CTEH CENTER FOR TOXICOLOGY AND ENVIRONMENTAL HEALTH, LLC

Air Sampling and Monitoring Work Plan

Mayflower Pipeline Incident

Prepared On Behalf Of:
ExxonMobil Pipeline Company

Mayflower, AR

Prepared By:

Center for Toxicology and Environmental Health, L.L.C.
5120 North Shore Blvd
Little Rock, AR 72118
501-801-8500
www.CTEH.com

April 1, 2013

	Name/Position	Signature	Date Signed
Prepared By:	JT Wilson/ESPM		4-1-2013
Reviewed By:	Paul Nony		4-1-2013
Approved By:			
Reviewed By (Exxon Mobil IH Supervisor):			

Air Sampling Plan Management of Change

Change from 1.1 to 1.2

- *Description of Change (include sections & page numbers):*
- *Table 3.2- Hydrogen Sulfide colorimetric tube addition. Page 7*

	Name/Position	Signature	Date Signed
Prepared By:	JT Wilson/ ESPM		3/30/13
Approved By:			

Change from 1.2 to 1.3

- *Description of Change (include sections & page numbers):*
- *Updated title page*
- *Added Hexane OELs to Table 2.1 Page 4*
- *Added Hexane PAC values to Table 2.2 Page 5*
- *Corrected weather information in section 3.4 Page 9*
- *Added Hexane to personal exposure sampling section 4.0 Page 10*

	Name/Position	Signature	Date Signed
Prepared By:	JT Wilson/ ESPM		3/30/13
Approved By:			

Change from 40435ExxonMobile_crude_oil_spill_version_1.3.docx to 40435ExxonMobile_crude_oil_spill_version_2.0.docx.

- *Description of Change (include sections & page numbers):*
- *Title Page: Change of response to Mayflower Pipeline Incident*
- *In the Introduction Section, language was updated to reflect more precise descriptions of air monitoring objectives.*
- *Update Analytical Air Sampling Section: change to 3M 3520 OVM badges or equivalent personal monitoring badges*
- *Data Management: Data will be sent to AIHA accredited laboratory*
- *n-Hexane: Removed TLV-STEL as no STEL available.*
- *Section 2.0 was updated to include the ExxonMobil OELs.*
- *Table 2.1 was updated to reflect the ExxonMobil OELs.*
- *Section 3.1: UltraRAE was added where previously omitted in Vs. 1.3 from text.*
- *Section 3.2: Gastec was removed as there may be other brands of colorimetric tubes used. The Gastec tube lable was included in the subsequent table to describe the exact type.*

	Name/Position	Signature	Date Signed
Prepared By:	Shawn Wnek/Tox.		3/31/13
Approved By:			

Introduction and Purpose

This work plan addresses air monitoring and sampling for crude oil released from the Pegasus pipeline in Mayflower, AR. The purpose of this monitoring and sampling includes the following:

- Monitoring worker exposures,
- Monitor air within the adjacent community to assess ambient concentrations of benzene and other crude oil related compounds,
- Provide toxicology and industrial hygiene consulting support and assist with compliance with exposure standards and guidelines for workers in the work area.
- It does not include in-door air quality monitoring for the purposes of the re-occupation of houses, businesses or public buildings. In-door air quality air monitoring criteria for re-occupation of houses, businesses or public buildings will be coordinated between the Arkansas State Department of Health and CTEH resources.
- Odor concerns will be subject of a separate plan and protocol.

All sampling data will be summarized and made available daily.

1.0 Air Sampling and Monitoring Locations and Target Analytes

Real-time[1] air monitoring and analytical air sampling[2] for constituents of crude oil may be performed at the following locations:

[1] The term "real–time air monitoring" generally refers to using handheld, portable direct reading instruments that rapidly detect and display the airborne concentration of a chemical.

