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U.S. Department of Energy, Office of River Protection Occupational Health Data Review

Incidence and Risk of Central Nervous System Disorders (ESQ:RLU 11-ESQ-95, 08/11/11)

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Office of River Protection

P.O. Box 450
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U.S. DEPARTMENT OF ENERGY, OFFICE OF RIVER PROTECTION
OCCUPATIONAL HEALTH DATA REVIEW

INCIDENCE AND RISK OF
CENTRAL NERVOUS SYSTEM DISORDERS

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Concurrence: _____ 8/11/11
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Executive Summary

The U.S. Department of Energy, Office of River Protection (ORP) provides oversight of the contractors' occupational health programs, to assess any early indications of adverse conditions. Oversight efforts are ongoing, however, the recent death of a former Hanford worker diagnosed with chronic toxic encephalopathy and indications of causative occupational exposures has prompted a special, comprehensive review. The overall objective of this study was to screen any possible indicators of concern, concurrent to seeking information or technology that can be used to improve program performance. The methodology included the identification and review of monitoring data for possible causative chemical agents, a review of Hanford Tank Farms (TF) and 222-S Laboratory health trending and mortality studies, and a review of workers compensation statistics.

Over 12,000 personal samples were collected from TF and Lab workers over the last ten years for the principle Chemicals of Potential Concern (COPC) which were identified as having the potential to cause toxic encephalopathy or other Central Nerve System (CNS) disorders. Four of the samples (all lead) were above the Occupational Exposure Limit (OEL) and in each case, proper respiratory protective equipment was utilized. Cumulative data for COPC vapors with similar effects were reviewed and demonstrate the total, effective exposure is significantly below the additive effects unity of the OELs, as were the same for recent grab samples. The data strongly suggests an absence of overexposure within the ten year period reviewed. Mercury vapor is a known cause of toxic encephalopathy and a reappearing point of concern by stakeholders. A review of medical surveillance reports since 2000 to present indicate no blood samples exceeded the Biological Exposure Indices for mercury, thereby validating the workplace mercury vapor monitoring data and controls.

A total of 16,867 claims filed under DOE self-insurance from 2000 to May 31, 2011, were reviewed. Of this total, five claims have been made for neurological complaints. Four of the five claims for neurological conditions were denied by Washington State Labor and Industries on the basis that the medical evidence did not support causality between the diagnosed condition and the work place. One claim was accepted. That claim is the basis for this study. Additionally, results of mortality statistics for former Hanford workers indicated 6 of 266 recorded deaths were due to some form of brain disorder. However, encephalopathy was not identified as a cause of death. The Standard Mortality Ratio for worker's deaths due to CNS disorders at Hanford was 0.75 or 75% of expected. The results of this study have not identified any indicator suggesting work at TF and/or Lab poses an elevated risk to workers of CNS disorders. ORP acknowledges that working with chemicals and waste clearly represents a potential risk of a serious nature. Furthermore, ORP and the professional Industrial Hygiene (IH) community recognize that individual sensitivity to chemicals is variable, due to genetics or pre existing conditions, which drives the ORP IH program to reduce exposures as low as reasonably achievable. This report describes additional actions and suggested screening considerations to further protect the workforce.

Table of Content

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AMH	AdvanceMed Hanford
ATSDR	Agency for Toxic Substance and Disease Registry
BEI	Biological Exposure Indice
CNS	Central Nervous System
COPC	Chemicals of Potential Concern
DEET	N,N-diethyl-meta-toluamide
DOE	U.S. Department of Energy
GC/MS	gas chromatograph/mass spectrophotometer
HEHF	Hanford Environmental Health Foundation
IH	Industrial Hygiene
NIOSH	National Institute for Occupational Safety and Health
NS	Nervous System
OEL	Occupational Exposure Limits
ORP	Office of River Protection
RL	Richland Operations Office
SMR	Standard Mortality Ratio
SOMD	Site Occupational Medicine Director
TF	Tank Farms
TFW	Tank Farm Worker
TLV	Threshold Limit Value
TOC	Tank Farms Operations Contractor
TWA	Time Weighted Average
VOC	Volatile Organic Compound

1.0 PURPOSE, OBJECTIVES, AND BACKGROUND

1.1 Purpose

The U.S. Department of Energy (DOE), Office of River Protection (ORP) provides oversight of the contractors' occupational health programs, which involves the integrated activities of both Industrial Hygiene (IH) and occupational medicine, to assess any early indications of adverse conditions. Oversight efforts are ongoing, however, the recent death of a former Hanford worker diagnosed with chronic toxic encephalopathy, has prompted a special, comprehensive review. The purpose of this effort is to review a broad spectrum of occupational health data, for the purpose of identifying any indications that there may be existing deficiencies with the Tank Farm (TF) Industrial Health Program, and/or means of improving the protection of the workers. ORP acknowledges that cleanup activities are potentially very dangerous and consistent vigilance is warranted in the analysis of existing information and pursuit of additional scientific and medical information or technologies for consideration of improved program performance.

1.2 Defining Encephalopathy

What is Encephalopathy?
"Encephalopathy is a term for any diffuse disease of the brain that alters brain function or structure. Encephalopathy may be caused by infectious agent (bacteria, virus, or prion), metabolic or mitochondrial dysfunction, brain tumor or increased pressure in the skull, prolonged exposure to toxic elements (including solvents, drugs, radiation, paints, industrial chemicals, and certain metals), chronic progressive trauma, poor nutrition, or lack of oxygen or blood flow to the brain. The hallmark of encephalopathy is an altered mental state. Depending on the type and severity of encephalopathy, common neurological symptoms are progressive loss of memory and cognitive ability, subtle personality changes, inability to concentrate, lethargy, and progressive loss of consciousness. Other neurological symptoms may include myoclonus (involuntary twitching of a muscle or group of muscles), nystagmus (rapid, involuntary eye movement), tremor, muscle atrophy and weakness, dementia, seizures, and loss of ability to swallow or speak. Blood tests, spinal fluid examination, imaging studies, electroencephalograms, and similar diagnostic studies may be used to differentiate the various causes of encephalopathy" – "The National Institute of Neurological Disorders and Stroke, National Institutes of Health, US Department of Health and Human Services."

Encephalopathy caused by prolonged exposure to chemical toxicants is classified as toxic encephalopathy. The results of an ORP screening of approximately 200 related articles from the Centers for Disease Control, suggest the most commonly cited toxicant causes of this rare disorder are lead, mercury, N,N-diethyl-meta-toluamide (DEET), and organic solvents; all of which have been used at Hanford.

1.3 Objective

This study is directed at reviewing exposure data, workers compensation data, medical surveillance input, and results of Hanford epidemiology studies. The Hanford Occupational Health process consists of two key interdisciplinary elements of interest in this review: industrial

hygiene and medical surveillance. The medical surveillance program is devoted to the early detection of overexposure and health effects. The IH program is devoted to hazard recognition, exposure monitoring, and associated control measures. The programs are intended to be integrated through a reciprocal process of informational exchange, so both clinicians and field safety personnel are knowledgeable of worker exposures and potential clinical manifestations of those exposures. This status of integration was also subject to review in the course of this effort.

The objective of this data review was to assess the overall viability of the consolidated occupational health programs in support of TF and the 222-S laboratory, relative to the prevention of disorders of the nervous system. It was conducted from June 15, 2011, to July 22, 2011. This surveillance is not an exhaustive study, but rather a review of all readily obtainable data and indicators of program status relative to the incident rate and risk of central nervous system disorders, for immediate consideration by ORP managers.

2.0 Assessment Methodology

The methodology was jointly developed in conjunction with the Hanford Site Occupational Medical Director, the Medical Risk Communicator, and the Director of the Verification and Confirmation Division. In addition, the review team consulted the DOE Chief Medical Officer, a senior DOE epidemiologist, and senior TF Contractor IH staff. The review team employed a phased approach to meeting the objectives as follows:

2.1 Phase I (June 15 through June 29, 2011) "Identify and review worksite chemical exposures which may cause NS disorders"

1. Compilation of a list of all chemical vapor constituents identified in the head space of tanks which are 1% or more of the associated occupational exposure limit.
2. Review each of these constituents against published sources, including the American Conference of Governmental Industrial Hygienists (ACGIH) "TLV booklet" and identify all those which reportedly impact the target organ systems associated with adverse effects of the Nervous System (NS).
3. Review the ACGIH publication "Documentation for TLVs," for all chemicals identified as having the potential to impact the Central Nerve System (CNS) and further identify those that may cause degenerative brain disease.
4. Of those that impact the NS, further identify those that are associated with CNS damage and specifically toxic encephalopathy.
5. Conduct a data search in the TF IH Data Base for those Chemicals of Potential Concerns (COPC) which impact the CNS and specifically the brain; note the range of data per unit time (e.g. per year or other as appropriately represented). The TF IH data base is a compilation of IH survey reports since 2005, searchable by COPC, period of time and/or type of survey.
6. Conduct a data search of the Hanford IH Data Base by Chemical Agent and facility. This data base contains archived IH data for all of Hanford, including TF IH data which precedes the TF IH system.

2.2 Phase II (June 22 through June 30, 2011) "Evaluate the prevalence of suspected NS Disorders"

1. Evaluate the prevalence of suspected occupationally induced NS disorders amongst TF and 222-S workers by request and analysis of Hanford workers compensation case studies from DOE Hanford Workers Compensation Office, for associated claims.
2. Search and review health studies which specifically address the Hanford worker population.
3. Review and consolidate any pertinent results associated with CNS and Brain Damage.

2.3 Phase III (July 5 through July 15, 2011) "Request Medical & IH Responses"

1. Provide Draft results to the Occupational Medicine, DOE Richland Operations Office (RL) Workers Compensation, DOE medical/epidemiological, and senior TF IH staff for factual accuracy assessment, additional ideas, and comment.

2.4 Phase IV (July15 through July 22, 2011) "Report results and recommendations."

3.0 Results

3.1 Identification of worksite chemical exposures which may cause NS disorders

The surveillance team reviewed information from stakeholder organizations, academia, and governmental organizations for the purpose of compiling a list of COPCs specific to affecting the CNS or specifically, the brain. Two reports were identified in the process. A 1997 report by the Center to Protect Worker's Rights, entitled "Surveillance of Former Construction Workers at Hanford: A Needs Assessment" identified lead and mercury as two primary NS causative agents that warrant medical surveillance. These same agents were identified in a University of Washington report, as were organic solvents including toluene and ketones.

