Exhibit 12

EPA Region 10, Technical Support Document, Review of
Shell's Ambient Air Quality Impact Analysis for the Kulluk OCS Permit
Application, Permit No. R10OCS030000 (July 18, 2011)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
SEATTLE, WASHINGTON

TECHNICAL SUPPORT DOCUMENT
REVIEW OF SHELL'S
AMBIENT AIR QUALITY IMPACT ANALYSIS
FOR THE KULLUK OCS PERMIT APPLICATION
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A. Introduction

This Technical Support Document (TSD) provides the U.S. EPA Region 10's (Region 10's) findings regarding the ambient air quality analysis submitted by Shell Offshore Incorporated (Shell) for the Shell Beaufort Sea Alaska Exploratory Drilling Program using the Kulluk Conical Drilling Unit (Kulluk). Shell submitted this analysis in support of their February 28, 2011 Outer Continental Shelf Permit Application, as revised on May 4, 2011 (Martin 05/04/11), June 22, 2011 (Winges 06/22/11), and July 13, 2011 (Rudy 07/13/11). For the reasons described below, Shell's analysis adequately shows that operating the Kulluk and associated support vessels within the requested constraints will not cause or contribute to violations of the National Ambient Air Quality Standards (NAAQS).

B. Background

Shell is planning to use the Kulluk to conduct exploratory drilling within select lease blocks on the Outer Continental Shelf (OCS) in the Beaufort Sea. Drilling would occur for up to 120 days during each July through November drilling season. The drilling season will likely include both open water and broken ice conditions. The locations and Shell's plan of operation are fully described in Region 10's Statement of Basis (SOB) accompanying the draft permit.

C. Regulatory Overview

The application requirements are fully described in the SOB. In summary, Shell's proposal is subject to the air quality permitting requirements under the OCS provisions of Title 40, Code of Federal Regulations (CFR), Part 55. Under these regulations, the applicable requirements depend on the source's relative location to shore. OCS sources located within 25 miles of a State's seaward boundary are subject to the Federal, and to the State and local requirements of the Corresponding Onshore Area (COA) which have been incorporated into EPA's OCS regulations at 40 CFR Part 55 (Part 55). OCS sources located beyond 25 miles of a State's seaward boundary are subject to only Federal requirements – i.e., COA requirements do not apply. In Shell's case, the State of Alaska is the designated COA and the air quality permitting requirements of the Alaska Department of Environmental Conservation (ADEC) which have been incorporated into 40 CFR Part 55 apply. See 40 CFR § 55.15, Appendix A.

Shell requested that Region 10 impose emission limits to avoid the Prevention of Significant Deterioration (PSD) construction permit requirements for operation on lease blocks that are both within and beyond 25 miles of Alaska's seaward boundary. For operations within 25 miles of Alaska's seaward boundary, Shell submitted a minor permit application pursuant to the COA's minor permit program in Title 18 of the Alaska Administrative Code (AAC), Chapter 50. For operations beyond 25 miles of Alaska's seaward boundary, Shell submitted a Title V operating permit application under 40 CFR Part 71 (Part 71). Shell is also requesting that Region 10 issue a Title V operating permit under the COA regulations for continued operation within 25 miles of the seaward boundary. The ambient demonstration obligations for these various classifications are summarized below in Table 1 and are described in more detail in the following subsections.

with the COARE dataset. Diagnosed mixing heights using the Richardson number along with imposed restrictions on mixing heights were also reviewed by Region 10 and found to be representative for use in the Kulluk analysis.

E.2 Meteorological Pre-Processing

The meteorological data must be processed into a format that AERMOD recognizes. As previously discussed, Shell used two different meteorological pre-processors: one to process the meteorological data during broken ice conditions (AERMET), and the other to process the meteorological data during open water conditions (COARE). Shell defined the open water period as the time a buoy could be deployed (August 5 – October 13, 2009; and August 14 – October 10, 2010).[5]

E.2.1 COARE

As previously noted, COARE is a non-Guideline model. Use of this model therefore requires Regional Office approval. It is also subject to public comment. The Regional Modeling Contact for Region 10 approved Shell's use of COARE for the Kulluk analysis on May 8, 2011 (EPA 05/08/11). The public will also be invited to comment on the use of COARE in the public notice which will accompany the draft permit.

E.2.2 AERMET

Shell used the current version of AERMET (06341) at the time of the February 28, 2011 submittal. EPA has subsequently released a newer version (11059), but this release does not alter the validity of Shell's submittal.[6]

AERMET requires the area surrounding the meteorological tower be characterized in regards to the following three surface characteristics: noon-time albedo, Bowen ratio, and surface roughness length (EPA 11/04 AERMET). Additional guidance regarding the selection and processing of these values may be found in the *AERMOD Implementation Guide* (EPA 03/19/09).