[2] The term "analytical air sampling" refers to air sampling methods that involve collection of air samples over a specified period, followed by analysis at a laboratory. The results of these samples represent the average airborne concentration for the sample period. These methods typically involve passing a known volume of air through a collection medium (e.g. charcoal sample tube or filter cassette) that efficiently traps and retains the compound until it can be analyzed by the laboratory. By knowing the volume of air collected, and the quantity of chemical absorbed onto the collection medium, the average air concentration can be calculated.

- Over the vapor space of the crude oil source to determine the primary constitutes of concern;
- Locations throughout adjacent community;
- Work area, and
- Additional areas of interest.

2.0 Exposure Standards and Guidelines

2.1 Occupational Exposure Standards and Guidelines

The Occupational Safety and Health Administration (OSHA) establishes workplace standards to protect the safety and health of workers. The American Conference of Governmental Industrial Hygienists (ACGIH), National Institute for Occupational Safety and Health (NIOSH), and ExxonMobil have also established exposure guidelines to protect workers from hazards on the job. Table 2.1 lists the OSHA, ACGIH and ExxonMobil values for all chemicals of interest.

Table 2.1 Occupational Exposure Standards and Guidelines*

Chemical	OSHA			ACGIH		EXXONMOBIL	
	PEL-TWA[a]	PEL-STEL[b]	PEL-CEIL[c]	TLV-TWA[d]	TLV-STEL (C)[e]	OEL-TWA	OEL-STEL
Benzene (ppm)	**1**	**5**	**25, 50****	**0.5**	**2.5**	**0.5**	**1.0**
Toluene (ppm)	**200**	**500****	**300**	**20**	**-**	**-**	**-**
Ethyl Benzene (ppm)	**100**	**-**	**-**	**20**	**125**	**-**	**-**
o-,m-,p-Xylene (ppm)	**100**	**-**	**-**	**100**	**150**	**-**	**-**
Hydrogen sulfide (ppm)	**-**	**-**	**20**	**1**	**5**	**5**	**10**
Hexane (ppm)	**500**	**-**	**-**	**50**	**1000**	**-**	**-**

*(ACGIH, 2012)

**10-min peak per 8-hour shift.

a. *OSHA PEL-TWA = The permissible concentration in air of a substance that shall not be exceeded in an 8-hour work shift or a 40-hour work week (OSHA 29 CFR: 1910.1000).*
b. *OSHA PEL-STEL = The time-weighted average exposure that should not be exceeded for any 15-minute period (OSHA 29 CFR: 1910.1000).*
c. *OSHA PEL-Ceiling = The exposure limit that shall at no time be exceeded. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time-weighted average (TWA) exposure, which shall not be exceeded at any time during the working day. (OSHA 29 CFR: 1910.1000).*
d. *ACGIH TLV-TWA = The Threshold Limit Value-TWA is the concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect (ACGIH, 2012c).*
e. *ACGIH TLV-Ceiling = The ceiling exposure limit is the to which workers can not be exposed to for any period of time (ACGIH, 2012c).*

2.2 Community Exposure Guidelines

The American Industrial Hygiene Association (AIHA) establishes Emergency Response Planning Guidelines (ERPGs) to protect communities from the adverse effects of chemicals. USEPA has developed Acute Exposure Guideline Levels (AEGLs) to protect communities in the event of emergency chemical releases. The Department of Energy's (DOE) Subcommittee on Consequence Assessment and Protective Action (SCAPA) developed Temporary Emergency Exposure Limits (TEELs) and Protective Action Criteria (PAC) for over 1,250 chemicals for which ERPGs have not

been developed. In cases where AEGL or ERPG values exist, SCAPA adopts the AEGL or ERPG values for the PAC-1, PAC-2, and PAC-3 values. TEEL values should be used only when an ERPG is not available for a given chemical. If an AEGL or ERPG value exists, the TEEL is the same as the AEGL or ERPG. Table 2.2 lists the PAC values for chemicals of interest.