The team expanded on this list through the compilation and review of the 143 TF, tank head space constituents that have been measured at 1% or higher, of each respective chemical's Occupational Exposure Limit (OEL). Note: the TF sampling program is based on 59 COPCs which meet or exceed a 10% of OEL screening value. A literature search was conducted to ascertain the target organ effects of each of the 143 chemicals (Appendix A) in various texts, including the ACGIHs Threshold Limit Values (TLV) booklet and the "2010 Documentation of TLVs and "Biological Exposure Indices" publication. This exercise resulted in the selection of the chemical constituents identified in Table 1, which may have the potential to contribute to NS disorders of some nature.

Table 1
TF Vapors measured at 1% of the OEL of higher related to NS disorders

Chemical	Primary Target Organ/Disorder	Informational Source(s)
Mercury	CNS	CNS per National Institute for Occupational Safety and Health (NIOSH) Pocket Guide Page 193 ACGIH States the TLV "is

		intended to minimize the potential for preclinical **central nervous system changes** and kidney effects"
Nitrous Oxide	CNS	CNS per ACGIH TLV Booklet. ACGIH states the TLV "is intended to minimize the potential for adverse effects on the reproductive, hematologic **and nervous system…**"
N hexane	Peripheral nerves and Brain	NS per NIOSH Pocket Guide Page 162, ACGIH TLV states the TLV "is intended to minimize the potential for **neurotoxic effects**, narcosis, and eye and mucous membrane irritation."
1,3 Butadiene	Carcinogen	CNS per NIOSH Pocket Guide. Page 35 ACGIH States: "the recommended TLV is intended to minimize the potential for cancer" & "There is likewise little concern for specific target organ toxicity at exposure levels likely to encountered in the workplace."
Carbon tetrachloride	Liver damage	CNS Per NIOSH Pocket Guide. Page 55, & CASARETT & DOULL'S TOXICOLOGY: The basis science of poisons. Fifth Edition Page 468 & ACGIH. TLVs "values are intended to minimize the potential for hepatotoxicity."
Benzene	Carcinogen	CNS per NIOSH Pocket Guide, Page 26, TLV is recommended by ACGIH "to minimize' the potential for leukemogenesis."
Tetrahydrofuran	CNS (and others)	CNS per NIOSH Pocket Guide Page 302, U.S. Department of Labor (OSHA) Gov ACGIH states that "A TLV-TWA of 50 ppm is recommended for occupational exposure to tetrahyrofuran to protect against irritation to respiratory tract mucous membrane, nephropathy, liver cell proliferation and CNS effects."
Methyl bromide	Irritant	CNS per NIOSH Pocket Guide Page 201 ACGIH States: "This value (TLV) is intended to minimize the potential for skin and respiratory tract irritation."

The review team also conducted a general literature search of industrial chemicals associated with CNS disorders, as a means of identifying other unique chemicals that may have an application at TF or 222-S and should be considered in this review, although not necessarily associated with tank waste. Those chemicals are:

Table 2
Industrial Chemicals most commonly associated with CNS Effects

Chemical	Source	Target Organ/Disorder	Informational Source(s)
Lead	Shielding, weights, misc.	Brain, peripheral nerves	ACGIH, NIOSH (multiple references)
Arsenic trioxide	Preservatives, pesticides, reagent, and manufacturing of glass and ceramics.	Encephalopathy (cerebral edema)	Agency for Toxic Substance Disease Registry (ATSDR): Medical Management Guidelines for Arsenic Trioxide
Organic Solvents,	Paints, adhesives, cleaners, etc.	Mild (Class II) or severe, Class III Encephalopathy	NIOSH Current Intelligence Bulletin March 31, 1987; (WHO Class III

			disorder only observed in self-induced inhalation (abuse)
Cholinesterase inhibitors	pesticides	Chronic neurotoxicity	ATSDR Cholinesterase Inhibitors: Including Pesticides and Chemical Warfare Nerve Agents Course: WB1102 CE October 2007
DEET	insect repellent		ATSDR, 2001 Centers for Disease Control, Morbidity and Mortality Weekly Report, October 6, 1989.

3.2 Evaluation of Exposure Records for Chemicals of Concern

ORP Selected all tank vapor COPCs identified in Section 3,1 as having some indication of relationship to CNS disorders plus lead, and consolidated data for both organic solvents (including chlorinated solvents) and pesticides for IH Data reviews. Table 3 summarizes the results of that effort. Appendix B contains examples of IH report runs for personal exposure results. The example in Appendix B depicts the results of a search for exposure monitoring results specific to: 1) lead, mercury and nitrous oxide; and 2) organic solvents from the TF IH data base, 2000 to 2011. The data summarized, represents personal samples collected over a time weighted average for the full working shift. Many shifts are less than 2 hours in duration and few exceed 6 hours due to the logistics of a controlled, nuclear waste site.

Table 3
Summation of IH Personal Exposure Records for COPC
January 2000 to June, 2011, TF and 222-S

COPC & Time Weighted Average (TWA) OEL	Number of samples collected	Number (%) above detection limits	Number of samples exceeded OEL *note Respirator Use	Highest Reported Exposure [TWA] (% of OEL)
Lead, 0.050 mg/M3	182	24 (11%)	4* (2004, lead wool gasket installation and removal with HEPA PAPR respirators used	TF:0.045 mg/M3 (90% OEL) Other: 0.14 mg/M3 280% OEL **(exposure effectively reduced to de minimis by PPE)**
Elemental Mercury, 0.025 mg/M3	2,269	67 (3%)	0	0.019 mg/M3 (76% OEL)
Nitrous Oxide, 50 ppm	2,682	1,179 (44%)	0	6.99 ppm (14% OEL)
Tetrahydrofuran, 50 ppm	286	37 (13%)	0	0.189 ppm (0.4% OEL)
Total organic Solvents listed, OELs variable	6,713	330 (5%)	1 (methylene chloride)	25.649 (104% of OEL)
Pesticides, DEET	No data	No data	No data	No data

Additive and synergistic effects

The identification of potential additive and synergistic effects of exposure to the TF COPCs listed and other trace chemicals present in TF units is essentially not feasible, due to the number of variants and long term research requirements, per ORP's discussion with representatives of NIOSH. However, approximately 39% of the TF COPCs selected for this review are also found in gasoline. There is literature on the additive effects of petroleum hydrocarbons as gasoline (a mixture of up to 250 different paraffinic, olefinic, and aromatic hydrocarbons) and potential impacts to the CNS. ACGIH has established a TWA OEL for gasoline which takes into account the toxicity of the mixture. The TWA OEL of 300 parts per million, total hydrocarbons was established "to minimize the potential for eye, mucous membrane and upper respiratory tract irritation;" (ACGIH). Additionally, ACGIH has established a short term exposure limit of 500 ppm for gasoline which "is intended to minimize the potential for acute depression of the central nervous system." It is noteworthy that ACGIH also reports an odor threshold of 0.25 ppm for gasoline. Petroleum hydrocarbons, particularly 1,3, butadiene, are believed to be the primary source of TF odors, based on the consistent identification of trace concentrations of these constituents at concentrations above reported odor thresholds. TFs has a standing policy of monitoring volatile organic compounds in totality with a real time meter (photoionization detector) and an associated action level of 2.0 ppm as a conservative approach to account for the variability of mixed Volatile Organic Compounds (VOC). The monitoring of VOCs receives considerable attention in the field by IH technicians due to the high vapor pressure characteristics of this group of COPCs relative to others. It also serves as a general indicator of total tank vapors at work sites in real time. This real time monitoring procedure and associate data is analyzed in conjunction with a spectrum of chemical specific personal monitoring data (Appendix B), other chemical specific monitoring results (e.g. mercury vapor), and the semi quantitative identification of VOCs in grab samples processed by HAPSITE® analysis (Appendix C). The results of this analysis demonstrate the presence of approximately 5-10 VOCs above detection limits (20 parts per billion), at personnel receptor sites. This collective approach provides conservatively sound confirmation that the known additive effects of organic solvents are significantly below individual and additive group OELs.

Additive and synergistic effects are also addressed through the Hanford medical surveillance program and trending reports. Physicians review test results for liver functions, urinalysis, blood chemistry and other test data in conjunction with the performance of a physical examination as a means of evaluating overall health status and screening for indicators of chemical and physical exposures from any single or combination of stressors. This is performed annually and in the event of examinations as a result of abnormal conditions (due to odors and/or symptoms). The results of these tests are now collectively assessed for the tank farm work population in annual trending reports, as noted in this report.

Elemental and Organic Mercury Vapor Differentiation

Both elemental and organic mercury compounds have been detected within the head space of some tanks, at Hanford TF. A study was conducted in 2004 specific to organic mercury and identified the constituents within the tanks of A and C TF, but in concentrations less than 10% of the 0.01 mg/M3 OEL (RPP-RPT-36071, Revisions 0). The nonorganic, or elemental mercury

vapor is however, a primary COPC at several TF. The monitoring of elemental mercury receives considerable attention, based on in its measured presence in excess of 10% or more of the 0.025 mg/M3 OEL within the headspace of some tanks. The monitoring includes personal exposure monitoring through conventional NIOSH methodologies as reflected in this report; area sampling with a Lumex® RA 915+ mercury vapor monitor, and grab sample analysis through the use of the HAPSITE® gas chromatograph/mass spectrophotometer (GC/MS) stationed in the HV2407 IH laboratory. Personal sampling for organic mercury vapor has not been conducted for TF workers, as the amount of vapor at the source, does not meet the administrative level of concern, i.e. it is less than 1% of its OEL within the headspace of tanks. The team contacted the OhioLumex Company and confirmed that the Lumex monitor used at TF is specific to elemental mercury and does not detect organic mercury. However, a review of the technical manual confirmed the HAPSITE GC/MS is capable of detecting organic mercury, but not elemental mercury. In effect, although the IH program does not provide direct sampling of organic mercury compounds, there is a process for screening grab samples collected in the course of abnormal operating conditions or events of interest for potential exposures. It is noteworthy, that CSC, the Hanford Occupational Medicine Provider, conducts biomonitoring of TF workers for total mercury, in both blood (short half life) and urine (long half life), as a means of testing for both elemental and organic mercury. CSC utilizes the Centers for Disease Control benchmark of 10 ug of mercury per liter of blood as a more conservative indicator of mercury exposure relative to the ACGIH Biological Exposure Indice (BEI) of 15 ug/L. The BEI was developed specifically for occupational settings, as it correlates with the elemental mercury OEL.

