Draft

Pending approval

U.S. Department of the Interior
Bureau of Ocean Energy Management
OMB Control No. 1010-0151
OMB Approval Expires: xx/xx/xxxx

GULF OF MEXICO AND ALASKA OCS REGIONS
AIR EMISSIONS CALCULATIONS INSTRUCTIONS FOR DOCDs
and PRA Statement

General

This document and the accompanying workbook were prepared by the Bureau of Ocean Energy Management (BOEM) to estimate potential air emissions for Development Operations Coordination Documents (DOCDs)[1] activities using emissions factors and activity throughput methodology. This document has been revised throughout the years to update emission factors and to estimate emissions for additional equipment types, including Alaska OCS Region specific sources, and pollutants. Sources specific to the BOEM Alaska OCS Region are on-ice equipment and vehicles, man camp operations, ice management vessels, and hovercraft.

This document is intended to standardize the estimation of potential air emissions for DOCDs approved by the BOEM. It is intended to be thorough but flexible to meet the needs of different operators. This instructions document gives the basis for the emission factors used in the emission spreadsheet as well as general instructions for using the spreadsheet. The following sections describe the spreadsheets in the BOEM-0139_DOCD_DPP_Air Emissions.xlsx workbook.

TITLE

The TITLE sheet requires input of the company's name, surface area(s), surface block(s), surface lease number(s), facility name (and associated complex ID/structure ID), a list of all specific well names and numbers, and contact information in the corresponding lines. Please do not use language such as "all wells" or subsea field names because BOEM will request that you clarify the well name(s)/number(s). These data will automatically be transferred to the EMISSIONS and SUMMARY sheets. Please place any additional data that the air quality reviewer should consider when reviewing your plan in the REMARKS field (such as drilling rig name and type).

The TITLE sheet also has a table for Lease Term Pipeline Construction Information. By inputting the first year of the proposed activity in the Lease Term Pipeline Construction Information in field A15, all other years should auto-populate not only on the pipeline table but on the EMISSIONS and SUMMARY sheets. Please input the number of lease term pipelines to be installed each year and the total number of construction days per year. These data should match the description of proposed activities and tentative schedule listed on the OCS Plan Information Form.

FACTORS

Emissions processes

The emission factors were compiled from the latest United States Environmental Protection Agency (USEPA) AP-42 references, USEPA's WebFIRE online emission factor repository, and other USEPA

---

[1] May also be referred to as Development and Production Plans (DPPs).

sources, or from industry studies if no USEPA references were available. Factors may be revised as more data becomes available. A change to the FACTORS sheet will automatically change the calculations in the EMISSIONS sheets. In some instances, BOEM does not have an emission factor (e.g., some sources of lead (Pb) and ammonia (NH_3)). If you have an emissions factor for these sources, replace "N/A" in the FACTORS sheet with the emissions factor and emissions will be estimated in the EMISSIONS sheets and shown in the SUMMARY sheet.

A Sulphur Content Source table was added in 1996. A change in this table will automatically revise SO_2 emission factors and the corresponding emission estimates. If your sulphur content is different than the default values in the table, you should change the values in the table to match your actual fuel sulphur content.

A natural gas (NG) Flare Parameters table was added in 2020. A change in this table will automatically revise VOC emission factors for NG Flares. If the VOC content of your flare gas is different than the default value shown in the table, or if your flare efficiency differs from the value shown in the table, then you should change the values in the table to match your actual values. See the Gas Flares section below for details about estimating the VOC content.

In 2020, the emissions factor table was expanded to include lead (Pb) and ammonia (NH_3) for all equipment, where available. The 2020 expansion also included emission factors for vessels based on the USEPA CMV model factors, as well as factors for sources unique to oil and gas operations in the Alaska Region, such as on-ice equipment. The flare emissions factor was also expanded to account for different smoke definitions (i.e., no, light, medium, and heavy smoke) from the 2018 revision of the AP-42.

The 2020 revisions also added separate tables for the heat value (HV) and density of diesel fuel and the heat value of natural gas. These values are used in various emissions factor calculations, which are linked to the values in these tables. A change in these table will automatically revise emission factors for diesel and NG turbines and engines, respectively. If the diesel and natural gas utilized has different density and heating values than specified in the table, then you can change the values to match your actual values. BOEM will ask for documentation to corroborate the change in values.

