APPENDIX A

RULE 12-16 EMISSION LIMITS METHODOLOGY

REGULATION 12, RULE 16
PETROLEUM REFINING FACILITY-WIDE EMISSIONS LIMITS

EMISSIONS LIMITS METHODOLOGY

This document describes the methodology used to develop the refinery facility emissions limits for GHG, PM_{10}, $PM_{2.5}$, NO_X, and SO_2 emissions to be included in Proposed Regulation 12, Rule 16: Petroleum Refining Facility-Wide Emissions Limits (Proposed Rule 12-16). Emission limits were developed for the petroleum refineries and associated support facilities listed in Table 1.

Table 1: Petroleum Refineries and Associated Support Facilities

Facility Name	Facility ID
Chevron Refinery	A-0010
Shell Refinery	A-0011
Phillips 66 Refinery	A-0016
Tesoro Refinery	B-2758/2759
Valero Refinery & Asphalt Plant	B-2626 & B-3193
Martinez Cogen LP	A-1820
Air Liquide H2 Plant	B-7419
Air Products H2 Plant	B-0295

The development of the emission limits involved: 1) evaluating facility annual emissions inventories from previous years, 2) adjusting annual inventories for excluded sources and facility changes, and 3) establishing emissions limits from the baseline levels. These steps are described below.

Annual Emissions Inventories

Criteria Pollutant Emission Inventories

Annual facility emissions of PM_{10}, $PM_{2.5}$, NO_X, and SO_2 were obtained from the Air District emission inventories (dated 10/21/2016). Emissions for the most recent five-year period available were used (calendar years 2010 – 2014). Note that although the Air District reports these emissions to the California Air Resources Board (CARB) via the California Emission Inventory Development and Reporting System (CEIDARS), CEIDARS reporting years are not necessarily indicative of calendar years. This difference is primarily due to reporting lag time and variability in source and facility reporting and permit renewal schedules. Therefore, source emissions were aggregated by the Air District to arrive at annual emissions that best represent actual calendar year emissions, resulting in calendar year emissions that may deviate from CEIDARS reporting year emissions.

Greenhouse Gas Emission Inventories

As stated in 12-16-207 of the proposed rule, GHG emissions should be calculated in a manner consistent with the CARB requirements for the Mandatory Greenhouse Gas Emissions Reporting Rule (MRR) for the purposes of Proposed Rule 12-16. Baseline GHG emissions were therefore based on the annual GHG emissions data reported to CARB under MRR. Annual emissions of GHGs (expressed as CO_2e) were obtained from the CARB Emissions Inventory for Mandatory GHG Reporting summary spreadsheets[1] (last updated 11/4/2016) using the entries under "Calculated Covered Emissions" for "Emitter Covered Emissions"[2]. CARB's MRR data reflects the use of an established GHG emissions inventory protocol, and provides consistency between the baseline emissions inventories and reporting of emissions for determinations of compliance under Proposed Rule 12-16.

[1] https://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/ghg-reports.htm

[2] Covered emissions refer to all emissions included in a compliance obligation under sections 95852 through 95852.2 of the cap-and-trade regulation.

GHG emissions for the most recent five-year period available were used (calendar years 2011 – 2015). Note that GHG emissions data was also reported to CARB for calendar years 2008 to 2010, but this data was subject to slightly different applicability, calculation, methodology, and verification requirements than current reported data. Beginning with GHG emissions data reported in 2011, CARB included changes in methodologies to harmonize with the U.S. EPA reporting regulation. CARB also included additional data collection to support the Cap-and-Trade Program and required annual third-party verification for GHG emissions data. Because of these differences in reporting requirements, and the availability of data over the most recent five-year period from 2011 to 2015, reported data from years 2010 and before were not used.

Adjusted Annual Emissions

Adjusted Criteria Pollutant Emission Inventories

A number of adjustments were made to the calendar year 2010 – 2014 emissions inventories to develop the PM_{10}, $PM_{2.5}$, NO_X, and SO_2 facility baseline emission levels. These adjustments are described in the sections below.

Adjustment for Flares and Cooling Towers

Emissions from flares and cooling towers were excluded from emissions inventories for PM_{10}, $PM_{2.5}$, NO_X, and SO_2 at CBE's request. Per the intent of the policy recommendation, the purpose of the proposed rule is to address emission increases associated with changes in refinery processing operations. Emissions associated with safety-related activities, such as flaring, are not intended to be limited, and are therefore excluded from the baseline emission levels. Similarly, entrained PM_{10} and $PM_{2.5}$ emissions associated with cooling towers are not intended to be limited, and therefore are also excluded from the baseline emission levels. These excluded sources are listed in Table 2.