Table 2.2 Community Exposure Guidelines*

Chemical	PAC-1 (ppm)	PAC-2 (ppm)	PAC-3 (ppm)
Benzene	52_A	800_A	4000_A
Ethyl Benzene	33_A	1100_A	1800_A
Toluene	200_A	1200_A	4500_A
o-,m-,p-Xylene	150	200	1000
Hydrogen sulfide	0.51_A	27_A	50_A
Hexane	300	3300_A	8600_A

**Community Exposure Guidelines* - AEGLs, ERPGs, and TEELs are collectively referred to as chemical Protective Action Criteria (PAC). The PAC concentration limit hierarchy is to use AEGLs first, then ERPGs, and finally TEELs.
A – denotes an AEGL value

a. *PAC-1 is the maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient health effects (DOE/SCAPA, 2012).*
b. *PAC-2 is the maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (DOE/SCAPA, 2012).*
c. *PAC-3 is the maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects (DOE/SCAPA, 2012).*

3.0 Real-Time Monitoring

Real-time air monitoring will be performed during the air monitoring activities. The term "real–time" refers to direct reading instruments that allow nearly instantaneous determinations of a chemical concentration in air. Real-time measurements provide immediate information for worker and community exposure scenarios and, with the use of appropriate site safety measures, help prevent overexposures. Real-time measurements are not directly comparable to OSHA or ACGIH 8-hour TWA values or to community exposure standards or guidelines. Instantaneous real-time samples do not necessarily represent conditions experienced throughout the workday and can substantially underestimate or overestimate exposures potentially experienced by workers. Direct reading instruments perform sampling and analyses within the instrument and concentration readings can

usually be obtained immediately. These instruments have fast response times and can follow rapid changes in concentration.

Real-time monitoring shall be conducted using the Rae Systems MultiRAE Plus PID, UltraRAE, and the Gastec GV-1000 piston pump with colorimetric tubes; AreaRAEs will be available for deployment if needed.

The MultiRAE plus PID will be equipped with oxygen and LEL sensors. MultiRAEs deployed in the work area may also be equipped with Hydrogen Sulfide (H2S) chemical specific sensors.

Table 3.0 Summary of Real-time Instrument Detection Limits

Instrument	Analyte	Detection Limit
UltraRAE 3000 (9.8 eV)	Benzene	0.05 ppm
AreaRAE & MultiRAE PID (10.6 eV)	Benzene	0.053 ppm
AreaRAE & MultiRAE PID (10.6 eV)	VOC	0.1 ppm
RAE Systems Oxygen Sensor	Oxygen	0.1%
RAE Systems LEL Sensor	LEL	1%
RAE Systems	Hydrogen Sulfide	0.1 ppm

3.1 Photo Ionization Detectors

MultiRAEs, UltraRAEs and AreaRAEs are used to measure airborne concentrations of volatile organic compounds (VOCs). Photo ionization is a nondestructive technique that is somewhat specific through selection of ultra-violet (UV) lamps of varying energies. PIDs use high energy UV light from a lamp housed within the detector to provide energy needed for ionizing VOCs. Ions are collected in an ionization chamber with accelerating and collecting electrodes designed to measure current. Current produced during VOC ionization is proportional to VOC concentrations.

MultiRAE and AreaRAE PIDs are not specific for any chemical, but can be applied specifically to benzene using the RAE Systems published correction factor of 0.53 for benzene. The presence of atmospheric humidity and other VOCs may be problematic while using the detectors. PIDs often need to account for background readings and need to be coupled with other real-time instruments.

3.2 Colorimetric Detectors

Colorimetric detector tubes will be used to determine concentrations of analytes of concern that can be found in crude oil. Detector tubes contain detecting reagents specifically designed to detect the target chemical. These thin glass tubes have printed calibration scales, which allow the user to directly read airborne concentrations of the substances being measured. Gastec detector tubes are hermetically sealed, the inner diameters are controlled, and detecting reagents with long-term stability are selected. All detector tubes undergo stringent quality control, and each production lot is independently tested and calibrated.