The basis for the fuel usage conversion factors is as follows:

1. NG Turbine   Fuel usage scf/hr = hp X 9.524 (10,000 btu/hp-hr / HV btu/scf)

2. NG Engine   Fuel usage scf/hr = hp X 7.143 (7,500 btu/hp-hr / HV btu/scf)

3. Diesel Engine   Fuel usage gals/hr = hp X 0.0514 (7,000 btu/hp-hr / HV X density btu/gal)

Equipment Calculations:

Natural Gas Engines and Turbines

1. The natural gas sulphur content assumed is 3.38 ppm. If your concentration is different, revise the ppm in the Sulphur Content Source table.

Diesel-Fired Engines and Turbines

1. The assumed diesel sulphur level is 0.0015% by wt. If your sulphur content is different (e.g., you do not use ultra-low sulphur diesel), change the % wt. in the Sulphur Source Content table.

2. Include the emissions from all vessels associated with your activities for their time of operation within a

25-mile radius of your facility.

Heater/Boiler/Firetube/NG-Fired

1. The assumed natural gas sulphur content is 3.38 ppm. If your concentration is different, revise the sulphur content by changing the ppm in the Sulphur Content Source table.

2. The VOCs emissions are based on total non-methane hydrocarbons.

Combustion Flare

1. A heating value of 1050 btu/cu. ft. for the flared gas is assumed. If your heating value is different, revise the value in the Heat Value of Natural Gas table and the applicable emission factors and emissions estimates will be automatically adjusted.

2. The SO_x emission factor is based on the atomic weight of SO_2 (64 grams/mol), the gas constant 379.4 scf/lb-mol, and an assumed sulfur content of 3.38 ppmv. If the sulfur content of the flared gas is not 3.38 ppmv, then revise the corresponding value in the Sulphur Content Source table.

3. The VOC content of the flared gas is assumed to be 0.6816 lb VOC per lb-mol gas. This value was estimated using the VOC components of the BOEM Gulfwide inventory default gas profile shown below.

Component	Default Mol%	Molecular Weight (lb/lb-mol)
CO2	0.80	44.010
CH4	94.50	16.043
C2	3.33	30.070
C3	0.75	44.097
i-C4	0.15	58.124
n-C4	0.15	58.124
i-C5	0.05	72.150
n-C5	0.05	72.150
C6	0.099	86.177
C7	0.011	100.272
C8+	0.007	114.231

The VOC content is calculated using the following equation:

$$\sum_{i=C3}^{C8+} ¿ \frac{Default\ Mol\%}{100} X\ Molecular\ Weight\left(\frac{lb}{lb-mol}\right) ¿ ¿$$

Liquid Flares

1. Assumes 1% by wt sulphur maximum in the crude oil. If your concentration is different, revise the percent sulphur in the Sulphur Content Source table.

2. VOCs equal non-methane hydrocarbons.

3. PM emission factor assumes Grade 5 oil.

Storage Tank

1. Average emission values were estimated from the BOEM 2014 Gulfwide Emission Inventory Study as indicated in the Ref. column. Total emissions from storage tanks are estimated according to the counts provided on the EMISSIONS sheets.

Fugitives

1. Fugitive emissions are based on the 1993 API Report. It requires that you count or estimate your components. The factor is based on average leak rate for light oil/gas facility.

Glycol Dehydrator

1. Average emission values were estimated from the BOEM 2011 Gulfwide Emission Inventory Study as indicated in the Ref. column. Total emissions from glycol dehydrators are estimated according to the counts provided on the EMISSIONS sheets.

Cold Vent

1. Average emission values were estimated from the BOEM 2014 Gulfwide Emission Inventory Study as indicated in the Ref. column. Total emissions from cold vents are estimated according to the counts provided on the EMISSIONS sheets.

Vessels

The marine vessel emission factors in the 2019 version replace the older USEPA AP-42 mobile source factors. The older factors that differentiated between engines with a power rating greater than or less than 600 horsepower are no longer meaningful for marine vessel engines with regard to current USEPA regulatory programs. Marine vessel engines are now categorized based on an engine's cylinder volume (i.e., Category 1 engines have a displacement less than 5 liters, Category 2 engines have a displacement between 5 and 30 liters, and Category 3 engines have a displacement greater than 30 liters). The updated factors were obtained from the USEPA and are used in the Commercial Marine Vessel (CMV) model - version 1, and the 2017 National Emissions Inventory.

