

Facility Name: Air Products and Chemicals, Inc.
SCAQMD ID# 003417

Facility Address: 23300 South Alameda Street
Carson, CA 90810

Contact Person: Jim Reebel
Environmental Specialist
(310) 847-7300

Permit to Construct

P2/S1: Reforming, Reformer Heater
P2/S2: Reforming, Air Pollution Control System

Section H of Title V Permit, ID# 003417

Proposed Permit and Conditions:

Equipment	ID No.	Connected To	RECLAIM Source Type/ Monitoring Unit	Emissions And Requirements	Conditions
Process 2: REFORMING					
System 1: REFORMER HEATER					
HEATER, H-101, REFORMER, NATURAL GAS, PSA GAS, 764 MMBTU/HR WITH A/N: 491306 Permit to Construct Issued:	D30	D24 C32	NOX: MAJOR SOURCE**	CO: 400 PPMV (5B) [RULE 1146, 11-17-2000]; CO: 10 PPMV (5) [RULE 1303(b)(2)-Offset, 5-10-1996; RULE 1303(b)(2)-Offset, 12-6-2002]; CO: 2000 PPMV (5A) [RULE 407, 4-2-1982]; NOX: 5 PPMV (4) [RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002] PM: 0.1 GRAINS/SCF (5B) [RULE 409, 8-7-1981]; PM: (9) [RULE 404, 2-7-1986]; PM10: 0.005 LBS/MMBTU (5) [RULE 1303(b)(2)-Offset, 5-10-1996; RULE 1303(b)(2)-Offset, 12-6-2002]	A63.1, A99.1, A195.1, C6.1, D12.1, D29.1, E57.2, H23.1, H23.2, K67.1
BURNER, NATURAL GAS, PSA GAS, JOHN ZINK, MODEL PFLD-SF, 117, DOWNFIRED, STAGED TYPE, WITH LOW NOX BURNER					

Equipment	ID No.	Connected To	RECLAIM Source Type/ Monitoring Unit	Emissions And Requirements	Conditions
HEAT EXCHANGER, PSA PURGE GAS PREHEATER, E-515, SHELL & TUBE TYPE, 15.74 MMBTU/HR					
Process 2: REFORMING					
System 2: AIR POLLUTION CONTROL SYSTEM					
SELECTIVE CATALYTIC REDUCTION, X-102, 42 MODULES, WITH AMMONIA INJECTION, 1490 CU FT; WIDTH: 6 FT 4 IN; HEIGHT: 3 FT; LENGTH: 3 FT 2 IN A/N: 491312 Permit to Construct Issued:	C32	D30		NH3: 20 PPMV (4) [RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]	D12.3, D29.1, H23.1

DEVICE CONDITIONS:

A63.1 The operator shall limit emissions from this equipment as follows:

CONTAMINANT	EMISSIONS LIMIT
CO	Less than or equal to 147 LBS IN ANY ONE DAY
NOX	Less than or equal to 121 LBS IN ANY ONE DAY
PM10	Less than or equal to 92 LBS IN ANY ONE DAY
ROG	Less than or equal to 129 LBS IN ANY ONE DAY
SOX	Less than or equal to 2 LBS IN ANY ONE DAY

The operator shall calculate the daily mass emissions for compliance determination based on the source test required under this permit.

[RULE 1303(b)(2)-Offset, 5-10-1996; RULE (b)(2)-Offset, 12-6-2002]

A99.1 The 5 PPM NOX emission limit(s) shall not apply during any startup or shutdown period. Startup or shutdown period shall be kept at a minimum, and in no case shall it exceed 48 hours.

[RULE 2005, 5-6-2005]

A195.1 The 5 PPMV NOX emission limit(s) is averaged over any 3 consecutive hours at 3 percent O2 dry basis.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

C6.1 The operator shall use this equipment in such a manner such that the temperature being monitored, as indicated below, does not exceed 450 Deg F.

To comply with this condition, the operator shall install and maintain a(n) temperature gauge to accurately indicate the temperature of the PSA purge gas to the reformer heater (D30).

The measuring device or gauge shall be accurate to within plus or minus 5 percent. It shall be calibrated in accordance to manufacturer specifications once every 12 months.

The 450 Deg F temperature limit(s) is averaged over any 3 consecutive hours.

The operator shall also install and maintain a device to continuously record the parameter being measured.

[RULE 2012, 5-6-2005]

D12.1 The operator shall install and maintain a(n) measuring device to accurately indicate the oxygen concentration in the flue gas at the convection section or exhaust stack of this heater. The excess oxygen such measured shall be at a minimum of 1 percent, dry basis, except during startup, shutdown, or process upset.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

D12.3 The operator shall install and maintain a(n) temperature gauge to accurately indicate the temperature across the SCR catalyst bed.

The operator shall also install and maintain a device to continuously record the parameter being monitored.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

D29.1 The operator shall conduct source test(s) for the pollutant(s) identified below:

Pollutant(s) to be tested	Required Test Method(s)	Averaging Time	Test Location
CO emissions	Approved District Method	1 hour	Outlet of the SCR
NOx emissions	Approved District Method	1 hour	Inlet and Outlet of SCR
PM10 emissions	Approved District Method	District-approved averaging time	Outlet of SCR
ROG emissions	Approved District Method	1 hour	Outlet of SCR
NH3 emissions	Approved District Method	1 hour	Outlet of SCR

The test shall be conducted at least annually for CO, NOx, PM10 and ROG.

The test shall be conducted at least quarterly for NH₃. The test frequency shall become annual after four successive quarterly tests demonstrating compliance after the initial startup of the purge gas pre-heat exchanger (E515).

The facility permit holder shall submit the protocol to the AQMD source test engineer no later than 45 days prior to the proposed test date and notify the District of the date and time of the test at least 10 days prior to the test.

After AQMD approval of the source test protocol, the test shall be conducted no later than 180 days after the initial start up of the purge gas pre-heat exchanger (E-515) and, at least, annually thereafter for CO, NO_x, PM₁₀ and ROG and, at least, quarterly thereafter for NH₃ until four successive tests have demonstrated compliance, after which the NH₃ test shall be conducted at least annually along with CO, NO_x, PM₁₀ and ROG.

Notwithstanding the above, the required test may commence without prior approval from the District, if it is conducted according to a source test protocol previously approved by the District for this equipment. A copy of the approval letter shall be submitted to the District at least 30 days prior to the test.

The source test results shall be submitted to the District no later than 60 days after the source test has been conducted.

Testing and sampling facilities shall be provided and maintained in accordance with District Source Test Method 1.1 or 1.2 and District Guidelines for Construction of Sampling and Testing Facilities.

The source test shall be conducted when the hydrogen plant is operating at least 80 percent of the permitted maximum rated capacity or within a capacity range approved by the District.

The test shall determine and report the concentrations and mass emission rates for NO_x, CO, PM₁₀, ROG, and the following:

- a) NO_x in lb/MMBTU of heat input, from the inlet and outlet of the SCR unit
- b) Excess oxygen in percent dry basis, from the SCR unit outlet
- c) Ammonia in ppmv, from the SCR unit outlet
- d) Flue gas flow rate in scf/hr, from the SCR unit outlet
- e) Fuel gas flow rate in scf/hr, to the hydrogen reforming heater
- f) Heating value (HHV), in BTU/SCF, of fuel gases supplied to the hydrogen reforming heater
- g) Control efficiency of the SCR unit

[RULE 1303(b)(2)-Offset, 5-10-1996; RULE 1303(b)(2)-Offset, 12-6-2002]

E57.2 The operator shall vent this equipment to an air pollution control equipment consisting of a selective catalytic reduction (SCR) system which is in full use whenever this equipment is in operation, except during startup or shutdown period. Startup or shutdown period, excluding the refractory dry-out period, shall not exceed 48 consecutive hours. If the heater exhaust reaches 570 degree F, the flue gas shall be vented through the SCR system using ammonia injection. Refractory dry out and steam blows shall be permitted up to a total of 144 consecutive hours to allow the curing of refractory materials and blow out of steam lines.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

H23.1 This equipment is subject to the applicable requirements of the following rules or regulations:

Contaminant	Rule	Rule/Subpart
CO	District Rule	407

This rule applies during normal operation, startup, shutdown, and unforeseen turndown of hydrogen demand.

[RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997; RULE 407, 4-2-1982]

H23.2 This equipment is subject to the applicable requirements of the following rules or regulations:

Contaminant	Rule	Rule/Subpart
CO	District Rule	1146

This rule applies during normal operation and unforeseen turndown of hydrogen demand.

[RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997; RULE 1146, 11-17-2000]

K67.1 The operator shall keep records, in a manner approved by the District, for the following parameter(s) or item(s):

During startup, shutdown and dry-out/steam blow periods, the hourly firing rates, flue gas temperature, process feed flow rates, inlet and outlet process fluid temperatures, excess oxygen and NOX emissions.

[RULE 2012, 5-6-2005]

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	PROCESSED BY: Thomas Lee	CHECKED BY <i>PL</i>

Permit to Construct

P2/S1: Reforming, Reformer Heater
P2/S2: Reforming, Air Pollution Control System

COMPANY NAME, MAILING AND LOCATION ADDRESS:

Name: Air Products and Chemicals, Inc.
SCAQMD ID # 003417

Mailing: 23300 South Alameda Street
Carson, CA 90810

Location: 23300 South Alameda Street
Carson, CA 90810

Contact Person: Jim Reebel
Environmental Specialist
(310) 847-7300

EQUIPMENT DESCRIPTION:

Additions to the equipment description are noted in underlines. Deletions are noted in ~~strikeouts~~.

Section H of Title V Permit, ID# 003417

Equipment	ID No.	Connected To	RECLAIM Source Type/ Monitoring Unit	Emissions And Requirements	Conditions
Process 2: REFORMING					
System 1: REFORMER HEATER					
HEATER, H-101, REFORMER, NATURAL GAS, PSA GAS, 764 MMBTU/HR WITH A/N: <u>337979 491306</u> Permit to Construct Issued: 08/03/01	D30	D24 C32	NOX: MAJOR SOURCE**	CO: 400 PPMV (5B) [RULE 1146, 11-17-2000]; CO: 10 PPMV (5) [RULE 1303(b)(2)-Offset, 5-10-1996; <u>RULE 1303(b)(2)-Offset, 12-6-2002</u>]; CO: 2000 PPMV (5A) [RULE 407, 4-2-1982]; NOX: 5 PPMV (4) [RULE 1303(a)(1)-BACT, 5-10-1996; <u>RULE</u>	A63.1, A99.1, A195.1, <u>C6.1</u> , D12.1, <u>D29.1</u> , D482.1 , E57.2, H23.1, H23.2, K67.1

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BURNER, NATURAL GAS, PSA GAS, JOHN ZINK, MODEL PFLD-SF, 117, DOWNFIRED, STAGED TYPE, WITH LOW NOX BURNER				1303(a)(1)-BACT, 12-6-2002] PM: 0.1 GRAINS/SCF (5B) [RULE 409, 8-7-1981]; PM: (9) [RULE 404, 2-7-1986]; PM10: 0.005 LBS/MMBTU (5) [RULE 1303(b)(2)-Offset, 5-10-1996; RULE 1303(b)(2)-Offset, 12-6-2002]	
HEAT EXCHANGER, PSA PURGE GAS PREHEATER, E-515, SHELL & TUBE TYPE, 15.74 MMBTU/HR					
Process 2: REFORMING					
System 2: AIR POLLUTION CONTROL SYSTEM					
SELECTIVE CATALYTIC REDUCTION, X-102, 42 MODULES, WITH AMMONIA INJECTION, 1490 CU FT; WIDTH: 6 FT 4 IN; HEIGHT: 3 FT; LENGTH: 3 FT 2 IN A/N: 337980-491312 Permit to Construct Issued: 9/11/98	C32	D30		NH3: 20 PPMV (4) [RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]	D12.3, D29.1, D182.1, H23.1

DEVICE CONDITIONS:

A63.1 The operator shall limit emissions from this equipment as follows:

CONTAMINANT	EMISSIONS LIMIT
CO	Less than or equal to 147 LBS IN ANY ONE DAY
NOX	Less than or equal to 121 LBS IN ANY ONE DAY
PM10	Less than or equal to 92 LBS IN ANY ONE DAY
ROG	Less than or equal to 129 LBS IN ANY ONE DAY
SOX	Less than or equal to 2 LBS IN ANY ONE DAY

The operator shall calculate the daily mass emissions for compliance determination based on the source test required under this permit.

[RULE 1303(b)(2)-Offset, 5-10-1996; RULE (b)(2)-Offset, 12-6-2002]

A99.1 The 5 PPM NOX emission limit(s) shall not apply during any startup or shutdown period. Startup or shutdown period shall be kept at a minimum, and in no case shall it exceed 48 hours.

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[RULE 2005, 5-6-2005]

A195.1 The 5 PPMV NOX emission limit(s) is averaged over every any 3 consecutive hours at 3 percent O2 dry basis.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

C6.1 The operator shall use this equipment in such a manner such that the temperature being monitored, as indicated below, does not exceed 450 Deg F.

To comply with this condition, the operator shall install and maintain a(n) temperature gauge to accurately indicate the temperature of the PSA purge gas to the reformer heater (D30).

The measuring device or gauge shall be accurate to within plus or minus 5 percent. It shall be calibrated in accordance to manufacturer specifications once every 12 months.

The 450 Deg F temperature limit(s) is averaged over any 3 consecutive hours.

The operator shall also install and maintain a device to continuously record the parameter being measured.

[RULE 2012, 5-6-2005]

D12.1 The operator shall install and maintain a(n) measuring device to accurately indicate the oxygen concentration in the flue gas at the convection section or exhaust stack of this heater. The excess oxygen such measured shall be at a minimum of 1 percent, dry basis, except during startup, shutdown, or process upset.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

D12.3 The operator shall install and maintain a(n) temperature gauge to accurately indicate the temperature across the SCR catalyst bed.

The operator shall also install and maintain a device to continuously record the parameter being monitored.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

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D29.1. The operator shall conduct source test(s) for the pollutant(s) identified below:

<u>Pollutant(s) to be tested</u>	<u>Required Test Method(s)</u>	<u>Averaging Time</u>	<u>Test Location</u>
<u>CO emissions</u>	<u>Approved District Method</u>	<u>1 hour</u>	<u>Outlet of the SCR</u>
<u>NOx emissions</u>	<u>Approved District Method</u>	<u>1 hour</u>	<u>Inlet and Outlet of SCR</u>
<u>PM10 emissions</u>	<u>Approved District Method</u>	<u>District-approved averaging time</u>	<u>Outlet of SCR</u>
<u>ROG emissions</u>	<u>Approved District Method</u>	<u>1 hour</u>	<u>Outlet of SCR</u>
<u>NH3 emissions</u>	<u>Approved District Method</u>	<u>1 hour</u>	<u>Outlet of SCR</u>

The test shall be conducted at least annually for CO, NOx, PM10 and ROG.

The test shall be conducted at least quarterly for NH3. The test frequency shall become annual after four successive quarterly tests demonstrating compliance after the initial startup of the purge gas pre-heat exchanger (E515).

The facility permit holder shall submit the protocol to the AQMD source test engineer no later than 45 days prior to the proposed test date and notify the District of the date and time of the test at least 10 days prior to the test.

After AQMD approval of the source test protocol, the test shall be conducted no later than 180 days after the initial start up of the purge gas pre-heat exchanger (E-515) and, at least annually thereafter for CO, NOx, PM10 and ROG and, at least quarterly thereafter for NH3 until four successive tests have demonstrated compliance, after which the NH3 test shall be conducted at least annually along with CO, NOx, PM10 and ROG.

Notwithstanding the above, the required test may commence without prior approval from the District, if it is conducted according to a source test protocol previously approved by the District for this equipment. A copy of the approval letter shall be submitted to the District at least 30 days prior to the test.

The source test results shall be submitted to the District no later than 60 days after the source test has been conducted.

Testing and sampling facilities shall be provided and maintained in accordance with District Source Test Method 1.1 or 1.2 and District Guidelines for Construction of Sampling and Testing Facilities.

