ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AIR PERMITS PROGRAM

TECHNICAL ANALYSIS REPORT
for
Air Quality Control Minor Permit AQ0311MSS03

Petro Star Inc.
Petro Star Valdez Refinery

Ultra-low Sulfur Diesel Project
And
Revisions to Construction Permit 311CP03

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Abbreviations/Acronyms

AAAQS .....Alaska Ambient Air Quality Standard
AAC .....Alaska Administrative Code
Department .....Alaska Department of Environmental Conservation
AS .....Alaska Statutes
ASTM.....American Society of Testing and Materials
C.F.R. .....Code of Federal Regulations
EF .....emission factor
EU .....emission unit
EPA .....Environmental Protection Agency
HHV .....higher heating value
ISO .....International Standards Organization
LHV.....lower heating value
MR&R.....monitoring, recordkeeping, and reporting
NA .....not applicable
NAICS .....North American Industry Classification System
NESHAPS .....National Emission Standards for Hazardous Air Pollutants
NSPS .....New Source Performance Standards
PSD.....Prevention of Significant Deterioration
PSVR.....Petro Star Valdez Refinery
PTE.....potential to emit
TAPS .....Trans Alaska Pipeline System
TAR.....Technical Analysis Report
ULSD .....ultra-low sulfur diesel

Units and Measures

dscf .....dry standard cubic foot
gph .....gallons per hour
gr./dscf.....grains per dry standard cubic feet (1 pound = 7,000 grains)
hp.....horsepower
kW, kW-e .....kilowatts, kilowatts electric
MMBtu .....million British Thermal Units
ppm.....parts per million
ppmv.....parts per million by volume
tph .....tons per hour
tpy .....tons per year
wt%.....weight percent

Pollutants

CO .....carbon monoxide
CO_2e .....carbon dioxide equivalent
GHG .....greenhouse gas
HAPs .....hazardous air pollutants
H_2S .....hydrogen sulfide
NO_X .....oxides of nitrogen
NO_2.....nitrogen dioxide
PM-10.....particulate matter with an aerodynamic diameter less than 10 microns
SO_2 .....sulfur dioxide
VOC .....volatile organic compound

1. Introduction

This Technical Analysis Report (TAR) provides the Alaska Department of Environmental Conservation's (Department's) basis for issuing Air Quality Control Minor Permit AQ0311MSS03 to Petro Star Inc. (Petro Star) for the Petro Star Valdez Refinery (PSVR). The Department is revoking Minor Permit AQ0311MSS01 and issuing Minor Permit AQ0311MSS03 in accordance with AS 46.14.280(a)(2) due to material mistakes in AQ0311MSS01. Minor Permit AQ0311MSS03 is classified under 18 AAC 50.502(c)(3) for an increase in NO_X emissions over 10 tpy and under 18 AAC 50.508(6) for revisions to terms and conditions of Construction Permit 311CP03. For the revisions under 18 AAC 50.508(6) this TAR only includes the basis for the revisions to Construction Permit 311CP03 requested by Petro Star. The TAR for Construction Permit 311CP03 contains the basis for that permit.

1.1 Stationary Source Description

PSVR is located in Prince William Sound near the town of Valdez and adjacent to the Trans-Alaska Pipeline System (TAPS). The PSVR is a petroleum refinery permitted to process up to 70,000 barrels of crude oil from TAPS per day. The refinery separates the diesel and kerosene fractions from crude oil by distillation. Petro Star blends the fractions to create the facility's products and injects the remaining products into TAPS.

PSVR currently operates under Construction Permit 311CP03 and Minor Permit AQ0311MSS01. Construction Permit 311CP03 rescinded and replaced Construction Permit 0071-AC015 (issued October 30, 2000), as well as, revised, rescinded, and/or replaced specific terms and conditions of Permit-To-Operate No. 9471-AA036 while requiring continued compliance with the permit. Construction Permit 311CP03 also authorized modification of EU ID 1, installation of EU IDs 15 and 16, and established owner requested limits in order to protect ambient air quality standards and avoid PSD major classification. Minor Permit AQ0311MSS01 authorized modification of the refinery to produce ultra-low sulfur kerosene (ULSD #1) and ultra-low sulfur diesel (ULSD #2). The permit also authorized installation of EU IDs 18 through 24 and modification of EU ID 10.

The Department issued an initial Title V operating permit (AQ0311TVP01) on July 24, 2002. The permit expired on August 24, 2007 but was not renewed because the stationary source was deemed a minor source (i.e., the PTE for each of the regulated air pollutant at the time was less than the 100 TPY threshold for a Title V major source). However, additional emission units authorized under Minor Permit AQ0311MSS01 triggered Title V permitting requirements, therefore Petro Star submitted an application for a new "initial" Title V permit on October 20, 2011.

1.2 Application Description

The Department determined Minor Permit AQ0311MSS01 contained material mistakes after meeting with Petro Star on February 5 and April 16, 2013. As stated in the letter from the Department to Petro Star dated May 13, 2013, Petro Star requested the Department revoke and reissue Minor Permit AQ0311MSS01 as provided in AS 46.14.280(a)(2) because the permit application contained material mistakes as follows:

1. Petro Star based their PTE on the design 'absorbed duty' numbers, which are lower than the actual maximum capacities of EUs 18 through 21.

2. The fuel usage numbers used to calculate PTE for EUs 18 through 21 were incorrect because of the incorrect assumption in (1).

3. Fuel usage numbers were only used to demonstrate the calculation of PTE and were never intended to restrict the flexibility to use different fuel combinations in EUs 18 through 21.

In accordance with the May 13, 2013 letter mentioned above, Petro Star submitted a modeling protocol addressing Petro Star's use of current modeling techniques and Petro Star's current emission unit inventory and a minor permit application with the requested information.

