

**GULF OF MEXICO AND ALASKA OUTER CONTINENTAL SHELF REGIONS
AIR EMISSIONS CALCULATIONS INSTRUCTIONS FOR EPs
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 Exploration Plans (EPs) activities using emissions factors and activity throughput methodology for those Outer Continental Shelf (OCS) areas that BOEM has air jurisdiction, including in the Gulf of Mexico and Alaska Regions. This document and accompanying workbook have been revised throughout the years to update emission factors and calculations, and to estimate emissions for additional equipment types (Alaska OCS Region specific sources) and pollutants (lead and ammonia). Sources specific to the Alaska OCS Region include on-ice equipment and vehicles, man camp operations, ice management vessels, and hovercraft.

This document and accompanying workbook are intended to standardize the estimation of potential air emissions for EPs 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 and calculations used in the emission spreadsheet as well as general instructions for using the spreadsheet.

The following sections describe the spreadsheets in the BOEM-0138_EP_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 headers in 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). If the specific drilling unit has not yet been determined, please submit only one set of spreadsheets for the type of drilling unit that has the highest potential emissions. Approval of the drill unit with highest potential emissions will ensure that your lower emitting drilling unit options are also approved. Please clarify the multiple rig types in the REMARKS field (i.e. DP Semisubmersible, drillship, etc.).

FACTORS

Emissions processes

The emission factors were compiled from the latest United States Environmental Protection Agency's (USEPA) AP-42 references, USEPA's WebFIRE online emission factor repository, and other USEPA sources, or from industry studies if no USEPA references were 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 (NH₃)). 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. Please note the use of a different emissions factor with reference on the TITLE page, REMARKS field.

A Sulfur Content Source table was added in 1996. A change in this table will automatically revise SO₂ emission factors and the corresponding emission estimates for combustion flares and liquid flares. If your sulfur content is different than the default values in the table, you should change the values in the table to match your actual fuel sulfur content. If H₂S is expected, indicate the expected concentration in the Sulphur Content Source table. The USEPA's 2017 National Emissions Inventory (NEI)¹ vessel emission factors assume that 15 ppm ultralow sulfur fuel is being used and these emissions factors in BOEM's spreadsheets do not change even if you adjust the sulfur content in the table.

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 (NH₃) for all equipment, where available. The 2020 expansion also included emission factors for vessels based on the USEPA's 2017 NEI¹, as well as factors for sources unique to oil and gas operations in the Alaska Region, such as on-ice equipment. Because the USEPA's NONROAD2008 model and 2017 NEI do not include TSP for vessels, the TSP emission factors for Alaska sources are from AP-42 (less than 600 hp used for non-vessels; greater than 600 hp used for vessels). The combustion 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 tables 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.

If you use any emission factors that are less than the default values in your calculation of the projected emission amounts, provide documentation supporting the use of the smaller emission factors. Documentation must be submitted with the plan every time. If documentation is not provided, verification of these reduced emission factors will be required upon startup and occasionally thereafter to prove that the reduced emission factors are being achieved and maintained. If the actual emission factor is known to be greater than the default emission factor, use the actual emission factor. You may use updated emissions factors from AP-42, USEPA's WebFIRE online emission factor repository, industry studies, and International Convention for the Prevention of Pollution from Ships (MARPOL). Please note the use of a different emissions factor with reference on the TITLE page, REMARKS field.

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

$$\frac{\text{NG Turbine}}{1} \quad \text{Fuel usage scf/hr} = \text{hp} \times 9.524 \text{ (10,000 btu/hp-hr / HV btu/scf)}$$

¹ USEPA. 2019. 2017 National emissions inventory, technical support document. Research Triangle Park (NC): U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.
<https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data>

2. **NNG 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:

Diesel-Fired Engines and Turbines

1. The emission factors used for marine vessels already account for use of ultralow sulfur fuels (see *Vessels* below). The default value for the sulfur content is set at 15 ppm, which represents the current US marine nonroad fuel value applicable for smaller Category 1 and 2 vessels.
2. The shuttle tanker row allows the user to estimate the propulsion emissions from shuttle tanker movements. The shuttle tanker emissions estimates use the emission factor for *Vessels-Propulsion*.

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 TSP, PM₁₀ and PM_{2.5} emission factors are based on the soot emission factor in AP-42, Chapter 13.5, Table 13.5-1. The soot emission factor is based on the flare smoking condition, which is a qualitative assessment of the level of smoke emitted from the flare. For non-smoking flares, the soot emissions are approximately 0 micrograms per liter. Soot emissions are approximately 40 micrograms per liter for light smoking flares, 177 micrograms per liter for medium smoking flares, and 274 micrograms per liter for heavy smoking flares. If the soot level is unknown, use the heavy smoking flare value.
3. The SO_x emission factor is based on the atomic weight of SO₂ (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 Sulfur Content Source table.
4. 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 2014 Gulfwide inventory² 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

² Wilson, D., R. Billings, R. Chang, S. Enoch, B. Do, H. Perez, and J. Sellers. 2017. Year 2014 Gulfwide emissions inventory study. US Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2017-044. 275 pp.

