

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

ENGINEERING DIVISION

APPLICATION PROCESSING AND CALCULATIONS

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APPLICANT'S NAME: Northrop Grumman Space and Mission Systems Corporation

FACILITY PERMIT ID# 800408

CONTACT PERSON: Ron Frazer

MAILING ADDRESS: ONE SPACE PARK DRIVE, R11/2000
REDONDO BEACH, CA 90278

EQUIPMENT ADDRESS: 1700 ROSECRANS AVE., BLDG D1
MANHATTAN BEACH, CA 90266

Title V Permit Revision:
Application No. 516127

**PERMIT TO CONSTRUCT
SECTION "H"**

Equipment Description:

PROCESS 10: D1 EAST LAB SYSTEM #2: Integrated Circuit Fabrication					
Equipment	Device ID	Connected To	Source Type/ Monitoring Unit	Emissions	Equipment Specific Conditions
PLASMA ETCHER, PLASMA THERM, WAFER BATCH 730 Reference A/N 441119 516124	D96	C161			
PLASMA ETCHER, DEPOSITION/ETCHER, PLASMA THERM, MODEL DUEL 790. Reference A/N 441119 516124	D97	C161			
PLASMA ETCHER, PLASMA THERM, MODEL NO. SL720. Reference A/N 441119 516124	D113				
DEPOSITION REACTOR, CHEMICAL VAPOR DEPOSITION, PEVCD TYPE, ELECTROTECH, MODEL DELTA 201, WITH THREE VACUUM PUMPS.	D306	C161		PM: (9) [RULE 405, 2-7-1986]	C1.6, K48.4

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Reference A/N 441119 <u>516124</u>					
PLASMA ETCHER, PLASMA THERM, BACKSIDE VIA ETCH. Reference A/N 441119 <u>516124</u>	D510	C161			B59.40
PLASMA ETCHER, MATRIX NO.6, MATRIX SYSTEM ONE STRIPPER, MODEL NO. 106. Reference A/N 441119 <u>516124</u>	D511	C161			B59.40
PLASMA ETCHER, NITRIDE ETCH, VLRII, UNAXIS/PLASMATHERM, MODEL NO VLR700. Reference A/N 441119 <u>516124</u>	D512	C161			B59.40
PLASMA ETCHER, VLRII, UNAXIS/PLASMATHERM, MODEL NO VLR700. Reference A/N 441119 <u>516124</u>	D513	C161			B59.40
PLASMA ETCHER, MATRIX NO.7, MATRIX SYSTEM ONE STRIPPER, MODEL NO. E2053 Reference A/N 441119 <u>516124</u>	D514	C161			B59.40
PLASMA ETCHER, MATRIX NO. 14, MATRIX SYSTEM ONE STRIPPER, MODEL NO. 105E. Reference A/N 441119 <u>516124</u>	D516	C161			B59.40
PLASMA ETCHER, NITRIDE ETCH, TEGAL, MODEL NO. 901E. Reference A/N 441119 <u>516124</u>	D517	C161			B59.40
PLASMA ETCHER, NO. 3, PLASMA THERM, MODEL NO. SLR SERIES, TWO VACUUM PUMPS. Reference A/N 441119 <u>516124</u>	D522	C161			B59.44, C1.36

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BENCH, PLASMA DESCUMMER, NO. 1, TECHNICS, MODEL NO. PE II/IIA, 2FT 8IN L X 2FT 6IN W X 2FT H, 2.2 KVA, AND 0.8 HP VACUUM SYSTEM. Reference A/N 441119 <u>516124</u>	D523	C161			B59.4, B59.43
BENCH, PLASMA DESCUMMER, NO. 1, TECHNICS, MODEL NO. PE II/IIA, 2FT 8IN L X 2FT 6IN W X 2FT H, 2.2 KVA, AND 0.8 HP VACUUM SYSTEM. Reference A/N 441119 <u>516124</u>	D524	C161			B59.4, B59.43
FURNACE, ELECTRIC, MRL INDUSTRIES, MODEL THERMTECH, 80-KW. Reference A/N 441119 <u>516124</u>	D94	C161			
ION IMPLANTER, VARIAN, MODEL EHP500, HEIGHT: 8FT, LENGTH: 16FT, WIDTH: 10FT 6IN. Reference A/N 441119 <u>516124</u>	D425				B59.12
PLASMA ETCHER, PLASMA THERM, MODEL 790, HEIGHT: 6FT 6IN, LENGTH: 3FT 5IN, WIDTH: 3FT 5IN, 65-KVA Reference A/N 441119 <u>516124</u>	D426				
DEPOSITION REACTOR, PECVD TYPE, PLASMA THERM, MODEL NO. 790. Reference A/N 441119 <u>516124</u>	D462				
VACUUM METALIZING FIJI F200 PLASMA ATOMIC LAYER DEPOSITION (ALD) Reference A/N <u>516124</u>	E611	C161	ADD		59.70

