ENVIRON

International Corporation

Final Report

Measurement and Assessment of Equipment Leak Fugitives in Industrial Ethylene and Other Chemical Sources

Prepared for:

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1. INTRODUCTION

In August and September 2000, an intensive field study, called the Texas Air Quality Study (TxAQS), was conducted in the Houston-Galveston area (HGA) to study ozone and other air pollution issues in that region. As part of TxAQS, aerial surveys of chemical species in the atmosphere above the HGA showed higher ozone and ozone-precursor concentrations than would be expected from the emission inventory of volatile organic compounds (VOCs). In a Technical Support Document dated June 5, 2002, the Texas Natural Resource Conservation Commission (TNRCC)[1], notes this discrepancy:

> *"Much of the early analysis focused on why the HGA is different from other areas of the nation. A survey of the area indicates the most striking difference in HGA and other areas of the nation is the extensive refining and petrochemical industry located around the Houston Ship Channel. The HGA produces over half of the chemical and refining needs of the nation. Not surprisingly, the early results have pointed to high levels of VOC emissions from industrial sources in the area; which are much higher than those reported in the annual and special emissions inventories."*[2]

One possible source of unreported emissions from industrial facilities are fugitive emissions. Fugitive emissions are relatively small and hard-to-detect emissions from valve packings, pump seals, compressor seals, and piping connections that occur as part of normal industrial plant operations. They are characterized by a diffuse release of volatile organic compounds (VOCs) or hydrocarbons into the atmosphere. Fugitive emissions from refineries and chemical plants have historically represented a large percentage of the volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from these facilities.

In May, 2002, ENVIRON International Corporation was retained by the Houston Advanced Research Center (HARC) to manage a project entitled "Measurement and Assessment of Equipment Leak Fugitives and Vent Emissions in Industrial Ethylene and Other Chemical Sources (Project H5.2002)". This project was recommended for funding by the TNRCC and approved by the Science Advisory Committee (SAC) of the Texas Environmental Research Consortium (TERC). The primary objectives of this project were as follows:

> evaluate the effectiveness of a portable optical gas imaging device (CO_2 laser) for measuring/detecting ethylene fugitive emissions;

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[1] On September 1, 2002, the TNRCC formally changed its name to the Texas Commission on Environmental Quality, or the TCEQ.

[2] TNRCC Technical Analysis Division, Air Modeling and Data Analysis Section. *Technical Support Document.*

evaluate the effectiveness of a portable optical gas imaging device for measuring/detecting ethylene emissions from process vents and other potentially undetected fugitive sources;

collect sufficient data and information from ethylene/propylene sites to assess the quality of fugitive emission inventory component counts;

determine the impact of pegged fugitive emission components and leaking equipment falsely identified as non-leaking; and

develop correlation equations specific for ethylene and propylene sources for estimating emissions from equipment leak fugitives.

assess the accuracy of fugitive emission inventories based on component count information collected at various facilities.

To complete this project, ENVIRON managed a team which included technical staff from URS Corporation, ICF Consulting, Gas Imaging Systems, and EFSI. Project work involved two comprehensive field studies to evaluate a portable optical gas imaging device for measuring/detecting fugitive emissions. In addition, the project team counted traditional fugitive emission components in seven separate industrial facilities.

CONCLUSIONS

The conclusions reached in this study suggest that an independent assessment of the accuracy of a facility's fugitive emission inventory, based on component counts and available monitoring data, can result in a range of calculated emissions both over and under that reported by the facility. The variability in calculated results is determined primarily by the accuracy of the facility's inventory of components and the emission factors used to convert emission concentrations to mass. Results also suggest that many facilities base their fugitive emission inventories on information provided, in many cases, by contractors responsible for conducting leak detection and repair and/or rely on fugitive emission software programs to calculate emission inventories from screening values. As a result, the facility's ability to conduct quality assurance/quality control assessments on the calculated emissions may be somewhat limited. As seen here, the use of one type of emission factor methodology over another for calculating fugitive emissions can have a large impact on the total emissions reported.

Areas where improvements can be made at a facility in regards to the calculation of fugitive emissions include the following:

Better assurance that all regulated components are identified and monitored on a routine basis - this assurance requires that the facility have a clear understanding of which components must be identified, the process stream that the component is in contact with, and the regulatory status of each process area within the facility. In conjunction with a clearer understanding of which components are regulated and fall within the scope of the facility's LDAR program, self-audits and effective management of change programs are required for quality assurance/quality control purposes to ensure that new components are identified and added to the LDAR program, and old components removed.

Consistent use of emission factors for all components in a facility – for facilities with different contractors and/or methods for calculating mass emissions, the use of a single method will provide more consistent results for the entire facility and a greater degree of control over calculated results. Notwithstanding this, it is recognized that certain methods for calculating emissions may be more suitable for various areas of a facility (i.e., unit-specific correlation equations) and therefore multiple approaches may be necessary. Regardless, the method used for calculating fugitive emissions should be clearly defined in the facility's LDAR operating procedures.

Quality assurance/quality control of fugitive emission inventories – many of the commercially available fugitive emission databases used by plant and contract personnel have the ability to calculate fugitive emission inventories under a variety of calculation methods. Moreover, these databases allow facilities to speciate component streams. Generally, if speciated data is not available, the database will calculate emissions based on the single compound identified for that stream. Facilities should periodically review stream information to ensure that it remains accurate and current. Furthermore, the method by which emission inventories are calculated in the database should be periodically reviewed to ensure that it provides the most accurate assessment of the facility's fugitive emissions.