3.3 Results of DOE Worker Mortality Study

One study was identified, by the Center for Protection of Worker's Rights, which involved the review of former DOE construction worker mortality records from 1996 to 2005. The study published in the American Journal of Industrial Medicine, identified the cause of death, for a cohort of 8,976 former workers at Hanford, Oak Ridge, the Savannah River Site and the Amchitka site. It included nervous system disorders as a categorical cause. The results identified in Table VI of that publication indicate a total of 18 deaths due to NS disorders, of an expected 23.87. The resulting standard mortality ratio for the total group is lower than expected at 0.75. ORP contacted the author of the study and requested the NS related death statistics for former Hanford workers. The Hanford statistics were nearly identical to the group as a whole. The following information with qualifiers was provided:

"We examined the group with Nervous System Disorders in our mortality study. There were 18 such cases; of these cases 6 had been employed at Hanford, as shown in the table." "Ours was a small mortality study unlikely to yield significant data in relationship to your questions. Our study was based on 2,779 Hanford workers who had participated in our medical screening program (www.btmed.org) before December 31, 2004. Of these, 266 had a recorded death in the National Death Index. An Independent Health Panel assembled by CH2M Hill Hanford Group, Inc. (in) which Dr. XXX (redacted) reviewed medical screening data on the more than 5,000 tank farm workers who as of 2004 had undergone medical surveillance as part of the occupational medical service for tank farm workers."

Table 4

Mortality Data for Hanford involving CNS related causation

Site	Cause	Gender	Race	Age	DOD	Cause_Death (ICD)	Cause_Death_description
H	52	Female	White	75	2002	G30.9	Alzheimer's disease, unspecified
H	52	Male	White	85	2004	G30.9	Alzheimer's disease, unspecified
H	52	Male	White	80	2001	G20	Parkinson's disease
H	52	Male	White	80	2003	G30.9	Alzheimer's disease, unspecified
H	52	Male	White	70	2004	G93.1	Anoxic brain damage, not elsewhere classified
H	52	Male	White	85	2001	G20	Parkinson's disease

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3.4 Review of TF Medical Surveillance Studies

- A TF Medical surveillance report for the period of 2000 through 2002 (Brady, Hanford Environmental Health Foundation [HEHF], January 27, 2003) discusses the need for case management for workers reporting tank vapor symptoms and basic surveillance data, but there is no specific indication that chemical biomonitoring was conducted for any COPC, including mercury, organic solvents, or lead during that period.
- The low mercury biological indicator data is consistent with the 2006 Site Occupational Medical Director (SOMD) Report on Epidemiology Surveillance.
- A recent Health Trending Report for Tank Farm Workers (June 23, 2010) was performed by AdvanceMed Hanford (AMH) for the period of October 2008 through March 2010, and included an assessment of mercury biomonitoring results. This analysis and reporting is now conducted annually. Over 2,200 test results for both blood and urine mercury tests for the period of October 1, 2008, through March 31, 2010, were included in the analysis. The mean values of these tests, 3.3 ug/L and 0.6 ug/L respectively, were both well below the laboratory reference range value of 10 ug/L. The positive rate remained low, at or below 1%, for most tests. CSC (formerly AMH) utilizes the Centers for Disease Control and Prevention reference level of 10 micrograms per liter of blood as opposed to the less conservative ACGIH BEI of 15 ug/L for blood mercury. No test results exceeded the BEI. The BEI value is "intended to prevent the symptoms of mercurialism including gingivitis, tremor, erethism and nephrotoxicity." It is not known if those workers in the higher bracket reflect a partial or total intake of mercury from dietary, background sources or occupational exposures without consulting the examining clinicians. The "ACGIH Documentation of TLV's and BEIs" clarifies "A significant amount of organic mercury can be ingested in food."

- The Health Trending Report for TF Workers (June 23, 2010) also addressed IH sampling data analysis relative to worker reports of odors symptoms from tank vapors. The following table summarizes the relationship:

"All industrial hygiene sampling measurements reported were below the action levels (AL) and below 10% of the occupational exposure limits (OELs). All dates with detectable levels of nitrous oxide also included reports of throat irritation, while the one date without nitrous oxide did not (Table 23). The dates with a larger number of substances detected tended to have a larger number of symptoms reported. The larger number of substances detected is reported by WRPS to be the result of enhancing the industrial hygiene investigative response process. There did not appear to be any correlation between the level of any substance detected and the presence of any specific symptom."

Table 5

Substances detected and symptoms reported at AMH following potential exposure incidents at TFs by date, 01/01/2010 through 03/31/2010

Date	Area or Representative Sample	Substance Detected	Result	Symptoms
1/4/2010	Area	Mercury	0.000004 mg/m3	headache, metallic taste, eye irritation
		Volatile Organic Compound (Species)	<20 ppb	
1/25 & 26 /2010	Area	Nitrous Oxide	0.854 ppm	burning lips/mouth/nose (3), headache (4), throat irritation (4), metallic taste (2), tinnitus, chest pain/pressure, abdominal cramping, eye irritation, nausea
		Mercury	0.000015 mg/m3	
		Volatile Organic Compound (Total)	0.775 ppm	
		Volatile Organic Compound (Species)	<20 ppb	
	Representative	Ammonia	0.012 ppm	
		Nitrous Oxide	0.772 ppm	
1/28/2010	Area	Mercury	0.000022 mg/m3	nasal irritation, eye irritation, metallic taste (4), headache (4), mouth/lip numbness (2), chest pain/pressure
		Nitrous Oxide	0.3 ppm	
		Volatile Organic Compound (Total)	1.2 ppm	
		Volatile Organic Compound (Species)	<20 ppb	
	Representative	Ammonia	0.036 ppm	
2/1/2010	Area	Nitrous Oxide	0.428 ppm	Throat irritation, cough
	Representative	Ammonia	0.052 ppm	
		Nitrous Oxide	0.587 ppm	
2/24/2010	Area	Ammonia	0.088 ppm	Headache (3), throat irritation, nausea (2), uvulitis
		Nitrous Oxide	1.207 ppm	
		Mercury	0.000013 mg/m3	

		Volatile Organic Compound (Total)	0.256 ppm	
		Volatile Organic Compound (Species)	<20 ppb	
3/6/2010	Area	Mercury	0.000002 mg/m3	headache
		Volatile Organic Compound (Species)	<20 ppb	

3.5 Results of ORP Worker Compensation Claim History Review

Workers compensation claims for over 70 Hanford contractors, including the Pacific Northwest Laboratories are managed by DOE RL. The total number of claims with activity under DOE self-insurance from 2000 to May 31, 2011, is 16,867. Of this total, 181 claims were associated with brain/head/neurological conditions of some nature. Of the 181 claims, five claims have been made for neurological complaints. Four of the five claims for neurological conditions were denied by Washington State Labor and Industries on the basis that the medical evidence did not support causality between the diagnosed condition and the work place. One claim was accepted based on: 1) medical evidence that supported causality between the diagnosed condition and specific exposures at the work place; and 2) the elimination of non occupational conditions commonly associated with causation of the disorder. The individual worked during a period of minimal exposure monitoring efforts and an absence of personal exposure monitoring data. One of the four cases denied, is currently before the Board of Industrial Insurance Appeals.

3.6 Follow up and Recommendations from IH, medical and Workers Compensation reviewers

A senior epidemiologist in DOE's Office of Health and Security: "HS-13 is currently conducting an assessment of morbidity among Tank Farm Workers (TFW) compared with non TFW from 2004 (the year IISP first has monitoring code data that identifies TFW) through 2010. A very preliminary, look at TFW compared to non-Tank Farm Workers (non-TFW) for the years 2004-2008. The study was conducted in 2009 and showed an increase in absenteeism among TFW. Between 14-19 percent of TFW missed work compared to 6-9 percent of non-TFW. A review of diagnoses among the two groups showed an excess of nervous system and sense organ diagnoses in TFW from 2003-2006. Absences due to cancer was also elevated among TFW compared to non-TFW 2005-2008. Absences due to injuries and poisonings were higher in TFW for the years 2004-2007. TFW had a higher percentage of "symptoms, signs and ill defined conditions" (such as dizziness, giddiness, and vertigo) in 2004, 2007, and 2008. Again, it is important to note that these findings are only preliminary and the current analyzes will show more detail."

DOE Medical Director: Occupational health organizations such as ACGIH clearly acknowledge that exposure limits are set to protect most, but not all workers, as some individuals have a greater susceptibility to health effects than others. This may be due to genetic disposition, and/or presence of preexisting conditions. ORP has a legal right and responsibility to provide worker protection for individuals presenting high susceptibility.

Hence, baseline medical examinations for TFW should consider screening liver function tests for evidence of viral or alcohol-induced hepatitis. Employers can legally remove workers with greater susceptibility that constitute a "direct threat" to themselves by working in an environment with potential to aggravate a pre-existing illness of this type.

Center for Protection of Worker's Rights, in reference to the "Mortality of Older Construction and Craft Workers Employed at Department of Energy Nuclear Sites: One suggestion from that investigation was a mortality study of this population. I don't know if it has been undertaken, but it would be worth doing."

4.0 Key Points

There have been five Hanford worker claims submitted to DOE's self-insurance compensation program for neurological complaints since the year 2000, of which one case was deemed compensable. The accepted claim was classified as occupationally induced toxic encephalopathy. The acceptance was based on medical evidence that supported causality between the diagnosed condition and specific exposures at the work place. In addition to the elimination of non occupational conditions commonly associated with causation of the disorder.

The results of a query for all listed chemical exposure data reports has confirmed that no personal exposure data for any of the COPCs identified in this study are above OELs. Additionally, the results of a cursory screening of data and application of the ACGIH Additive Mixture Formula for all COPC VOCs strongly suggest the total VOC exposures at TF are significantly below additive effects unity of the individual exposures relative to the OELs.

An assessment of representative grab samples collected during off normal events suggests the potential additive effects due to potential concurrent exposure to multiple organic solvents, are significantly below any individual or additive OELS for those test results reviewed. ORP acknowledges that logistics interfere with the ability to collect a sample which is truly representative of spontaneous conditions. However, the vast number of samples collected and the relative consistency of the results suggest a sound characterization of the environment. A special effort is underway by the Tank Farms Operations Contractor (TOC) IH program in cooperation with a Hanford Concerns Council Independent Review Panel to improve and analyze the data to add assurance to the process.

