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Advances in Perimeter Air Monitoring During the Cleanup of Former MGP Sites

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Abstract

Advancements in the use of optical remote sensing (ORS) as applied to perimeter air monitoring during the cleanup of former manufactured gas plant (MGP) sites are described. Presented first is a summary of an ORS-based, perimeter air monitoring program carried out during the November 2004 cleanup of a Tennessee MGP site by Atmos Energy Corporation, followed by discussion of a 26-month R&D initiative currently underway by the Gas Technology Institute (GTI). The GTI project, which builds upon Atmos Energy's demonstrated success with this technology, is intended to gain support from the USEPA for the standardization and regulatory acceptance of this air monitoring approach for MGP site cleanups around the nation. Direct benefits to the natural gas industry include facilitation of mitigative decision-making, elimination of adverse community exposure, and minimization of legal risk to the site owners.

Summary of Earlier Work

Instrument Selection

In 2005, Atmos Energy Corporation reported on its experience of using optical remote sensing (ORS) during a November 2004 removal action at a former manufactured gas plant (MGP) site in Bristol, Tennessee (Schulz et al., 2005). In that article, dissatisfaction was expressed with the use of traditional point monitoring, as the point measurement data from several prior Atmos Energy MGP site cleanups simply could not meet the project needs. The inability to satisfactorily address the data quality objective (DQO) for data representativeness (in both time and space), together with the time required for sample collection, shipment, and laboratory analysis, resulted in the failure to produce the desired level of legal protection from potential claims alleging unacceptable off-site exposure. In essence, it was only upon completion of the MGP site cleanup that a reasonable assessment of acceptable community exposure could be made.

In anticipation of the cleanup of the Bristol former MGP site, Atmos Energy began researching alternative, off-the-shelf perimeter air monitoring approaches which would be able to address these shortcomings. This was particularly important at the Bristol site, as it was located in the historic downtown center of the city, within 30 meters of a complex housing the Sullivan County Court House, the Bristol Police Station, and the Bristol juvenile center. Due to the political sensitivity and the attendant potential for legal claims, alternative technologies were sought which were able to maintain sufficiently low minimum detection limits (MDLs), acquire data in real time, meet the data-representativeness DQO, and be unobtrusive. Optical remote sensing, in the form of open-path spectroscopy, met all of these objectives.

Figure 1. Sullivan County Court House

Atmos Energy selected open-path, Fourier-transform infrared (FTIR) spectroscopy as the air monitoring method for use at the Bristol site. Besides its ability to meet the above objectives, this ORS technology was chosen because of its proven track record for use in numerous Superfund site remediations and its legal status as a USEPA-approved ORS method – Toxic Organic Compendium Method 16 or Method TO-16 (USEPA, 1999). The consulting firm of Minnich and Scotto was retained to implement the perimeter air monitoring program.

Figure 2. Open-Path FTIR Spectrometer at the Bristol Site Cleanup

An EDO Corporation RAM2000 open-path FTIR spectrometer was used to measure 14 gaseous target compounds, including benzene and naphthalene, along the downwind site perimeter about 1.5 meters above the ground. A Climatronics TACMET Weather Sensor, equipped to monitor wind speed, wind direction, and the standard deviation of the horizontal wind direction, was also employed.

The Cross-Sector-Averaging Technique

The *cross-sector-averaging technique* (Hudson, 1992, and Minnich et al., 2005) was used for the direct assessment of off-site contaminant exposure. This technique involves dividing the path-integrated, crosswind spectroscopic contaminant data collected downwind of the source (ppb-m) by the plume width (m) to yield a representative maximum concentration along the beam path (ppb). In this manner, the spatial data-representative problem, pervasive in the traditional point monitoring approach, is solved as the contaminant plume cannot pass off-site undetected. Each monitoring event was precisely 10 minutes in duration.

A 10-minute-averaged action level (AL) was defined for each target compound to ensure that its pre-established *ambient air acceptable concentration* (AAAC) – either 1-, 8-, or 24-hour-averaged value, depending on the exposure scenario considered – was never exceeded. This was accomplished by setting each AL equal to the respective target compound's AAAC. The ALs served as very conservative proxies for their AAACs owing to both temporal and spatial considerations: much shorter averaging times were employed for the ALs than for the AAACs (temporal consideration), and no "credit" was taken for the fact that the location of maximum off-site impact for each monitoring event was continually changing based on changes in the mean wind direction between monitoring events (spatial consideration). A "dilution factor" was applied to the maximum measured concentration in order to account for the increasing amount of contaminant "loss" due to atmospheric dispersion as the plume was transported off-site toward the downwind community.

