

ACCESS NUMBER: 31021

STUDY TITLE: Gulfwide Emission Inventory for the Regional Haze and Ozone Modeling Effort

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CONTRACT NUMBER(S): 1435-01-00-CT-31021

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREA(S): Central and Western Gulf of Mexico

FISCAL YEAR(S) OF PROJECT FUNDING: 2000; 2001; 2002; 2003; 2004

COMPLETION DATE OF REPORT: October 2004

COST(S): FY 2000 \$86,890; FY 2001: \$149,440; FY 2002: \$289,345; FY 2003: \$88,520; FY 2004: \$131,929; **CUMULATIVE PROJECT COST:** \$746,124

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KEY WORDS: Air pollutant emissions inventory, Gulf of Mexico, GOADS, criteria pollutants, greenhouse gases.

BACKGROUND: Measurements of ozone concentrations in onshore areas of Texas and Louisiana periodically exceed the national standard for one-hour ozone in nonattainment areas, with some observations nearly three times the national standard. Shoreline and inland locations in Texas and Louisiana could potentially be influenced by emission sources in the Gulf of Mexico. The Minerals Management Service (MMS) is responsible for determining if air pollutant emissions from Outer Continental Shelf (OCS) oil and natural gas platforms and other sources in the Gulf of Mexico influence the ozone attainment and nonattainment status of onshore areas. Consequently, MMS initiated a research study to develop a base year 2000 inventory of criteria air pollutant emissions and greenhouse gas emissions from offshore oil and gas exploration, development, and production in the Gulf of Mexico. The inventory also includes non-OCS oil and gas production sources such as the Louisiana Offshore Oil Port (LOOP), military vessels, and commercial marine vessels.

OBJECTIVES: 1- Describe and quantify emission sources in the OCS that release criteria air pollutants (i.e., carbon monoxide, sulfur dioxide, nitrogen oxides, particulate matter, and volatile organic compounds) and greenhouse gases (i.e., carbon dioxide, methane, and nitrous oxide) over the course of one calendar year; 2- prepare a report that summarizes the emissions data, describes the methodology used to generate the emissions inventory; 3- prepare data files for platform and non-platform emissions sources that can be used in air quality modeling studies; and 4- update and improve the computer software used to collect activity data for oil and gas production platforms, and the Oracle program used to develop the emission estimates.

DESCRIPTION: The Gulfwide Emission Inventory Study includes all oil and gas production platforms and non-platform sources in the Central and Western Gulf of Mexico. Pollutants covered in the inventory are the criteria pollutants as well as greenhouse gases. MMS attempted to collect activity data from every active offshore oil production platform in the Gulf. Operators were provided with the Gulfwide Offshore Activities Data System (GOADS) Visual Basic activity data collection software for compiling monthly data for calendar year 2000. Nearly 2,900 oil and gas production platforms submitted monthly equipment activity data files. Non-platform sources were also included in the inventory, such as pipelaying vessels, drilling vessels, and support helicopters and vessels. Rigorous quality assurance/quality control (QA/QC) activities were performed on the activity data collected from platform operators. The monthly activity data collected from the platform operators were then combined with emission factors and algorithms to develop the platform production equipment emission estimates. Base year 2000 activity data for non-platform sources were collected and combined with emission factors to develop emission estimates for non-platform sources in the Gulf. Inventory data files were compiled with the oil and gas production platform data, suitable for use in air quality modeling applications. In addition to monthly emission estimates by pollutant and individual piece of equipment, the files include the company, structure, and complex ID, lease number, block and area number, and latitude/longitude. For each piece of equipment, stack parameter information such as outlet height, exit velocity, and exit temperature is also presented. Non-platform emission estimates were allocated using Geographic Information System (GIS) software to lease blocks and areas.