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The source test shall be conducted when the hydrogen plant is operating at least 80 percent of the permitted maximum rated capacity or within a capacity range approved by the District.

The test shall determine and report the concentrations and mass emission rates for NOX, CO, PM10, ROG, and the following:

- a) NOX in lb/MMBTU of heat input, from the inlet and outlet of the SCR unit
- b) Excess oxygen in percent dry basis, from the SCR unit outlet
- c) Ammonia in ppmv, from the SCR unit outlet
- d) Flue gas flow rate in scf/hr, from the SCR unit outlet
- e) Fuel gas flow rate in scf/hr, to the hydrogen reforming heater
- f) Heating value (HHV), in BTU/SCF, of fuel gases supplied to the hydrogen reforming heater
- g) Control efficiency of the SCR unit

[RULE 1303(b)(2)-Offset, 5-10-1996; RULE 1303(b)(2)-Offset, 12-6-2002]

~~D182.1 The operator shall test this equipment in accordance with the following specifications:~~

~~The test(s) shall be conducted at least annually.~~

~~During the test, the hydrogen plant shall be operated at least 80 percent of the permitted maximum rated capacity or within a capacity range approved by the District.~~

~~A source test protocol shall be submitted to the District no later than 60 days before the proposed test date. The annual test may commence without prior approval from the District if it is conducted according to a source test protocol previously approved by the District for this equipment. The District shall be notified of the date and time of the test at least 15 days prior to the test. A report shall be submitted to the District no later than 90 days after conducting the test.~~

~~Testing and sampling facilities shall be provided and maintained in accordance with District Source Test Method 1.1 or 1.2 and District Guidelines for Construction of Sampling and Testing Facilities.~~

~~The test shall determine and report the concentrations and mass emission rates for NOX, CO, PM10, ROG, and the following::~~

- a) ~~NOX in lb/MMBTU of heat input, from the inlet and outlet of the SCR unit~~

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- b) ~~Excess oxygen in percent dry basis, from the SCR unit outlet~~
- e) ~~Ammonia in ppmv, from the SCR unit outlet~~
- d) ~~Flue gas flow rate in scf/hr, from the SCR unit outlet~~
- e) ~~Heating value (HHV), in BTU/SCF, of fuel gases supplied to the hydrogen reforming heater~~
- f) ~~Control efficiency of the SCR unit~~

~~[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]~~

E57.2 The operator shall vent this equipment to an air pollution control equipment consisting of a selective catalytic reduction (SCR) system which is in full use whenever this equipment is in operation, except during startup or shutdown period. Startup or shutdown period, excluding the refractory dry-out period, shall not exceed 48 consecutive hours. If the heater exhaust reaches 570 degree F, the flue gas shall be vented through the SCR system using ammonia injection. Refractory dry out and steam blows shall be permitted up to a total of 144 consecutive hours to allow the curing of refractory materials and blow out of steam lines.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

H23.1 This equipment is subject to the applicable requirements of the following rules or regulations:

Contaminant	Rule	Rule/Subpart
CO	District Rule	407

This rule applies during normal operation, startup, shutdown, and unforeseen turndown of hydrogen demand.

[RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997; RULE 407, 4-2-1982]

H23.2 This equipment is subject to the applicable requirements of the following rules or regulations:

Contaminant	Rule	Rule/Subpart
CO	District Rule	1146

This rule applies during normal operation and unforeseen turndown of hydrogen demand.

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[**RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997; RULE 1146, 11-17-2000**]

K67.1 The operator shall keep records, in a manner approved by the District, for the following parameter(s) or item(s):

During startup, shutdown and dry-out/steam blow periods, the hourly firing rates, flue gas temperature, process feed flow rates, inlet and outlet process fluid temperatures, excess oxygen and NOX emissions.

[**RULE 2012, 5-6-2005**]

COMPLIANCE RECORD REVIEW:

A five year printout of the facility's compliance history is shown in Attachment 1. No NOV's were issued during this time period and the only NC listed has been brought back 'in compliance'. The facility has no pending compliance issues at this time.

BACKGROUND:

Air Products & Chemical, Inc. operates a Hydrogen (H₂) production facility in Carson, California that produces 99.9% pure H₂ for dedicated 'over the fence' sales (via pipeline) to several neighboring refineries. The facility, known as the Carson Hydrogen Plant, began operations in late 1999 and has the capacity to produce up to 96 MMSCFD of 'pure' H₂ gas for use in refinery operations. Air Products also owns and operates a similar hydrogen plant in the city of Wilmington.

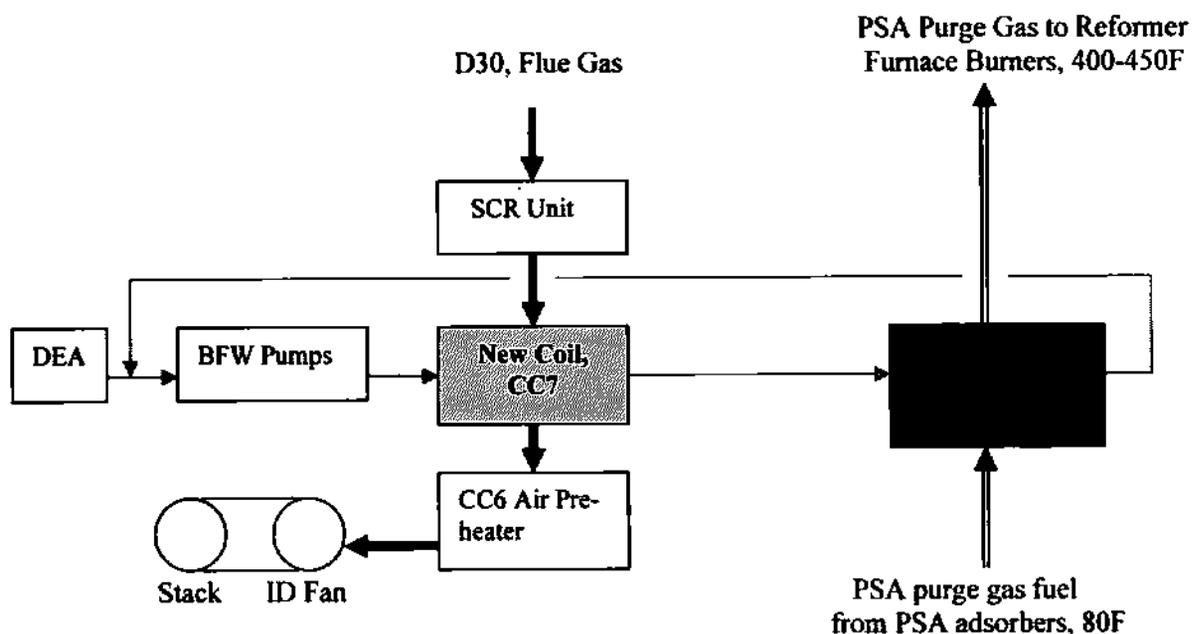
The hydrogen production process at Carson involves the reforming of compressed natural gas (methane) with water vapor (steam) to produce a synthesis gas (syngas) consisting of CO, CO₂, and H₂ over a catalyst bed in the reformer furnace (D30). This intermediate product stream goes through several purification processes by utilizing additional steam to convert the CO component of the syngas to CO₂ while producing additional H₂ via high temperature shift conversion (HTS). Unlike the Wilmington plant, the Carson facility does not have a second stage of the shift reaction at low temperature. During the final purification process, residual CO, CO₂ and unreacted methane are removed by adsorption in the Pressure Swing Adsorbers (PSA). The PSA adsorbers are regenerated by pressure swings and purged with hydrogen gas to remove most impurities from the product stream.

The purge gas stream from the PSA adsorbers is routed to D30 and used as the primary combustion fuel to generate the elevated temperature needed for the endothermic reaction of reforming methane to produce H₂. Commercial natural gas (NG) is used as the supplemental (trim) fuel to attain the necessary heat input since the heating value of PSA purge gas is relatively low (292 BTU/scf). With this HHV and a flow rate of 165M lbs/hr (from material balance), the amount of NG required by the reformer furnace to attain the permitted firing rate of 764 MMBTU/hr at maximum plant capacity is ~ 4,609 lbs/hr. The stoichiometric fuel mixture ratio combusted in the reforming furnace is approximately 20:1 PSA purge gas/NG by volume (or 6:1 based on heat supply ratio). The flue gas from the reforming furnace is vented to a SCR (C32) unit for the control of NOx emissions to less than 5 ppmv (BACT) over any 3 consecutive hours using aqueous ammonia injection.