Table 3.2 Colorimetric Tubes and Detection Limits

Instrument	Analyte	Tube Name	Detection Limit	Sampling Volume
Gastec GV100 with Colorimetric Tubes	Benzene	121L	0.05 ppm	500 mL
Gastec GV100 with Colorimetric Tubes	Ethyl Benzene	122L	1.0 ppm	200mL
Gastec GV100 with Colorimetric Tubes	Toluene	122L	0.5 ppm	400mL
Gastec GV100 with Colorimetric Tubes	Xylene	123L	1.0 ppm	200mL
Gastec GV100 with Colorimetric Tubes	Hydrogen Sulfide	4LL	0.1 ppm	1000mL
Gastec GV100 with Colorimetric Tubes	Hexane	102L	1.0 ppm	500mL

3.3 Real-Time Air Monitoring Locations

Real-time instruments will be used to detect VOCs in various locations throughout the surrounding community. Hand-held instruments will be positioned at breathing zone levels away from potential air path obstructions such as the operator's body, vehicles, etc. Readings will be documented using hand-held data devices designed to log individual manual real-time data points. Real-time air monitoring locations will be divided into two categories; fixed real time (FRT) monitoring locations and roaming locations. An AreaRAE real-time air monitoring category may be added if after an initial site assessment determines they are needed. If needed, AreaRAEs will be set to log individual readings from fixed locations. These readings will be sent back to a central computer for data analysis and data storage. FRT locations will be strategically placed in areas surrounding the crude oil impacted areas. Roaming locations may be added in areas of interest in response to changes in site conditions, work area activities, or in response to odor concerns. Air monitoring and sampling may be increased in areas downwind of the source during significant wind direction changes.

3.4 Weather Monitoring

Weather, in the form of wind speed, wind direction, temperature, time, and date, will be monitored and documented throughout air monitoring activities if the needed. An on-site meteorological station will be utilized to collect weather conditions on-site. Individual real time data, from both FRT and roaming locations, will have the latest weather data stamped with each logged reading collected. Real time air monitoring locations are to provide a perimeter of monitoring around the source of the spill, as much as the surrounding landscape will safely allow access.

4.0 Analytical Air Sampling

Analytical air sampling may be conducted for the purpose of collecting data that represents TWA concentrations of VOCs throughout the day, or as whole-air samples that attempt to identify these compounds in ambient air. When applicable, sampling will be conducted and analyzed for VOCs using 1 liter Minicans with 24-hour regulators. Personal exposure sampling for BTEX (benzene, toluene, ethyl benzene, xylene, and hexane) may be conducted on personnel performing work at the release site using 3M 3520 OVM badges or equivalent personal monitoring badges. At least one worker may be chosen for personal sampling from a representative exposure group. STEL sampling for these compounds may also be conducted during activities that may cause short-term increases in

concentrations, e.g. breaking down hoses after transfer operations. This sampling may be further developed to include additional constituents, if indicated by on site conditions. A comprehensive plan for worker exposure monitoring is attached in Appendix A.

All samples will be held according to method/laboratory requirements and will be shipped to an AIHA accredited laboratory for subsequent analysis. Additional analytical air sampling methods and locations may be added throughout the response as deemed appropriate following changes in on site conditions.

Table 4.0 Summary of Analytical Air Sampling Methods

Analyte	Analytical Method	Sample Media
VOC	EPA TO-15	Minican
BTEX + n-hexane	NIOSH 1500/1501	3M 3520 OVM Badge or equivalent
BTEX + n-hexane	NIOSH 1500/1501	Coconut Shell Charcoal tube

5.0 Data Management

- All analytical air samples will be sent to an AIHA Accredited Laboratory.
- A request for complete data packages will be made to the laboratory for all samples analyzed.
- The data packets will be reviewed and the data will undergo a data validation process.
- Calibration logs will be completed daily.
- Real-time readings will be documented by handwritten notes, handheld PDA, or by the use of data logging capabilities of the instrument, if available.
- Real-time data will be entered on site and drafts made available upon request.