The Department is allowing Petro Star to base permit applicability for this project as if Minor Permit AQ0311MSS01 (The Ultra-low Sulfur Diesel Project) was never issued. Petro Star determined permit applicability using regulations for minor permits under Article 5 of 18 AAC 50 and regulations for Construction Permits under Article 3 of 18 AAC 50 based on the PTE of the source after the issuance of Construction Permit 311CP03 and the change in PTE due to the Ultra-low Sulfur Diesel Project. Petro Star also determined permit applicability for the project using only the pollutants that were subject to permit applicability for Minor Permit AQ0311MSS01, as allowed by the Department. The Department is allowing this because no permit classifications were avoided with the Department-imposed limits of Condition 4 in Minor Permit AQ0311MSS01, which were for the protection the annual NO_2 Alaska Ambient Air Quality Standard (AAAQS).

Petro Star is also requesting the following changes to permit 311CP03 under 18 AAC 508(6):

- Revisions to Condition 37. Petro Star would like to use the allowed fuel for EU 2 in EU 3, since there is a combined ton per year limit for NO_X for these units and EU 2 has been removed.

- Rescinding Condition 38. Petro Star requests the removal of the fuel consumption limits for the emergency generator and backup firewater pump engine (EUs 4 and 16). Petro Star states in the application that the limits were applied to avoid classification as a major facility under 18 AAC 50.300(c)(2), and now that the facility is classified as a major facility, they would like the limits removed.

Additionally, Petro Star states they are willing to take an owner-requested limit (ORL) of 2,000 hours per year to limit permitted emissions from the emergency glycol heater (EU 27).

2. Emission Summary

Table 1 shows the potential and assessable emissions for the stationary source. Emissions are as calculated in the minor permit application unless noted otherwise in Table 1. The assessable PTE listed in Table 1 is the sum of the PTE of each individual air pollutant for which the stationary source has the potential to emit quantities greater than 10 tpy. All significant HAPs are VOCs, so those emissions are not included in the assessable total to prevent double counting of emissions.

Table 1 – Potential and Assessable Emissions

Activity	*EU ID*	Potential to Emit (tpy)						
		NO_X	**CO**	**SO_2**	**PM-10**	**VOC**	**HAPs**	**Total**
Existing (311CP03)	-	**84**	**29**	**16**	**12**	**47** [a]	**5.7** [a]	
ULSD Project	*18*	21.6	6.3	4.1	0.93	1.3	0.31	
	19	24	7	4.6	1	1.5	0.34	
	20	15	1.6	0.54	3.7	0.5	0.66	
	21	4.7	3.0	0.31	0.29	0.38	0.03	
	6-10, 13-15, 23, & 24 (change in emissions)	0	0	0	0	-0.5	0.1	
	17 (change in emissions)	0	0	0	0	2.6	0.69	
	Equipment Leaks (change in emissions)	0	0	0	0	10.1	2.62	
	Total	**65.3**	**17.9**	**9.6**	**5.9**	**15.9**	**4.8**	
Off-permit Change [b]	*25A & B*	0.25	0.06	0.42	0.03	0	1.4E-05	
	26A & B	1.5	0.37	2.5	0.17	0.03	9.5E-05	
	27 [c]	4.1	0.92	6.39	0.26	0.04	4.3E-04	
	28 [d]	3.34	0.15	0.4	0.01	0.02	1.6E-05	
	Total	**9.2**	**1.5**	**9.7**	**0.5**	**0.1**	**5.6E-04**	
18 AAC 50.508(6) Changes	*2* (change in emissions)	-1.6	-0.33	-2.3	-0.15	-0.01	-8.0E-05	
	3 (change in emissions)	1.6	0.36	2.3	0.03	0.05	2.0E-04	
	4 (change in emissions)	2.6	0.65	0.2	0.04	0.07	6.9E-06	
	16 (change in emissions)	1.4	0.29	0.1	0.1	0.11	2.8E-06	
	Total	**4**	**1**	**0.3**	**0.02**	**0.2**	**1.3E-04**	
PTE		162	49	36	18	63	11	318 [e]
Assessable PTE		162	49	36	18	63	0	318

Notes:

[a] Petro Star provided revised PTE in the application for AQ0311MSS03.

[b] Installation of these EUs occurred without a Title I permit due to PTE below permit thresholds. The change occurred after the issuance of AQ0311MSS01 (USLD project), but Petro Star included these emissions in the ambient analysis, as requested by the Department.

[c] The 2,000 hour ORL is not included in AQ0311MSS03. Therefore, PTE is based on 8,760 hours of operation.

[d] PTE calculated using vendor data and an engine rating of 851 kW.

[e] HAPs are not included in the total because all significant HAPs are VOCs.

Table 2 – Minor Permit Thresholds

PTE or Permit Threshold	Emissions (tpy)			
	NO_X	SO_2	PM-10	Pb
Existing PTE (311CP03)	84	16	12	0.006
Minor Source Permit Threshold (18 AAC 50.502(c)(1))	40	40	15	0.6
Is existing PTE above the minor permit threshold?	**Yes**	**No**	**No**	**No**
ULSD Project PTE	65			
Minor Modification Threshold (18 AAC 50.502(c)(3))	10			
Is project PTE above the minor modification threshold?	**Yes**			

3. Department Findings

Based on the review of the application, the Department finds that:

- The ULSD project is classified under 18 AAC 50.502(c)(3) as needing a minor permit for air quality protection because the increase in potential NO_X emissions exceeds 10 tpy, and the existing potential NO_X emissions (before project) exceeds 40 tpy.
- Under the requirements of 18 AAC 50.540(c)(2), an applicant requesting a minor permit classified under 18 AAC 50.502 must demonstrate compliance with the Alaska Ambient Air Quality Standards (AAAQS) for the pollutant of concern. Modeling is required to demonstrate compliance for NO_2 for this project. Petro Star conducted modeling according to the Department-approved protocol and demonstrated that the stationary source will be in compliance with the AAAQS for nitrogen dioxide (NO_2). The modeling review memorandum attached to this TAR as Appendix A summarizes the Department's review of the modeling.
- The ambient analysis submitted by Petro Star shows that the stationary source will comply with the AAAQS for NO_2 based on the maximum estimated potential emissions. To ensure compliance with the AAAQS, the Department established an emission unit stack configuration requirement, as recommended in the attached modeling review memo.
- Minor permit AQ0311MSS03 is also classified under 18 AAC 50.508(6) because Petro Star requested revising or rescinding the terms and conditions of a Title I permit. The requested changes under 18 AAC 50.508(6) do not trigger permit requirements under 18 AAC 50.502(c)(3) because the increases in PTE for each pollutant is less than 10 tpy, which is less than all thresholds under 18 AAC 50.502(c)(3).