Precision and accuracy were assessed for all open-path FTIR data collected. For each monitoring event, carbon tetrafluoride (CF_4) was introduced into the spectrometer's flow-through cell from a NIST-traceable cylinder and measured for precision. Accuracy was assessed at the beginning and end of each day by measuring sulfur hexafluoride (SF_6), similarly introduced into the flow-through cell. Excellent precision and accuracy were noted during each monitoring day – well within the project measurement quality objectives (Minnich and Scotto, 2004). The average precision achieved for all of the FTIR data was ±1.56%, and the average accuracy was −5.72%.

Achievement of Objectives

The main objective of ensuring that safe ambient air conditions were maintained at all times throughout the local community was achieved, as was the secondary objective of supporting on-site mitigative decision-making. Despite the need to periodically slow down cleanup activities and implement mitigative measures, there was virtually no impact to the overall project timetable

and the daily schedule for excavation and off-site waste hauling was never compromised. In fact, the perimeter air monitoring program quickly became an integral part of the overall site management due to its capability of characterizing off-site impacts, in real time, as a function of cleanup activity. Application of the *cross-sector-averaging technique* proved to be an unobtrusive and particularly straightforward approach for meeting the project objectives.

GTI R&D Initiative

Background

On June 29, 2005, Atmos Energy was formally honored by its natural gas industry peers for utilizing the "eye that never sleeps" technology to monitor air emissions during its Bristol MGP site cleanup. At a ceremony held in Nashville, the Southern Gas Association (SGA) awarded Atmos Energy the "2005 Environmental Excellence New Technology Award" for its use of the open-path FTIR technology.

On February 12, 2007, SGA awarded Atmos Energy the "2007 Environmental Excellence Technology Award" for its continued efforts in furthering the application of ORS technologies during MGP site cleanups. Atmos Energy received this prestigious award for its 2005 R&D proposal to the Gas Technology Institute (GTI) which included development of an open-path ultraviolet (UV) spectrometer for use as a complementary monitoring tool. GTI is the leading research, development, and training organization serving the natural gas industry and energy markets. Many of the more than 3,000 MGP sites requiring cleanup in the US are owned by GTI member companies.

In January 2006, the Operations Technology Development (OTD) group, a consortium of utility companies, funded GTI to conduct the R&D program as proposed by Atmos Energy, "ORS Methods Development for Perimeter Air Monitoring During MGP Site Cleanups." Minnich and Scotto is GTI's principal contractor for this 26-month endeavor, while Atmos Energy has the unique distinction of being both an investor and a technical consultant.

The project is intended to gain support from the USEPA for the standardization and regulatory acceptance of the ORS-based, perimeter air monitoring approach for MGP site cleanups around the nation. Direct benefits to the natural gas industry include facilitation of mitigative decision-making, elimination of adverse community exposure, and minimization of legal risk to the site owners. Specific project objectives are to: (a) compare ORS-based (open-path FTIR and UV) and traditional point-monitoring approaches; (b) enhance the state-of-the-art, data-management and reporting software developed by Minnich and Scotto for use at the Bristol site; and (c) create a standard operating procedure (SOP). Each objective is discussed below, followed by identification of the Project Evaluation Committee and discussion of GTI's vision for the future.

Monitoring Approach Comparison

Comparison of the monitoring approaches involves the simultaneous field testing (one week) of open-path FTIR, open-path UV, and traditional point monitoring at each of two former MGP sites during active cleanup. Testing at the first site (Illinois) was performed in December 2006, and testing at the second site (New York) is scheduled for April 2007.

Figure 3. EDO FTIR and IMACC UV Spectrometers at First MGP Site Cleanup

The monitoring approaches are being evaluated in the context of likely end-user needs: facilitation of mitigative decision-making; real-time demonstration of acceptable community risk; and assessment of long-term community exposure. Emphasis is on benzene and naphthalene, the typically controlling contaminants, both of which are easily detected with each ORS instrument.