PROJECT SCOPE

The facility submitted the applications listed in Table 1 to modify the SCR flue gas exhaust and purge gas inlet (to the reformer furnace) to allow preheating of the PSA purge gas stream. The project scope entails the installation of a new coil to capture the SCR flue gas exhaust heat (using BFW as the transfer fluid) and transferring the heat content of the heated BFW to the PSA purge gas via a new shell & tube (S&T) heat exchanger, E-515. The new E-515 specification sheet from the manufacturer can be found in Appendix A of the submitted application package. A simplified schematic of the proposed modification is shown in Figure 1.

Figure 1
Schematic of Proposed Changes



The increase in PSA purge gas temperature from 80F to 450F is expected to reduce trim fuel (NG) usage because less sensible heat will be required to heat the noncombustible components of the purge gas stream during the combustion process. Air products estimated that the total NG savings could be as high as 5,280 therms per day at maximum plant capacity.

The PSA purge gas stream is essentially sulfur free because the process feed gas (NG) is inherently low in sulfur (Rule 431.1 compliant) and is further treated by the zinc oxide desulfurizer, V-105, at the front end of the reforming process (to prevent sulfur poisoning of the downstream reforming and shift conversion catalysts). The PSA purge gas contains the following composition and has a molecular wt. of 27.87 lb/lbmole:

Component	Mole %
CH ₄	18.83
CO	8.55

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CO ₂	49.39
H ₂	21.98
H ₂ O	0.66
N ₂	0.59

APPLICATION SUMMARY

The applications submitted by Air Products & Chemicals, Inc. are summarized in Table 1 below:

Table 1 - Applications Submitted

A/N	Project Scope	Process	System	Evaluation Scope
491306	Modify Reformer Heater, D-30, by preheating purge gas fuel stream with new E-515.	2	1	PC (Section H)
491309	Title V Permit Amendment	NA	NA	NA
491312	Modify SCR, C32, to route flue gas through new CC7 coil	2	2	PC (Section H)

FEE SUMMARY:

Air Products & Chemicals, Inc. has requested the applications be processed expeditiously pursuant to R301(u) and has paid the appropriate fees. Table 2 is a summary of the fees paid for the applications under evaluation:

Table 2 - Application Fee Summary

A/N	Deemed Complete Date	Equipment	Type	Status	Fee Schedule	Application Fees Required \$	XPP Fees Required R301(u)	Fees Paid \$	Previous A/Ns
491306	12-2-08	D30	50	20	E	5,148.93	2,574.47	7,723.40	337979
491309	12-2-08	NA	85	21	NA	1,687.63	NA	1,687.63	NA
491312	12-2-08	C32	50	20	C	3,244.91	1,622.46	4,867.37	337980
Grand Total						10,081.47	4,196.93	14,278.40	

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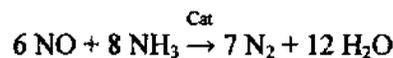
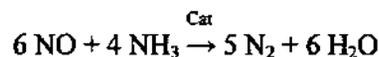
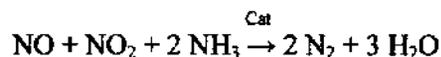
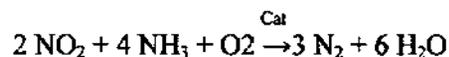
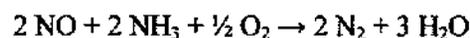
PROCESS DESCRIPTION:

The process of reforming NG using steam to produce high purity H₂ was discussed earlier in the Background section of this evaluation. Under this section, control of the affected air pollutant, NO_x, will be discussed to comprehend the impact of air emissions from this project.

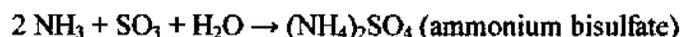
As shown in Figure 1, Air Product's design basis for the new heat exchanger, E-515, is to preheat the PSA purge gas temperature to 400-450 °F. The hotter purge gas fuel is expected to increase the adiabatic flame temperature of the dedicated burners in the reformer furnace that combust PSA purge gas. Higher flame temperature has a direct impact on NO_x emissions when all the other combustion variables such as fuel composition, excess air, air preheat and furnace temperatures are kept constant. Uncontrolled NO_x emission is expected to increase by 5 lb/hr (see Table 3) while the other criteria pollutants should not be impacted by this project.

Air Products currently employ Selective Catalytic Reduction (SCR) with aqueous ammonia injection to control NO_x emissions to less than 5 ppmv and NH₃ slip to less than 20 ppmv at 3% O₂. These requirements are currently specified on the permit. The reformer furnace and SCR were constructed in the late 1990s and were subjected to NSR. Baseline PTE (pre-modification) for the furnace with SCR control is summarized in the Emissions section of this evaluation. The use of SCR for NO_x control to 5 ppmv at the time of initial permit approval was considered BACT and, to this date, this BACT still applies.

SCR is a process by which NO_x is combined with a reducing agent, ammonia, in the presence of a catalyst bed, to produce inert N₂ and H₂O. The process is 'selective' because the ammonia reacts primarily with NO and NO_x by the following reactions:



Secondary reactions:



The formation of sulfate (PM₁₀) from the secondary reaction is anticipated to be insignificant since negligible SO_x formation will result from the combustion of sulfur free PSA purge gas and Rule 431.1 compliant natural gas (see Attachment 3).

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The SCR unit is manufactured by Cormetech and has 42 ceramic catalyst modules made from a mixture of tungsten oxide (TiO_2) and vanadium pentoxide (V_2O_5). The SCR has a total catalyst volume of ~1490 cubic feet and Cormetech's CM-33[™] catalyst is used. Aqueous ammonia is injected into the flue gas upstream of the SCR unit to allow mixing of the ammonia and flue gas NOx. With proper ammonia and flue gas distribution, NOx reduction can easily exceed 90% when the exhaust gas temperature is maintained between 570 to 750F. If these variables are outside the optimum range, lower NOx conversion will be realized.

Ammonia for the SCR unit is supplied from an existing aqueous ammonia storage tank (V-135) permitted under A/N 337981.

EMISSIONS:

By preheating the purge gas portion of the combustion fuel for D30 to 400-450F, Air Products estimated, based on plant simulation studies, that uncontrolled NOx emissions will increase by no more than 5.3 ppmv at maximum plant capacity and a flue gas exhaust rate of 9,281,280 SCFH. This increase in NOx was based on the difference in the adiabatic flame temperature using the Aspen Plus multivariate optimization simulation for the current Carson plant configuration and the proposed configuration where the PSA purge gas was preheated to 450F, both at a production rate of 96 MMSCFD. This optimization model has been validated against operating data available from the facility over a range of production rates.

The increase in uncontrolled NOx emissions is summarized in Table 3. Emissions of other criteria pollutants is not adversely affected and should actually decrease due to the reduction of natural gas and the lower flue gas flow rate (from the lower demand for oxygen when less natural gas is combusted).