The results of an independent review of mortality statistics for former Hanford workers did not identify encephalopathy as a specific cause of death. However, 6 of 266 recorded deaths of former Hanford workers were due to some form of brain disorder. In this limited study, the Standard Mortality Ratio (SMR) for worker's deaths due to NS disorders was 0.75 or 75% of expected. This SMR of 0.75 is consistent with the numbers recorded for the five DOE sites included in the study.

The results of a review of medical surveillance reports since 2000 to present indicate no blood samples exceeded the BEI for mercury. A small (0.15%) number of the results exceeded Center for Disease Control recommendations for the public. Results of individual TFW blood lead

levels has not been collectively compiled, as lead is not a predominant COPC at TF or 222-S laboratory per sampling results. However, blood lead levels are assessed on an individual basis.

The technology available for medical surveillance monitoring specific to many individual organic solvents is available, although challenging to capture and process. There are biokinetic models for many VOCs to enable reconstruction of exposure based upon bioanalyses, as warranted. However, the level of measured exposure is significantly below thresholds which would warrant such testing. Therefore the medical surveillance program is designed to track general indicators of possible adverse exposure such as liver function tests. However, as solvents may damage the liver (and brain), so may alcohol, pathogenic organisms, and systemic disease.

Organic mercury vapor has been identified within A and C TF in what is described as significantly less than 1% of the OEL. Clarification on the speciation and concentrations of organic mercury vapor and any HAPSITE data points is a follow up action for ORP IH to assess the possible need to better characterize or eliminate concern for exposure.

5.0 Conclusions and Recommendations to ORP Management

The results of this study have not identified any metric or data that would suggest work at TF under current or recent past conditions contributes to an elevated risk of chronic toxic encephalopathy or any other related conditions. The case that prompted this review is an isolated incident. There is however, an ongoing concern by some individuals and stakeholder organizations that the occupational health program is not fully comprehensive with respect to optimal monitoring of chemical exposures and associated exposure history reporting for workers compensation purposes. This underlying criticism is further fueled by what some perceived to be a toxicologically uncharacterized chemical vapor mix, suspect of a multitude of health risks.

Neither ORP nor any other organization can state with absolute certainty that work under current conditions of residual vapors at TF is risk free. ORP can however, demonstrate that chemical exposures monitored are overwhelmingly well below what is believed to be a safe threshold for "nearly all workers who may be repeatedly exposed day after day, over a working life time without adverse effects" [ACGIH]. The IH data is consistent with the results of medical monitoring and health studies, which collectively demonstrate in the opinion of the ORP IH, a solid baseline occupational health program.

However, ORP seeks to establish an occupational health process which is "best in class" and significant improvements are currently underway within the IH and medical surveillance programs. The IH program is currently implementing 12 recommendations made by the Hanford Concerns Council's IH Independent Review Panel, subject to an assessment in August of 2011. The TOC IH program has also added new procedures and instrumentation to better characterize vapor emissions and response conservatively to fluctuations. The Occupational medicine program is introducing new staff and new technologies including digital X ray equipment. The recommendation to management is to continue the level of support provided to the contractors in their efforts and maintain high expectations for continued improvements. It is equally important

to provide transparency and continue to educate those entities that question the validity of the program, through the support of non bias, 3rd party reviewers.

6.0 References

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- CASARETT & DOULL'S TOXICOLOGY: The basis science of poisons, Fifth Edition, Author: Curtis D. Klaassen, Editors: Mary O. Amdur, Ph.D., John Doull, Ph.D., M.D.
- "Hazardous Materials Toxicology; Clinical Principles of Environmental Health" John B. Sullivan and Gary R. Krieger, Williams and Wilkins, ©1992
- Data Bases

- TF IH Data Base (2005-present)
- Hanford IH Data Base, Chemical Agent and Facility Reports sorted by Facility and Decreasing Exposure levels

- Web Pages:
  - Centers for Disease Control
  - DOE Center Epidemiological Data Research
  - National Institute of Neurological Disorders and Stroke, NIH – US Department of Health and Human Services
  - Agency for Toxic Substance Disease Registry, US Department of Health and Human Services
  - U.S. Department of Labor, Occupational Safety & Health Administration, OSHA.Gov

APPENDIX A
Table of COPCs at 1% or greater of OEL in Headspace

CAS Number	Chemical Name	OEL*	% of OEL measured in tank head space: 10%+;greater than or equal to 10%; 1% less than or equal to 1%
623-87-0	1,2,3-Propanetriol, 1,3-dinitrate	0.05 ppm	10% +
106-99-0	1,3-Butadiene	1 ppm	10% +
3457-91-8	1,4-Butanediol, dinitrate	0.05 ppm	10% +
51595-87-0	2-(2-Methyl-6-oxoheptyl)furan	1 ppb	10% +
717-21-5	2-(3-Oxo-3-phenylprop-1-enyl)furan	1 ppb	10% +
108-47-4	2, 4-Dimethylpyridine	0.5 ppm	10% +
1191-99-7	2,3-Dihydrofuran	1 ppb	10% +
1615-70-9	2,4-Pentadienenitrile	0.3 ppm	10% +
1708-29-8	2,5-Dihydrofuran	1 ppb	10% +
625-86-5	2,5-Dimethylfuran	1 ppb	10% +
1703-52-2	2-Ethyl-5-methylfuran	1 ppb	10% +
645-62-5	2-Ethyl-hex-2-ena	0.10 ppm	10% +
1184-60-7	2-Fluoropropene	0.1 ppm	10% +
591-78-6	2-Hexanone	5 ppm	10% +
1115-11-3	2-Methyl-2-butenal	0.03 ppm	10% +
1647-11-6	2-Methylene butanenitrile	0.3 ppm	10% +
534-22-5	2-Methylfuran	1 ppb	10% +
594-70-7	2-Nitro-2-methylpropane	0.30 ppm	10% +
4179-38-8	2-Octylfuran	1 ppb	10% +
3777-69-3	2-Pentylfuran	1 ppb	10% +
4229-91-8	2-Propylfuran	1 pb	10% +
34314-82-4	3-(1,1-Dimethylethyl)-2,3-dihydrofuran	1 ppb	10% +
78-94-4	3-Buten-2-one	0.2 ppm	10% +
34379-54-9	4-(1-Methylpropyl)-2,3-dihydrofuran	1 ppb	10% +
928-68-7	6-Methyl-2-heptanone	8 ppm	10% +
75-05-8	Acetonitrile	20 ppm	10% +
71-43-2	Benzene	0.5 ppm	10% +
123-72-8	Butanal	25 ppm	10% +
109-74-0	Butanenitrile	8 ppm	10% +
928-45-0	Butyl nitrate	2.5 ppm	10% +
544-16-1	Butyl nitrite	0.1 ppm	10% +
Varies	Chlorinated Biphenyls	0.2 ppm	10% +

78-46-6	Dibutylbutylphosphonate	0.007 ppm	10% +
84-66-2	Diethyl Phthalate	5 mg/m3	10% +
75-04-7	Ethylamine	5 ppm	10% +
110-00-9	Furan	1 ppb	10% +
629-08-3	Heptanenitrile	6 ppm	10% +
628-73-9	Hexanenitrile	6 ppm	10% +
7439-97-6	Mercury	25 ug/m3	10% +
624-83-9	Methyl Isocyanate	20 ppb	10% +
624-91-9	Methyl nitrite	0.1 ppm	10% +
55-18-5	N-Nitrosodiethylamine	0.1 ppb	10% +
62-75-9	N-Nitrosodimethylamine	0.3 ppb	10% +
10595-95-6	N-Nitrosomethylethylamine	0.3 ppb	10% +
110-59-8	Pentanenitrile	6 ppm	10% +
107-12-0	Propanenitrile	6 ppm	10% +
110-86-1	Pyridine	1 ppm	10% +
126-73-8	Tributylphosphate	0.2 ppm	10% +
79-34-5	1,1,2,2-Tetrachloroethane	1 ppm	1%
57-14-7	1,1-Dimethyl hydrazine	0.01 ppm	1%
106-88-7	1,2-Epoxybutane	NA-	1%
75-55-8	1,2-Propylenimine (2-methylaziridine)	NA-	1%
100-97-0	1,3,5,7-Tetraazatricyclo[3.3.1.13,7]decane	NA-	1%
71-36-3	1-Butanol	20 ppm	10% +
106-98-9	1-Butene	NA-	1%
111-70-6	1-Heptanol	NA-	1%
109-67-1	1-Pentene	NA-	1%
71-23-8	1-Propanol	NA-	1%
115-07-1	1-Propene	NA-	1%
115-11-7	1-Propene, 2-methyl-	NA-	1%
78-93-3	2-Butanone (Methyl ethyl ketone)	200 ppm	1%
4170-30-3	2-Butenal	NA-	1%
110-43-0	2-Heptanone	NA-	1%
107-83-5	2-Methylpentane	NA -	1%
79-46-9	2-Nitropropane	10 ppm	1%
107-18-6	2-Propen-1-ol	NA-	1%
126-98-7	2-Propenenitrile, 2-methyl-	NA-	1%
109-75-1	3-Butenenitrile	8 ppm	10%+
106-35-4	3-Heptanone	NA-	1%
814-78-8	3-Methyl-3-butene-2-one	0.02 ppm	10% +
106-68-3	3-Octanone	NA	1%