The marine vessel calculations in the BOEM-0139 workbook assumes that vessels will be equipped with Category 2 medium speed engines, built prior to 2000, and that propulsion engines are slow speed diesel engines and auxiliary engines are highspeed diesel engines. The calculations assume that the engines will operate at a service speed engine load. For well stimulation vessels, a weighted engine load is used to account for the vessel pumps and generators used for well stimulation. The emission factors are consolidated into three groups representing different engine assignments (i.e., propulsion, auxiliary, and boilers). To be consistent with the USEPA, the boiler factors are in terms of g/hp-hrs. The SO_x factors account for use of Emission Control Area (ECA) compliant fuels. The default value for the sulfur content is set at 15 ppm, which is the current US onroad value applicable for smaller Category 1 and 2 vessels.

Man Camp

The man camp factors are based in terms of tons per people per day. They were developed from the 2014 BOEM Arctic Air Quality Impact Assessment Modeling Study. The people of people per day will vary therefore the factors are based off the maximum number of people for the purposes of this analysis.

EMISSIONS

The emissions estimates should be based on and reflect the activity description and schedule required as part of the plan. The emissions from an operation should be presented for a calendar year (2020, 2021, etc.). The operation may include production only or production in conjunction with other activities such as drilling or construction operations. For additional years, the Emissions Spreadsheet is renamed EMISSIONS2, EMISSIONS3, etc. The different operating parameters for each year should be entered to calculate revised emissions for that year. The spreadsheet will calculate maximum fuel usage (GAL/HR) using the known horsepower. It will assume maximum fuel usage is equal to actual fuel (GAL/DAY) usage unless the actual fuel usage is known. If so, insert actual fuel usage in the appropriate column. (Please note that the use of actual fuel might require mitigation and post approval monitoring.) The emissions will be calculated as follows:

Emission rate (lb/hr) = (hp-hr or hourly fuel consumption rate) X Emission Factor (Potential to emit)
To customize the workbook for your application, it is possible to delete lines for non-applicable equipment/activities or copy/insert an entire line if more than one similar type of equipment is present. If you add or delete rows, you should confirm that the correct cells are being referenced from the FACTORS sheet and rows added are included in the column totals. If you used alternate emission factors, you should confirm that the calculation methodology is correct for your alternate factors. If you have multiple sequential years with the same equipment, activity, and emissions, you don't have to fill out the following EMISSIONS sheets (only the first year), as the SUMMARY sheet will take the latest populated emissions amounts and auto-populate the following years. A column was added in the EMISSIONS sheet for you to identify each emission unit with a unique identifier (e.g., tag number, unit number, etc.). This should be the identifier on the nameplate of the physical equipment.

The production equipment can be customized further by adding the use of the equipment behind the equipment type name. For example, "TURBINE nat gas" could be changed to "TURBINE nat gas – Gas Compressor"; or "BURNER" could be changed to "BURNER - Line Heater". Operator should also identify each emission unit with a unique identifier (e.g., tag number, unit number, etc.).

When you populate the distance from land in miles (field B72) in the EMISSIONS1 sheet, the same distance will auto-populate on future EMISSIONS sheets. For purposes of calculating the emissions exemption level, the distance to shore should be expressed in tenths of a statue mile up to 20 miles.

SUMMARY

The SUMMARY sheet is designed to show a proposed estimate of emissions from an activity over a 10-year period. The first line (Row 7) of the summary sheet is linked to the yearly totals in the EMISSIONS1 sheet; the second line (Row 8) is linked to the EMISSIONS2 sheet, etc. The EMISSIONS tabs also populate the years in the first column of the table.

Once emissions are constant the values are carried to the end of the 10-year period.

The SUMMARY sheet includes the allowable amount (i.e., emission exemption formula result) in the last row for comparison. This allowable value is provided for PM, SO_x, NOx, VOC, and CO. The remaining pollutants, Pb and NH_3, do not have allowable values as an emission exemption formula is not available for these pollutants.