Table 3
Uncontrolled NOx PTE from Reformer Furnace (D30)

	Pre-Modification	Post Modification
Flue Gas Stack Flow, SCFM	157,120.5	154,688.1
Flue Gas Stack Flow, lb/hr	727,124.4	716,356
Flue Gas Stack Flow, lbmole/hr	24,842	24,458
Uncontrolled NOx emissions, ppm	48.3	53.6
NOx emissions increase, ppm	-	5.3
Uncontrolled NOx emissions, lb/day	1305.9	1426.76
NOx emissions increase, lb/day	-	120.86
NOx emissions increase, lb/hr	-	5.0

Although uncontrolled NOx emission is expected to slightly increase as a result of this project, the reduction in flue gas flow rate should provide sufficient residence time for the SCR to maintain controlled NOx emissions below the current 5 ppmv BACT limit. Additionally, the current ammonia slip limit of 20 ppmv at the SCR outlet is not expected to be affected as the increase in residence time across the SCR reactor should enable any un-reacted ammonia to reduce the incremental increase in NOx emissions to N_2 and H_2O . Assuming the NH_3/NOx ratio is already at optimum level, additional ammonia can be injected to reduce any excess NOx to maintain the existing 5 ppmv BACT limit. Based on a worst case simulation scenario, the increase in aqueous ammonia injection is anticipated to be no more than 5.7 lb/hr at the maximum ammonia slip limit of 20 ppmv. This is based on the following calculations:

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Pre-modification Space Velocity of SCR:

$$V = \frac{\text{Volumetric Flow}}{\text{SCR Catalyst Volume}} = \frac{(157120 \text{ scfm})(60 \text{ min/hr})}{1490 \text{ scf}} = 6,327 \text{ hr}^{-1}$$

Post-modification Space Velocity of SCR:

$$V = \frac{\text{Volumetric Flow}}{\text{SCR Catalyst Volume}} = \frac{(154688 \text{ scfm})(60 \text{ min/hr})}{1490 \text{ scf}} = 6,229 \text{ hr}^{-1}$$

NH₃ injection rate can be estimated from the following equation:

$$\text{NH}_3 \text{ slip (ppmv)} = [a \cdot b \cdot c / 1E6] \cdot 1E6 / b$$

Where a = NH₃ injection rate (lb/hr)/17 (lb/lbmole)
b = dry exhaust gas flow rate (lb/hr)/29 (lb/lbmole)
c = change in measured NO_x across the SCR (ppmvd at 3 percent O₂)

Pre-modification ammonia rate at maximum NH₃ slip limit of 20 ppmv:

$$20 = \left[\frac{a}{17 \text{ lb/lbmole}} - \left(\frac{727,124 \text{ lb/hr}}{29.3 \text{ lb/lbmole}} \right) \left(\frac{48.3 - 5.0 \text{ ppmvd}}{1E6} \right) \right] \left[\frac{1E6}{727,124 \text{ lb/hr} / 29.3 \text{ lb/lbmole}} \right]$$

$$a_1 = 27.0 \text{ lb/hr NH}_3 \text{ injection}$$

Post-modification ammonia rate at maximum NH₃ slip limit of 20 ppmv.

$$20 = \left[\frac{a}{17 \text{ lb/lbmole}} - \left(\frac{716,356 \text{ lb/hr}}{29.3 \text{ lb/lbmole}} \right) \left(\frac{53.6 - 5.0 \text{ ppmvd}}{1E6} \right) \right] \left[\frac{1E6}{716,356 \text{ lb/hr} / 29.3 \text{ lb/lbmole}} \right]$$

$$a_2 = 28.6 \text{ lb/hr NH}_3 \text{ injection}$$

Therefore, the maximum increase in ammonia is expected to be:

$$\text{NH}_{3\text{inj}} = 28.6 - 27.0 = 1.6 \text{ lb/hr}$$

Based on the aqueous ammonia solution (28 to 30 percent ammonia by weight) Air Products uses for the SCR, the maximum increase in injection rate is expected to be ~ 5.7 lb/hr.

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$$\text{Aqueous NH}_3 \text{ injection} = \frac{1.6 \text{ lb/hr}}{\text{wt.\%NH}_3} = 5.7 \text{ lb/hr}$$

According to Air Products, the existing ammonia system is capable of handling this incremental increase in injection rate since the system is currently operating at less than 50% capacity. At a nominal H₂ production rate of 75-80 MMSCFD, aqueous NH₃ is typically injected at ~ 40 lb/hr and the system has a design capacity of 90 lb/hr. Therefore, NO_x emissions is expected to be controlled by the SCR to below the current 5 ppmv BACT limit with less than 20 ppmv NH₃ slip.

As a newly constructed facility in the late 1990s, the reformer heater was subject to NSR. Baseline PTE emission limits were established and are listed in the 'Emissions and Requirements' column of the permit as well as permit condition A63.1. Table 4 below is a summary of the pre- and post-modification controlled PTE for this project. As shown, there is no increase in emissions for all criteria air pollutants.

The NSR pre-modification PTE emissions limits were based on the following parameters:

The fuel combination of natural gas and PSA gas has a maximum permitted total heat input of 764 MMBTU/hr HHV.

Maximum capacity is defined as the design H₂ production capacity of 96 MMSCFD.

PSA purge gas production rate is 5922.7 lb-mole/hr (165M lb/hr) at the designed hydrogen production rate with HHV of 292 BTU/scf. This is based on material balance.

Maximum NO_x concentration in flue gas is 5 ppmv measured dry at 3% O₂ at the SCR outlet based on BACT.

Maximum CO concentration in flue gas is 10 ppmv measured dry at 3% O₂ at the SCR outlet based on source test data from the Wilmington facility.

Flue gas flow rate of 8,290,000 SCFH dry at 3% O₂ (calculated based on material balance)

Emission factor for PM₁₀ is 0.005 lbs/MMBTU based on source test data from the Wilmington facility.

Emission factor for ROG is 0.007 lbs/MMBTU based on District emission factor for natural gas fired heaters (assuming PSA gas has the same emission factor).

Emission factor for SO_x is 0.83 lbs/MMSCF of natural gas used. The sulfur contents in the process feed gas is removed by the zinc oxide desulfurizer such that only a small residual amount is found in the PSA purge gas. Therefore the SO_x emission factor will only apply to the natural gas portion of the fuel gas.

Natural gas used as fuel carries 0.107408 MMSCFH with HHV of 1050 BTU/scf.

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The overall control efficiency of the SCR is assumed to be 95%.

NOx Emissions
$$\frac{(5 \text{ ppmv})(8,290,000 \text{ SCFH})(46 \text{ lbs / lbmole})}{(379.4 \text{ SCF / lbmole})(1 \text{ E}06)}$$

= 5.03 lbs/hr = 121 lbs/day = 44,024 lbs/yr

CO Emissions
$$\frac{(10 \text{ ppmv})(8,290,000 \text{ SCFH})(28 \text{ lb / lbmole})}{(379.4 \text{ SCF / lbmole})(1 \text{ E}06)}$$

= 6.12 lbs/hr = 147 lbs/day = 53,594 lbs/yr

PM10 Emissions
$$(0.005 \text{ lbs / MMBTU})(764 \text{ MMBTU / hr})$$

= 3.82 lbs/hr = 92 lbs/day = 33,463 lbs/yr

ROG Emissions
$$(0.007 \text{ lbs / MMBTU})(764 \text{ MMbtu / hr})$$

= 5.35 lbs/hr = 129 lbs/day = 46,866 lbs/yr

SOx Emissions
$$(0.83 \text{ lbs / MMSCF})(0.107408 \text{ MMSCFH})$$

= 0.089 lbs/hr = 2 lbs/day = 730 lbs/yr

NH3 Emissions
$$\frac{(20 \text{ ppmv})(8,290,000 \text{ SCFH})(17 \text{ lb / lbmole})}{(379.4 \text{ SCF / lbmole})(1 \text{ E}06)}$$

= 7.43 lbs/hr = 178 lbs/day = 65,079 lbs/yr

Post Modification Uncontrolled Emissions:

NOx Emissions
$$\frac{(53.6 \text{ ppmv})(9,281,280 \text{ SCFH})(46 \text{ lbs / lbmole})}{(379.4 \text{ SCF / lbmole})(1 \text{ E}06)}$$

= 60.3 lbs/hr = 1447 lbs/day = 528,369 lbs/yr

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The 53.6 ppmv NOx emissions is based on the Aspen Plus multivariate optimization simulation conducted by Air Products as discussed earlier. Table 4 summarizes the pre and post modification uncontrolled and controlled emissions. As shown, no net increase in emissions is expected for all criteria pollutants.

