ENGINEERING EVALUATION REPORT
ALTA DEVICES, INC
APPLICATION NUMBER 025946

BACKGROUND:
Alta Devices, Inc. (P# 20677), a semiconductor manufacturer, has applied for a change of permit conditions for the Cleanroom (S-2) as follows:

Condition #25321

- Part 1: Increase wipe cleaning gross usage limits for Acetone and Isopropyl Alcohol from 100 gallons per year (each) to 300 gallons per year (each).

- Part 2: Increase/modify allowable chemical vapor deposition chemical usage as follows:

Phosphine	~~60~~ 10,000 pounds
Arsine	~~55~~ 10,000 pounds
Chlorine	~~90~~ 2,000 pounds
Trimethylaluminium	~~25~~ 75 ~~gallons~~pounds
Trimethylindium	~~15~~ 50 ~~gallons~~pounds
Trimethylgallium	~~25~~ 1,500 ~~gallons~~pounds
Carbon Tetrabromide	~~15~~ 50 ~~gallons~~pounds

EMISSIONS DISCUSSION:

Wipe Cleaning Solvent:
For wipe cleaning operations, it is assumed that 100% of the gross product usage will be emitted to the atmosphere. Therefore, increased emissions of NPOC (Acetone, 6.60 lb/gal) and POC (Isopropyl Alcohol, 6.53 lb/gal) will be as follows:

NPOC = (200 gal/yr x 6.60 lb/gal)
= 1,320 lb/yr

POC = (200 gal/yr x 6.53 lb/gal)
= 1,306 lb/yr

Condition #25321, Parts 3.a. and 3.b. currently limits POC emissions from S-2 to 0.837 tons per year and NPOC emissions to 0.33 tons per year. Daily POC and NPOC emissions are limited to 9 pounds per highest day for each. Based on the proposed total wipe cleaning solvent usages of 300 gallons per year each of Acetone and Isopropyl Alcohol, the potential annual NPOC and POC emissions will be:

NPOC = (300 gal/yr x 6.60 lb/gal)
= 1,980 lb/yr
= 0.990 tons/yr

POC = (300 gal/yr x 6.53 lb/gal)
= 1,959 lb/yr
= 0.980 tons/yr

The applicant has stated that wipe cleaning operations are performed 5 days a week, 52 weeks per year. Therefore, daily NPOC and POC emissions will be 7.6 lb/day and 7.5 lb/day, respectively. From Regulation 2-5, Table 2-5-1 the Acute and Chronic TAC trigger levels for Isopropyl Alcohol are 7.1 lb/hr and 2.7 E+05 lb/yr respectively. The projected emissions are well below these levels.

Changes to Condition #25321 part 3 will be made as necessary to account for the proposed increased solvent usage.

Chemical Vapor Deposition, Inorganic Gases:
Alta Devices has proposed substantial increases to the currently permitted limits for Phosphine, Arsine, and Chlorine; all toxic air contaminants (TAC). These gases are currently, and will continue to be abated by the Dry Scrubber A-1. Condition #25321, Part 5 currently requires that the concentration of toxic gases at the outlet be less than 25 ppb.

Given the following:

MW of Arsine (AsH_3):	77.946 lb/lb-mole
MW of Chlorine (Cl_2):	70.906 lb/lb-mole
MW of Phosphine (PH_3):	33.998 lb/lb-mole
Molar Volume of Gas @ 60^{o}F:	380 scf/lb-mole
Maximum Scrubber Flow Rate:	200 liters/min (7.06 cu.ft./min; 423.6 scf/hr)
Maximum Outlet Concentration:	25 ppb (25 E-09)
Max. Annual Hours of Operation:	8,760 hrs/yr

The highest inorganic gas TAC emissions will be:

Arsine = (25 E-09) x (77.946 lb/lb-mole / 380 scf/lb-mole) x (423.6 scf/hr) x (8,760 hrs/yr)
= 0.019 lb/yr

Chlorine = (25 E-09) x (70.906 lb/lb-mole / 380 scf/lb-mole) x (423.6 scf/hr) x (8,760 hrs/yr)
= 0.017 lb/yr

Phosphine = (25 E-09) x (33.998 lb/lb-mole / 380 scf/lb-mole) x (423.6 scf/hr) x (8,760 hrs/yr)
= 0.008 lb/yr

Highest 1-hour emissions (assuming 25 ppb at the outlet) will be:

Arsine:	2.17 E-06 lb/yr
Chlorine:	1.94 E-06 lb/yr
Phosphine:	9.13 E-07 lb/hr

Both maximum annual and 1-hour emission rates are below the following Regulation 2-5 TAC Trigger Levels:

	Acute (lb/hr)	Chronic (lb/yr)
Arsine:	4.4 E-04	5.8 E-01
Chlorine:	4.6 E-01	7.7 E+00
Phosphine:	N/A	3.1 E+01

Chemical Vapor Deposition, Organic Semiconductor Compounds:
The applicant has requested that the usage units for Trimethylaluminium (liquid), Trimethylindium (solid), Trimethylgallium (liquid), and Carbon Tetrabromide (solid) be changed from gallons to pounds. For all but Trimethylgallium, this does not impact emissions. For Trimethylgallium, Alta Devices has requested an increase of usage from 25 gallons per year to 1,500 pounds per year.

Trimethylgallium is unstable at normal atmospheric conditions and will react violently with water and spontaneously combust when exposed to air. All usage of this compound is vented to the Dry Scrubber A-1, where the destruction efficiency is said to be at least 99% (wt). Although it is likely that none of the original compound could exist once emitted to the atmosphere, if it is assumed that the abated emissions are 1% (as POC), the highest emissions are:

POC = (1,500 lb/yr) x (1.0 – 0.99)
= 15 lb/yr

CUMULATIVE EMISSIONS INCREASE:
The cumulative emissions increase for this application is estimated to be:

(lbs/day)		(tons/yr)	
POC	= 3.6	POC	= 0.661
NPOC	= 3.6	NPOC	= 0.660

TOXIC RISK ASSESSMENT:
As previously discussed, highest potential emissions of Arsine, Chlorine, Isopropyl Alcohol, and Phosphine will be below the Acute and Chronic trigger levels for each compound. Although Trimethylgallium is a hazardous material, it is not listed as a toxic air contaminant by the District.

BACT REVIEW:
Best Available Control Technology (BACT) review is triggered for any new or modified source which results in an emission from a new source or an increase in emissions from a modified source and which has the potential to emit 10.0 pounds or more per highest day of POC or NPOC.

As discussed above, the applicant has proposed solvent usage increases at the Wipe Cleaning operations for the Cleanroom S-2 that will increase POC and NPOC emissions. However, based on the proposed total usages of 300 gal/yr Isopropyl Alcohol and 300 gal/yr Acetone, the highest day POC and NPOC emissions will be less than 10 pounds per day. Furthermore, Condition #25321, Parts 3.a. and 3.b limit POC and NPOC emissions to 9 pounds per highest day. Therefore, BACT is not triggered.

OFFSET REVIEW:
In accordance with Regulation 2-2-302 before the APCO may issue an authority to construct or a permit to operate for a new or modified source at a facility which emits or will be permitted to emit more than 10 tons per year but less than 35 tons per year of precursor organic compounds, emission offsets shall be provided, by the District at a 1.0 to 1.0 ratio for the emission from the new or modified source and any pre-existing cumulative increase, minus any onsite contemporaneous emission reduction credits determined in accordance with Section 2-2-605 from the Small Facility Banking account in the District's Emissions Bank in accordance with the provisions of Regulations 2-4-414.

The Databank emissions inventory states that the facility currently has 0.847 tons/yr of permitted POC emissions. This application has a POC emissions increase of 0.661 tons/yr, bringing the total permitted POC emissions to 1.508 tons/yr. Offsets are not required for this application.

STATEMENT OF COMPLIANCE:
The Cleanroom S-2 is subject to the requirements of Regulation 8, Rule 30 "Semiconductor Wafer Fabrication Operations". There are no new requirements triggered by the proposed condition changes.

Permits for "Semiconductor Manufacturing Operations" are considered to be ministerial operations (Permit Handbook Chapter 7.4). Therefore, this application is not subject to CEQA review.

This operation is not subject to NESHAP requirements (Subpart BBBBB "Emission Standards for Hazardous Air Pollutants for Semiconductor Manufacturing") because it is not a "major source" of HAPs (i.e. any single HAP at a rate of 10 tons per year or more or any combination of HAP at a rate of 25 tpy or more).

This application is subject to the requirements of Regulation 2-1-412 "Public Notice, Schools".

PERMIT CONDITIONS:
It is recommended that Permit Condition #025321 be modified as shown below to incorporate the changes requested by the applicant.