Shell assumed the noon-time albedo is 0.8, the Bowen ratio is 2.0 and the surface roughness length is 0.001. These values are identical to the values previously approved by ADEC for winter conditions (i.e., ice conditions) on the Beaufort Sea (ADEC 2007).

F. Background Air Quality Data

Background monitoring data is used in conjunction with modeled predictions to determine if the combined impact complies with the NAAQS. The data should represent impacts from sources not specifically modeled; such as natural, area-wide, long-range transport and distant stationary sources.

[5] Once deployed, Shell left the buoys in the Beaufort Sea until they were destroyed by the pack-ice.

[6] The primary reason for EPA's recent release of a new version of AERMET is to provide applicants the ability to derive wind information from 1-minute, rather than hourly, NWS data. The use of 1-minute NWS data is not required, though, and this additional algorithm is non-applicable when using site-specific meteorological data.

Because there are no islands, platforms, or infrastructure in the Beaufort Sea in the vicinity of Shell's offshore operations on which to install, operate, and maintain ambient air quality monitoring equipment, it is appropriate to use onshore preconstruction monitoring data as a conservative representation of background concentrations in the vicinity of Shell's operations. The onshore data is expected to be conservative because these onshore monitoring stations will be influenced by local sources that are not present in the vicinity of Shell's offshore operations.

Shell used ambient data collected at a number of on-shore monitoring stations for their background concentrations. They originally used the 2009 monitoring data that they collected near Badami for the background NO_2 and PM-2.5 concentrations. They later switched to data collected from the greater Prudhoe Bay area to better account for possible impacts from existing sources. The location of each background data set proposed by Shell is summarized below in Table 8.

Table 8: Location of Background Data Used by Shell

Air Pollutant	Data Location	Data Period
NO_2	Prudhoe Bay A Pad	2006, 2007, 2009
PM-2.5	Deadhorse	July 2010 – Nov 2010
PM-10	Prudhoe Bay CCP [a]	2006, 2007
SO_2	Endicott SDI [b]	July 2007 – Nov 2007 for short-term averages, Feb 2007 – Jan 2008 for annual average
CO	Endicott SDI [b]	Endicott (July 2007 – Nov 2007

[a] Shell identified the PM-10 data as "BPX Prudhoe Bay area." BPXA operates two ambient air monitoring stations within Prudhoe Bay. However, BPXA only collects PM-10 data at the "Central Compressor Plant" (CCP) site.

[b] Shell identified the SO_2 and CO data as "BPXA Liberty." This title actually refers to a project. BPXA collected the "Liberty" data set at the Endicott Satellite Development Island (SDI).

Region 10 considered the datasets presented by Shell and then conducted an independent evaluation of the available monitoring data to determine which datasets Region 10 believes are most representative of background values. Region 10 made this determination for both the offshore locations near the Shell lease blocks, as well as at the onshore communities where the air quality impact from the Kulluk and associated fleet is being evaluated. Region 10's findings are described in a June 23, 2011 memorandum, "EPA Region 10 Determination of Appropriate Background Values for the Chukchi Sea and Beaufort Sea OCS Permits." Table 9 summarizes the monitoring sites and the background values that Region 10 believes best represent offshore locations in the Beaufort Sea.[7] Each of the data sets used for the Kulluk offshore locations are discussed in more detail below.

[7] Table 6 of Region 10's June 23, 2011 memorandum incorrectly highlighted the CCP value for the annual average NO_2 concentration at offshore locations (19 $\mu g/m^3$). Region 10 intended to highlight the A Pad value (11 $\mu g/m^3$). While Shell can demonstrate compliance with the annual average NO_2 NAAQS using either value, Region 10 considers the CCP value to be an overly conservative estimate of the expected background concentration at the offshore lease blocks. Region 10 therefore used the A Pad value in this TSD.

Table 9: Background Values for Use with Modeled Impacts at Offshore Locations

Air Pollutant	Averaging Period	Concentration ($\mu g/m^3$)	Data Source
NO_2	1-hour	Varies by hour	A Pad
	Annual	11	
PM-2.5	24-hour	17	Deadhorse
	Annual	4	
PM-10	24-hour	53	CCP
SO_2	1-hour	29	CCP
	3-hour	29	
	24-hour	22	
	Annual	4	
CO	1-hour	1,742	SDI
	8-hour	1,094	

Table 10 summarizes the monitoring sites and background values that Region 10 believes are appropriate for evaluating impacts in the Kaktovik and Nuiqsut onshore communities. Region 10 used the offshore values presented in Table 9 to represent the background concentrations in Deadhorse.