- EUs 2 and 3 had a combined NO_X tpy limit for PSD avoidance in permit 311CP03 and individual fuel consumption limits, which were equivalent to the combined NO_X tpy limit. Petro Star has shutdown EU 2 and removed it from the stationary source. Since EUs 2 and 3 had the same NO_X emission factor (24 lbs of NO_X/1,000 gallons of diesel) in permit 311CP03, transferring the allowed fuel use for EU 2 to EU 3 does not affect the PSD avoidance limit for NO_X or NO_X PTE. Therefore, the Department revised Condition 37 of 311CP03 as requested by Petro Star.
- The Department cannot remove the operational limits for EUs 4 and 16 because they were established for PSD avoidance (NO_X) in previous Title I permits. Those limits cannot be relaxed above the PSD threshold they were avoiding at the time the Title I permits were issued without subjecting those units to the PSD requirements that were avoided. Instead of removing the fuel consumption limits, the Department revised the NO_X emission limit and established a 500 hour of operation limit for each of EUs 4 and 16. Petro Star used those operating hour values in their modeling analysis, and the new limits continue to meet the PSD avoidance limits established in previous Title I permits.
- The 2,000-hour limit for EU 27 requested by Petro Star is not necessary for PSVR to avoid any permit classification, and the attached modeling memo indicates the stationary source remains in compliance with the ambient NO_X standard at unlimited operation. Therefore, the 2,000-hour limit is not included in AQ0311MSS03.

4. Permit Requirements

State regulations in 18 AAC 50.544 describe the elements the Department must include in minor permits. This section of the TAR provides the technical and regulatory basis for the permit requirements in AQ0311MSS03.

4.1 General Requirements for all Minor Permits

As described in 18 AAC 50.544(a)(1), the cover page of AQ0311MSS03 identifies the stationary source, the project, the Permittee, and contact information. AQ0311MSS03 also includes requirements to pay fees as required under 18 AAC 50.544(a)(2), standard permit conditions as required under 18 AAC 50.544(a)(5), and conditions to protect ambient air quality as required under 18 AAC 50.544(a)(6).

4.2 Requirements for a Minor Permit Under 18 AAC 50.502(c)

For the ULSD project, AQ0311MSS03 contains terms and conditions as necessary to ensure that the proposed stationary source or modification will not cause or contribute to a violation of any ambient air quality standard as required under 18 AAC 50.544(c)(1), including operational limits reflecting assumptions made in the modeling analysis provided by Petro Star.

18 AAC 50.544(c)(2) requires terms and conditions requiring performance tests for emission limits under 18 AAC 50.050 - 18 AAC 50.090. Petro Star demonstrated initial compliance with state standards under AQ0311MSS01. The Department is not requiring initial compliance demonstrations under AQ0311MSS03, because Petro Star has not physically modified the emission units subject to state standards.

AQ0311MSS03 also contains terms and conditions requiring maintenance of equipment according to the manufacturer's or operator's maintenance procedures, including requirements to keep a copy of either the manufacturer's or the operator's maintenance procedures, as required under 18 AAC 50.544(c)(3).

4.3 Requirements for a Minor Permit Under 18 AAC 50.508(6)

AQ0311MSS03 contains terms and conditions as necessary to ensure the Permittee will construct and operate the stationary source in accordance with 18 AAC 50, as required under 18 AAC 50.544(i).

4.4 AQ0311MSS03 Permit Condition Summary

The Department is rescinding AQ0311MSS01 and the remaining active construction permit (311CP03) and creating a new minor permit (AQ0311MSS03) for the ULSD project and the revised and remaining applicable construction permit conditions. Since permit 311CP03 required compliance with Permit to Operate 9471-AA036, the revised and remaining applicable conditions from this permit are also included in AQ0311MSS03. Table 3 and Table 4 below provide comparisons of construction permit and permit to operate requirements to the requirements of AQ0311MSS03.

Table 3 – Comparison of 311CP03 to AQ0311MSS03

311CP03 Condition Number and Description	AQ0311MSS03 Condition Number	Description of revision
1, 4, & 5. Rescinding permit 0071-AC015	NA	Permit 0071-AC015 remains rescinded because it was rescinded in 311CP03.
2 & 3. Compliance with permit 9471-AA036	NA	Applicable conditions from permit 9471-AA036 are included in AQ0311MSS03.
6 & 6.1-6.3. Revisions to permit 9471-AA036	NA	Use of HAGO is prohibited under 311CP03, Condition 35. Owner-requested limits are under 311CP03, Conditions 37 and 38. SO_2 limits are under 311CP03, Condition 45.3. Conditions not included in AQ0311MSS03.
6.4. Revise EU 1 rating	Table 1	Rating revised in emission unit table.
6.5. Revise crude oil throughput limit	16	Not revised.
7 & 8. Rescinding nitrogen content requirements for liquid fuel in permit 9471-AA036	NA	Permit 9471-AA036 expired on December 31, 1995 and compliance with the permit is no longer required. Conditions not included in AQ0311MSS03.
9. Rescinding conditions 7 through 9 of permit 9471-AA036	NA	Permit 9471-AA036 expired on December 31, 1995 and compliance with the permit is no longer required. Condition not included in AQ0311MSS03.
10-12. Revisions to tank throughput requirements	17 through 19	Not revised.