**Table 4
EMISSIONS SUMMARY**

Pollutants	Pre-Modification PTE (lbs/day)		Post Modification PTE (lbs/day)		Net Increase in Emissions (Controlled Post Modification PTE – Controlled Pre Modification PTE), lb/day
	Uncontrolled	Controlled	Uncontrolled	Controlled	
NOx	1325	121	1447	121	0
SOx	2	2	2	2	0
CO	147	147	147	147	0
ROG	129	129	129	129	0
PM ₁₀	92	92	92	92	0
NH ₃	178	178	178	178	0

SOx emissions is anticipated and has been confirmed by repeated source test (see Attachment 2) to be negligible since the PSA purge gas portion of the reformer fuel is sulfur free (the sulfur content in the process feed gas is removed by the zinc oxide desulfurizer) and the trim fuel (NG) is Rule 431.1 compliant. The use of low sulfur fuel gases is considered as control measure for SOx. The emission factor of 0.60 lbs/MMSCF, based on District emission factor for natural gas fired heaters, is used only for the natural gas portion of the fuel gas to determine SOx PTE. No significant effect on the other criteria air pollutants (CO, PM₁₀, VOC) are anticipated because they should not be affected by the increase in burner flame temperature from pre-heating the purge gas portion of the reformer fuel. In fact, this project is expected to reduce the flue gas flow rate since the reduction in NG fuel used will result in a lower demand for oxygen in the combustion process.

Flue gas from the reformer furnace is vented to a SCR unit with aqueous ammonia injection for the control of NOx emissions to less than 5 ppmv. Ammonia slippage will continue to be limited to 20 ppmv measured at 3% oxygen dry basis. Oxygen trim is maintained to reduce CO emissions. PM₁₀ emissions from the formation of ammonium bisulfate will not be a factor since this is a function of H₂O, NH₃ and SO₃ in the flue gas. Since the amount of sulfur compounds has not increased, the proposed modification is not expected to increase ammonium bisulfate formation per catalyst manufacturer when compared to the formation under the present operating conditions.

RULE EVALUATION:

PART 1 SCAQMD REGULATIONS

Rule 212	Standards for Approving Permits	November 14, 1997
There is no emissions increase of the air contaminants listed in subpart (g) of this rule and the project is well beyond 1000 feet of a school. Hence, public notice is not		

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required. Furthermore, the permit units of this project were designed to operate without emitting air contaminants in violation of provisions of Division 26 of the State Health & Safety Code or SCAQMD rules. The project meets all criteria in Rule 212 for PC approval.

Rule 401 **Visible Emissions** **November 9, 2001**
 Visible emissions are not expected under normal operating conditions. Compliance is expected.

Rule 402 **Nuisance** **May 7, 1976**
 Odor problems and nuisance complaints are not expected under normal operating conditions. Compliance is expected.

Rule 404 **Particulate Matter – Concentration** **February 7, 1986**

This rule specifies that PM emissions from any source shall exceed the concentration limit show in Table 404(a). At a flue gas volumetric flow rate of 154,668 scfm, the concentration limit is 0.028 grain/scf (extrapolated from table 404(a)). Based on PM emissions of 92 lbs/day, the emissions concentration is calculated to be:

$$\text{Emissions Conc.} = \frac{(92\text{lbs} / \text{day})}{(20.9 - 3)} \frac{(20.9)}{(24\text{hrs} / \text{day})} \frac{(7000\text{grains} / \text{lb})}{(60 \text{min} / \text{hr})} \frac{(1)}{(154,668\text{SCFM})}$$

$$= 0.0034 \text{ grain/scf}$$

This concentration is well below the limit of 0.028 grain/scf. Therefore, compliance with Rule 404 is expected.

Rule 407 **Liquid and Gaseous Air Contaminants** **April 2, 1982**

This rule limits the CO emissions to 2000 ppmv max and the sulfur content of the exhaust to 500 ppmv for equipment not subject to the emission concentration limits of Rule 431.1, 40 CFR Subpart J, or RECLAIM. Since the primary PSA purge gas fuel is sulfur free and the trim fuel is commercial natural gas (Rule 431.1 compliant), only the 2000 ppmv CO limit of this rule applies. A BACT CO emission limit of 10 ppmv was imposed on this furnace when it was constructed in the late 90s under NSR. This is well below the rule limit of 2000 ppmv. Compliance with this rule is expected.

Rule 409 **Combustion Contaminants** **August 7, 1981**

Combustion contaminants (PM) are expected to be less than 0.1 grain per dry standard cubic foot and has been demonstrated with recent source test dated 12-16-08 showing PM concentration of 0.000483 grain/dscf. Compliance with this rule is expected.

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Rule 1123	Refinery Process Turnarounds	December 7, 1990
<p>Hydrogen production is considered as part of the refinery operations when the hydrogen is produced for use in refineries. All process turnarounds are conducted in a manner that meets the requirements of this rule. Compliance with this rule is expected.</p>		

Rule 1146	Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	September 5, 2008
<p>This rule specifies the CO emissions limit to not exceed 400 ppmv. Compliance with the Rule 1146 limit has always been met since the heater also has to comply with the more stringent 10 ppmv BACT limit. Source tests have verified compliance and continued compliance is expected.</p>		

Rule 1189	Emissions from Hydrogen Plant Process Vents	January 21, 2000
<p>This rule limits VOC emissions from all hydrogen plant process vents to less than 2.5 lb of VOC per MMSCF of hydrogen produced. In accordance with this rule, source test has been conducted to demonstrate compliance and is contained in the application folder for reference. Continued compliance with this rule is expected.</p>		

REG XIII	New Source Review	
BACT:		
1303(a)	BACT	December 6, 2002
<p>This project is not anticipated to result in any net increase in emissions of non-RECLAIM pollutants. Nevertheless, the facility has and will continue to comply with BACT through the use of a SCR with ammonia injection to control NOx emissions. BACT for VOC and PM10 has been and will continue to be met by using commercial natural gas and PSA purge gas as combustion fuel for the reformer heater. Oxygen trim is used to reduce CO emissions and meets BACT requirements for CO.</p>		
1303(b)(1)	Modeling	December 6, 2002
<p>Modeling is not required because there is no increase in emissions as a result of this project.</p>		
1303(b)(2)	Offsets	December 6, 2002
<p>ERCs are not required because there is no increase in emissions as result of this project.</p>		

Rule 1401	New Source Review of Toxic Air Contaminants	March 4, 2005
<p>There is no emissions increase of toxic air contaminants as result of this project. Therefore, this rule is not applicable and a health risk assessment is not required.</p>		

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REG XX RECLAIM

Rule 2005 New Source Review for RECLAIM May 6, 2005
 Air Products & Chemical, Inc. in Carson is an existing NOx RECLAIM facility. This project is anticipated to increase uncontrolled NOx emissions by more than 1 lb/day (as shown in Table 4) and is, therefore, subject to NOx BACT. However, a NOx LAER/BACT limit of 5 ppmv was placed on the reformer heater when the Permit to Construct was granted in 1999. To this date, this BACT still applies and the heater is expected to continue to comply with this BACT limit through the use of SCR with aqueous ammonia injection. Controlled NOx emission is expected to remain the same and no net increase in NOx emissions is expected. CEMS for NOx has been installed as required. Compliance with this rule is expected.

Rule 2012 Requirement for Monitoring, Reporting, and Recordkeeping for Oxides of Nitrogen (NOx) Emissions May 6, 2005
 This rule establishes the monitoring, reporting, and recordkeeping requirements for NOx emissions under the RECLAIM program. The SCR outlet for the reformer heater is equipped with a NOx CEMS and has been recertified by the District. Compliance with this rule is expected.

REG XXX TITLE V PERMITS

Rule 3002 Requirements November 14, 1997
 Air Products & Chemical, Inc. in Carson is designated as a Title V facility. The facility's initial Title V permit was issued on 9-4-08 and is due to expire on 9-3-13. The federal Title V permit program is enforced through the District's REG XXX.

 This project is not expected to result in any net increase in emissions and meets all the criteria of Rule 3000(b)(12) and Rule 3005(c). Therefore, the issuance of the permit to construct meets all the parameters of a 'minor permit revision' of the Title V permit. As such, public notice is not required but the proposed permit and evaluation will be submitted to EPA for a 45 review pursuant to REG XXX.

PART 2 STATE REGULATIONS

California Environmental Quality Act (CEQA)
 CEQA requires that the environmental impacts of proposed projects be evaluated and that feasible methods to reduce, avoid, or eliminate identified significant adverse impacts of these projects be considered. The CEQA Applicability Form and supplemental information submitted by Air Products indicated this project should not have any adverse impact to the environment. Therefore, a CEQA analysis is not required.

