

GULF OF MEXICO AIR EMISSIONS CALCULATIONS INSTRUCTIONS

General

This updated document and workbook (EP_AQ.XLS) were prepared by the Bureau of Ocean Energy Management (BOEM), formerly Minerals Management Service (MMS). This document and the companion workbook have been revised extensively with updated emission factors and emission estimation methods, and additional pollutants and equipment types. Note that the units associated with the data you are required to enter may be different than in the previous version of the workbook. This document is intended to standardize the way we estimate our potential air emissions for Exploration Plans (EP) approved by BOEM. To facilitate spreadsheet review by BOEM, any changes you make to emission factors or cell formulas will automatically be highlighted. It is intended to be thorough but flexible to meet the needs of different users. This instructions document gives the basis for the emission factors used in the EMISSIONS spreadsheets as well as general instructions for using the spreadsheets.

The following sections describe the spreadsheets in the EP_AQ.XLS workbook.

TITLE

The TITLE sheet requires input of the company's name, area, block, OCS-G number, platform and/or well(s), drilling rig name and type, contact information, and distance to shore in the corresponding lines. These data will automatically be transferred to the EMISSIONS and SUMMARY sheets

STATIONARY FACTORS

The emission factors were compiled from the latest U.S. Environmental Protection Agency (USEPA) AP-42 references (USEPA 2014a) or from industry studies if no USEPA AP-42 reference was available. Factors may be revised as more data becomes available. A change to the STATIONARY FACTORS sheet will be automatically changed in the EMISSIONS sheets. A Sulfur Content table was added in 1996. A change in this table will automatically revise SO₂ emission factors and the corresponding emission estimates. 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.

Engines, Boilers/Burners, and Liquid Flaring

1. Particulate matter (PM) emission factors for natural gas combustion are for filterable PM only.
2. It is assumed that PM = PM₁₀ = PM_{2.5} unless individual species are provided in AP-42.
3. If an emission factor for VOC is not provided in AP-42, it is assumed that TOC or nonmethane TOC = VOC.
4. The EMISSIONS sheets allow you to enter either the Heat Input Capacity (MMBtu/hr) **or** the horsepower rating (HP) for turbines and natural gas-fired engines. You should only enter activity data for one of the units specified per piece of equipment. If you enter activity data for MMBtu/hr and HP for a single piece of equipment, the total emissions for the platform will be overestimated.
5. Fuel Usage Conversion Factors are provided on the STATIONARY FACTORS sheet for natural gas and diesel-fired turbines and engines. If your fuel usage conversion factors are different than the default values in the table, you should change the values in the table to match your actual fuel usage conversion factors.

Natural Gas Flares

The emission factors are from AP-42, Chapter 13.5. The emission factors are in units of lbs/MMBtu. These factors are multiplied by a heat value of 1050 MMBtu/MMscf to convert units to lbs/MMscf. The VOC factor is based on the hydrocarbon emission factor in table 13.5-1 and the average non-methane components in table 13.5-2. The SO₂ emission factor is based on an

assumed gas density of 0.0947 lbs H₂S/ft³ H₂S, the atomic weights of SO₂ and H₂S, and the sulfur content of the flared gas. If the sulfur content of the flared gas is not 3.38 ppmv, then the corresponding value in the sulfur content table should be revised.

VESSEL FACTORS

The VESSEL FACTORS sheet was added in 2015 to accommodate revised emission factors for vessels and drilling rigs. Emissions from support helicopters need not be quantified. The emission factors are provided by engine category. The emission factors were obtained from the following sources: e-mail communications with the USEPA regarding data from USEPA's regulatory program; NEI 2011 documentation (USEPA 2014b); and USEPA's Federal Marine Compression-Ignition (CI) Engines -- Exhaust Emission Standards (USEPA 2012).

The emission factors are presented relative to USEPA marine compression engine categories which are presented in Table 1. The categories are defined relative to displacement volume (in liters) of a single cylinder.

Table 1. USEPA Categories for Compression Ignition Marine Engines

USEPA Category	Propulsion Engine Displacement per Cylinder (liters)
C1	Less than 5
C2	Equal to 5, less than 20
C3	Equal to or greater than 20

It is appreciated that detailed information about the fleet of vessels that will be needed for the exploration project may not be available at the time that the exploration permit is being submitted; the emission factors presented here may be an overestimation of vessel characteristics and emissions providing a worst case estimate. This overestimation of emissions ensures that once exploration is implemented activities will not be limited due to assumptions about vessel characteristics and emissions made in the application.

For use in the Alaska OCS, separate emission factors are provided for on-ice equipment based on the onroad diesel fuel emissions factors. These emissions are calculated in a separate section in the EMISSIONS sheets.