311CP03 Condition Number and Description	AQ0311MSS03 Condition Number	Description of revision
13-20. Standard permit conditions	36 through 41 and 54	Revised to reflect updated standard condition language. 311CP03, Condition 16 is no longer a standard condition for Title I permits.
21-24. Recordkeeping, reporting, & testing	34, 44, and 46 through 53	Revised to reflect updated standard condition language.
25. Monitoring, recordkeeping, and reporting alternatives	31	Not revised.
26. CEM requirements	32 and 33	Not revised.
27 & 28. Reporting requirements	55	Revised to reflect updated standard condition language.
29. Required copies of permit, regulations, and statutes	NA	No longer a standard condition.
30. Authorization for EUs 1, 15, & 16	20	Changed “source” to “EU”.
31. General compliance requirement	NA	Standard conditions require compliance with permit conditions. Title V permits will contain NSPS requirements.
32. Maintenance requirements	21	Removed reference to permit 9471-AA036.
33. Ambient air quality protection	22	Not revised.
34. Ambient air quality protection	23	The Department repealed 18 AAC 50.370, so Condition 34.2.1 is not included. Changed “source” to “EU”. Petro Star removed EU 2, so it is not included. Revised “fuel oil” to “diesel fuel” in 311CP03, Condition 34.3 to be consistent with fuel requirements in 311CP03, Conditions 37.2 and 38.2.
35. Prohibit the use of HAGO	24	Petro Star removed EU 2, so it is not included. Changed “source” to “EU”.
36. PSD avoidance limits for EU 1	25	Removed the reference to LAGO in Condition 36.3.3.2. Changed “source” to “EU”.
37. PSD avoidance limits for EUs 2 and 3	26	Petro Star removed EU 2, so it is not included. Added the allowed fuel use for EU 2 to EU 3. Changed “source” to “EU”.
38. PSD avoidance limits for EUs 4 and 16	27	Revised the fuel consumption limits to a limit of 500 hours of operation for each unit and changed “source” to “EU”.
39-44. NSPS requirements	NA	Title V permit will contain applicable NSPS requirements.

311CP03 Condition Number and Description	AQ0311MSS03 Condition Number	Description of revision
45-47. State standards under 18 AAC 50.055	28 through 30	Petro Star removed EU 2, so it is not included. Changed "source" to "EU". Updated the visible emission condition to reflect current standard condition language. Removed the requirement for monthly visible emission readings for EU 1 because Petro Star has already shown compliance with this requirement. Removed LAGO requirement in 311CP03, Condition 45.3.2 because EU 1 is required to have an SO_2 CEM. Revised "#1 fuel oil" to "diesel fuel" in 311CP03, Condition 45.3.2 to be consistent with fuel requirements in 311CP03, Conditions 37.2 and 38.2.
48. Air pollution prohibited	35	Updated to reflect current standard condition language.
Exhibit A	Section 9 Permit Documentation	Added 311CP03 TAR and the application for AQ0311MSS03 to the Permit Documentation.
Exhibit B	15 and Table 1	Petro Star removed EU 2, so it is not included. Petro Star never installed the incinerator (EU 5) or the tanks identified as EUs 11 and 12, so they are not included.

Table 4 – Comparison of 9471-AA036 to AQ0311MSS03

9471-AA036 Condition Number and Description	AQ0311MSS03 Condition Number	Description of revision
1. Ambient air quality standards	NA	Revised by 311CP03, Condition 34.
2. General compliance requirement	36	Updated to reflect current standard condition language.
3. Operation and maintenance	9	Not revised.
4 & 5. Hour limit for EU 4	NA	Revised by 311CP03, Condition 38.2.
6. Fuel meters for liquid fuel	12	Petro Star removed EU 2, so it is not included. Petro Star never installed the incinerator (EU 5), so it is not included. Changed "source" to "EU".
7-9. Fuel requirements for EUs 1 through 5	NA	Rescinded by 311CP03, Condition 9
10. 40 C.F.R. 60 Subpart Kb requirements	NA	Title V permits contain applicable NSPS requirements.
11-13. Tank throughput requirements	NA	Revised by 311CP03, Conditions 10 through 12
14. 40 C.F.R. 60 Subpart GGG requirements	NA	Title V permits contain applicable NSPS requirements.

9471-AA036 Condition Number and Description	AQ0311MSS03 Condition Number	Description of revision
15. One-time reporting requirement for standard air pollution prohibited requirement	NA	One-time requirement. However, Petro Star must continue to comply with the air pollution prohibited requirement, since it is a standard condition.
16. One-time NO_X emission test requirement for EU 1	NA	One-time requirement for a 1996 source test. However, Petro Star must comply with periodic source test requirements for EU 1.
17-22. Standard source test requirements	44 through 50	Not revised, or revised to reflect updated standard condition language.
23. CEM requirements for SO_2 for EU 1	10	Removed "within 60 days of receiving this permit", since Petro Star has already installed the CEM.
24. One-time SO_2 CEM certification requirement	NA	One-time requirement.
25. Sulfur content analysis for liquid fuel	NA	As required in 311CP03, Condition 46.5.1.
26. Fuel gas H_2S requirements for EU 1	NA	As required in 311CP03, Condition 46.5.2.
27. Liquid fuel nitrogen content requirements	NA	Rescinded by 311CP03, Conditions 7.1 and 7.2.
28 & 29. Reporting excess emissions	55	Revised to reflect updated standard condition language.
30. Access to the facility	41	Revised to reflect updated standard condition language.
31. Operating report requirements	56	Revised to reflect updated standard condition language.
32. Recordkeeping requirements	NA	As required in 311CP03, Condition 23.
33. Operation requirements	14	Not revised.
34. Permit display and regulation requirements	NA	No longer a standard condition.
Exhibit A	Table 1	Petro Star removed EU 2, so it is not included. Petro Star never installed the incinerator (EU 5) or the tanks identified as EUs 11 and 12, so they are not included.
Exhibit B, Operating limits	NA	Crude oil throughput limit revised by 311CP03, Condition 6.5. EU 1 limits rescinded by 311CP03, Condition 9. EU 4 hour limit already a requirement under 9471-AA036, Condition 4. Petro Star never installed the incinerator (EU 5), so it is not included.
Exhibit B, Opacity and particulate matter	NA	As required in 311CP03, Conditions 45.1 and 45.2.