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PART 3 FEDERAL REGULATIONS

**40CFR 60
Subpart J
§60.100**

NSPS for Petroleum Refineries

This NSPS applies to FCCU, fuel gas combustion devices, and Claus sulfur recovery plants at a petroleum refinery. Since hydrogen production is considered as part of the refinery operation when the hydrogen is produced for the use in a refinery, the reformer heater is an affected facility subject to this NSPS.

For fuel gas combustion devices, the following requirements apply:

The owner or operator shall not burn any fuel gas that contains hydrogen sulfide (H₂S) in excess of 0.10gr/dscf. This limitation is equivalent to 160 ppmv H₂S.

Since the fuel gases used in this heater contain sulfur compounds equal to or less than that of natural gas (<16 ppmv), compliance with this rule is expected.

40CFR 64

Compliance Assurance Monitoring (CAM)

The reformer heater is a major source for NO_x and VOC emissions. However, the requirements of this rule do not apply since compliance with the BACT limits for NO_x will be based on CEMS, which is considered a continuous compliance determination method pursuant to §64.2(b)(vi), is exempt from CAM. The VOC BACT limit will be met through the use of PSA purge gas or commercial natural gas without any add-on control equipment. Therefore, CAM does not apply.

CONCLUSION:

This modification is not expected to result in any increase in criteria, toxics or hazardous air pollutants and all affected devices in Process 2, Systems 1 and 2 will continue to operate in compliance with District, State and Federal rules/regulations. Therefore, a Permit to Construct is recommended with the conditions listed on pages 1-7 of this evaluation.

The following is a summary of the permit action under this evaluation:

A/N	Equipment Description	Device ID	Recommended Action
491306	Install new heat exchanger E-515 for PSA Purge gas preheat to D30	D30	Approve PC
491309	Title V Permit Amendment	-	Approve Permit Amendment
491312	Modify SCR, C32, to route flue gas through new CC7 coil	C32	Approve PC

Attachments

1	5-Year Compliance History Report
2	Most Recent Source Test Report, 12-16-08
3	Letter from Cormetech, Inc.

Attachment 1

5 Year Compliance History

South Coast Air Quality Management District

NOV / NC Report

Notice No	Type	Issued Date	Violation Date	Insp Id	Team	Facility Id	Facility Name	Final Action	Date	Asgmt. No	Follow-up Status	Follow-up Number	Inspector	Date	Violation Description
D06713	NC	01/19/07	01/19/07	PC01	C	3417	AIR PROD & CHEM INC			977806	INCOMP		PC01	02/24/07	PROVIDE COMPLIANC

Total: 1

Attachment 2

Source Test Report, 12-16-08

COMPLIANCE TEST REPORT

REFORMER HEATER

Source Location:

**Carson Hydrogen Plant
Air Products and Chemicals, Inc.
23300 South Alameda Street
Carson, California 90509
Facility ID: 003417**

**Test Date: December 16, 2008
Issue Date: February 4, 2009
Revision: 0**

Prepared for:

**Air Products and Chemicals, Inc.
23300 S. Alameda St.
Carson, California 90810**

Prepared by:

**AirKinetics, Inc.
1308 S. Allec Street
Anaheim, California 92805
(714) 254-1945 Fax: (714) 956-2350
AKI No.: 12746 B**

Prepared By: _____

Jason Mai
**Jason Mai
Report Writer**

Reviewed By: _____

Son Bui
**Son Bui
Vice President**



**EMISSIONS CHARACTERIZATION
AND TESTING SERVICES**

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1.0 SUMMARY

1.1 Source Information

Plant Name and Address: Carson Hydrogen Plant
Air Products and Chemicals, Inc.
23300 South Alameda Street
Carson, California 90509

Facility ID No.: 003417

Source Tested: Reformer Heater

Plant Contact: Jim Reebel, Environmental Specialist

Phone Number: 310-847-7300 ext. 13

1.2 Testing Firm Information

Firm Name and Address: AirKinetics, Inc.
1308 S. Allec Street
Anaheim, California 92805

Firm Contact: Son Bui, Vice President

Phone Number: 714-254-1945 ext. 107

1.3 Test Information

Test Requested By: Air Products and Chemicals, Inc.

Firm Contact: Jim Reebel, Environmental Specialist

Phone Number: 310-847-7300 ext. 13

Test Objective: To demonstrate annual compliance

Test Date: December 16, 2008

Test Methods:

SCAQMD 1.1	Sampling Points
SCAQMD 2.1	Velocity
SCAQMD 4.1	Moisture
SCAQMD 25.3	ROG
SCAQMD 100.1	O ₂ , CO ₂ , NO _x , CO
SCAQMD 207.1	Ammonia
EPA Method 201A/202	PM10

1.4 Test Personnel

Test Coordinator: Jim Reebel, Environmental Specialist

AirKinetics Test Personnel: Nick Pham, Project Supervisor
Tony Mai, Project Supervisor

2.0 TEST RESULTS AND DATA PRESENTATION

The results of the test program are summarized in Table 2-1. All data pertaining to the tests are included in the appendices to this report. O₂, CO₂, and NO_x results, field data, calibration gas certificates, and fuel firing rate data are presented in Appendix A. Particulate matter < 10 microns results, field data, and analytical data are presented in Appendix B. Reactive Organic Compounds (ROG) results, field data, and analytical data are presented in Appendix C. Ammonia results, field data, and analytical data are presented in Appendix D. Equipment calibrations are presented in Appendix E. Sampling method descriptions and schematics are presented in Appendix F. Facility process data are presented in Appendix G.

TABLE 2-1
 TEST RESULTS

PARAMETER	UNIT	RUN 1	RUN 2	AVERAGE	PERMIT LIMIT
Heating ⁽¹⁾	Btu/SCF ⁽²⁾	331			
SCR Inlet					
NO _x	lb/MMBtu ⁽²⁾	0.0640			
Stack					
NO _x	ppmvd @ 3% O ₂	3.44			5.0
	lb/day	77.7			121
	lb/MMBtu ⁽²⁾	0.00563			
CO	ppmvd @ 3% O ₂	0 (4.22)*			10
	lb/day	0 (58.0)*			147
PM10	gr/dscf ⁽²⁾	0.000483			
	lb/day	13.7			92
ROG ⁽²⁾	ppmvd @ 3% O ₂	4.98			
	lb/day	35.6			129
NH ₃	ppmvd @ 3% O ₂	0.69	0.65	0.67	20.0
Flue Gas Composition ⁽²⁾ S-M2.1/M207.1-1	% H ₂ O	15.2			
	dscfm ⁽²⁾	138611			
	Excess % O ₂	3.94			
SCR Efficiency (based on lb/MMBtu)	% NO _x removal	91.2			

⁽¹⁾ - Gross Dry Heating Value, weighted average of the two fuel streams. The data are presented in Appendix A.4.

⁽²⁾ - Standard Temperature of 60 °F.

* - Actual measured CO concentrations were below 20% of analyzer range. Values in parentheses are calculated values using 20% of the analyzer's range. Compliance was demonstrated, since the calculated values equal to 20% of the analytical range were below the emission limit.

3.0 INTRODUCTION

On December 16, 2008 AirKinetics, Inc. conducted a source test for Air Products and Chemicals, Inc. at the Carson Hydrogen Plant in Carson, California. The test objective was to demonstrate annual compliance. Testing was conducted on the Reformer Heater. A test log shown in Table 3-1 presents the test locations, date, run times, methods, test objectives, and run numbers.

AirKinetics certifies that the independent testing laboratory criteria established in District Rule 304 (k), (1), (2), (3), and (4) are satisfied and that no conflict of interest exists between parties involved in the test program per District Rule 304.