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:

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

Liquid Flares

1. Assumes 1% by wt sulfur maximum in the crude oil. If your concentration is different, revise the percent sulfur in the Sulfur Content Source table.
2. VOCs equal non-methane hydrocarbons.
3. PM emission factor assumes Grade 5 oil.

Vessels

The marine vessel emission factors in the USEPA's 2017 NEI¹ replace the older USEPA's 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 regarding 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's 2017 NEI¹.

The marine vessel calculations in the BOEM-0138 workbook assumes that vessels will be equipped with Category 2 medium speed engines, built prior to 2000 (Tier 0). The calculations assume that the engines will operate at 100 percent engine load. The emission factors are consolidated into three groups representing different engine assignments (i.e., propulsion, auxiliary, and boilers). The SO_x factors account for use of ultralow sulfur fuels. The default value for the sulfur content is set at 15 ppm, which represents the current US marine nonroad fuel 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 Study³. The number 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 drilling only or other activities such as construction operations. For additional years, the Emissions Spreadsheet is renamed EMISSIONS2, EMISSIONS3, etc. The different operating parameters for

³ Fields Simms, P., R. Billings, M. Pring, R. Oommen, D. Wilson, and M. Wolf. 2014. Prepared by Eastern Research Group, Inc., Sacramento, CA for U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region, Anchorage, AK. OCS Study BOEM 2014-1001. 169 pp.

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.

In the 2020 revisions, 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 and used for emissions inventory reporting purposes. The equipment can also be customized further by adding a vessel name behind the equipment type name. For example, "VESSELS – Drilling – Propulsion Engine – Diesel" could be changed to "VESSELS – Drilling – Propulsion Engine – Diesel – Captain Jack."

Distance to shore

When you populate the distance from land in miles (field B25) in the EMISSIONS1 sheet, the same distance will auto-populate on future EMISSIONS sheets. For purposes of calculating the emissions exemption thresholds (EETs), the distance to shore should be expressed in tenths of a statute mile up to 20 miles, and in whole statute miles for distances beyond 20 miles. The nearest point of any land should be used. This is defined as the distance from the facility to the mean high water mark of any State, including barrier islands and shoals.

Vessels

Emissions from all vessels directly related to the proposed activity must be included for the duration of their activity within 25 miles of the facility. This typically includes crew boats, supply boats, work boats, tugboats, anchor handling vessels, lift boats, pile drivers, standby boats, construction barges/vessels, stimulation vessels, etc. Even though all vessels must be reported on the spreadsheets, only vessels attached to the seabed (drilling) and construction vessels will be included in the emissions exemption threshold (EET) analysis.

The emissions estimates for vessels assume engines are operating at 100% load. A different operating load can be used by adjusting the maximum fuel usage rate (Column E on the EMISSIONS sheets) and the actual fuel usage (Column F on the EMISSIONS sheets). If columns E and /or F are revised to adjust the operating load, documentation will need to be provided to BOEM. Please note the use of different fuel usage rates on the TITLE page, REMARKS field.

Emissions Reduction Measures

You must describe any proposed emission reduction measures, including a description of the affected source(s), the emission reduction control technologies or procedures, quantity of reductions to be achieved, and the monitoring system you propose to use to measure emissions. BOEM could apply mitigations that require annual filing and/or stack testing. BSEE may take enforcement action if the reduction is exceeded or there is no annual submittal/stack testing. Please note use of emissions reduction measures on the TITLE page, REMARKS field.

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., EET) in the last row for comparison. This allowable threshold is provided for TSP, SO_x, NO_x, VOC, and CO. The remaining pollutants, Pb and NH₃, do not have allowable values as an emission exemption threshold is not available for these pollutants.

The **Paperwork Reduction Act of 1995** (44 U.S.C. 3501 et seq.) requires us to inform you that BOEM collects this information as part of an applicant's DOCD submitted for our approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 250.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget (OMB) control number. Responses are mandatory (43 U.S.C. 1334). The reporting burden for this form is included in the burden for preparing EPs and DOCDs. We estimate that burden to average 600 hours per response, including the time for reviewing instructions, gathering and maintaining the data, and completing and reviewing the forms associated with subpart B. Direct comments on the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166.