9471-AA036 Condition Number and Description	AQ0311MSS03 Condition Number	Description of revision
Exhibit B, Sulfur Dioxide	NA	Revised by 311CP03, Condition 6.3.
Exhibit B, Nitrogen Oxides	NA	EU 1 emission limit revised by 311CP03, Condition 36.1. Nitrogen content requirements rescinded by 311CP03, Condition 9.
Exhibit B, Volatile Organic Compounds	NA	Revised by 311CP03, Conditions 10 through 12
Exhibit C, EU 1 SO_2 CEM	10	Not revised.
Exhibit C, EU 4 hour meter	NA	Already a requirement under 9471-AA036, Condition 5
Exhibit C, fuel gas H_2S monitoring	NA	Revised by 311CP03, Condition 46.5.2.
Exhibit C, fuel gas rate monitoring	11	Not revised.
Exhibit C, LAGO sulfur content monitoring requirements	NA	311CP03, Condition 9 rescinded fuel specific requirements. Fuel requirements established under 311CP03, Conditions 36, 37 and 38. EU 1 is allowed to fire on LSR, but is required to have SO_2 CEM.
Exhibit C, liquid fuel rate monitoring requirements	12	Not revised.
Exhibit C, liquid fuel nitrogen content monitoring requirements	NA	Rescinded by 311CP03, Condition 7.1.
Exhibit D, Reporting Requirement, hours of operation	NA	Hour limit for EU 4 is replaced with fuel limit in 311CP03, Condition 38.
Exhibit D, Reporting Requirement, storage tank throughput	13.1	Not revised.
Exhibit D, Reporting Requirement, fuel gas consumption	NA	311CP03, Condition 9 rescinded fuel specific requirements. Fuel requirements and MR&R established under 311CP03, Conditions 36, 37 and 38.
Exhibit D, Reporting Requirement, HAGO fuel consumption	NA	Rescinded by 311CP03, Condition 6.1.
Exhibit D, Reporting Requirement, LAGO and naphtha fuel consumption	NA	311CP03, Condition 9 rescinded fuel specific requirements. Fuel requirements and MR&R established under 311CP03, Conditions 36, 37 and 38.
Exhibit D, Reporting Requirement, fuel gas quality and liquid fuel nitrogen content	NA	Fuel gas requirements revised by 311CP03, Condition 47.2. Liquid fuel nitrogen content requirement rescinded by 311CP03, Condition 8.

9471-AA036 Condition Number and Description	AQ0311MSS03 Condition Number	Description of revision
Exhibit D, Reporting Requirement, liquid fuel sulfur content	NA	Petro Star removed EU 2 and never installed EU 5. EUs 3 and 4 were authorized to fire on diesel under 311CP03, Conditions 37.2 and 38.2.
Exhibit D, Reporting Requirement, fuel quality (sulfur dioxide)	13.2	Revised EU 1 SO_2 reporting to ppm, since the state standard is in ppm.
Exhibit D, Reporting Requirement, excess emission summary and authorized agent signature	NA	Updated standard conditions apply.
Exhibit E, Permit Application Documentation	Section 9 Permit Documentation	Added 311CP03 TAR and the application for AQ0311MSS03 to the Permit Documentation.

5. Permit Administration

The Department intends to incorporate the terms and conditions of AQ0311MSS03 into AQ0311TVP02 prior to issuing TVP02. Petro Star may operate under AQ0311MSS03 upon issuance.

Appendix A: Modeling Review Memorandum

MEMORANDUM

State of Alaska
Department of Environmental Conservation
Division of Air Quality

TO: File
DATE: February 3, 2014

THRU:
FILE NO: AQ0311MSS03

PHONE: (623) 271-9028
FAX:

FROM: Alan E. Schuler, PE
Engineer, DEC
Air Permits Program

SUBJECT: Review of Petro Star Valdez Refinery Ambient Assessment

INTRODUCTION

This memorandum summarizes the Department's findings regarding the nitrogen dioxide (NO_2) ambient analysis submitted by Petro Star Inc. (Petro Star) for the Petro Star Valdez Refinery (PSVR). Petro Star submitted this analysis in support of their November 6, 2013 minor permit application (AQ0311MSS03). Petro Star's analysis adequately demonstrates that operating the PSVR emissions units (EUs) within the restrictions listed in this memorandum will not cause or contribute to a violation of the annual average NO_2 Alaska Ambient Air Quality Standard (AAAQS) as provided in 18 AAC 50.010.

BACKGROUND

PSVR is an existing stationary source near Valdez, Alaska. PETRO STAR presently operates PSVR under Construction Permit 311CP03, Minor Permit AQ0311MSS01, and an application shield for Operating Permit AQ0311TVP02. Due to material mistakes in the permit application for Minor Permit AQ0311MSS01, the Department is revoking Minor Permit AQ0311MSS01 and reissuing the decision as Minor Permit AQ0311MSS03.[1] The material mistakes regarded inaccurate equipment rating, which lead to incorrect emission estimates. The mistakes are detailed in the Technical Analysis Report (TAR) for Minor Permit AQ0311MSS03.

Minor permit AQ0311MSS01 was classified under **18 AAC 50.502(c)(3)** for oxides of nitrogen (NOx). Per 18 AAC 50.540(c)(2)(A), applicants must provide an ambient AAAQS analysis for each triggered pollutant. Petro Star fulfilled this requirement by submitting an annual average NO_2 demonstration. The demonstration was reviewed on behalf of the Department by MACTEC. MACTEC's findings are described in the April 20, 2009 memorandum, *Review of Impact Assessment for Petro Star Valdez Refinery Ultra Low Sulfur Diesel Project Minor Source Air Quality Permit Application*.

[1] Permit applications are numbered sequentially for each stationary sources. Petro Star submitted and then withdrew a permit application for what would have been Minor Permit AQ0311MSS02.