**TABLE 3-1
TEST LOG**

LOCATION	TEST METHOD	PARAMETER	DATE	RUN TIME	RUN NO.
Inlet	SCAQMD 100.1	NO _x and O ₂	12/16/08	1321-1420	I-M100.1-1
Stack	SCAQMD 25.3	ROG		1320-1420	S-M25.3A,B
	SCAQMD 100.1	NO _x , CO, O ₂ , and CO ₂		1321-1420	S-M100.1-1
	SCAQMD 207.1	NH ₃		1320-1420	S-M207.1-1
				1610-1710	S-M207.1-2
	EPA 201A/202	PM10		1125-1732	S-M201A-1

4.0 SOURCE PROCESS AND EQUIPMENT DESCRIPTION

4.1 Process Description

Air Products and Chemicals, Inc. constructed a hydrogen plant in Carson, California. The hydrogen plant supplies hydrogen to the Shell Los Angeles Refinery and the British Petroleum Refinery in Carson, California. Gaseous hydrogen is produced by reacting a hydrocarbon feedstock with steam. Steam is generated in the hydrogen plant by heat recovery. The basic raw materials used in the hydrogen production process are the hydrocarbon feedstock and water. Hydrogen production consists of four basic process steps: (1) feedstock hydrogenation and sulfur removal; (2) reforming in the steam methane reformer (SMR); (3) shift conversion; and (4) hydrogen purification. The hydrocarbon feedstock is commercial natural gas. The water is delivered by a tie-in connection from the Dominguez Water Company. The gaseous hydrogen product is supplied by pipelines to off-site refineries.

4.2 Sampling Location Description

A summary of the test location information is presented in Table 4-1. Sampling location schematics are presented in Appendix B.

TABLE 4-1
TEST LOCATION INFORMATION

Location	Dimensions (inches)	Cross Sectional Area (in ²)	Upstream Distance		Downstream Distance	
			Inches	Equivalent Diameter	Inches	Equivalent Diameter
Stack	117 ID	10,751	756	6.46	204	1.74

5.0 SAMPLING AND ANALYTICAL PROCEDURES

Following is a list of the sampling and analytical procedures employed during this test program. Sampling method descriptions and schematics are presented in Appendix F.

TABLE 5-1
SAMPLING AND ANALYTICAL PROCEDURES

PARAMETER	TEST METHOD
Traverse Points	SCAQMD Method 1.1
Velocity	SCAQMD Method 2.1
Moisture	SCAQMD Method 4.1
Oxygen, Carbon Dioxide, Nitrogen Dioxide, and Carbon Monoxide	SCAQMD Method 100.1
Ammonia	SCAQMD Method 207.1
PM10	EPA Method 201A/202

6.0 TEST CRITIQUE

6.1 Fuel Samples

APCI has two fuels: Pressure Swing Adsorption (PSA) purge gas and natural gas. Due to cyclical nature of the PSA process, the composition and flow rate of the purge gas vary over time, and flow rate, composition, and heating value are best obtained from simulation. A grab sample would not be representative of the actual fuel composition. Therefore, the firing rate calculated by Air Products and Chemicals, Inc. was used to calculate the emission rate (lb/MMBtu) throughout the report instead of the Fd.

6.2 Reactive Organic Compounds

No sampling train leaks were observed during testing. ROG in tanks were measured by flame ionization detection/total combustion analysis (FID/TCA). Organic carbon in the water vial sample was measured by Infrared differential total organic carbon analyzer. A set of 2 SUMMA canister and 2 impinger sample was analyzed for methane and TGNMO and total organic carbon.

6.3 O₂, CO₂, NO_x, and CO

The CO sample value was less than the SCAQMD mandated $\geq 20\%$ of analyzer's range. However, the CO concentration qualitatively demonstrates it is within permit limits. Otherwise, all reference measurement system calibration bias and drift checks for each valid test run were within the specifications of the SCAQMD. The sampling system bias before and after each test run was less than ± 5 percent of span. Also the calibration drift during each run was less than ± 3 percent of span. No sampling system leaks were observed during testing.

The emission rates (lb/hr) for all runs were calculated using the volumetric flow rate from the concurrent velocity traverses. The emission rates (lb/MMBtu) for all runs were calculated using the APCI calculated firing rate.

Along with the initial calibration error test, AirKinetics performed interference response tests on both CAI NO_x analyzers. The sum of interference response for the analyzers was 0.4% of span. Hence, the criteria of $< 2\%$ was met. The NO_x Conversion Efficiency Test yielded 98.4% (inlet) and 98.2% (stack) conversion efficiency. Both tests satisfied the criterion of $> 90\%$ conversion efficiency.

The measured CO₂ concentrations at the exhaust ranged from 19 to 21.14 and were greater than the typical 0-20% instrument test range. Moreover, the CO₂ linearity was more than ± 1 percent of span. These anomalies should have minimal impact on the results, since CO₂ is used for molecular weight only.

6.4 Ammonia

No sampling train leaks were observed during testing. The sampling trains were operated at a sampling rate of 0.75 cfm. The analyses were performed using Ion Specific Electrode (ISE) by Airkinetics, Inc.. A reagent blank was also analyzed with no ammonia measured above the detection limit.

Test runs S-M207.1-1 and S-M207.1-2 used O₂ concentrations from the reference test method S-M100.1-1.

6.5 Particulate Matter < 10 Microns

All cut sizes were between 9 and 11 and no sampling points were outside of the D_{pmin} and D_{pmax}. No sampling train leaks were observed during testing. The O₂ and CO₂ for molecular weight calculations are from the concurrent RATA test program. Acetone, methylene chloride and DI water blanks were analyzed, with 0.1 mg, 0.1 mg, and 0.6 mg particulate detected, respectively.

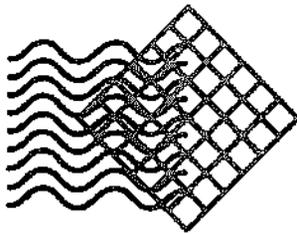
6.6 Selective Catalytic Reduction Efficiency

AirKinetics, Inc. used dual sampling system to concurrently monitor the flue gas concentrations at the inlet to the SCR and at the stack location. The APC1 calculated firing rate was used to calculate the NO_x emission rate at each location to determine the SCR efficiency.

No other anomalies were encountered during the test program.

Attachment 3

Cormetech, Inc. letter dated 6-16-09



Cormetech, Inc.
Environmental Technologies
Treyburn Corporate Park
5000 International Drive
Durham, North Carolina 27712
919-620-3000
fax 919-595-8701

CORMETECH

via email reebeljc@airproducts.com
June 16, 2009

Jim Reebel
Environmental Engineer
Air Products and Chemicals, Inc.
Los Angeles Area

Subject: Process revision expected impact to SCR catalyst performance.

Reference: e-mail from Jim Reebel/Air Products and Chemicals, Inc. to William Buynitzky/Cormetech dated 6/9/2009

Dear Jim:

I have reviewed the data provided and compared the current SCR operating condition and the expected SCR operating condition. The following changes, and their impact on SCR performance, are shown below.

<i>Parameter</i>	<i>Units</i>	<i>Current Operation</i>	<i>Proposed Operation</i>	<i>SCR Impact</i>
Flow Rate	lb/hr	786,892	714,850	Less Stringent
Inlet NOx	ppmvdc	39.6	53.6	More Stringent
NOx removal	%	91.8 (3.3 ppmvdc outlet NOx)	93.8 (3.3 ppmvdc outlet NOx)	More Stringent

The increased inlet NOx raises the performance requirement for the SCR. Not only is the required NOx removal efficiency raised, but the molar ratio of ammonia to NOx is effectively decreased since the ammonia slip limit has not increased. The stated reduction in flow rate lowers the performance requirement for the SCR, but does not completely offset the increased performance requirement from the increased NOx loading.

The proposed change raises the performance requirement. Based on the SCR performance measured during the December 2008 field test, there was sufficient catalytic potential to meet the revised performance requirements based on the changes shown above and outlet ammonia remaining below 5 ppmvdc. This analysis does not account for any changes in flow distribution, temperature distribution, or ammonia to NOx distribution.

Formation of ammonium bisulfate is a function of H₂O, NH₃, and SO₃ in the flue gas. If the amount of sulfur compounds does not increase, the proposed change to the system will not increase ammonium bisulfate formation when compared to the formation under the current operating conditions and end of life SCR performance. If SO₃ is the limiting reagent, then reductions in SO₃ would be expected to reduce ammonium bisulfate emissions.

Regards,
William Buynitzky

END OF EVALUATION