6.0 Project Organization

CTEH® will be responsible for the following:

- Air monitoring and sampling
- Toxicology support
- Quality Assurance/Quality Control
- Data evaluation
- Reporting

7.0 Equipment Decontamination

If required, equipment will be decontaminated by appropriately trained personnel. The decontamination will be with damp cloths as the equipment cannot be submerged under water.

8.0 Field Documentation

During the project, the team members will maintain various field books, reports, electronic database, and logs. These documents include, but are not limited to, calibration logs, safety briefings, chains of custody, and individual project notes. Where air-monitoring data is concerned, tasks descriptions, PPE and RPE worn by monitored response personnel will be noted in field notes. All of these documents will be retained by CTEH, and will be made available upon request.

9.0 Calibration and Maintenance of Field Instruments

The calibration and maintenance of field equipment and instrumentation will be in accordance with each manufacturer's specifications or applicable test/method specifications, and shall be documented in the calibration logs or site safety and health logbooks.

10.0 Sample Labels and Chain of Custody (COC)

Each sample will be identified on a chain of custody record. The analytical sample numbering system will include site name, date, analyte or sampling method, and identification code unique to each sample.

11.0 Packaging and Shipping

Packaging and shipping of samples will vary depending upon sample media, contaminant concentration, preservation technique, and sample container. The person packaging the samples is responsible to ensure that the sample packaging is in suitable condition for shipping.

12.0 References

ACGIH. Documentation of the TLVs and BEIs with Other Worldwide Occupational Exposure Values. CD-ROM 2011. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists; 2012.

AIHA. 2011 Emergency Response Planning Guidelines (ERPG) and Workplace Environmental Exposure Level (WEEL) Handbook. Fairfax, VA: American Industrial Hygiene Association; 2011.

ATSDR. Minimal risk levels (MRLs). Atlanta, GA: Agency for Toxic Substance and Disease Registry; 2012 Feb. http://www.atsdr.cdc.gov/mrls/index.asp

DOE/SCAPA. Protective Action Criteria (PAC): Chemicals with AEGLs, ERPGs & TEELs: Rev. 27. Washington, DC: U.S. Department of Energy; 2012 Feb. http://www.atlintl.com/DOE/teels/teel.html

IARC. Agents Classified by the IARC Monographs, Volumes 1-100. Lyon, France: International Agency for Research on Cancer; 2010. http://monographs.iarc.fr/ENG/Classification/index.php

NIOSH. NIOSH Pocket Guide to Chemical Hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health; 2005 Sep; DHHS (NIOSH) Publication No.2005-149.

Appendix A

Worker Exposure Monitoring Plan

Mayflower Pipeline Incident
Worker Exposure Monitoring Plan

Prepared On Behalf Of:
ExxonMobil Pipeline

Mayflower, AR

Prepared By:

Center for Toxicology and Environmental Health, L.L.C.
5120 North Shore Blvd
Little Rock, AR 72118
501-801-8500
www.CTEH.com

March 30, 2013

	Name/Position	Signature	Date Signed
Prepared By:	Scott Skelton, MS, CIH		3/30/2013
Reviewed By:	Paul Nony, PhD		3/30/2013
Approved By:	Paul Nony, PhD		3/30/2013

Change from 1.0 to 1.1
• *On title page and throughout the document the title was changed to Mayflower Pipeline Incident* • *Table 2.1: Updated to include ExxonMobil specific OELs. NIOSH REL was removed from footnotes.* • *Table 2.2: Changed Remediation Technicians to Clean-up Technicians. Added Boom Handling task.* • *Table 3.2 Colorimetric Tubes and Detection Limits was removed.* • *Table 3.3: OVM Badge Detection Limits was removed.*

	Name/Position	Signature	Date Signed
Prepared By:	Scott Skelton, MS, CIH		4/1/2013
Approved By:	Paul Nony, PhD		4/1/2013

1 Introduction and Purpose

On March 29, 2013, ExxonMobil experienced a release of crude oil from the Pegasus pipeline near North Starlite Road in Mayflower, AR. Shortly thereafter, ExxonMobil requested that Center for Toxicology and Environmental Health, LLC (CTEH) provide air monitoring and industrial hygiene services to assist in worker health and safety in support of response operations.