The Department stated in a May 13, 2013 letter to Petro Star that they would need to update their annual average NO_2 demonstration in order for the Department to reissue a minor permit. The letter further stated that Petro Star needed to submit a modeling protocol, and use current modeling techniques and their current emissions unit (EU) inventory in the updated demonstration.

Modeling Protocol Submittal

Petro Star's consultant, CH2M Hill, submitted the protocol on June 19, 2013. CH2M Hill provided supplemental information and revisions in respond to Department questions on August 1, 19 and 28, 2013 and on October 8, 2013. The Department approved the protocol, with comment, on October 10, 2013.

Approach

Petro Star modeled two scenarios. The first scenario represents the maximum operating conditions. The second scenario represents the "turndown" phase where operations are at only 50-percent of the normal operating conditions. They also compared the project impacts to the significant impact level (SIL), as well as determine the total (cumulative) impact. Since the project impacts from both scenarios exceed the SIL, the Department will only present the cumulative impacts in the Results section of this memorandum.

Project Classification

Petro Star's minor permit application continues to be classified under **18 AAC 50.502(c)(3)** for NOx. The application is also classified under **18 AAC 50.508(6)** due to Petro Star's request to revise owner requested limits (ORLs) in Construction Permit 311CP03. However, none of the ORLs have an underlying ambient demonstration, so the request does not trigger additional ambient assessments under 18 AAC 50.540(k)(3).

SOURCE IMPACT ANALYSIS

Petro Star continued to use computer analysis (modeling) and local background data to estimate the total annual average NO_2 concentration. The Department's findings regarding Petro Star's demonstration are provided below.

Model Selection

There are a number of air dispersion models available to applicants and regulators. The U.S. Environmental Protection Agency (EPA) lists these models in their *Guideline on Air Quality Models* (Guideline), which the Department has adopted by reference in 18 AAC 50.040(f). Petro Star used EPA's AERMOD Modeling System (AERMOD) for their ambient analysis. AERMOD is an appropriate modeling system for this application.

The AERMOD Modeling System consists of three major components: AERMAP, used to process terrain data and develop elevations for the receptor grid and EUs; AERMET, used to process the meteorological data; and the AERMOD dispersion model, used to estimate the ambient pollutant concentrations.

Petro Star used AERMAP version 11103; AERMET version 12345; and AERMOD version 12345. These were the current versions at the time Petro Star submitted their modeling analysis.

EPA has subsequently released updated versions of AERMET and AERMOD (version 13350). The Department general does not make applicants update their permit applications if there is a subsequent model change. Nevertheless, the Department evaluated the potential effects of the changes and found them to be mostly innocuous for this project. The one possible exception regards a "bug" fix that may lead to lower results. Therefore, Petro Star's use of AERMET and AERMOD version 12345 is acceptable.

Meteorological Data

AERMOD requires hourly meteorological data to estimate plume dispersion. According to the Guideline, a *minimum* of one-year of site-specific data, or five years of representative National Weather Service (NWS) data should be used. When modeling with site-specific data, the Guideline states that up to five additional years should be used, when available, to account for year-to-year variation in meteorological conditions.

Petro Star used one-year of surface meteorological data from the Alyeska Pipeline Service Company (APSC) Valdez Marine Terminal (VMT) Jackson Point monitoring station. APSC's consultant, TRC Companies, Inc. (TRC), processed the data for this project and provided the AERMOD-ready meteorological data files to Petro Star. TRC used concurrent cloud cover observations from the National Weather Service (NWS) airport station in Valdez, along with concurrent NWS upper air data from Anchorage.

The Jackson Point station is located 3.8 kilometers (km) west of PSVR. The data represent the meteorological transport conditions of the PSVR air emissions and therefore, the Department considers the data to be "site-specific" for air quality modeling purposes.

APSC collected the data from a 30-meter (m) tower between October 1, 2004 and September 30, 2005. APSC measured horizontal wind speed and direction, vertical wind speed, and temperature at both the 10m and 30m levels. They also measured total solar radiation, net solar radiation, relative humidity, precipitation and barometric pressure. APSC calculated and recorded the difference in temperature measures (30m minus 10m), along with the standard deviation of various wind measurements.

TRC used most of the measured and calculated Jackson Point parameters in developing the meteorological data files needed by AERMOD. However, at the Department's request, they did not use the 30m-to-10m temperature difference (aka "delta-T") data. Current EPA guidance recommends the use of temperature data from the 2m and 10m levels for determining atmospheric stability in an AERMOD analysis. While AERMET will accept additional delta-T readings from non-standard levels, the use of just delta-T readings from larger distances between the sensors may lead to fictitious neutral stability determinations. The Department was not aware of the need for obtaining 2m temperature data when APSC originally collected the data. To resolve this concern, TRC used Valdez airport cloud cover data instead of the delta-T data. Their approach is described in Petro Star's August 1, 2013 modeling protocol supplement. TRC's approach is reasonable and appropriate. Petro Star provided the TRC AERMET input and output files as part of their permit application.

Quality Assurance Review

Site-specific meteorological data must meet the Prevention of Significant Deterioration (PSD) quality assurance requirements outlined in EPA's *Meteorological Monitoring Guidance for Regulatory Modeling Applications*, per 18 AAC 50.215(a)(3). APSC previously submitted the data for Department review. The Department's contractor, MACTEC Federal Programs, Inc. (MACTEC), reviewed the data on behalf of the Department. MACTEC found that most of the data meet the PSD quality assurance requirements, although the standard deviation of horizontal wind speed (10m and 30m) do not due to inadequate data capture. The Department accepted MACTEC's findings and reported their results to APSC on March 2, 2009.

Surface Characteristics

AERMET requires the area surrounding the meteorological tower to be characterized with regard to the following three surface characteristics: noon-time albedo, Bowen ratio, and surface roughness length. EPA has provided additional guidance regarding the selection and processing of values for these surface characteristics in their *AERMOD Implementation Guide*.