Traditional point monitoring is being performed in compliance with existing plans and protocols, and ORS monitoring is being performed in compliance with a program plan, monitoring plan, and quality assurance project plan. Of particular importance is the demonstration that the philosophy and guidance set forth in USEPA's DQO process is followed throughout the planning and testing phase.

Data-Management and Reporting Software Enhancement

Minnich and Scotto's existing software enables continual, real-time assessment of compliance with 10-minute-averaged off-site action levels to be made via application of the *cross-sector averaging technique* as discussed above. Enhancements already made under the GTI project include:

- operating system conversion from EXCEL to MS Windows-based client/server application

- the capability for automatic entry of all data directly from the FTIR and UV spectrometers and the on-site meteorological system

- more sophisticated reporting and documentation capabilities

Creation of a Standard Operating Procedure

The USEPA understands the advantages that "whole-plume" monitoring offers over traditional, point-monitoring techniques for characterizing emissions from complex area and volume sources. Over the past few years, USEPA has funded several R&D initiatives intended to forward the incorporation of ORS technologies into the regulatory compliance and enforcement arenas for these source types.

The SOP will provide a straightforward ORS-based methodology for generating legally admissible data which ensures compliance with applicable off-site health criteria during the cleanup of former MGP sites. Prepared in conformance with applicable USEPA guidance, the SOP is designed to ensure that data-collection efficiency is optimized, thereby resulting in a reduced work effort and the generation of data of the highest quality. Use of the SOP will empower the site owner in being proactive with a highly cost-effective approach for simultaneously managing the cleanup and the attendant legal risk, and will ensure methods standardization and application consistency from site to site.

Project Evaluation Committee

Objectivity is inherent through the creation and integral involvement of a diverse Evaluation Committee beginning at the planning level and spanning the duration of the project. The Committee is comprised of representatives drawn from the following project stakeholders: GTI, OTD member companies, Baker & McKenzie (outside legal counsel), USEPA Office of Research & Development (ORD), USEPA Office of Air Quality Planning and Assessment (OAQPS), USEPA National Environmental Response Team (ERT), the Illinois EPA, the New York State Department of Environmental Conservation (NYSDEC), and the New York State Department of Health (NYSDOH).

GTI's Vision

The project is a visible demonstration of GTI's ongoing commitment to provide unparalleled service to the natural gas industry. This breakthrough technology reinvents the management of former MGP site cleanups worldwide by revolutionizing how perimeter air monitoring is performed. It is GTI's vision that the legal and political roadblocks to the effective, expeditious cleanup of MGP sites are eliminated, and that each cleanup is performed within a "partnership triangle" comprised of the site owner, responsible regulators, and the local community.

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Authors

Stuart P. Schulz Jr. has more than 15 years experience in the environmental remediation field and management of manufactured gas plant sites. He was the Atmos Energy project manager for the Bristol former MGP Removal Action, responsible for all phases of the project. He holds a BA in Geology from the University of Tennessee, Knoxville, and a MSc in Environmental Management from the University of Maryland, University College.

Stephen F. Takach is a senior scientist and project manager at the Gas Technology Institute. His accomplishments there include development of perimeter air monitoring methods for use during site cleanups, measurement of indoor air quality, and development of pipeline inspection technologies, such as remote field eddy current inspection, for the natural gas industry. Dr. Takach has been a faculty member at Wayne State University, a post-doctoral associate at Cambridge University in England, and has worked on experimental projects at Fermi National Lab, CERN (Geneva, Switzerland) and the Brookhaven National Lab. He received a patent on a method for improving electromagnetic locators for underground utilities, and has published 94 articles in international peer-reviewed journals. He earned a BS in physics from Notre Dame, an MS in physics from Yale, and a Ph.D. in elementary particle physics from Yale.

Timothy R. Minnich is a meteorologist and atmospheric scientist with nearly 30 years experience in the design, management, and implementation of air toxics investigations. Since 1988, he has designed and managed more than 25 ORS-based field investigations, most of which were performed for regulatory application. He is the project manager for the GTI perimeter air monitoring R&D initiative, principal developer of the *cross-sector-averaging technique* as applied to open-path spectroscopic data for the real-time assessment of off-site AL compliance during MGP site cleanups, and co-developer of Minnich and Scotto's state-of-the-art, data-management and reporting software for this application.

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