Table 2: Excluded Cooling Tower and Flaring Emission Sources

Facility Name	Facility ID	Cooling Tower Sources	Flaring Sources
Chevron Refinery	A-0010	4073, 4076, 4172, 4173, 4187, 4191, 4329, 6051	6010, 6012, 6013, 6015, 6016, 6019, 6039, 32110
Shell Refinery	A-0011	1456, 1457, 1460, 1778, 4210	-103, -102, -101, 1470, 1471, 1771, 1772, 4201, 32110
Phillips 66 Refinery	A-0016	452, 453, 455, 456, 457, 458, 500	296, 398, 32110
Tesoro Refinery	B-2758/2759	846, 975, 976, 977, 978, 979, 980, 981, 982, 983, 985, 987, 988	854, 943, 944, 945, 992, 1012, 1013, 1517, 1524, 32110
Valero Refinery & Asphalt Plant	B-2626 & B-3193	Refinery: 29 Asphalt Plant: N/A	Refinery: -15, -14, 16, 17, 18, 19, 32110 Asphalt Plant: N/A
Martinez Cogen LP	A-1820	N/A	N/A
Air Liquide H2 Plant	B7419	N/A	3
Air Products H2 Plant	B-0295	N/A	N/A

Adjustments for Equipment and Operational Changes

Additional adjustments were made to the emissions inventories to more appropriately reflect current and ongoing operations at the facilities. Adjustments were made to the Phillips 66 Refinery and Valero Refinery and Asphalt Plant emission inventories as described below. No adjustments were made to the baseline emissions at Air Liquide, Air Products, Chevron Refinery, Martinez Cogen, Shell Refinery, and Tesoro Refinery.

Phillips 66 Refinery – Source S14, Unit 240 B-401 Heater, was idled in October 2011 and the facility applied for a permanent shutdown of the unit in March 2012, which was subsequently approved and incorporated into the facility's current operating permit. Because S14 would not be expected to continue generating emissions, emissions from S14 were excluded from consideration in developing a representative baseline for the current operations. Emissions from S14 were therefore removed from the emissions inventories of the previous years.

Valero Refinery and Asphalt Plant – Changes were made to the Fluidized Catalytic Cracking Unit (S5) and Coker Unit (S6) abatement system at the Valero Refinery in late 2010. CO furnaces (S3 and S4) and their thermal DeNOx systems (A52 and A53) plus the ESPs abatement (A1 through A5) were shut down in late 2010. These units were replaced by new CO furnaces (S1059 and S1060), which are abated by Selective Catalytic Reduction Units (A1059 and A1060) and a Prescrubber/Regenerative Amine Scrubber (A1047). This represents a substantial change in the emissions at the Valero Refinery, and annual emissions before this change are not representative of the ongoing operations at the facility. Because this change involved several sources and abatement devices being removed and replaced with new sources and a different abatement system, year 2010 emissions do not reflect the current facility operations. Emissions from the 2010 calendar year were therefore not considered in establishing the maximum annual emissions level.

Source S32000, which represents combined minor combustion sources, was also excluded from the baseline emissions. Air District staff found in 2015 that emissions reported under this source were already being reported under other sources, resulting in duplicate reported emissions from S32000. This reporting issue has been resolved, and emissions from S32000 are no longer being reported for years 2014 and after. Emissions from S32000 are therefore being removed from the 2010 – 2013 emissions inventories for the purposes of this baseline inventory.

Adjusted Greenhouse Gas Emission Inventories

For GHG inventories, detailed GHG emission data from CARB was not available for the specific sources within each facility. Therefore, adjustments were not made to the GHG emissions inventories.

Emissions Limits

Emissions limits were developed for each facility based on the adjusted baseline emissions inventories. For each pollutant, a maximum annual emission rate was determined from the adjusted baseline emissions. A 7% increase was added to this maximum annual emission rate to develop the emission limit. The use of the maximum annual emission rate and the 7% increase are intended to allow for year-to-year variability in operations. The annual emission limits are shown in Tables 3 through 7.