Table 10: Background Values for Use with Modeled Impacts at Onshore Locations

Air Pollutant	Averaging Period	Katkovik		Nuiqsut	
		Concentration ($\mu g/m^3$)	Data Source	Concentration ($\mu g/m^3$)	Data Source
NO_2	1-hour	21	Badami	94	A Pad
	Annual	1		11	
PM-2.5	24-hour	6	Badami	17	DeadHorse
	Annual	3		4	
PM-10	24-hour	53	CCP	53	CCP
SO_2	1-hour	10	SDI	14	A Pad
	3-hour	11		180	
	24-hour	4		25	
	Annual	2		4	
CO	1-hour	1,742	SDI	1,742	SDI
	8-hour	1,094		1,094	

While ambient data is currently being collected in Nuiqsut, Region 10 instead used ambient data from Prudhoe Bay to represent the background values in Nuiqsut. Region 10 took this approach since the Nuiqsut data has not been submitted to Region 10 for review. The Prudhoe Bay data should also provide a more conservative estimate of the background values due to the close proximity of these monitoring stations to the oil and gas sources in Prudhoe Bay. Where available, Region 10 has used data from sites west of Prudhoe Bay for Nuiqsut and sites to the

east of Prudhoe Bay for Katktovik, with a preference for more recent data if more than one site has data for the same pollutant. As discussed above, the only reviewed PM-10 data is from the CCP site and so that data set was used for both Nuiqsut and Kaktovik. From the available data, Region 10 calculated background values following the provisions of the applicable appendices to 40 CFR Part 50 and EPA modeling guidance.

F.1 A Pad NO_2 Data

As previously noted, Shell switched from Badami data to Prudhoe Bay A Pad data to represent the NO_2 background concentrations at their offshore locations. As discussed in Section D.11, Region 10 agrees that this switch better accounts for the possible impacts from on-shore sources.

There are three years of recent PSD-quality NO_2 data available from A Pad (2006, 2007 and 2009). The 2008 NO_2 data is not PSD-quality, and therefore, should not be used for regulatory purposes (Enviroplan 2010a). The NO_2 data from the other years was reviewed by ADEC, who found them to be PSD-quality (ADEC 2008, ADEC 2009, Enviroplan 2010b). Shell used the maximum annual average NO_2 concentration between the three years of available data to represent the annual average NO_2 background concentration. The use of the maximum concentration is appropriate.

The 1-hour NO_2 NAAQS is based on an annual distribution of the daily maximum 1-hour value. Due to the probabilistic nature of this standard, applicants may use the monitored design value to represent the background concentration, rather than the maximum measured concentration (EPA 03/01/11). They may also use hourly values that represent the seasonal diurnal pattern of the ambient concentrations. In this case, applicants may add the multi-year average of the 98^{th} percentile of the available background concentrations by season and hour-of-day to the modeled concentration. In rare cases, the use of additional refinements, such as combining the background and modeled concentrations on an hour-by-hour basis may be warranted.

Shell originally paired the hourly background concentration and hourly modeled concentration on an hour-by-hour and day-by-day basis. Region 10 felt this approach was not adequately robust for purposes of this ambient demonstration, and instead asked Shell to use hourly background concentrations that reflect the diurnal profile of the NO_2 concentrations measured during the July through November drilling season.

Shell calculated a diurnal NO_2 profile based on a three-year average of the NO_2 concentrations measured in 2006, 2007 and 2009. They then combined the modeled concentrations with the background concentration on an hour-of-day basis to determine the total impact. The 98^{th} percentile of the maximum daily 1-hour total impact was then compared to the 1-hour NO_2 NAAQS.

F.2 CCP PM-10 and SO_2 Data

As with the NO_2 data, PM-10 and SO_2 data from the Prudhoe Bay area is warranted in order to best represent the possible impact from onshore sources at the offshore locations. The only PM-10 data set within Prudhoe is from the CCP. This is a conservative data set due to its close proximity (on the order of 100 meters) to two large Prudhoe Bay stationary sources: the Central Power Plant and Central Gas Facility.

G. Results and Discussion

The maximum modeled NO_2, SO_2, PM-10, PM-2.5, and CO impacts, background concentrations, total impacts, and NAAQS are summarized below in Table 11. All of the total impacts are less than the NAAQS. The modeling results show that the emissions associated with the proposed permit are not expected to cause or contribute to a violation of the NAAQS. The maximum 8-hour NH_3 impact is 6.6 µg/m^3 which is well below the State of Alaska air quality standard of 2,100 µg/m^3.