TRC used the approach and values described in Petro Star's August 28th modeling protocol clarification and elaborated on in Section 5.2.1 of the application. The approved values are reiterated below in Table 1.

Table 1 – Approved AERMET Surface Parameters for Jackson Point

Surface Parameter		Winter	Spring	Summer	Fall
Albedo		0.291	0.138	0.138	0.138
Bowen Ratio		0.374	0.249	0.239	0.267
Surface Roughness Length (m)					
Sector	Range				
1	260º - 110º	0.005	0.006	0.006	0.005
2	110º - 260º	0.412	0.513	0.525	0.412

Table Notes: season are defined as follows: spring, April and May; summer, June through August; fall, September through October; winter, November through March.

Coordinate System

Air quality models need to know the relative location of the EUs, structures and receptors in order to properly estimate ambient pollutant concentrations. Therefore, applicants must use a consistent coordinate system in their analysis. Petro Star used the Universal Transverse Mercator (UTM) system.

Terrain

Terrain features can influence plume dispersion and the resulting ambient concentration. Digitized terrain elevation data is therefore generally included in a modeling analysis, unless the entire modeling domain is over water or the terrain features are so slight that a "flat terrain" assumption can be made. AERMOD's terrain preprocessor, AERMAP, utilizes digital terrain data to obtain the elevation for EUs, building bases, and receptors.

Petro Star used National Elevation Dataset (NED) files for their analysis. NED is the most current terrain elevation dataset provided by the United States Geological Survey.

EU Inventory

Petro Star included all of their full-burning EUs in their modeling analysis, except for the control building boilers (EU25A and EU25B). At a rated capacity of only 0.2 million British Thermal Units per hour (MMBtu/hr) each, the Department informed Petro Star that these units could be better represented through the background data than through an explicit modeling analysis.

Petro Star used the correct equipment ratings in their updated modeling analysis. The modeled EUs and equipment rating are listed in Table 2.[2] The exhaust stack for EU 1 (Crude Heater) includes the exhaust emissions from the Copper Valley Electric Association (CVEA) cogeneration plant (see Offsite Impact discussion).

[2] The permit application lists two different ratings for the EU28 emergency generator: 750 kW and 851 kW. 750 kW is the electrical rating of the generator. 851 kW is the output rating of the engine.

Table 2 – Modeled EUs

EU	Model ID	Description	Installed Rating
EU1	CRUDE	Crude Heater	153 MMBtu/hr
CVEA		Cogeneration Plant Turbine	5 MW
EU3	400HP	Utility Boiler	400 hp
EU4	EGEN	Emergency Generator	500 kW
EU16	DIESEL	Firewater Pump Engine	460 hp
EU18	DTHEAT	DHT Reactor Heater	28.0 MMBtu/hr
EU19	DHTBOIL	DHT Splitter Reboiler	31.2 MMBtu/hr
EU20	H2HEAT	Hydrogen Heater	31.0 MMBtu/hr
EU21	FLARE	Flare	7.84 MMscf/yr
EU26A & B	EU26	Administrative Building Boilers	1.19 MMBtu/hr (ea)
EU27	EU27	Emergency Glycol Heater	5.5 MMBtu/hr
EU28	EU28	Emergency Generator	750 kW

EU Release Parameters

The assumed emission rates and characterization of how the emissions enter the atmosphere will significantly influence the modeled results. The Department therefore reviews these parameters very carefully.

Emission Rates

Petro Star used the installed capacity and the corrected emission factors to estimate the NOx emission rates. They also used the operational restrictions listed in Table 3. Petro Star assumed all other EUs operate continuously throughout the year.

Table 3 – Assumed Operating Limits

EU	Description	Operating Restriction
EU3	Utility Boiler	221,000 gal/yr
EU4	Emergency Generator	500 hrs/yr
EU16	Firewater Pump Engine	500 hrs/yr
EU27	Emergency Glycol Heater	2,000 hrs/yr
EU28	Emergency Generator	500 hrs/yr

The Department determined that the assumed operating restrictions are not needed to protect the annual average NO_2 AAAQS. The most restrictive restriction is the 500 hour per year assumption. The modeled impacts are so far below the AAAQS though, that PSVR could have demonstrated compliance even if the modeled impact is increased by the ratio of continuous operation to this restriction (i.e., 8,760 hours per year divided by 500 hours per year). In this case, the maximum impact (including background), would be 82.9 micrograms per cubic meter ($\mu g/m^3$), which is still less than the 100 $\mu g/m^3$ AAAQS.

Point Source Parameters

Petro Star used the updated the stack diameters, exhaust flow rates (exit velocities), and exhaust temperatures described in their approved modeling protocol. All stack heights remained as previously modeled.

Horizontal/Capped Stacks

The presence of non-vertical stacks or stacks with rain caps requires special handling in an AERMOD analysis. The proper approach for characterizing these types of stacks is described in EPA's *AERMOD Implementation Guide*. When specifying the model parameters for non-vertical or capped stacks that are subject to building downwash, a user should input the actual stack diameter and exit temperature, but set the exit velocity to a nominally low value i.e. 0.001 meters-per-second (m/s). If the non-vertical or capped stack is not subject to downwash, then the 0.001 m/s exit velocity should be used along with a surrogate diameter that allows the actual exhaust flow rate to be maintained. Minor adjustments to the stack height may also be warranted.

EPA has developed a non-default option in AERMOD that will revise the stack characteristics as warranted, for stacks that are identified as horizontal or capped. EPA Region 10 granted the Department permission to generally use this option in October 2007.[3]

Petro Star stated the firewater pump engine (EU16), the administrative building boilers (EU26A and EU26B), and the emergency glycol heater (EU27) have rain caps. They also used the non-default option in AERMOD to characterize the capped stacks. While not modeled, Petro Star further noted that the control building boilers (EU 25A and EU25B) have horizontal stacks. All of the other EUs have uncapped, vertical releases. Because the modeled impacts from horizontal or capped stacks are typically greater than the impacts from stacks with vertical, uncapped discharges, the Department is including a permit condition that requires vertical, uncapped stacks, except for the EUs listed above.