This Worker Exposure Assessment Plan is an amendment pursuant to the CTEH Air Sampling and Monitoring Work plan, title: "Mayflower *Pipeline Incident Air Sampling and Monitoring Work Plan Vs 2.0"*.

2 Basic Characterization of Operations

This section is a basic characterization of the work operations for the remediation activities intending to describe: work tasks, work environments, potential chemical hazards, and similar exposure groups (SEGs). The work operations data was collected from site observations, work area surveys, and operational briefings at incident command.

2.1 Description of the Work Area

Site officials have identified six work areas where response activity will occur. These areas have been identified as Area A, B, C, D, E & F. Area A involves the point of release and the impacted neighborhood along North Starlite Rd. The area of impact originates at the source and includes the areas of the North Starlite Road where crude oil migrated downhill. Area B includes the drainage ditch that runs north of Starlite Road along the UPRR rail line. This work area involves the impacted ditch and the ditch banks. Work Area C has been identified as a wetland area and runs east from the rail line to Highway 365. Area D includes the irrigation canal that runs adjacent to and beneath Interstate 40. Area E begins out the outlet of the Area D canal and the subsequent wetland area. Area F includes the cove wetland area.

The majority of work conducted includes the removal of crude oil using vacuum trucks as well as sorbent pads and boom.

2.2 Description of Operations

The following work activities are likely to occur during work operations and therefore will be considered in the determination of the appropriate exposure assessment strategy.

- incident command
- field supervision
- field safety inspection
- materials handling
- machine operation
- environmental sampling
- vacuum ops and product removal
- transportation
- decontamination

"Incident Command" – refers to all persons conducting full-shift work operations at the incident command post. The job tasks at incident command are not conducted in close proximity to impacted areas.

"*Field Supervision"* – refers to in-field management or supervision of remediation workers. Field supervisors are in relative proximity, and may work directly within impacted areas for the duration of their work shift.

"*Field Safety Inspection"* – refers to safety supervisors, safety leads, and/or safety observers that represent in-field maintenance of the Pegasus Pipeline Release Health and Safety Plan for remediation efforts.

"*Materials Handling"* – refers to workers that work directly with or may handle materials or objects impacted by crude oil during remediation operations.

"*Machine Operation"* – refers to the operation of a track-hoe, back-hoe, front-end loader, or other machine-driven equipment used to manipulate incident related materials.

"*Environmental Sampling-Air"* – refers to air sampling technicians that frequent work areas where remediation activity takes place.

"*Environmental Sampling-Soil"* – refers to soil sampling technicians that frequent work areas where remediation activity takes place.

"*Environmental Sampling-Water"* – refers to water sampling technicians that frequent work areas where remediation activity takes place.

"Vacuum Ops & Product Removal" – refers to workers who are working to remove crude oil from impacted soil, water, or roadways.

"*Transportation"* – refers to workers operating commercial and non-commercial vehicles for the purpose of transporting workers and/or project supplies to work sites in the remediation area.

"Decontamination" – refers to workers performing decontamination operations of personnel and equipment performing work in regulated areas.

2.3 Identification of Potential Occupational Exposures

Benzene, toluene, ethyl benzene, xylene, and hydrogen sulfide have been identified as the chemicals of primary concern (COPCs) for the response operations. The occupational exposure limits (OELs) and TLV basis for these COPCs are stated in Table 2.1.

