PERMITTED SOURCES

Source	Description	Pollutant	Emissions (tons) 2011	2012	2013
COATship	Exterior and interior painting using marine coatings	VOC, VOHAP	45.8	74.7	69.5
COATmisc	Shop coating of nonmarine parts	VOC, VOHAP	7.3	14.5	2.8
SBO	Outdoor sandblasting of marine and nonmarine parts	PM	15.4	10.2	5.7
		PM10	5.4	3.6	2
SBI	Interior sandblasting of marine and nonmarine parts	PM	0.1	0.2	0.1
		PM10	0.03	0.1	0.03
BWT	Product throughput in tank farm	VOC	54.2	51.9	50.6
ROT	Oil throughput in reclaimed oil tanks	VOC	12.7	10.5	2.7
ROL	Oil loadout to trucks	VOC	1	0.9	0.8
CUB	Boilers	VOC	0.1	0.13	0.12
		SO2	0.1	0.12	0.1
		NOx	5.3	6.6	6.2
		CO	1.3	1.6	1.5
		PM10	0.1	0.1	0.1
WLD	Welding rod consumption	PM10	3	4.4	3.6
PIR	Vehicle miles	PM	3.8	8.4	8.4
		PM10	3.1	6.7	6.7
		Manhours	851,514	1,562,197	1,306,981

OBJECTIVES

- Review emission sources and identify opportunities to reduce/eliminate emissions
- Review sources of nuisance odors and identify solutions to eliminate
- Inform stakeholders/receive feedback, select and prioritize issues
- Develop action plans to address prioritized issues
- Develop mechanisms for ongoing follow-up and collaboration

OPPORTUNITIES

- Product substitution
- Product elimination
- Engineering controls
- Technology
- Adaptive controls
- Address non-permitted sources

APPROACH

- The engineering firm ERM was hired to conduct top to bottom analysis of shipyard emissions
- Sampling of odor sources for compound identification and quantification
- Evaluation of HAPs in VOC emissions and PM emissions from fugitive and stack sources
- Evaluation of emission control systems
- Sampling of selected emission sources
- Odor surveys conducted by UP
- Meteorological monitoring
- Prioritization of issues and response actions

Scope of Work

Air/Odor Emissions Analysis and Alternatives Assessment

Vigor Industrial – Portland, Oregon

ERM is providing this draft scope of work for assessing air and odor emissions and alternatives for emissions reductions from Vigor's shipyard operations on Swan Island in Portland, Oregon. The primary focus of the study is to identify potential measures that could reduce emissions (point source and fugitive) associated with odors, air toxic compounds, and particulate matter. Alternatives to be evaluated include process modifications, material substitution, better capture of emissions to be directed to existing controls or new control devices, and the implementation of new control measures to reduce emissions.

The assessment will encompass all major emission sources found in Vigor's Oregon Title V Operating Permit. These sources can be grouped as:

- Coating operations, including painting of marine vessels and parts in dry docks and berths, as well as painting miscellaneous parts in paint spray booths within Buildings 10 and 73;
- Ballast Water Treatment Plant slop oil storage tanks and treatment operations;
- Reclaimed oil storage tanks and transfer operations with volatile organic compound (VOC) emissions controlled by an enclosed flare system (thermal oxidizer);
- Reclaimed oil loading operations into tanker trucks for transport off site;
- Abrasive blasting of marine vessel exteriors and parts not performed within a blast booth;
- Abrasive blasting of marine vessel interiors and miscellaneous parts within a blast booth and emissions controlled by a baghouse;
- Welding operations, including cutting and grinding, within Building 4; and
- Utility boilers in the Central Utility Building and diesel generators used as backup power on the dry docks.

The overall assessment will be accomplished in accordance with the following tasks.

Task 1 – Baseline Assessment of Emissions and Emission Controls

ERM will review existing documents and process information to establish the current baseline emissions and operations for each of the major sources. This review will include equipment descriptions and emission limits contained in the air operating permits, as well as recent relevant operating and maintenance records to assess maximum "potential to emit" operations and normal routine operations. Documents included in the review will be:

- Operating permit conditions and recordkeeping requirements;
- Material composition and usage records;
- Air flow rates for ventilations systems;
- Design parameters for control systems, including baghouses and the thermal oxidizer;
- Stack test data and stack characteristics;
- Logs of odor complaints received by the facility;
- Relevant plant maintenance procedures associated with processes, ventilation systems, and control devices;
- Existing emissions inventory information; and
- Results of any special studies and data prepared by Vigor or other parties.

Building on a previous site visit by Mr. Larry Hottenstein of ERM in July 2013 to identify potential odor sources at the facility, ERM senior engineers will conduct site visits to tour the facility, observe the various process operations, verify as-found conditions of all capture and control systems, and conduct a detailed review of the facilities, operations, and control systems. Interviews with Vigor staff will be conducted to include operators, environmental staff, engineering staff, and supporting contractors and consultants.

During the site visits, odor emission samples will be collected in Tedlar bags from the potential odor sources identified previously for subsequent odor panel analysis. Sampling will be performed using an indirect-fill, bag-in-drum technique which maintains sample integrity and avoids contact with pumps or materials that may impart additional odor to the sample. Samples will be sent overnight to St. Croix Sensory in Stillwater, Minnesota for olfactory analysis. Odor concentrations will be determined by dynamic dilution olfactometry in accordance with American Society of Testing and Materials (ASTM) Standard Practice E679-04, *Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series of Limits*, incorporating the European Standard EN-13725:2003, and ASTM Method E544-99, *Referencing*

Suprathreshold Odor Intensity. The resultant odor emission levels will be used in Task 2 to predict potential off-site odor impacts. For the purposes of this scope of work, it is assumed that three odor samples will be collected from up to six sources over a 2- to 3-day field program for a total of 18 samples. All samples will be analyzed for odor concentration as Dilutions-to-Threshold (D/T) and intensity by St. Croix Sensory.