Ambient NO_2 Modeling

The modeling of ambient NO_2 concentrations can sometimes be refined through the use of ambient air data or assumptions. Section 5.2.4 of the Guideline describes several approaches that may be considered in modeling the annual average NO_2 impacts. Petro Star used the national default ambient NO_2-to-NOx ratio of 0.75, as provided in the Guideline, to improve the estimated annual average NO_2 concentrations. Petro Star's approach is reasonable.

[3] E-mail from Herman Wong (EPA Region 10) to Alan Schuler (Department), *RE: Capped/Horizontal Stack Issue*, dated October 2, 2007.

Downwash

Downwash refers to conditions where nearby structures influence plume dispersion. Downwash can occur when a stack height is less than a height derived by a procedure called "Good Engineering Practice," which is defined in 18 AAC 50.990(42). The modeling of downwash-related impacts requires the inclusion of dimensions from nearby buildings.

EPA has established specific algorithms for determining which buildings must be included in the analysis and for determining the profile dimensions that would influence the exhaust plume from a given stack. EPA has incorporated these algorithms into the "Building Profile Input Program" (BPIP) computer program. Petro Star used EPA's PRIME version of BPIP (BPIPPRM, version 04274) to determine the building profiles needed by AERMOD. This is an appropriate version of BPIP.

Ambient Air Boundary

For the purposes of air quality modeling, *ambient air* means outside air to which the public has access. Ambient air typically excludes that portion of the atmosphere within a stationary source's boundary. Petro Star used the PSVR fence line as the ambient air boundary. This is an appropriate boundary.

CVEA operates a turbine generating facility within the PSVR property boundary. The ambient air aspects of this situation is discussed in a June 2007 EPA memorandum as follows:[4]

> *When two (or more) companies operate separate sources on property owned by one company and leased in part to the other, and the lessor retains control over public access to the entire property and actually maintains a physical barrier around it to preclude public access:*
> - *The air over the entire property (including the leased portion) is not ambient air to the lessor.*

Petro Star controls the PSVR property and has a fence around the entire property to prevent public access. Therefore, the CVEA facility is not ambient air for purposes of Petro Star's ambient demonstration.

[4] EPA Memorandum: *Interpretation of "Ambient Air" In Situations Involving Leased Land Under the Regulations for Prevention of Significant Deterioration (PSD)*; June 22, 2007.

Receptor Grid

Petro Star used the following receptor resolution in their maximum operating and turn-down scenarios:

- 25-meters (m) along the ambient boundary;
- 25-m from the ambient boundary to a distance of 500 m;
- 50-m from 100 m to 500 m;
- 100-m from 500 m to 1,000 m;
- 500-m from 1,000 m to 5,000 m.

The maximum impacts occur west of PSVR. The largest impact from the maximum operating scenario occurs at the outer edge of the 100-m grid – i.e., 1 kilometer (km) from the fence-line. Petro Star therefore conducted a second run using a 100-m grid centered on this maximum impact location. This lead to a slightly increased concentration located 1.2 km west of the fence-line. The largest impact from the turn down scenario occurs along the fence-line. In both cases, Petro Star's grid has sufficient resolution and coverage to determine the maximum impacts.

Off-Site Impacts

The impact from neighboring (off-site) sources must be accounted for in a cumulative impact assessment. In accordance with Section 8.2.3 of the Guideline, "*…all sources expected to cause a significant concentration gradient in the vicinity of the [applicant's source] should be explicitly modeled.*" The impact from other sources can be accounted for through ambient monitoring data.

The off-site inventory and background concentration must be evaluated on a case-specific basis for each of the modeled pollutants. The data used to represent the background concentration must represent the non-modeled sources such as natural, area and long-range transport. Once the background concentration is determined, it is added to the modeled concentration to estimate the total ambient concentration.

Petro Star included the CVEA turbine emissions, which are exhausted in the Crude Heater (EU1) stack, in their modeling analysis. There are no off-site stationary sources that would cause a significant concentration gradient within the PSVR vicinity. Petro Star instead used the most recent ambient monitoring data from VMT to represent the impact from VMT and other background sources. APSC collected the ambient data between October 2004 and September 2005. The Department determined that the pollutant data is PSD-quality on March 3, 2009. The annual average NO_2 concentration was 6.3 $\mu g/m^3$.

RESULTS AND DISCUSSION

The maximum modeled annual average NO_2 impact from each scenario is presented in Table 4. As previously discussed, the results are pro-rated to reflect unrestricted operation. The background concentration, total impact, and ambient standard are also presented for comparison. The total modeled impacts are less than the AAAQS. Therefore, Petro Star has demonstrated compliance with the annual average NO_2 AAAQS.

Table 4 – Maximum Annual Average NO_2 Impacts

Scenario	Max. Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	Ambient Standard ($\mu g/m^3$)
Max Operating	82.9	6.3	**89.2**	100
Turndown	74.8		**81.1**	

CONCLUSION

The Department reviewed Petro Star's PSVR modeling analysis and concluded the following:

1. The NOx emissions associated with operating the proposed EUs will not cause or contribute to a violation of the annual average NO_2 AAAQS listed in 18 AAC 50.010.
2. Petro Star's modeling analysis fully complies with the showing requirements of 18 AAC 50.540(c)(2).
3. Petro Star conducted their modeling analysis in a manner consistent with the Guideline, as required under 18 AAC 50.215(b)(1).

The Department determined that Minor Permit AQ0311MSS03 only needs a single ambient air condition to ensure Petro Star complies with the annual average NO_2 AAAQS. The condition is:

> Maintain vertical, uncapped exhaust stacks for all EUs, except for EU16, EU25A, EU25B, EU26A, EU 26B and EU27. For purposes of this condition, flapper valve rain covers, or other similar designs, that do not hinder the vertical momentum of the exhaust plumes shall not be considered as a rain cap.