100-40-3	4-Ethenylcyclohexane	NA	1%
105-42-0	4-Methyl-2-hexanone	0.02 ppm	10% +
75-07-0	Acetaldehyde	25 ppm ©	1%
64-19-7	Acetic Acid (Ethanoic acid)	10 ppm	1%
141-78-6	Acetic acid ethyl ester	NA-	1%
123-86-4	Acetic acid, butyl ester	NA-	1%
67-64-1	Acetone	500 ppm	1%
98-86-2	Acetophenone	NA-	1%
107-02-8	Acrolein (2-Propenal)	0.1 ppm ©	1%
79-10-7	Acrylic acid	2 ppm	1%
7664-41-7	Ammonia	25 ppm	10%+
122-39-4	Benzenamine, N-phenyl-	NA -	1%
101-84-8	Benzene, 1,1`-oxybis-	NA-	1%
3622-84-2	Benzenesulfonamide, N-butyl-	NA-	1%
100-47-0	Benzonitrile	NA -	1%
92-52-4	Biphenyl	0.2 ppm	10%+
109-21-7	Butanoic acid, butyl ester	NA-	1%
75-15-0	Carbon disulfide	10 ppm	1%
56-23-5	Carbon tetrachloride (Tetrachloromethane)	5 ppm	1%
1467-79-4	Cyanamide, dimethyl-	NA -	1%
110-82-7	Cyclohexane	300 ppm	1%
1191-96-4	Cyclopropane, ethyl-	NA-	1%
62108-27-4	Decane, 2,4,6-trimethyl-	NA-	1%
3891-98-3	Dodecane, 2,6,10-trimethyl-	NA-	1%
31295-56-4	Dodecane, 2,6,11-trimethyl-	NA-	1%
61141-72-8	Dodecane, 4,6-dimethyl-	NA-	1%
6117-97-1	Dodecane, 4-methyl-	NA-	1%
64-17-5	Ethanol	1000 ppm	1%
106-93-4	Ethylene dibromide (Dibromoethane)	A3: Animal carcinogen	1%
75-21-8	Ethylene oxide (1,2-Epoxyethane)	1 ppm	1%
107-15-3	Ethylenediamine	NA-	1%
50-00-0	Formaldehyde	0.3 ppm ©	10%+
629-78-7	Heptadecane	NA-	1%
544-76-3	Hexadecane	NA-	1%
108-10-1	Hexone (Methyl isobutyl ketone)	50 ppm	1%
75-50-3	Methanamine, N,N-dimethyl-	NA-	1%
67-56-1	Methanol	200 ppm	10%+
74-83-9	Methyl bromide (Bromomethane)	1 ppm	1%

60-34-4	Methyl hydrazine	0.01 ppm	1%
75-09-2	Methylene chloride (Dichloromethane)	50 ppm	1%
2958-76-1	Naphthalene, decahydro-2-methyl-	NA-	1%
124-18-5	n-Decane	NA-	1%
112-40-3	n-Dodecane	NA-	1%
142-82-5	n-Heptane	NA-	1%
110-54-3	n-Hexane	NA-	1%
1712-64-7	Nitric acid, 1-methylethyl ester	NA-	1%
627-13-4	Nitric acid, propyl ester	NA-	1%
10024-97-2	Nitrous Oxide	50 ppm	10% +
59-89-2	N-Nitrosomorpholine	NA-	1%
109-66-0	n-Pentane	NA-	1%
629-59-4	n-Tetradecane	NA-	1%
629-50-5	n-Tridecane	NA-	1%
1120-21-4	n-Undecane	NA-	1%
629-62-9	Pentadecane	NA-	1%
128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	NA-	1%
123-38-6	Propanal	NA-	1%
108-99-6	Pyridine, 3-methyl-	NA-	1%
123-75-1	Pyrrolidine	NA-	1%
100-42-5	Styrene (Ethenylbenzene)	20 ppm	1%
109-99-9	Tetrahydrofuran	50 ppm	1%
108-88-3	Toluene	50 ppm	1%
75-69-4	Trichlorofluoromethane (Freon 11)	1000 ©	1%
1560-96-9	Tridecane, 2-methyl-	NA-	1%
13287-21-3	Tridecane, 6-methyl-	NA-	1%
17301-27-8	Undecane, 2,10-dimethyl-	NA-	1%
17301-23-4	Undecane, 2,6-dimethyl-	NA-	1%
7045-71-8	Undecane, 2-methyl-	NA-	1%
17301-29-0	Undecane, 3,7-dimethyl-	NA-	1%
1002-43-3	Undecane, 3-methyl-	NAp	1%
75-01-4	Vinyl chloride (Chloroethene)	5 ppm	1%
75-02-5	Vinyl fluoride (Fluoroethene)	500 ppm	1%

***NA= not available**

Appendix B
Example IH Data Reports Reviewed

IH Personal Air Sampling Summary Counts by Limit Type

Agent(s): Lead, Mercury, Nitrous Oxide
From Date: 01/01/2000 **To Date:** 06/01/2011
Percent of OEL: Include All

Data As Of: 06/26/2011, 07:22 PM

222-S TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Lead		11/06/2006 - 04/19/2011	36	16	0.045 mg/m3	0.050 mg/m3
Mercury	X	07/13/2006	1	1	0.0005 mg/m3	0.025 mg/m3

242A EVAP TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	11/17/2004 - 03/24/2005	10	1	0.008 mg/M3	0.025 mg/m3
Lead		06/15/2005 - 08/04/2010	65	0	ND	0.050 mg/m3
Mercury	X	10/11/2006 - 09/28/2010	5	0	ND	0.025 mg/m3
N2O	X	11/17/2004 - 03/24/2005	7	0	ND	50 ppm
Nitrous Oxide	X	10/11/2006 - 02/04/2010	2	1	1.173 ppm	50 ppm

244-A TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Mercury	X	06/07/2005 - 02/01/2007	6	0	ND	0.025 mg/m3
Nitrous Oxide	X	12/23/2005 - 02/01/2007	3	1	0.688 ppm	50 ppm

702-AZ TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Mercury	X	11/20/2009	1	0	ND	0.025 mg/m3

A FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	09/15/2004 - 03/08/2005	13	0	ND	0.025 mg/m3
Mercury	X	04/11/2006 - 05/18/2011	38	1	0.0002 mg/m3	0.025 mg/m3
N2O	X	06/01/2004 - 03/08/2005	20	16	1.641 ppm	50 ppm
Nitrous Oxide	X	04/11/2006 - 05/18/2011	35	17	2.161 ppm	50 ppm

AN FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	11/30/2004 - 12/09/2004	15	0	ND	0.025 mg/m3
Lead		02/11/2010	1	0	ND	0.050 mg/m3
Mercury	X	06/02/2005 - 04/13/2011	205	2	0.0004 mg/m3	0.025 mg/m3
N2O	X	04/30/2004 - 12/09/2004	21	4	1.806 ppm	50 ppm
Nitrous Oxide	X	06/02/2005 - 04/13/2011	189	87	5.961 ppm	50 ppm

AP FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	01/13/2005 - 03/06/2005	4	0	ND	0.025 mg/m3
Mercury	X	04/17/2005 - 01/20/2011	149	3	0.019 mg/m3	0.025 mg/m3
N2O	X	04/30/2004 - 03/06/2005	8	1	1.665 ppm	50 ppm
Nitrous Oxide	X	04/17/2005 - 01/20/2011	161	44	2.624 ppm	50 ppm

AR244 TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Mercury	X	04/10/2009 - 04/15/2009	3	0	ND	0.025 mg/m3
Nitrous Oxide	X	04/10/2009 - 04/15/2009	3	2	0.849 ppm	50 ppm

AW FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	12/07/2004 - 04/10/2005	16	0	ND	0.025 mg/m3
Lead		02/23/2010	1	0	ND	0.050 mg/m3
Mercury	X	04/14/2005 - 02/17/2011	136	2	0.0004 mg/m3	0.025 mg/m3
N2O	X	11/27/2004 - 12/28/2004	12	7	1.275 ppm	50 ppm
Nitrous Oxide	X	11/17/2005 - 02/17/2011	101	45	2.161 ppm	50 ppm

AX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	09/15/2004	1	0	ND	0.025 mg/m3
Mercury	X	06/27/2006 - 01/19/2010	8	0	ND	0.025 mg/m3
N2O	X	06/15/2004	2	2	1.627 ppm	50 ppm
Nitrous Oxide	X	06/27/2006 - 06/24/2010	11	5	1.080 ppm	50 ppm

AY FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	04/05/2005 - 04/26/2005	11	0	ND	0.025 mg/m3
Lead		06/03/2009	1	0	ND	0.050 mg/m3
Mercury	X	05/09/2005 - 02/16/2011	83	0	ND	0.025 mg/m3
N2O	X	04/30/2004 - 04/28/2005	36	18	1.627 ppm	50 ppm
Nitrous Oxide	X	05/09/2005 - 02/16/2011	79	46	2.315 ppm	50 ppm

AZ FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	08/18/2004	10	0	ND	0.025 mg/m3
Mercury	X	06/24/2005 - 04/08/2011	38	0	ND	0.025 mg/m3
N2O	X	04/30/2004 - 08/25/2004	24	5	1.627 ppm	50 ppm
Nitrous Oxide	X	03/24/2008 - 05/10/2011	23	10	1.698 ppm	50 ppm

B FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	11/22/2004	1	0	ND	0.025 mg/m3
Mercury	X	12/20/2006 - 09/06/2010	12	0	ND	0.025 mg/m3
Nitrous Oxide	X	12/20/2006 - 02/08/2011	13	7	2.269 ppm	50 ppm

BX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	04/11/2005 - 04/12/2005	3	0	ND	0.025 mg/m3
Lead		11/03/2009	1	0	ND	0.050 mg/m3
Mercury	X	06/21/2006 - 09/28/2010	29	0	ND	0.025 mg/m3
N2O	X	11/11/2004 - 04/12/2005	6	0	ND	50 ppm
Nitrous Oxide	X	06/21/2006 - 11/17/2010	13	9	1.698 ppm	50 ppm

BY FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	02/17/2005 - 03/31/2005	6	0	ND	0.025 mg/m3
Mercury	X	11/10/2005 - 04/05/2011	44	1	0.0004 mg/m3	0.025 mg/m3
N2O	X	12/07/2004 - 04/17/2005	9	2	1.292 ppm	50 ppm
Nitrous Oxide	X	11/22/2005 - 04/05/2011	38	24	2.213 ppm	50 ppm

C FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	09/07/2004 - 03/31/2005	99	7	0.013 mg/M3	0.025 mg/m3
Lead		03/24/2010	1	0	ND	0.050 mg/m3
Mercury	X	05/12/2005 - 05/05/2011	978	37	0.0008 mg/m3	0.025 mg/m3
N2O	X	04/30/2004 - 04/28/2005	207	97	2.062 ppm	50 ppm
Nitrous Oxide	X	05/12/2005 - 05/05/2011	880	420	6.099 ppm	50 ppm

Cross Site XFR TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Mercury	X	11/19/2010	1	0	ND	0.025 mg/m3
Nitrous Oxide	X	11/19/2010	1	0	ND	50 ppm

ER-311 TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Mercury	X	10/01/2006 - 10/03/2006	4	0	ND	0.025 mg/m3
Nitrous Oxide	X	10/01/2006 - 10/03/2006	4	3	1.192 ppm	50 ppm