Table 2.1 Occupational Exposure Limits*

Chemical	ACGIH		EXXONMOBIL	
	8-hr-TWA[a]	15 min-STEL (C)[b]	8-hr-TWA[a]	15 min-STEL (C)[b]
Benzene (ppm)	0.5	1.0[c]	.5	1.0
Toluene (ppm)	20	-	-	-
Ethyl Benzene (ppm)	20	125	-	-
o-,m-,p-Xylene (ppm)	100	150	-	-
n-Hexane (ppm)	50	-	-	-
Hydrogen sulfide (ppm)	1	5	5	10

*(ACGIH, 2012)
**10-min peak per 8-hour shift.

a. *ACGIH TLV-TWA = The Threshold Limit Value-TWA is the concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect (ACGIH, 2012c).*
b. ACGIH TLV-STEL = The STEL exposure limit is a 15 minute time weighted exposure that should not be exceeded at any time during a work day. (ACGIH, 2012c).

2.4 Similar Exposure Groups

A similar exposure group (SEG) is a group of workers having the same general exposure profile based on similarities and frequency of the tasks they perform, the materials/processes in which they work, and the similarity of the manner in which the task in performed. To establish the SEGs, a job task analysis has been conducted to determine job classifications, work practices, and job task frequency and duration. The work activities of the Pegasus Pipeline response may be considered non-routine based on the following observed site characteristics:

- Variable duration work task,
- transient work force,
- variable work sites,
- and, variable work practices.

To address the unpredictable nature of non-routine work operations, SEGs will be established using a comprehensive exposure strategy. The comprehensive strategy includes characterizing exposures to the COPCs for all workers using observational and quantitative methods. Five primary SEGs have been identified by observational methods. The SEGs are described in Table 2.2 on the following page.

Table 2.2 Similar Exposure Groups

SEG	Description
Incident Management	*Workers with infrequent, short-duration excursions to the field remediation sites.*
	Tasks: • Incident Command • Transportation
Field Supervision	*Field Supervisors for remediation operations. Continuous presence at remediation work sites, with limited close proximity work to potentially contaminated materials.*
	Tasks: • Field Supervision • Field Safety Inspection Supervisors
Environmental Field Specialists	*Workers collecting environmental and occupational air, soil, and/or water samples at remediation sites. Continuous presence at remediation work sites, with infrequent short-duration handling of potentially contaminated material.*
	Tasks: • Environmental Sampling-Air • Environmental Sampling-Water • Environmental Sampling-Soil
Clean-up Technicians	*Workers with continuous presence at remediation sites with frequent, moderate-to-long duration work among or near potentially contaminated material.*
	Tasks: • Materials Handling • Boom Handling • Vacuum Operations & Product Removal • Machine Operation • Decontamination of Workers, PPE, and Equipment

The "Environmental Field Specialists" and "Clean-up Technicians" SEGs have been identified as the "Maximum Risk" worker SEGs based on the results of initial air monitoring data collected on 3/29/2013 and additional factors such as: type of work practice, job task frequency and duration, and proximity to the crude oil or impacted areas. Therefore, worker exposure samples will be collected on a representative population of the Environmental Field Specialist and Clean-up Technician SEGs for the COPCs.

The Incident Management and Field Supervision SEGs require no personal exposure samples to be collected. However, real-time monitoring will be used where applicable to supply workers from these SEGs exposure information during their presence in the field.

3 Sampling Methods

~~T~~wo methods are being used to evaluate worker exposure, real-time monitoring and worker exposure sampling. These methods are described in sections 3.1 and 3.2 below.

3.1 Real-time Monitoring

Real-time air monitoring will be used in the work area to protect workers by assessing airborne concentrations of the COPCs in real-time. Air monitoring personnel will be equipped with hand-held instruments that provide instantaneous measurement of COPCs so that controls may be implemented in rapid fashion to limit unnecessary exposure.

The term "real–time" refers to direct reading instruments that allow nearly instantaneous determinations of a chemical concentration in air. Real-time measurements provide immediate information for worker scenarios and, with the use of appropriate site safety measures, help prevent exposures.

Real-time monitoring shall be conducted using the Rae Systems UltraRAE and MultiRAE Plus PID, and the Gastec GV-1000 piston pump with colorimetric tubes; AreaRAEs will be available for deployment if needed.

The MultiRAE plus PID will be equipped with oxygen and LEL sensors. MultiRAEs deployed in the work area may also be equipped with Hydrogen Sulfide (H2S) chemical specific sensors.