Conditions:

B59.4 The operator shall not use the following material(s) in this device:
Materials containing VOC.

B59.12 The operator shall not use the following material(s) in this device.
Toxic Air Contaminants in Table 1 of Rule 1401 with a Listing Date of 8/13/99 or earlier.

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- B59.40 The operator shall not use the following material(s) in this device.
Toxic Air Contaminants in Table 1 of Rule 1401 with a Listing Date of 5/02/03 or earlier except chlorine, hydrochloric acid, phosphoric acid, hydrofluoric acid, ammonia, and isopropyl alcohol.
- B59.43 The operator shall not use the following material(s) in this device.
Toxic Air Contaminants in Table 1 of Rule 1401 with a Listing Date of 5/02/03 or earlier.
- B59.44 The operator shall not use the following material(s) in this device.
Toxic Air Contaminants in Table 1 of Rule 1401 with a Listing Date of 5/02/03 or earlier except chlorine, arsenic and isopropyl alcohol.
- B59.70 The operator shall not use the following material(s) in this device.
Toxic Air Contaminants in Table 1 of Rule 1401 with a Listing Date of 9/10/10 or earlier.
- C1.6 The operator shall limit the material processed to no more than 3600 in any one month.
For the purpose of this condition, material processed shall be defined as the total number of wafers processed.
- C1.36 The operator shall limit the material processed to no more than 0.50 gallon(s) per month.
For the purpose of this condition, material processed shall be defined as isopropyl alcohol.
- K48.4 The operator shall maintain records in a manner approved by the District, to demonstrate compliance with the following condition number(s):
Condition C1.6

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Equipment Description:

PROCESS 1: CONTROL EQUIPMENT					
Equipment	Device ID	Connected To	Source Type/ Monitoring Unit	Emissions	Equipment Specific Conditions
SCRUBBER, FS-41, HARRINGTON, MODEL NO. HPH 78-FB, MIST ELIMINATOR, A 15 H.P. EXHAUST FAN, 9FT 8IN W. X 15FT L. X 10FT 1 IN H., WITH THREEE 3-HP WATER CIRCULATION PUMPS. Reference A/N 441419 <u>516125</u>	C161	D94,D96,D97, D98,D99,D100, D101,E280, E281,E282, E283,E284, E285,E286, E300,D306, D475,D510, D511,D512, D513,D514, D515,D516, D517,D518, D519,D520, D521,D522, D523,D524 E611	ADD	PM: (9)[RULE 404, 2-7-1986]	C8.5, C8.9, D90.1, E158.1, E159.1, I331.1, K67.3

Conditions:

C8.5 THE OPERATOR SHALL USE THIS EQUIPMENT IN SUCH A MANNER THAT THE FLOW RATE BEING MONITORED, AS INDICATED BELOW, IS NOT LESS THAN 125 GPM.

To comply with this condition, the operator shall install and maintain a(n) flow meter to accurately indicate the flow rate of the recirculating scrubbing solution.

C8.9 THE OPERATOR SHALL USE THIS EQUIPMENT IN SUCH A MANNER THAT THE pH BEING MONITORED, AS INDICATED BELOW, IS NOT LESS THAN 8 OF THE pH SCALE

To comply with this condition, the operator shall monitor and record the pH as specified in condition D90.1.

D90.1 THE OPERATOR SHALL PERIODICALLY MONITOR THE pH OF THE SCRUBBING SOLUTION ACCORDING TO THE FOLLOWING SPECIFICATIONS:

The operator shall use litmus paper or a portable pH analyzer to monitor the parameter.