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest	OEL
Lead		04/20/2011	1	0	ND	

Non-Farm TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Lead		05/18/2006 - 06/29/2010	6	1	0.004 mg/m3	0.050 mg/m3
Mercury	X	08/15/2007 - 02/18/2010	17	0	ND	0.025 mg/m3
Nitrous Oxide	X	08/15/2007 - 02/12/2010	17	7	2.439 ppm	50 ppm

Office Building TWA

Agent	COPC	Date Range	# Taken	# Above	Highest	OEL

				Detection Limit	TWA	
Lead		07/12/2010	1	0	ND	0.050 mg/m3

S FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	09/22/2004 - 05/07/2005	76	0	ND	0.025 mg/m3
Lead		02/14/2008 - 03/25/2008	27	0	ND	0.050 mg/m3
Mercury	X	04/19/2005 - 04/14/2010	78	8	0.0006 mg/m3	0.025 mg/m3
N2O	X	06/03/2004 - 05/07/2005	135	53	2.100 ppm	50 ppm
Nitrous Oxide	X	04/19/2005 - 05/10/2011	327	138	4.569 ppm	50 ppm

SX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	02/23/2005	8	0	ND	0.025 mg/m3
Mercury	X	04/15/2005 - 11/04/2009	23	0	ND	0.025 mg/m3
N2O	X	07/30/2004 - 02/23/2005	16	4	0.752 ppm	50 ppm
Nitrous Oxide	X	04/15/2005 - 02/17/2011	48	21	3.376 ppm	50 ppm

SY FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	11/06/2004 - 03/08/2005	30	0	ND	0.025 mg/m3
Lead		07/07/2009 - 07/16/2009	10	0	ND	0.050 mg/m3
Mercury	X	05/29/2005 - 06/09/2010	69	8	0.001 mg/m3	0.025 mg/m3
N2O	X	04/29/2004 - 03/08/2005	47	11	1.787 ppm	50 ppm
Nitrous Oxide	X	05/29/2005 - 04/07/2011	77	35	1.729 ppm	50 ppm

T FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL

Mercury	X	02/06/2007 - 05/24/2007	5	0	ND	0.025 mg/m3
Nitrous Oxide	X	02/06/2007 - 05/06/2011	25	9	3.921 ppm	50 ppm

TX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	02/18/2005	1	0	ND	0.025 mg/m3
Lead		11/03/2009	1	0	ND	0.050 mg/m3
Mercury	X	06/09/2005 - 03/24/2011	12	3	0.0004 mg/m3	0.025 mg/m3
N2O	X	07/09/2004 - 04/01/2005	8	6	1.342 ppm	50 ppm
Nitrous Oxide	X	06/09/2005 - 03/24/2011	42	15	5.125 ppm	50 ppm

TY Farm TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Mercury	X	02/13/2006 - 01/17/2010	11	3	0.0004 mg/m3	0.025 mg/m3
Nitrous Oxide	X	02/14/2006 - 01/06/2011	7	3	0.596 ppm	50 ppm

U FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Elemental Mercury	X	11/28/2004 - 03/23/2005	26	2	0.0006 mg/M3	0.025 mg/m3
Mercury	X	05/17/2005 - 06/09/2010	15	2	0.001 mg/m3	0.025 mg/m3
N2O	X	11/19/2004 - 03/23/2005	36	21	2.083 ppm	50 ppm
Nitrous Oxide	X	05/17/2005 - 12/30/2010	24	8	3.087 ppm	50 ppm

Vent & Balance TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Mercury	X	05/10/2006	2	0	ND	0.025 mg/m3
Nitrous Oxide	X	05/10/2006	1	1	0.849 ppm	50 ppm

IH Personal Air Sampling Summary Counts by Limit Type (Organic Solvents)

Agent(s): 1,1,1-Trichloroethane, 1,1,2,2-Tetrachloroethane, 1,1-Dichloroethene, 1,2,4-Trimethylbenzene, 1,2-Dibromoethane, 1,2-Dichloroethane, 1,3-Butadiene, 1-Butanol, 2-Hexanone, Arsenic, Carbon disulfide, Carbon Tetrachloride, Decane, Hexanal, Hexanenitrile, Methyl isobutyl ketone, Methylamine, Methylene Chloride, N-Heptane, n-Hexadecane, n-Hexane, N-Octane, n-Pentadecane, N-Pentane, n-Tetradecane, n-Tridecane, n-Undecane, ortho-xylene, para-Xylene, Tetrachloroethylene, Toluene, Trichloroethylene, Xylene, (o, m, & p isomers), Xylene-all isomer

From Date: 01/01/2000 **To Date:** 06/01/2011

Percent of OEL: Include All

Data As Of: 06/26/2011, 07:22 PM

222-S TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1-Butanol	X	01/28/2010 - 10/18/2010	3	1	0.0005 ppm	20 ppm
2-Hexanone	X	01/28/2010 - 10/18/2010	3	0	ND	5 ppm
Hexanenitrile	X	01/28/2010 - 10/18/2010	3	0	ND	6 ppm
Methyl isobutyl ketone		01/14/2009	1	0	ND	50 ppm
Methylene Chloride		05/14/2007 - 07/15/2009	24	4	0.394 ppm	25 ppm
n-Hexadecane		01/28/2010	1	0	ND	200 ppm
n-Hexane		07/15/2009	1	0	ND	50 ppm
n-Tetradecane		01/28/2010	1	0	ND	200 ppm
n-Tridecane		01/28/2010	1	1	0.0008 ppm	200 ppm

242A EVAP TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,2,4-Trimethylbenzene		02/14/2009 - 02/21/2009	3	2	0.320 ppm	25 ppm
Arsenic		07/19/2010 - 08/04/2010	4	0	ND	0.010 mg/m3
Methyl isobutyl ketone		11/17/2004 - 03/24/2005	8	0	ND	50 ppm
Methylamine		08/14/2007	1	0	ND	5 ppm
n-Butanol	X	11/17/2004 - 03/24/2005	8	0	ND	20 ppm
ortho-xylene		11/17/2004 - 08/28/2007	10	2	0.043 ppm	100 ppm
para-Xylene		08/28/2007	2	2	0.053 ppm	100 ppm
Toluene		11/17/2004 - 02/21/2009	13	1	0.036 ppm	20 ppm
Xylene, (o, m, & p isomers)		11/17/2004 - 08/28/2007	10	2	0.109 ppm	100 ppm

Xylene-all isomer		02/14/2009 - 02/21/2009	3	3	13.703 ppm	100 ppm

244-A TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1-Butanol	X	12/23/2005	1	0	ND	20 ppm
Methyl isobutyl ketone		12/23/2005	1	0	ND	50 ppm
Methylamine		01/31/2007 - 02/01/2007	2	0	ND	5 ppm
ortho-xylene		12/23/2005	1	0	ND	100 ppm
Toluene		12/23/2005	1	0	ND	20 ppm
Xylene, (o, m, & p isomers)		12/23/2005	1	0	ND	100 ppm

2707-SX STEL

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest STEL	OEL
Methylene Chloride		11/09/2006 - 11/15/2006	6	3	94.969 ppm	125 ppm

2707-SX TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Methylene Chloride		11/09/2006 - 11/15/2006	7	4	25.649 ppm	25 ppm

6241 BUILDING TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,2,2-Tetrachloroethane		04/04/2006	1	0	ND	1 ppm
1,1-Dichloroethene		04/04/2006	1	0	ND	5 ppm
1,2-Dibromoethane		04/04/2006	1	0	ND	20 ppm
1,2-Dichloroethane		04/04/2006	1	0	ND	10 ppm
1,3-Butadiene	X	04/04/2006	1	0	ND	1 ppm
1-Butanol	X	04/04/2006	1	0	ND	20 ppm
2-Hexanone	X	04/04/2006	1	0	ND	5 ppm
Carbon disulfide		04/04/2006	1	0	ND	1 ppm
Carbon Tetrachloride		04/04/2006	1	0	ND	5 ppm
Decane		04/04/2006	1	0	ND	200 ppm
Hexanenitrile	X	04/04/2006	1	0	ND	6 ppm

Methyl isobutyl ketone		04/04/2006	1	0	ND	50 ppm
Methylene Chloride		04/04/2006	1	0	ND	25 ppm
N-Heptane		04/04/2006	1	0	ND	400 ppm
n-Hexane		04/04/2006	1	0	ND	50 ppm
N-Pentane		04/04/2006	1	0	ND	600 ppm
ortho-xylene		04/04/2006	1	1	0.002 ppm	100 ppm
Tetrachloroethylene		04/04/2006	1	0	ND	25 ppm
Toluene		04/04/2006	1	1	0.0008 ppm	20 ppm
Trichloroethylene		04/04/2006	1	0	ND	10 ppm
Xylene, (o, m, & p isomers)		04/04/2006	1	1	0.005 ppm	100 ppm

A FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Methyl isobutyl ketone		06/15/2004 - 03/08/2005	22	0	ND	50 ppm
Methylamine		03/27/2007 - 05/18/2011	9	0	ND	5 ppm
n-Butanol	X	06/15/2004 - 03/08/2005	22	0	ND	20 ppm
n-Hexadecane		12/01/2010	1	0	ND	200 ppm
n-Tetradecane		12/01/2010	1	0	ND	200 ppm
n-Tridecane		12/01/2010	1	0	ND	200 ppm
ortho-xylene		06/15/2004 - 03/08/2005	22	0	ND	100 ppm
Toluene		06/15/2004 - 03/08/2005	22	0	ND	20 ppm
Xylene, (o, m, & p isomers)		06/15/2004 - 03/08/2005	22	0	ND	100 ppm

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest	OEL
Hexanal		09/20/2010	1	0	ND	

AN FARM STEL

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest STEL	OEL
Methylene Chloride		05/13/2009	2	0	ND	125 ppm