Table 11: Modeled Impacts at the Location of Maximum Impact

Air Pollutant	Averaging Period	Shell Only Impacts (without background) (µg/m^3)	Background Concentration (µg/m^3)	Total Impact Including Background (µg/m^3)	NAAQS (µg/m^3)	Total Impact as a % of NAAQS
NO_2	1-hour	110.6	40.9	**151.5**	188	81%
	Annual	4.4	11	**15.4**	100	15%
PM-2.5	24-hour	17.0	17	**34.0**	35	97%
	Annual	1.0	4	**5.0**	15	33%
PM-10	24-hour	20.8	53	**73.8**	150	49%
SO_2	1-hour	14.0	29	**43.0**	196	22%
	3-hour	8.9	29	**37.9**	1,300	3%
	24-hour	2.8	22	**24.8**	365	7%
	Annual	0.2	4	**4.2**	80	5%
CO	1-hour	1,268	1,742	**3,010**	40,000	8%
	8-hour	712	1,094	**1,806**	10,000	18%

H. Ozone

This section provides additional information regarding ozone and why Region 10 believes it is appropriate not to require a quantitative assessment that includes modeling for this pollutant. Ozone is inherently a regional pollutant, the result of chemical reactions between emissions from many sources over a period of hours or days, and over a large area. Ozone is formed in the atmosphere through a chemical reaction that includes NOx, VOC, and CO in the presence of sunlight. The sources of these air pollutants are mainly combustion sources such as power plants, refineries, and automobiles.

EPA does not have a recommended modeling approach for assessing the impact of an individual source on ozone. Individual source impacts are generally within the range of "noise" of regional ozone models (i.e., imprecision in predicted concentration due to uncertainty in model inputs for emissions, chemistry, and meteorology). Section 5.2.1(a) of Appendix W reflects this understanding: "Simulation of ozone formation and transport is a highly complex and resource intensive exercise." Paragraph (c) states: "Choice of methods used to assess the impact of an individual source depends on the nature of the source and its emissions. Thus, model users

Table 12: Maximum Modeled Impacts at Nearest Communities (from Kulluk operations, excluding background concentrations)

Air Pollutant	Averaging Period	Kulluk Impacts (µg/m^3) at			SIL (µg/m^3)
		Nuiqsut	Deadhorse	Kaktovik	
NO_2	1-hour	0.04	0.02	0.3	**8**
	Annual	0.03	0.02	0.1	**1**
PM-2.5	24-hour	0.2	0.1	0.5	**1.2**
	Annual	0.004	0.004	0.01	**0.3**
PM-10	24-hour	0.3	0.2	0.5	**5**
SO_2	1-hour	0.4	0.5	0.7	**8**
	3-hour	0.2	0.2	0.3	**25**
	24-hour	0.05	0.03	0.1	**5**
	Annual	0.001	0.001	0.002	**1**
CO	1-hour	201	182	333	**2,000**
	8-hour	117	105	180	**500**

Table 13: Total Impacts at Nearest Communities (from Kulluk operations and including background concentrations)

Air Pollutant	Averaging Period	Total Impacts (µg/m^3) at			NAAQS (µg/m^3)
		Nuiqsut	Deadhorse	Kaktovik	
NO_2	1-hour	94	94	21	**188**
	Annual	11	11	1	**100**
PM-2.5	24-hour	17	17	7	**35**
	Annual	4	4	3	**15**
PM-10	24-hour	53	53	53	**150**
SO_2	1-hour	14	29	10	**196**
	3-hour	180	29	11	**1,300**
	24-hour	25	22	4	**365**
	Annual	4	4	2	**80**
CO	1-hour	1,943	1,924	2,075	**40,000**
	8-hour	1,211	1,199	1,274	**10,000**

J. Conclusions

Region 10 has reviewed and determined that the materials, air quality data, meteorological measurements, and model input and output files submitted by Shell satisfy the requirements in Appendix W to make adequate demonstration of compliance with the NAAQS. The AERMOD and AERMOD-COARE modeling predicted concentrations with representative background concentrations do not show a violation of any NAAQS. Shell has used the worst case emissions and has used worst case vessel emissions when more than one candidate vessel is available.

Movement of the drilling ship will decrease short-term impacts of all pollutants, especially in the near field where high modeled concentrations occur, if averaging were performed over multiple years. The assumption of a fixed drilling location for the entire 120 day OCS period produces a conservative analysis (i.e., the predicted modeled impacts are larger than what would likely be realized with a moving ship with averaging over a longer period of time).

Finally, modeled impacts generally decrease as the distance from the 500 meter assumed ambient air boundary increases, and on average there is a rapid decrease in concentrations as the distance from the Kulluk increases. Modeled impacts at all on-shore locations are well below the NAAQS.