SIGNIFICANT CONCLUSIONS: Because this inventory includes volatile organic compound (VOC) and methane, the data gathering effort for oil and gas production platforms includes new emission sources such as losses from flashing, pneumatic pumps, and pressure/level controllers. For OCS oil and gas production platforms, activity data were submitted by 55% more platforms than in a previous 1995 emission inventory effort performed by MMS. For carbon monoxide (CO), emissions reported in this study increased four-fold, primarily because of natural gas engines. Emissions did not show an increase for all pollutants, however. For VOC, emissions in the current study are slightly lower than in the 1995 study. The two studies have a similar number of boiler, diesel and natural gas engine, and natural gas turbine units (irrespective of the

increased number of platforms included), but emission estimates for nitrogen oxides (NO_x) and particulate matter (PM) are higher in the 1995 study. Estimates for both studies were developed based on U.S. Environmental Protection Agency (EPA) published emission factors, and the factors have changed for natural gas engines and natural gas turbines. For example, the average NO_x emission factor for natural gas engines is 50% lower than the factor applied in the 1995 study. The contribution of natural gas engines to total NO_x emissions accounts for a large portion of the decrease in emissions compared to the 1995 study. In addition, the particulate matter emission factor is 65% lower for natural gas engines. Emissions of sulfur dioxide (SO₂) decreased significantly in the Gulfwide Study, primarily due to the amine unit estimates.

The Gulfwide Study non-platform inventory built upon the 1995 inventory such that many of the assumptions made in the earlier inventory were used in this study, especially with regard to typical vessel horsepower and operating load, seasonal variation, and hours of operation. However, the Gulfwide Study estimates were based on more recent emission factors, and activity data specific to 2000. In many cases, the difference between the 1995 study estimates and those in the Gulfwide Study are due to the use of different marine diesel emission factors. The 1995 study was based on older EPA emission factors, while the Gulfwide Study estimates were based on the marine diesel emission factors derived from regression analysis performed on recent marine diesel emissions testing data. These new emission factors were recently developed to support the EPA's new marine diesel rule making.

STUDY RESULTS: The inventory results indicate that OCS oil and gas production platform and non-platform sources emit the majority of criteria pollutants in the Gulf of Mexico. OCS platform and non-platform sources account for 89% of total CO emissions, 77% of NO_x emissions, 72% of VOC emissions, 69% of PM emissions, and 66% of SO₂ emissions. Oil and gas production platforms account for the majority of the CO, VOC, and NO_x emissions. Non-platform OCS oil and gas production sources such as support vessels and drilling vessels emit the majority of the estimated SO₂ and PM emissions. Platform sources account for almost all of the greenhouse gas emissions. Commercial marine vessels and vessel lightering are the top-emitting non-OCS oil and gas production sources in the inventory.

Recommendations for future inventory efforts for platform sources in the Gulf of Mexico focus on the data gathering tools used. There is high uncertainty associated with the losses from flashing, vent, and flare emission estimates. Much of the uncertainty is thought to be due to the interpretation of the data requested by the operators. Work is underway to improve the GOADS software for these equipment types. In addition, an overall improvement will be made to the software to simplify the data requested each month to only the equipment variables that change monthly. This will reduce data entry volume, processing time, and the likelihood of data entry errors.

For non-platform sources, implementation of a survey of marine vessels supporting offshore oil platforms can provide important data that would allow for the development of a more accurate estimate of emissions from support vessels. This support vessel survey could collect detailed information about vessel size, horsepower rating, and typical operating loads, as well as annual and seasonal activity. The new survey vessel inventory could be used to develop emission estimates in terms that can be readily applied to state-of-the-art GIS tools to spatially allocate emissions with greater accuracy. For drilling vessels, MMS collects very specific data on where specific drill ships operate and the length of time they spend at a given site. In the Gulfwide inventory, the average horsepower and load data were used to estimate emissions from these sources. Some vessels may be significantly larger or smaller than these average values; however, such that actual emissions may differ significantly from the estimated emissions. A drill ship database could contain information about vessel size, the number and horsepower of the primary propulsion engine and ancillary engines, and better estimates on typical operating loads. This database could be linked up with MMS's drill ship-specific activity data and available emission factors to provide more accurate emission estimates.

STUDY PRODUCT(S): Wilson, D.L., J.N. Fanjoy, and R.S. Billings. 2004. Gulfwide Emission Inventory Study for the Regional Haze and Ozone Modeling Effort: Final Report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2004-072. 273 pp.

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