.

RULE REQUIREMENTS:

Rule 406 – Specific Contaminants (Amended 12/6/1978)

This rule limits the emission of sulfur compounds and combustion contaminants.

A person shall not discharge into the atmosphere from any single source of emission equipment whatsoever:
a. Sulfur compounds in any state or combination thereof exceeding in concentration at the point of discharge: sulfur compounds, calculated as sulfur dioxide: 0.2% volume.
b. Combustion contaminants in any state or combination thereof exceeding in concentration at the point of discharge: 0.23 grams per dry standard cubic meter (0.1 grains per dry standard cubic foot) of gas calculated to 12% carbon dioxide at standard conditions.

South Coast AQMD

BACT

Source: SCAQMD BACT Guidelines for Non-Major Polluting Facilities (Last Revised 2/1/2019)

No BACTs were identified as applicable to this application.

RULE REQUIREMENTS:

REG II Rule 219 (Amended 4-7-2023)
Per section (d)(2)(C)(iii) Combustion equipment that is rated less than 2 MMbtu/hr and is not treating VOCs greater than 1 lb/day is exempt from permit obligations. Since the equipment is less than 2 MMbtu/hr and is not treating VOCs it would be exempt from permitting requirements.

Per section (e)(1)(C) A permit would be required if the equipment was used to meet the emission limitation requirements of an ATCM or a NESHAP. The source is not subject to 40 CFR BBBBB Semiconductor operations since it is not a major source of an individual HAP or total HAPs.

Rule 1147 NOx reduction from Miscellaneous Sources
Per Table 2 for "Other unit or Process Temperature" the NOx requirement would be 30 PPM for units that operate less than 1,200°F or 60 PPM for units operating at or greater than 1200°F. The dry etch control typically operates at 600°F and 700°F but can operate at higher temperatures as needed to meet the required destruction efficiency. This rule has not been applied to equipment that is smaller than 2 MMbtu/hr that does not treat VOCs due to the fact that a permit would not be required. The treatment of dry etch exhaust is a specialized application. There are no known burners that will meet 30 or 60 PPM standard used for this application. Therefore, this rule will not be considered achieved in practice. No technologically feasible analysis will be done as part of this BACT based on the small emitter policy. Since it is not achieved in practice the limits of this rule will not be considered.

San Joaquin Valley APCD

BACT
Source: SJVAPCD Guidelines
There are no BACT standards published in the clearinghouse.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Rule 2020 – Exemptions (12/18/24)
This rule would subject the unit to a permit because, per section 6.19.2 "Low Emitting Units with uncontrolled HAP emissions that may cause a significant health risk to the public, shall require an Authority to Construct or Permit to Operate." Since the unit is creating HCl & HF as well as treating HAP generated from the process, a permit would be required.

Rule 4801 – Sulfur Compounds (Amended 12/17/1992)
A person shall not discharge into the atmosphere sulfur compounds, which would exist as a liquid or gas at standard conditions, exceeding in the concentration at the point of discharge: two-tenths (0.2) percent by volume calculated as sulfur dioxide, on a dry basis averaged over 15 consecutive minutes.

San Diego County APCD

BACT
Source: NSR Requirements for BACT (November 2023)
There are no BACT determinations for this type of air pollution control equipment.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
Regulation 4, Rule 68 – Fuel-Burning Equipment – Oxides of Nitrogen (9/20/1994)
This rule applies to fuel burning equipment which has a maximum input rating of greater than or equal to 50 MMBtu/hr. The rule is not applicable to equipment of this size.

Regulation 4, Rule 53 – Specific Air Contaminants – (1/22/1997)
A person shall not discharge into the atmosphere from any single source of emission equipment whatsoever:
1. Sulfur compounds calculated as sulfur dioxide: 0.05 percent, by volume, on a dry basis.
2. Combustion particulates: 0.1 grains per dry standard cubic foot of gas which is standardized to 12% of carbon dioxide by volume.

Bay Area AQMD

BACT
Source: BAAQMD BACT Guidelines
The referenced BACT is for the process that this air pollution control device is controlling. Not for the control device itself. There were no BACT determinations that reference the control device.