The operator shall monitor once every day provided any equipment served by this control system is in operation.

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E158.1 THE OPERATOR SHALL MAINTAIN A CONTINUOUS OVERFLOW OF WATER FROM THE SCRUBBER SUMP TO PREVENT THE BUILD UP OF CONTAMINATION.

E159.1 THE OPERATOR SHALL MAINTAIN INSPECTION PORTS WHICH, WHEN OPENED, ALLOW THE OBSERVATION OF THE SPRAY NOZZLES AND SCRUBBING SOLUTION BEING SPRAYED ON THE PACKING.

I331.1 THE CONDITIONS AND REQUIREMENTS FOR THIS DEVICE IN SECTION H SHALL TAKE EFFECT, AND SHALL SUPERSEDE THOSE IN SECTION D, WHEN THE MODIFICATIONS AUTHORIZED IN SECTION H ARE COMPLETED. THE OPERATOR SHALL NOTIFY THE AQMD WHEN THE MODIFICATIONS ARE COMPLETE.

K67.3 THE OPERATOR SHALL KEEP RECORDS, IN A MANNER APPROVED BY THE DISTRICT, FOR THE FOLLOWING PARAMETERS OR ITEMS:

pH of scrubbing solution on a daily basis.

Flow rate of recirculating scrubbing solution on a daily basis.

Background

Northrop has filed application, 516124 and 516125 on 11/09/10, to add device E611 a vacuum metalizing unit to D1 East Lab which is under Process 10 System 2. The device will be vented to scrubber, C161 which has a previous permit, F78849. The new equipment is exempt under rule 219(e)(20), vacuum metalizing. The modification to Process 10, system 2 will not cause an emission increase in excess of one pound PM10 nor will there be a toxic impact of greater than one in a million or increase of the hazard index greater than one.

This is a RECLAIM Cycle 2 and title V facility. The proposed project is considered as a "de minimus" significant permit revision to this facility title V permit.

The district records indicate that during the last five years Northrop Grumman was issued two Notices of Violation (NOV). Notice P49771 was issued on 11/08/2006 for operating without submitting the 3rd quarter, cycle 1 emissions report in a timely manner. NOV P50342 was issued on 5/5/2010 for failure to conduct the source tests for boilers D365 and D457. These issues have been resolved and Northrop is now in full compliance.

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APPLICATION PROCESSING AND CALCULATIONS**Process Description:**

The vacuum metalizing deposition system will use organo-mellatic gases to deposit several different metals onto semiconductor substrates. The Fiji 200 Atomic Layer Deposition (ALD) system uses inductive coupling to heat water or nitrogen into a plasma. The flow of plasma and organo-metallic gases are alternatively pulsed and reacted in the deposition chamber to deposit metals on microelectronic substrates. The gases are reacted with either water or nitrogen to form metallic oxides or nitrides that are deposited onto either Silicon, Silicon Carbide, Gallium Arsenide or Indium Phosphide substrates. The maximum usage for any precursor gas will be approximately 8 grams per year. This is based on a usage of 0.075 grams per batch, a maximum of 16 batches per week over 52 weeks per year. The equipment will be operated 3 hours per day, 7 days per week and 52 weeks per year. The average usage will be less since four different precursor gases will be used and the average number of batches will be less than 16 per week.

Emissions Calculations:**E611 Vacuum Metalizer:**

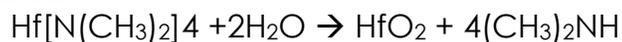
Precursor Gas:

Tetrakis Hafnium (TH) – $\text{Hf}[\text{N}(\text{CH}_3)_2]_4$
 Trimethyl Aluminum (TA) – $\text{Al}(\text{CH}_3)_3$
 Tetrakis Zirconium (TZ) – $\text{Zr}[\text{N}(\text{CH}_3)_2]_4$
 Tetrakis Titanium (TT) – $\text{Ti}[\text{N}(\text{CH}_3)_2]_4$

Reactant Gas:

Water vapor and Nitrogen

Reactions:



$$\text{MW}_{(\text{Hf}[\text{N}(\text{CH}_3)_2]_4)} = 354.79$$

$$\text{MW}_{(\text{CH}_3)_2\text{NH}} = 45.08$$

Per Wafer:

$$0.075\text{gm TH} / 354.79 = 0.0002114 \text{ moles TH}$$

1 mole TH:4 moles Dimethylamine(D)

$$= 4 \times 0.0002114 \text{ mole TH} = 0.0008455 \text{ moles D}$$

$$= 0.0008455 \text{ moles D} \times 45.08\text{gm/mole} = 0.0381 \text{ grams D/wafer}$$

4 wafers per batch, 16 batches per week, operating 7 days per week

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= 0.0381 gm D/wafer(4 wafer/batch)(16 batches/week)(week/7days)

= 0.349 grams Dimethylamine/day

Reactions:



$\text{MW}_{(\text{Al}(\text{CH}_3)_3)} = 72.09$

$\text{MW}_{(\text{CH}_4)} = 16.04$

Per Wafer:

0.075gm TA /72.09 =0.00104 moles TA

1 mole TA:6 moles Methane(M)

= 6 x 0.00104 mole TA = 0.00624 moles M

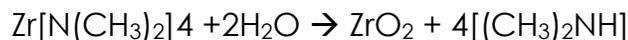
= 0.00624 moles M x 16.04gm/mole = 0.100 grams M/wafer

4 wafers per batch, 16 batches per week, operating 7 days per week

= 0.10 gm M/wafer(4 wafer/batch)(16 batches/week)(week/7days)

= 0.915 grams Methane/day

Reactions:



$\text{MW}_{(\text{Zr}[\text{N}(\text{CH}_3)_2]_4)} = 267.09$

$\text{MW}_{(\text{CH}_3)_2\text{NH}} = 45.08$

Per Wafer:

0.075gm TZ /267.09 =0.0002808 moles TZ

1mole TZ:4 moles Dimethylamine(D)

= 4 x 0.0002808 mole TZ = 0.001123 moles D

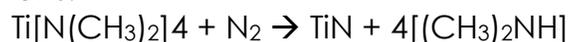
= 0.001123 moles D x 45.08gm/mole = 0.05063 grams D/wafer

4 wafers per batch, 16 batches per week, operating 7 days per week

= 0.05063 gm D/wafer(4 wafer/batch)(16 batches/week)(week/7days)

= 0.463 grams Dimethylamine/day

Reactions:



$\text{MW}_{(\text{Ti}[\text{N}(\text{CH}_3)_2]_4)} = 224.18$

$\text{MW}_{(\text{CH}_3)_2\text{NH}} = 45.08$

Per Wafer:

0.075gm TT /224.18 =0.0003345 moles TT

1mole TT:4 moles Dimethylamine(D)

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$$= 4 \times 0.0003345 \text{ mole TT} = 0.001338 \text{ moles D}$$

$$= 0.001338 \text{ moles D} \times 45.08 \text{ gm/mole} = 0.06033 \text{ grams D/wafer}$$

4 wafers per batch, 16 batches per week, operating 7 days per week

$$= 0.06033 \text{ gm D/wafer}(4 \text{ wafer/batch})(16 \text{ batches/week})(\text{week}/7 \text{ days})$$

$$= \underline{0.552 \text{ grams Dimethylamine/day}}$$

The maximum number of batches this equipment could perform based on maximum rated capacity is 24 per day. That is one hour per batch including loading, processing and unloading of the device. It is unlikely that this will ever occur since the maximum number of batches won't exceed 16 per week. At this rate, 24 batches per day, a maximum Dimethylamine emission of:

$$0.552 \text{ grams}(24 \text{ batches}/16 \text{ batches}) = 0.828 \text{ grams D/day}$$

The maximum methane emission of :

$$0.915 \text{ grams}(24 \text{ batches}/16 \text{ batches}) = 1.37 \text{ grams CH}_4/\text{day}$$

The equipment is vented to a scrubber but would be used primarily for odor control because dimethylamine's ammonia odor. It is assumed that any ammonia would be eventually released to the atmosphere and that methane is not controlled by the scrubber.