Table 3: GHG Emission Limits (metric tons CO_2e/year)

Facility Name	Facility ID	Maximum Annual Adjusted Baseline Emissions	Emission Limit (Baseline Emissions Plus 7%)
Chevron Refinery	A-0010	4.46 M	4.77 M
Shell Refinery	A-0011	4.26 M	4.56 M
Phillips 66 Refinery	A-0016	1.50 M	1.61 M
Tesoro Refinery	B-2758/2759	2.44 M	2.61 M
Valero Refinery & Asphalt Plant	B-2626 & B-3193	2.94 M	3.15 M
Martinez Cogen LP	A-1820	421 K	450 K
Air Liquide H2 Plant	B-7419	885 K	947 K
Air Products H2 Plant	B-0295	271 K	290 K

M = Millions, K = Thousands

Table 4: PM_{10} Emission Limits (tons/year)

Facility Name	Facility ID	Maximum Annual Adjusted Baseline Emissions	Emission Limit (Baseline Emissions Plus 7%)
Chevron Refinery	A-0010	491	525
Shell Refinery	A-0011	550	589
Phillips 66 Refinery	A-0016	77.7	83.1
Tesoro Refinery	B-2758/2759	90.7	97.0
Valero Refinery & Asphalt Plant	B-2626 & B-3193	125	134
Martinez Cogen LP	A-1820	17.6	18.8
Air Liquide H2 Plant	B-7419	16.1	17.2
Air Products H2 Plant	B-0295	9.71	10.4

Table 5: $PM_{2.5}$ Emission Limits (tons/year)

Facility Name	Facility ID	Maximum Annual Adjusted Baseline Emissions	Emission Limit (Baseline Emissions Plus 7%)
Chevron Refinery	A-0010	469	502
Shell Refinery	A-0011	463	495
Phillips 66 Refinery	A-0016	70.1	75.0
Tesoro Refinery	B-2758/2759	72.6	77.7
Valero Refinery & Asphalt Plant	B-2626 & B-3193	124	133
Martinez Cogen LP	A-1820	17.6	18.8
Air Liquide H2 Plant	B-7419	15.0	16.1
Air Products H2 Plant	B-0295	9.06	9.69

Table 6: NO_X Emission Limits (tons/year)

Facility Name	Facility ID	Maximum Annual Adjusted Baseline Emissions	Emission Limit (Baseline Emissions Plus 7%)
Chevron Refinery	A-0010	907	970
Shell Refinery	A-0011	998	1.07 K
Phillips 66 Refinery	A-0016	270	289
Tesoro Refinery	B-2758/2759	949	1.02 K
Valero Refinery & Asphalt Plant	B-2626 & B-3193	1.20 K	1.28 K
Martinez Cogen LP	A-1820	111	119
Air Liquide H2 Plant	B-7419	12.7	13.6
Air Products H2 Plant	B-0295	3.21	3.43

K = Thousands

Table 7: SO_2 Emission Limits (tons/year)

Facility Name	Facility ID	Maximum Annual Adjusted Baseline Emissions	Emission Limit (Baseline Emissions Plus 7%)
Chevron Refinery	A-0010	368	394
Shell Refinery	A-0011	1.36 K	1.46 K
Phillips 66 Refinery	A-0016	365	391
Tesoro Refinery	B-2758/2759	602	644
Valero Refinery & Asphalt Plant	B-2626 & B-3193	65.1	69.7
Martinez Cogen LP	A-1820	2.15	2.30
Air Liquide H2 Plant	B-7419	2.35	2.51
Air Products H2 Plant	B-0295	2.18	2.33

K = Thousands

REGULATION 12, RULE 16
PETROLEUM REFINING FACILITY-WIDE EMISSIONS LIMITS
EMISSION LIMITS REVISION – AIR PRODUCTS H2 PLANT B-0295

This document describes revisions made to the emission limits for PM_{10}, $PM_{2.5}$, NO_X, and SO_2 at Air Products H2 Plant B-0295 (Air Products) to be included in Proposed Regulation 12, Rule 16: Petroleum Refining Facility-Wide Emissions Limits (Proposed Rule 12-16).

Basis of Revisions

Air Products representatives provided comments to Air District staff regarding potential inconsistencies between the emission inventories used to develop the Rule 12-16 limits and the facility's data that had been recorded and reported to the Air District for compliance purposes. Staff examined the Air District's emission inventories and the compliance data submitted by Air Products to the Air District in 2010-2014, and found some instances of substantial discrepancies between the two data sets. The emissions data submitted for compliance reporting by Air Products was based on direct measurements and/or stack testing, and represent a more accurate characterization of the emissions compared to the Air District's emissions inventories, which are based on emission factors and had not been updated to reflect this data. These discrepancies are not unique to Air Products and the Air District is working to improve our emissions inventory process to avoid such issues in the future. For the purposes of Proposed Rule 12-16, the Air District has made the necessary adjustments so that the limits for Air Products are consistent with the intent of the groups that developed the Rule 12-16 policy recommendation.

Emission Revisions

Revisions to the annual emission inventories and limits are shown in Table 1. NO_X emissions were revised for calendar years 2010-2014. PM_{10}, $PM_{2.5}$, and SO_2 emissions were revised for calendar year 2014. These emission revisions resulted in corresponding changes to the maximum annual emissions and emission limits for NO_X and SO_2, as shown in the table. No revisions were made to the GHG emission inventory or limit.