AN FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/18/2004	1	0	ND	350 ppm

1,2,4-Trimethylbenzene		07/03/2007 - 04/20/2011	5	2	0.022 ppm	25 ppm
1,3-Butadiene	X	03/17/2010 - 04/08/2011	5	0	ND	1 ppm
1-Butanol	X	06/02/2005 - 04/13/2011	26	5	0.003 ppm	20 ppm
2-Hexanone	X	01/29/2010 - 04/13/2011	21	0	ND	5 ppm
Arsenic		02/11/2010	1	0	ND	0.010 mg/m3
Carbon Tetrachloride		05/18/2004	1	0	ND	5 ppm
Hexane		05/18/2004	1	0	ND	50 ppm
Hexanenitrile	X	05/18/2004 - 04/13/2011	22	0	ND	6 ppm
Methyl isobutyl ketone		05/18/2004 - 06/06/2005	26	0	ND	50 ppm
Methylamine		05/21/2006 - 04/12/2011	21	0	ND	5 ppm
Methylene Chloride		05/18/2004	1	1	0.0001 ppm	25 ppm
n-Butanol	X	05/18/2004 - 12/09/2004	21	0	ND	20 ppm
n-Hexadecane		02/11/2010 - 04/12/2011	6	0	ND	200 ppm
n-Octane		05/18/2004	1	1	0.0001 ppm	300 ppm
n-Pentane		05/18/2004	1	1	0.001 ppm	600 ppm
n-Tetradecane		02/11/2010 - 04/12/2011	6	1	0.00007 ppm	200 ppm
n-Tridecane		02/11/2010 - 04/12/2011	6	1	0.00006 ppm	200 ppm
ortho-xylene		05/18/2004 - 07/17/2007	30	3	0.079 ppm	100 ppm
para-Xylene		07/03/2007 - 07/17/2007	4	3	0.186 ppm	100 ppm
Tetrachloroethylene		05/18/2004	1	0	ND	25 ppm
Toluene		05/18/2004 - 06/06/2005	26	0	ND	20 ppm
Xylene, (o, m, & p isomers)		05/18/2004 - 07/17/2007	30	3	0.136 ppm	100 ppm
Xylene-all isomer		04/20/2011	1	1	0.191 ppm	100 ppm

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest	OEL
1,2,4-Trimethylbenzene		12/15/2010 - 02/09/2011	8	0	ND	

AP FARM STEL

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest STEL	OEL
Xylene-all isomer		12/15/2010 - 02/09/2011	8	4	9.798 ppm	150 ppm

AP FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/14/2004	1	0	ND	350 ppm

1,2,4-Trimethylbenzene		10/21/2010 - 01/19/2011	3	0	ND	25 ppm
1-Butanol	X	04/17/2005 - 01/08/2006	4	0	ND	20 ppm
Carbon Tetrachloride		05/14/2004	1	0	ND	5 ppm
Hexane		05/14/2004	1	0	ND	50 ppm
Hexanenitrile	X	05/14/2004	1	0	ND	6 ppm
Methyl isobutyl ketone		05/14/2004 - 01/08/2006	10	0	ND	50 ppm
Methylamine		06/26/2007 - 07/28/2010	16	0	ND	5 ppm
Methylene Chloride		05/14/2004 - 09/09/2008	3	0	ND	25 ppm
n-Butanol	X	05/14/2004 - 03/06/2005	6	1	0.012 ppm	20 ppm
n-Octane		05/14/2004	1	0	ND	300 ppm
n-Pentane		05/14/2004	1	0	ND	600 ppm
ortho-xylene		05/14/2004 - 01/08/2006	10	1	0.0004 ppm	100 ppm
Tetrachloroethylene		05/14/2004	1	0	ND	25 ppm
Toluene		05/14/2004 - 01/08/2006	10	1	0.0003 ppm	20 ppm
Xylene, (o, m, & p isomers)		05/14/2004 - 01/08/2006	10	1	0.001 ppm	100 ppm
Xylene-all isomer		10/21/2010 - 01/19/2011	3	2	0.291 ppm	100 ppm

AW FARM STEL

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest STEL	OEL
Methylene Chloride		01/15/2010 - 08/17/2010	4	0	ND	125 ppm

AW FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/24/2004	2	0	ND	350 ppm
1,2,4-Trimethylbenzene		04/27/2007 - 04/16/2010	3	0	ND	25 ppm
1-Butanol	X	11/17/2005 - 02/17/2011	24	0	ND	20 ppm
2-Hexanone	X	04/19/2010 - 02/17/2011	5	0	ND	5 ppm
Arsenic		02/23/2010	1	0	ND	0.010 mg/m3
Carbon Tetrachloride		05/24/2004	2	0	ND	5 ppm
Hexane		05/24/2004	2	0	ND	50 ppm
Hexanenitrile	X	05/24/2004 - 02/17/2011	7	0	ND	6 ppm
Methyl isobutyl ketone		05/24/2004 - 04/04/2006	35	0	ND	50 ppm
Methylamine		05/16/2006 - 06/04/2007	24	0	ND	5 ppm
Methylene Chloride		05/24/2004	2	0	ND	25 ppm

n-Butanol	X	05/24/2004 - 12/28/2004	16	0	ND	20 ppm
n-Octane		05/24/2004	2	0	ND	300 ppm
n-Pentane		05/24/2004	2	0	ND	600 ppm
ortho-xylene		05/24/2004 - 04/27/2007	36	1	0.002 ppm	100 ppm
para-Xylene		04/27/2007	1	1	0.002 ppm	100 ppm
Tetrachloroethylene		05/24/2004	2	0	ND	25 ppm
Toluene		05/24/2004 - 04/04/2006	35	1	0.022 ppm	20 ppm
Xylene, (o, m, & p isomers)		05/24/2004 - 04/27/2007	36	2	0.019 ppm	100 ppm
Xylene-all isomer		04/16/2010	2	0	ND	100 ppm

AX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1-Butanol	X	03/09/2006	1	0	ND	20 ppm
Methyl isobutyl ketone		06/15/2004 - 03/09/2006	5	0	ND	50 ppm
Methylamine		04/02/2007	1	0	ND	5 ppm
n-Butanol	X	06/15/2004 - 09/17/2004	4	0	ND	20 ppm
ortho-xylene		06/15/2004 - 03/09/2006	5	0	ND	100 ppm
Toluene		06/15/2004 - 03/09/2006	5	0	ND	20 ppm
Xylene, (o, m, & p isomers)		06/15/2004 - 03/09/2006	5	0	ND	100 ppm

AY FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,2,4-Trimethylbenzene		06/22/2009 - 06/23/2009	2	2	0.087 ppm	25 ppm
1,3-Butadiene	X	11/07/2010 - 02/16/2011	47	0	ND	1 ppm
1-Butanol	X	05/09/2005 - 11/05/2010	28	4	1.689 ppm	20 ppm
2-Hexanone	X	10/21/2010 - 11/05/2010	13	0	ND	5 ppm
Hexanenitrile	X	10/21/2010 - 11/05/2010	13	0	ND	6 ppm
Methyl isobutyl ketone		06/15/2004 - 05/22/2005	51	0	ND	50 ppm
Methylamine		10/23/2006 - 12/05/2007	17	0	ND	5 ppm
n-Butanol	X	06/15/2004 - 04/28/2005	36	0	ND	20 ppm
ortho-xylene		06/15/2004 - 05/22/2005	51	0	ND	100 ppm
Toluene		06/15/2004 - 06/23/2009	53	1	0.064 ppm	20 ppm
Xylene, (o, m, & p isomers)		06/15/2004 - 05/22/2005	51	0	ND	100 ppm
Xylene-all isomer		06/22/2009 - 06/23/2009	2	2	0.846 ppm	100 ppm

AZ FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,3-Butadiene	X	11/18/2010 - 04/08/2011	3	0	ND	1 ppm
1-Butanol	X	04/08/2011	1	0	ND	20 ppm
2-Hexanone	X	04/08/2011	1	0	ND	5 ppm
Hexanenitrile	X	04/08/2011	1	0	ND	6 ppm
Methyl isobutyl ketone		06/15/2004 - 08/25/2004	8	0	ND	50 ppm
n-Butanol	X	06/15/2004 - 08/25/2004	8	0	ND	20 ppm
n-Hexadecane		04/08/2011	1	0	ND	200 ppm
n-Tetradecane		04/08/2011	1	0	ND	200 ppm
n-Tridecane		04/08/2011	1	0	ND	200 ppm
ortho-xylene		06/15/2004 - 08/25/2004	8	0	ND	100 ppm
Toluene		06/15/2004 - 08/25/2004	8	0	ND	20 ppm
Xylene, (o, m, & p isomers)		06/15/2004 - 08/25/2004	8	0	ND	100 ppm

B FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/19/2004	1	0	ND	350 ppm
1,3-Butadiene	X	06/05/2008 - 09/10/2009	4	0	ND	1 ppm
1-Butanol	X	12/20/2006 - 09/10/2009	7	3	0.0007 ppm	20 ppm
2-Hexanone	X	12/20/2006 - 09/10/2009	7	0	ND	5 ppm
Carbon Tetrachloride		05/19/2004	1	0	ND	5 ppm
Hexane		05/19/2004	1	0	ND	50 ppm
Hexanenitrile	X	05/19/2004 - 09/10/2009	8	0	ND	6 ppm
Methyl isobutyl ketone		05/19/2004 - 11/30/2004	3	0	ND	50 ppm
Methylamine		06/04/2008 - 06/05/2008	2	0	ND	5 ppm
Methylene Chloride		05/19/2004 - 05/29/2007	6	3	0.0005 ppm	25 ppm
n-Butanol	X	05/19/2004 - 11/30/2004	3	0	ND	20 ppm
n-Octane		05/19/2004	1	0	ND	300 ppm
n-Pentane		05/19/2004	1	0	ND	600 ppm
ortho-xylene		05/19/2004 - 11/30/2004	3	0	ND	100 ppm
Tetrachloroethylene		05/19/2004	1	0	ND	25 ppm
Toluene		05/19/2004 - 11/30/2004	3	0	ND	20 ppm

Xylene, (o, m, & p isomers)		05/19/2004 - 11/30/2004	3	0	ND	100 ppm

BX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,3-Butadiene	X	02/13/2008 - 11/17/2010	8	0	ND	1 ppm
1-Butanol	X	02/13/2008 - 03/30/2009	17	0	ND	20 ppm
2-Hexanone	X	02/13/2008 - 03/30/2009	17	0	ND	5 ppm
Arsenic		11/03/2009	1	0	ND	0.010 mg/m3
Hexanenitrile	X	02/13/2008 - 03/30/2009	17	0	ND	6 ppm
Methyl isobutyl ketone		11/11/2004 - 04/12/2005	5	0	ND	50 ppm
Methylamine		02/13/2008 - 03/10/2008	3	0	ND	5 ppm
n-Butanol	X	11/11/2004 - 04/12/2005	5	0	ND	20 ppm
ortho-xylene		11/11/2004 - 04/12/2005	5	0	ND	100 ppm
Toluene		11/11/2004 - 04/12/2005	5	0	ND	20 ppm
Xylene, (o, m, & p isomers)		11/11/2004 - 04/12/2005	5	0	ND	100 ppm