Assuming the maximum PM10 emission would be equivalent to the maximum methane emission, the worst case is still negligible.

$$1.37 \text{ gm/day}/(454 \text{ gm/lb}) = 0.003 \text{ lbs/day}$$

Risk Assessment:

Ammonia is the only potential byproduct listed under Rule 1401. The Tier one threshold at 100 meters is 8.57 lbs/hr. Assuming that all the emissions, dimethylamine and methane were to be ammonia, the emissions will not exceed the Tier one threshold therefore no further modeling will be required.

Rule Review

Specific compliance with the following rules is expected.

Rule 212: Public Notice

The addition of these two devices to Process 10, system 2 will not constitute a significant project. There are no schools

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within 1,000 feet from the source. The toxic air contaminant emissions are less than the Tier One thresholds and there are no VOC emissions. A public notice is not required.

Rule 401: Opacity.

No visible emissions are expected.

Rule 402: Nuisance.

Operation of the above equipment is not likely to create a public nuisance.

Rule 1164: Process 10, system 2 is a integrated circuit fabrication system. No VOCs are used in the new device. Compliance with this rule is expected.

REG XIII: New Source Review.

Since the emissions from the plasma etchers are negligible, the proposed project will not trigger a "New Source Review".

Rule 1401: Toxics

The vacuum metalizer will be materials that may generate ammonia during the processing of wafers. The emissions estimate will not exceed the Tier One threshold so compliance with this rule is expected.

REG. XX: This modification has no impact on NOx. Compliance with this Regulation is expected.

REGULATION XXX:

This facility is in the RECLAIM program. The proposed project is considered as a "de minimis significant permit revision" for non-RECLAIM pollutants or hazardous air pollutants (HAPs), and a "minor permit revision" for RECLAIM pollutants to the RECLAIM/Title V permit for this facility.

Non-RECLAIM Pollutants or HAPs

Rule 3000(b)(6) defines a "de minimis significant permit revision" as any Title V permit revision where the cumulative emission increases of non-RECLAIM pollutants or HAPs from these permit revisions during the term of the permit are not greater than any of the following emission threshold levels:

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Air Contaminant	Daily Maximum (lbs/day)
HAP	30
VOC	30
NOx*	40
PM10	30
SOx*	60
CO	220

* Not applicable if this is a RECLAIM pollutant

To determine if a project is considered as a “de minimis significant permit revision” for non-RECLAIM pollutants or HAPs, emission increases for non-RECLAIM pollutants or HAPs resulting from all permit revisions that are made after the issuance of the Title V renewal permit shall be accumulated and compared to the above threshold levels. This proposed project is the 2nd permit revision to the Title V renewal permit issued to this facility on June 8, 2010. The following table summarizes the cumulative emission increases resulting from all permit revisions since the Title V renewal permit was issued:

Revision	HAP	VOC	NOx*	PM10	SOx	CO
Previous Permit Revision Total Cumulative to date. Title V permit renewed June 8, 2010	0	0	0	1.0	0	0
2 nd Permit Revision; <u>A/N 516127</u> Facility permit revision to; <u>A/N 516124-125</u> add one vacuum metalizer(E611) and vent to scrubber C161. <u>A/N 516126</u> replace existing open top vapor degreaser D309 by a new a new degreaser D612. <u>A/N 516129 & 516486</u> add one Plasma Etcher(D613) and vent to scrubber C160.	0	1.0	0	0	0	0
Cumulative Total	0	0	0	1.0	0	0
Maximum Daily	30	30	40*	30	60	220

* RECLAIM pollutant, not subject to emission accumulation requirements

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Since the cumulative emission increases resulting from all permit revisions are not greater than any of the emission threshold levels, this proposed project is considered as a "de minimis significant permit revision" for non-RECLAIM pollutants or HAPs.

RECOMMENDATION

The proposed project is expected to comply with all applicable District Rules and Regulations. Since the proposed project is considered as a "de minimis significant permit revision" for non-RECLAIM pollutants and a "minor permit revision", for RECLAIM pollutant, it is exempt from the public participation requirements under Rule 3006 (b). A proposed permit incorporating this permit revision will be submitted to EPA for a 45-day review pursuant to Rule 3003(j). If EPA does not raise any objections within the review period, a revised Title V permit will be issued to this facility.

Conclusion:

This equipment will operate in compliance with all District Rule and Regulations. A Permits to Construct are recommended for application numbers 516124-126, 516129 & 516486 subject to preceding conditions.