Table 3.0 Summary of Real-time Instrument Detection Limits

Instrument	Analyte	Detection Limit
UltraRAE 3000 (9.8 eV)	Benzene	0.05 ppm
AreaRAE & MultiRAE PID (10.6 eV)	Benzene	0.053 ppm
AreaRAE & MultiRAE PID (10.6 eV)	VOC	0.1 ppm
RAE Systems Oxygen Sensor	Oxygen	0.1%
RAE Systems LEL Sensor	LEL	1%
RAE Systems	Hydrogen Sulfide	0.1 ppm

Photo Ionization Detectors

MultiRAEs and AreaRAEs are used to measure airborne concentrations of volatile organic compounds (VOCs). Photo ionization is a nondestructive technique that is somewhat specific through selection of ultra-violet (UV) lamps of varying energies. PIDs use high energy UV light from a lamp housed within the detector to provide energy needed for ionizing VOCs. Ions are collected in an ionization chamber with accelerating and collecting electrodes designed to measure current. Current produced during VOC ionization is proportional to VOC concentrations.

PIDs are not specific for any chemical, but can be applied specifically to benzene using the RAE Systems published correction factor of 0.53 for benzene. The presence of atmospheric humidity and other VOCs may be problematic while using the detectors. PIDs often need to account for background readings and need to be coupled with other real-time instruments.

Colorimetric Detectors

Gastec colorimetric detector tubes will be used to determine concentrations of analytes of concern that can be found in crude oil. Gastec detector tubes contain detecting reagents specifically designed to detect the target chemical. These thin glass tubes have printed calibration scales, which allow the user

to directly read airborne concentrations of the substances being measured. Gastec detector tubes are hermetically sealed, the inner diameters are controlled, and detecting reagents with long-term stability are selected. All detector tubes undergo stringent quality control, and each production lot is independently tested and calibrated.

3.2 Worker Exposure Sampling

Worker exposure to benzene, toluene, ethyl benzene and xylene (BTEX) and hexane will be evaluated using an organic vapor monitor (OVM) badge placed in the worker's breathing zone. These analytical samples will be collected on the 3M 3500/3520 organic vapor monitor (OVM) badge or equivalent and analyzed for BTEX and hexane using gas chromatography flame ionization detector (GC/FID) in accordance with the National Institute for Occupational Safety and Health (NIOSH) air sampling method 1500/1501 (Appendix A). The OVM badge is a passive dosimeter, composed of a permeation membrane and activated charcoal sorbent media, which collects air samples at a flow rate controlled by the physical process of diffusion. Collected samples will be logged and shipped to an AIHA accredited laboratory for subsequent analysis.

Once analyzed, the time-weighted average (TWA) concentration will be calculated for samples with positive detections of BTEX to determine if the worker's exposure meets or exceeds the established exposure limits

4 Action Level Exceedances

In the event that concentrations of the COPCs exceed site action levels, appropriate action will be taken to reduce or eliminate worker exposures. Methods of controlling exposure include administration controls as well as respiratory protection. Administrative controls used include: site-wide communication of action levels, area barricades, and worker egress. Site control may be established to prevent un-protected workers from entering the designated areas without the appropriate level of personal protective equipment. Access to any affected area will be limited to workers with appropriate respiratory protection. Workers with respiratory protection must meet the criteria documented in 29 CFR 1910.134, and discussed herein:

- Must have medical clearance to dawn the designated respiratory protection for the affected area,

- Must have been trained on proper use of the selected respiratory protection,
- Must have been fit-tested resulting in a satisfactory fit for the respirator being used within 1 year, and
- Must be trained on the maintenance and storage of the respiratory being used.

5 Quality Control

Each sample date represents one sample delivery group (SDG). With each of the five SDGs, five field blanks were submitted for quality control purposes. The results of the quality control testing can be found at the end of each lab report included in Appendix B

Appendix A

NIOSH Method 1500/1501