CONDITIONS FOR S-2

1. The owner/operator of S-2 shall not exceed the following gross usage limits for wipe cleaning during any consecutive 12 month period:

Acetone	~~100~~ 300 gallons
Isopropyl Alcohol (IPA)	~~100~~ 300 gallons

(basis: Cumulative Increase)

2. The owner/operator of S-2 shall not exceed the following gross usage limits at any chemical vapor deposition operation during any consecutive twelve-month period:

Phosphine	~~60~~ 10,000 pounds
Arsine	~~55~~ 10,000 pounds
Chlorine	~~90~~ 2,000 pounds
Trimethylaluminium	~~25~~ 75 ~~gallons~~pounds
Trimethyllindium	~~15~~ 50 ~~gallons~~pounds
Trimethylgallium	~~25~~ 1,500 ~~gallons~~pounds
Carbon Tetrabromide	~~15~~ 50 ~~gallons~~pounds

(Basis: Cumulative Increase, Regulation 2-5)

3. The owner/operator may use an alternate material other than the materials specified in Parts 1 and 2 and/or usages in excess of those specified in Parts 1 and 2, provided that the owner/operator can demonstrate that all of the following are satisfied:
   a. Total POC emissions from S-2 shall not exceed ~~0.837 tons~~ 1 ton in any consecutive twelve month period and 9 pounds per highest day;
   b. Total NPOC emissions from S-2 shall not exceed ~~0.33 tons~~ 1 ton in any consecutive twelve month period and 9 pounds per highest day; and
   c. The use of these materials shall not result in an increase in toxic emissions above any risk screening trigger level in Regulation 2-5.

   For the purposes of emission calculations, 30% of the gross usage at solvent stations shall be assumed to be emitted, 100% of the gross usage for wipe cleaning shall be assumed to be emitted, and 90% of the gross usage at photoresist spinners shall be assumed to be emitted, unless the Air Pollution Control Officer has provided written approval to the owner/operator of this source to use other emission factors. The owner/operator shall submit to the District a Data Form X and Material Safety Data Sheet for each alternate material other than the materials specified in Parts 1 through 3. (Basis: Cumulative Increase; Regulation 2-5)

4. The owner/operator shall abate emissions from S-2 with the following properly maintained and properly operated abatement device during all periods of S-2 operation:

   A-1 Scrubber, 14 CFM, electrically driven

5. The owner/operator shall ensure the following is achieved at A-1:

   - Effluent concentration shall be below 25 ppb of toxic gases
   - If the effluent concentration exceeds 25 ppb of toxic gases, canister shall be replaced within 5 days

   (basis: Cumulative Increase)

6. To demonstrate compliance with part 5, the owner/operator shall ensure that A-1 is equipped with effluent sensors and a continuous effluent concentration monitor. The owner/operator shall calibrate the effluent sensors annually at a minimum. (basis: Cumulative Increase)

7. To determine compliance with the above parts, the owner/operator shall maintain the following records and provide all of the data necessary to evaluate compliance with the above parts, including the following information:
   a. Quantities of each type of coating and solvent used at this source, and emissions calculations for this source, on a daily and monthly basis.
   b. If a material other than those specified in Part 1 is used, POC/NPOC and toxic component contents of each material used; and mass emission calculations to demonstrate compliance with Part 3, on a daily and monthly basis;
   c. Monthly usage and/or emission calculations shall be totaled for each consecutive twelve-month period;
   d. Daily records of the parametric levels specified in Part 5;
   e. Dates of A-1 canister replacement

   All records shall be retained on-site for two years, from the date of entry, and made available for inspection by District staff upon request. These recordkeeping requirements shall not replace the recordkeeping requirements contained in any applicable District Regulations. (Basis: Cumulative Increase; Toxics)

RECOMMENDATION:

The District has reviewed the material contained in the permit application for the proposed project and has made a preliminary determination that the project is expected to comply with all applicable requirements of District, state, and federal air quality-related regulations. The preliminary recommendation is to issue a Change of Permit Conditions as shown above. However, the facility is located within 1000 feet of a school, which triggers the public notification requirements of District Regulation 2-1-412. After the comments are received and reviewed, the District will make a final determination on the permit.

I recommend that the District initiate a public notice and consider any comments received prior to taking any final action on issuance of a change of permit conditions.

By: _____

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Senior Air Quality Engineer