Table 1: Revised Annual Emissions and Limits (tons/year) for Air Products H2 Plant B-0295

Pollutant	**2010**	**2011**	**2012**	**2013**	**2014**	**Maximum Annual (tons/year)**	**Emission Limit (tons/year)**
PM_{10}	7.96	9.60	8.02	9.71	0.29 ~~*6.76*~~	**9.71**	**10.39**
$PM_{2.5}$	7.43	8.95	7.49	9.06	0.29 ~~*6.31*~~	**9.06**	**9.69**
NO_X	4.04 ~~*2.62*~~	5.04 ~~*3.15*~~	5.74 ~~*2.65*~~	8.25 ~~*3.21*~~	7.47 ~~*2.23*~~	**8.25** ~~***3.21***~~	**8.83** ~~***3.43***~~
SO_2	1.78	2.15	1.79	2.18	2.70 ~~*1.52*~~	**2.70** ~~***2.18***~~	**2.89** ~~***2.33***~~
Notes: Previous values that are being changed in this revision are shown in strikethrough for reference.							

NO_X emissions were revised using data recorded by the facility's continuous emission monitor (CEM), which directly measures the NO_X emissions from the source. Revisions to the PM_{10}, $PM_{2.5}$, and SO_2 emissions were driven primarily by source testing requirements that were part of Air Products' Authority to Construct (ATC) application 23933 for a burner replacement project in 2013. The project involved the replacement of 20 of the 50 burners in the furnace, and additional testing and monitoring requirements were added to the permit conditions to more accurately characterize the source emissions and adequately demonstrate compliance with permit limits. This testing was conducted in 2013 after the burner replacement project was completed. Emission revisions for each pollutant are discussed in detail

below.

PM_{10} Emissions

PM_{10} emissions are calculated in the Air District's inventory using fuel throughputs and default PM_{10} emission factors for the fuels combusted at the source, which include natural gas and pressure swing adsorption (PSA) gas. As a component of Air Products' Authority to Construct 23933, Air Products was required to conduct a stack test in 2013 to establish a site-specific PM_{10} emission factor for use in monthly compliance reporting. The monthly emissions reported are calculated based on the site-specific PM_{10} emission factor and the monitored stack firing rate at the source. This emission factor and the associated emission estimates had not been incorporated into the Air District's inventory.

This revision updates the Air District's inventory with the PM_{10} emission estimates submitted by Air Products for compliance reporting. Calendar year 2014 was the first complete calendar year of submitted reports with emissions based on the site-specific PM_{10} emission factor.

$PM_{2.5}$ Emissions

$PM_{2.5}$ emissions are calculated in the Air District's inventory using the PM_{10} emissions associated with each fuel combusted (natural gas and PSA gas) and applying the respective PM size fraction profile, which indicates the fraction of PM_{10} that is in the $PM_{2.5}$ size range. The updated $PM_{2.5}$ emissions are based on the total PM_{10} emissions and a $PM_{2.5}$ fraction of 1.00.

This revision updates the Air District's inventory with the $PM_{2.5}$ emission estimates calculated from the PM_{10} emission estimates submitted by Air Products. As noted above, calendar year 2014 was the first complete calendar year of submitted reports with PM_{10} emissions based on the site-specific PM_{10} emission factor.

SO_2 Emissions

SO_2 emissions are calculated in the Air District's inventory using fuel throughputs and default SO_2 emission factors for the fuels combusted at the source (natural gas and PSA gas). As a component of Air Products' Authority to Construct 23933, Air Products was required to conduct fuel sampling in 2013 to establish a site-specific SO_2 emission factor for use in monthly compliance reporting. The monthly emissions reported are calculated based on the site-specific SO_2 emission factor and the monitored stack firing rate at the source. This emission factor and the associated emission estimates had not been incorporated into the Air District's inventory.

This revision updates the Air District's inventory with the emission estimates submitted by Air Products for compliance reporting. Calendar year 2014 was the first complete calendar year of submitted reports with emissions based on the site-specific SO_2 emission factor.

NO_X Emissions

NO_X emissions are calculated in the Air District's inventory using fuel throughputs and default NO_X emission factors for the fuels combusted at the source (natural gas and PSA gas). Air Products is required to operate a continuous emission monitor to measure and calculate NO_X emissions for monthly compliance reporting. These emissions had not been incorporated into the Air District's inventory.

This revision updates the Air District's inventory with the emission calculations submitted by Air Products for compliance reporting. CEM data for NO_X is available for calendar years 2010-2014.