In conjunction with the odor sampling, exhaust flow rates will be determined from point sources, such as stacks or vents, using Type S or standard pitot tubes in accordance with U.S. Environmental Protection Agency (USEPA) Reference Methods 1–4. If suitable sampling ports are not available for flow measurements, exhaust fan ratings will be used as necessary to estimate ventilation rates. Exhaust flow rates are needed in conjunction with odor concentrations in order to predict potential downwind odor impacts. For area sources, such as aeration basins or open roof tanks, the surface area of the source of the source will be documented and the odor emission sample will be collected immediately above the surface. If possible, a surface isolation flux chamber will be used to collect a sample directly from the surface for determination of odor emissions per square meter per minute.

For selected sources, emission samples will be collected for laboratory analysis of chemical compounds in addition to odor panel analysis. This effort will help identify air toxic compounds associated with the odor emissions. It is anticipated that the odorous compounds of primary interest will be reduced sulfur compounds associated with waste oil processing or volatile organic compounds and hydrocarbons associated with waste oil processing and surface coating operations. ERM proposes to collect up to six emission samples in evacuated 6-liter Silonite™ glass-lined canisters for subsequent analysis. Volatile organic compounds will be quantified following USEPA Method TO-15 using gas chromatography/mass spectrometry (GC/MS) for a target analyte list of 75 compounds, most of which are considered air toxics. A target analyte list of 20 reduced sulfur compounds, including hydrogen sulfide and various mercaptans, will be analyzed in accordance with ASTM Method 5504-08 using gas chromatography with sulfur chemiluminescence detection (GC-SCD). The advantage of using the Silonite canisters is that either or both analyses can be performed from the same sample. ERM will use ALS Laboratory in Simi Valley, California for these analyses.

As appropriate, it is anticipated that certain screening level measurements may also be performed on other sources during the site visits. These measurements may include verifying ventilation and exhaust flow rates with pitot tubes or hot-wire anemometers

and monitoring VOC, hydrogen sulfide, or fugitive dust concentrations around sources or process areas to assist in estimating fugitive emissions.

The results of Task 1 will be summarized in a technical memo that includes a spreadsheet emissions inventory for the facility and all operations. Emissions will be characterized to the extent possible as peak, routine, controlled, and fugitive for each process operation. This inventory will be compared with Vigor's inventory of emission points and quantities developed as part of the Title V permit process. Again, this effort will focus on emissions of particulate matter, VOC and odors, and hazardous air pollutants (HAPs). The technical memo will be submitted to Vigor to provide comments on the completeness and accuracy of process emissions, provide alternate views on technical assumptions related to the emissions, and provide further details on potential upset conditions or emissions excursions.

Task 2 – Source Prioritization and Assessment of Control Alternatives

Once the baseline inventory of sources and potential emissions has been established, the sources and process operations will be prioritized in terms of their emissions and potential off-site impacts to the community. For the odor emission sources, odor modeling will be conducted using the measured odor emission rates. AERMOD, the newest USEPA-approved dispersion model, capable of calculating downwind concentrations from both point and area sources as well as incorporating building downwash, will be used to assess the potential impacts. The model estimates hourly averaged concentrations for user-specified receptor locations based upon source inputs and hourly meteorological data and has the ability to provide source contributions for each concentration calculated. Since odor impacts are instantaneous by nature and nuisance complaints do not result from hourly average impacts, the model results are adjusted using peak-to-mean ratios to convert hourly averaged concentrations to short-term concentrations. In addition, source emission inputs will be adjusted to provide the appropriate units to calculate odor D/T concentrations as output. Local historical records of meteorological data, if available, and on-site wind data will be used for the modeling.

The modeling analysis will not only predict potential odor impacts in the community from Vigor sources, but will be able to rank the relative contribution of each source to downwind impacts. For example, it may be found that one particular operation is the major contributor to potential offsite odor impacts. Then effort may be focused on evaluating odor mitigation measures for this source or activity. The degree of control required to minimize downwind odor impacts will be determined, as necessary, in

order to avoid potential community complaints. Increases in stack heights, add-on control equipment, process changes, ventilation or building modifications, and other control measures may be evaluated with the model to determine the most cost-effective mitigation measure.

Existing control systems will be evaluated and improved or alternative control measures assessed. As part of this review, ERM will identify candidate emission reduction strategies in use by other shipyards and companies with similar operations, including referenced lists of best available control technologies for specific sources and operations. Detailed assessments of potential emission reduction strategies and control measures will be performed with respect to technical feasibility, cost effectiveness, and other potential environmental impacts.

The potential emissions reduction strategies will be developed through a comprehensive assessment of the relationships between materials used, processes employed, potential emissions generated, and the emissions captured and controlled. Recommended reductions may include product substitution or source reduction, improved monitoring or maintenance procedures, improved capture efficiency, or better control equipment and/or dispersion. The alternatives will be prioritized based on the potential emissions reductions and feasibility of implementation at Vigor's operations. A final ranking of control strategies will be prepared based on the emission reduction potential; the potential to reduce odor, HAP, and particulate matter impacts on the community; and technical and economic feasibility. Recommendations will be provided in terms of the operations model for current and future processes and the business model for current and potential future capacity and capability.

Task 3 – Report Preparation and Presentation

ERM will prepare a preliminary report containing the assessments described above. Upon review by Vigor, it is expected that the report and a presentation of findings will be provided to Vigor's neighbors and the Oregon DEQ. Based on feedback received from Vigor and other stakeholders, ERM will finalize the report. ERM will participate in meetings with community and agency stakeholders as necessary.