Semiconductor Fabrication – Siliconizing Reactors, Furnace Chambers, and Chemical Vapor deposition Reactors Document 149A.3.1 1/10/92	
Pollutant	**Standard**
VOC	No standard
NOx	No standard
SOx	No standard
PM10	Exhaust vented to a combustion chamber followed by wet scrubber w/ particulate control efficiency ≥ 99% (control of process emissions)
PM2.5	No standard
CO	No standard

The use of this type of APCD would be considered BACT for a dry etch process, but there are no available emission limitations identified.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Reg 8 Rule 30 Semiconductor Wafer Fabrication Operations (revised 4-24-2018)
This rule governs the VOC usage at semiconductor fabrication facilities. This rule does not cover dry etch operations, since there are no VOCs involved.

Reg 9, Rule 3 – Inorganic Gaseous Pollutants; NOx from Heat Transfer Operations §9-3-301(3-17-1982)
This rule does not apply to any new or modified heat transfer operation designed for a maximum heat input of less than 264 GJ (250 million BTU) per hour.

Summary of Achieved in Practice Control Technologies

The following control technologies have been identified and are ranked based on stringency:

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
Pollutant	**Standard**
VOC	1. No Standard [USEPA, CARB, SMAQMD, SCAQMD, BAAQMD, SJVAPCD, SDAPCD]
NOx	1. No standard [USEPA, CARB, SMAQMD, SCAQMD, BAAQMD, SJVAPCD, SDAPCD]
SOx	1. No standard [USEPA, CARB, SMAQMD, SCAQMD, BAAQMD, SJVAPCD, SDAPCD]
PM10	1. Control efficiency ≥ 99% of process emissions (A) [BAAQMD] 2. No standard [USEPA, CARB, SMAQMD, SCAQMD, SJVAPCD, SDAPCD]
PM2.5	1. No standard [USEPA, CARB, SMAQMD, SCAQMD, BAAQMD, SJVAPCD, SDAPCD]
CO	1. No standard [USEPA, CARB, SMAQMD, SCAQMD, BAAQMD, SJVAPCD, SDAPCD]
T-BACT	1. 95% control of HAPs [USEPA 40 CFR 63 Subpart BBBBB 2. No standard [SCAQMD, CARB, BAAQMD, SJVAPCD, SDAPCD]

(A) BAAQMD identifies the use this combustion chamber and water scrubber as the control for a dry etch process with control efficiency ≥ 99% of the process emissions but does not prove any limits on emissions for the control.

Summary Table

The following control technologies have been identified as the most stringent, achieved in practice control technologies:

BEST CONTROL TECHNOLOGIES ACHIEVED IN PRACTICE		
Pollutant	**Standard**	**Source**
VOC	No standard	All
NOx	No standard	All
SOx	No standard	All
PM10	Control efficiency ≥ 99% of the process emissions	BAAQMD
PM2.5	No standard	All
CO	No standard	All
T-BACT	95% control of inorganic HAPs	US EPA 40 CFR 63 Subpart BBBBB

B. TECHNOLOGICALLY FEASIBLE AND COST EFFECTIVE (Rule 202, §205.1.b.):

The District's Small Emitter and "Otherwise-Exempt Equipment" BACT Determinations policy (dated 5/16/2019) states that units which are classified as small emitters (less than 10 lbs/day of VOC, NOx, SOx, PM10, or PM2.5 and less than 550 lbs/day of CO) and are located at non-major stationary sources are only required to meet BACT standards that have been achieved in practice. Therefore, this BACT determination will only be based on what is achieved in practice and will only be applied to small emitters at non-major sources. BACT will be evaluated on a case-by-case basis for units that do not fit these criteria.

C. SELECTION OF BACT:

Based on the above analysis, BACT for VOC, NOx, SOx, PM10, and CO will remain at what is currently achieved in practice and BACT for PM2.5 will be set to be the same as for PM10.

BACT FOR Dry Etch Emission Control		
Pollutant	**Standard**	**Source**
VOC	No standard	All
NOx	No standard	All
SOx	No standard	All
PM10	Control efficiency ≥ 99% of process emissions	BAAQMD
PM2.5	No standard	All
CO	No standard	All

T-BACT FOR Dry Etch Emission Control		
Pollutant	**Standard**	**Source**
HAP	95% control of HAPs	USEPA 40 CRF 63 Subpart BBBBB

APPROVED BY: *Brian F Krebs* **DATE:** **02-11-2025**