The VESSEL FACTORS sheet also includes a lookup table for the adjustment factors for operating loads less than 20%. Formulas in the EMISSIONS sheet reference these tables automatically if the engine load is indicated to be less than 21%. Any changes to the adjustment factors in this tab will affect all vessel calculations.

One additional piece of information necessary to calculate the SO₂ emission factors for vessels is the sulfur content in the fuel. The fuel sulfur content needs to be entered in a separate table in the VESSEL FACTORS sheet. The recommended default for vessel fuel sulfur content for projects implemented after 2012 is 15 ppm.

If you need to include multiple vessels with different power ratings, additional vessels can be added to the table in the VESSEL FACTORS sheet as a row "copy and paste," but you will need to carefully re-link the additional vessels in the EMISSIONS sheet. If done wrong it could lead to errors.

VESSEL KW RATINGS

The VESSEL kW RATINGS sheet was added in 2015 to provide a lookup of the default kW ratings of vessels for emission calculations. The EMISSIONS sheets have the capability to accept a custom kilowatt rating, if the vessel is known. Please see the instructions on the EMISSIONS sheets for more details.

METHODOLOGY

The METHODOLOGY sheet was added in 2015 to show the formulas used to estimate emissions on the EMISSIONS sheets.

EMISSIONS

The emissions from an operation should be presented for a calendar year (2015, 2016, etc.). The operation may include drilling only, or drilling in conjunction with facility installation and test well drilling. For additional years, the EMISSIONS sheets are renamed EMISSIONS_2, EMISSIONS_3, etc. The sheets are designed to auto-populate all the equipment entered in the previous year. The different operating parameters for each year should be entered to calculate revised emissions for that year. The emissions will be calculated as shown on the METHODOLOGY sheet for each equipment type.

To customize the spreadsheet 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 STATIONARY FACTORS and VESSEL FACTORS sheets.** If you used alternate emission factors, you should confirm that the calculation methodology is correct for your alternate factors. If you add rows, it is recommended you insert a blank row within the appropriate operation section and copy a row with comparable calculations. This will ensure that the appropriate formulas and emissions factor tables are used, as well as SUMMARY sheet calculations are preserved.

For 2015, the ability to enter a vessel's engine load factor has been incorporated into the spreadsheet. If no engine load factor is entered for a vessel, the calculation assumes 100% load for Auxiliary engines and 82% load for Main engines based on values entered for Engine Type (column E). The formulas also allow for either default power rating for vessels or custom values in the activity column. The default values for the various vessel types are provided in the VESSEL kW RATINGS sheet. If the Engine Type column (E) indicates a custom kilowatt rating, and none is supplied in the ACTIVITY column (H) the emissions calculations will produce an error message of "Enter Activity".

The Estimated Duration fields, Start Date and End Date, should be populated for each row. These fields are used to estimate maximum rolling monthly total emissions. The dates are limited to the calendar year associated with the EMISSIONS year, which is indicated just above the estimated duration column. Failing to enter a start year on the title page will result in an error message when entering dates. If the End Date is prior to the Start Date, the End Date cell will turn red to indicate the error.

Simple error checking has been added to the sheet to ensure all necessary values are included for the calculations. Please review the columns for MAXIMUM POUNDS PER HOUR and ESTIMATED TONS PER YEAR to ensure there are no error messages for active rows.

SUMMARY

The SUMMARY sheet is designed to show a proposed estimate of emissions from an activity over a ten year period. The first line (Row 7) of the summary sheet is linked to the yearly totals in the EMISSIONS_1 sheet; the second line (Row 8) is linked to the EMISSIONS_2 sheet, etc. If additional years of calculations are necessary to reach a constant, then a spreadsheet can be copied and linked to the SUMMARY sheet for future years. Once emissions are constant the values are carried to the end of the ten year period.

In 2015, additional summary tables were added to the SUMMARY sheet to show maximum monthly emissions, maximum hourly emissions, maximum 3-hour emissions, maximum 8-hour emissions, and

maximum 24-hour emissions. The SUMMARY tab also includes the maximum emissions from any 12-month period.

REFERENCES

U.S. Environmental Protection Agency (USEPA). 2012. Federal Marine Compression-Ignition (CI) Engines -- Exhaust Emission Standards. <http://www.epa.gov/otaq/standards/nonroad/marineci.htm>

U.S. Environmental Protection Agency (USEPA). 2014a. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources. AP-42. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. <http://www.epa.gov/ttn/chief/ap42/index.html>

U.S. Environmental Protection Agency (USEPA). 2014b. 2011 National Emissions Inventory (NEI) Documentation. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. <http://www.epa.gov/ttn/chief/net/2011inventory.html#inventorydoc>