BY FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,2,2-Tetrachloroethane		11/21/2006	1	0	ND	1 ppm
1,1-Dichloroethene		11/21/2006	1	0	ND	5 ppm
1,2-Dichloroethane		11/21/2006	1	0	ND	10 ppm
1,3-Butadiene	X	11/21/2006 - 04/05/2011	19	0	ND	1 ppm
1-Butanol	X	11/10/2005 - 09/20/2010	33	3	0.0003 ppm	20 ppm
2-Hexanone	X	11/21/2006 - 09/20/2010	14	4	0.00004 ppm	5 ppm
Carbon disulfide		11/21/2006	1	0	ND	1 ppm
Carbon Tetrachloride		11/21/2006	1	0	ND	5 ppm
Decane		11/21/2006	1	0	ND	200 ppm
Hexanenitrile	X	11/21/2006 - 09/20/2010	14	0	ND	6 ppm
Methyl isobutyl ketone		12/07/2004 - 11/21/2006	18	0	ND	50 ppm
Methylamine		06/09/2008 - 06/19/2008	3	0	ND	5 ppm
Methylene Chloride		11/21/2006 - 04/27/2007	6	5	0.009 ppm	25 ppm
n-Butanol	X	12/07/2004 - 04/17/2005	12	0	ND	20 ppm
N-Heptane		11/21/2006	1	0	ND	400 ppm
n-Hexane		11/21/2006	1	1	0.0002 ppm	50 ppm

N-Pentane		11/21/2006	1	1	0.0004 ppm	600 ppm
ortho-xylene		12/07/2004 - 11/21/2006	18	1	0.0002 ppm	100 ppm
Tetrachloroethylene		11/21/2006	1	0	ND	25 ppm
Toluene		12/07/2004 - 11/21/2006	18	2	0.007 ppm	20 ppm
Trichloroethylene		11/21/2006	1	0	ND	10 ppm
Xylene, (o, m, & p isomers)		12/07/2004 - 02/14/2006	17	0	ND	100 ppm
Xylene-all isomer		11/21/2006	1	1	0.0004 ppm	100 ppm

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest	OEL
Hexanal		07/25/2010 - 11/04/2010	35	0	ND	

C FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/13/2004 - 11/07/2005	12	0	ND	350 ppm
1,1,2,2-Tetrachloroethane		04/11/2006	3	0	ND	1 ppm
1,1-Dichloroethene		04/11/2006	3	0	ND	5 ppm
1,2-Dibromoethane		10/25/2005 - 04/11/2006	8	0	ND	20 ppm
1,2-Dichloroethane		10/25/2005 - 04/11/2006	8	0	ND	10 ppm
1,3-Butadiene	X	04/11/2006 - 03/17/2010	27	0	ND	1 ppm
1-Butanol	X	05/12/2005 - 04/15/2011	254	59	0.060 ppm	20 ppm
2-Hexanone	X	10/25/2005 - 04/15/2011	144	0	ND	5 ppm
Arsenic		03/24/2010	1	0	ND	0.010 mg/m3
Carbon disulfide		10/25/2005 - 04/11/2006	8	0	ND	1 ppm
Carbon Tetrachloride		05/13/2004 - 04/11/2006	15	0	ND	5 ppm
Decane		04/11/2006	3	0	ND	200 ppm
Hexane		05/13/2004 - 06/25/2004	7	0	ND	50 ppm
Hexanenitrile	X	05/13/2004 - 04/15/2011	151	0	ND	6 ppm
Methyl isobutyl ketone		05/13/2004 - 04/11/2006	358	0	ND	50 ppm
Methylamine		11/24/2006	1	0	ND	5 ppm
Methylene Chloride		05/13/2004 - 04/11/2006	15	1	0.0004 ppm	25 ppm
n-Butanol	X	05/13/2004 - 04/28/2005	240	1	0.152 ppm	20 ppm
N-Heptane		04/11/2006	3	0	ND	400 ppm
n-Hexadecane		10/25/2005 - 11/04/2010	39	6	0.00007 ppm	200 ppm
n-Hexane		10/25/2005 - 04/11/2006	8	0	ND	50 ppm
N-Octane		05/13/2004 - 11/07/2005	12	0	ND	300 ppm

n-Pentadecane	10/25/2005 - 11/07/2005	6	0	ND	200 ppm
N-Pentane	05/13/2004 - 04/11/2006	15	2	0.003 ppm	600 ppm
n-Tetradecane	10/25/2005 - 11/04/2010	39	21	0.0003 ppm	200 ppm
n-Tridecane	10/25/2005 - 11/04/2010	39	12	0.001 ppm	200 ppm
n-Undecane	10/25/2005 - 11/07/2005	6	0	ND	200 ppm
ortho-xylene	05/13/2004 - 04/11/2006	358	0	ND	100 ppm
Tetrachloroethylene	05/13/2004 - 04/11/2006	15	0	ND	25 ppm
Toluene	05/13/2004 - 04/11/2006	358	7	0.021 ppm	20 ppm
Trichloroethylene	10/25/2005 - 04/11/2006	8	0	ND	10 ppm
Xylene, (o, m, & p isomers)	05/13/2004 - 04/11/2006	358	2	0.004 ppm	100 ppm

Cross Site XFR TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1-Butanol	X	11/19/2010	1	0	ND	20 ppm
2-Hexanone	X	11/19/2010	1	0	ND	5 ppm
Hexanenitrile	X	11/19/2010	1	0	ND	6 ppm
n-Hexadecane		11/19/2010	1	1	0.0002 ppm	200 ppm
n-Tetradecane		11/19/2010	1	1	0.0002 ppm	200 ppm
n-Tridecane		11/19/2010	1	1	0.0006 ppm	200 ppm

ER-311 TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Methylamine		10/03/2006	2	0	ND	5 ppm

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest	OEL
1,2,4-Trimethylbenzene		07/13/2010	2	0	ND	

Non-Farm STEL

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest STEL	OEL
Xylene-all isomer		07/13/2010	2	1	1.229 ppm	150 ppm

Non-Farm TWA

Agent	COPC	Date Range	# Taken	# Above	Highest	OEL

				Detection Limit	TWA	
1,2,4-Trimethylbenzene		11/11/2009 - 04/13/2010	3	2	0.081 ppm	25 ppm
1,3-Butadiene	X	10/26/2007	2	0	ND	1 ppm
1-Butanol	X	08/20/2007 - 02/18/2010	4	1	0.002 ppm	20 ppm
2-Hexanone	X	08/20/2007 - 02/18/2010	4	0	ND	5 ppm
Arsenic		05/18/2006 - 06/29/2010	4	0	ND	0.010 mg/m3
Hexanenitrile	X	08/20/2007 - 02/18/2010	4	0	ND	6 ppm
Methylamine		10/26/2007	1	0	ND	5 ppm
Methylene Chloride		07/15/2009	2	0	ND	25 ppm
ortho-xylene		05/14/2008	2	0	ND	100 ppm
para-Xylene		05/14/2008	2	0	ND	100 ppm
Toluene		05/14/2008	2	1	0.024 ppm	20 ppm
Xylene, (o, m, & p isomers)		05/14/2008	2	1	0.005 ppm	100 ppm
Xylene-all isomer		11/11/2009 - 04/13/2010	3	2	2.473 ppm	100 ppm

Office Building TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
Arsenic		07/12/2010	1	0	ND	0.010 mg/m3
Methylene Chloride		09/28/2006 - 09/29/2006	5	5	0.960 ppm	25 ppm
N-Heptane		09/28/2006 - 09/29/2006	5	4	0.204 ppm	400 ppm
n-Hexane		09/28/2006 - 09/29/2006	5	4	0.163 ppm	50 ppm
ortho-xylene		09/28/2006 - 09/29/2006	5	0	ND	100 ppm
Toluene		09/28/2006 - 09/29/2006	5	5	0.691 ppm	20 ppm
Xylene, (o, m, & p isomers)		09/28/2006 - 09/29/2006	5	0	ND	100 ppm
Xylene-all isomer		01/26/2007	1	1	4.265 ppm	100 ppm

S FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/26/2004 - 06/08/2004	5	0	ND	350 ppm
1-Butanol	X	04/19/2005 - 03/21/2006	58	0	ND	20 ppm
Carbon Tetrachloride		05/26/2004 - 06/08/2004	5	0	ND	5 ppm
Hexane		05/26/2004 - 06/08/2004	5	1	0.001 ppm	50 ppm
Hexanenitrile	X	05/26/2004 - 06/08/2004	5	0	ND	6 ppm
Methyl isobutyl ketone		05/26/2004 - 03/21/2006	223	1	0.0005 ppm	50 ppm

Methylene Chloride		05/26/2004 - 06/08/2004	5	0	ND	25 ppm
n-Butanol	X	05/26/2004 - 05/09/2005	165	1	0.0003 ppm	20 ppm
n-Octane		05/26/2004 - 06/08/2004	5	1	0.009 ppm	300 ppm
n-Pentane		05/26/2004 - 06/08/2004	5	1	0.013 ppm	600 ppm
ortho-xylene		05/26/2004 - 03/21/2006	223	0	ND	100 ppm
Tetrachloroethylene		05/26/2004 - 06/08/2004	5	0	ND	25 ppm
Toluene		05/26/2004 - 03/21/2006	222	4	0.028 ppm	20 ppm
Xylene, (o, m, & p isomers)		05/26/2004 - 03/21/2006	223	1	0.0003 ppm	100 ppm
Xylene-all isomer		01/25/2007	3	3	11.079 ppm	100 ppm

SX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/19/2004	1	0	ND	350 ppm
1-Butanol	X	04/15/2005 - 01/11/2007	16	0	ND	20 ppm
2-Hexanone	X	01/11/2007	1	0	ND	5 ppm
Carbon Tetrachloride		05/19/2004	1	0	ND	5 ppm
Hexane		05/19/2004	1	0	ND	50 ppm
Hexanenitrile	X	05/19/2004 - 01/11/2007	2	0	ND	6 ppm
Methyl isobutyl ketone		05/19/2004 - 11/10/2005	37	0	ND	50 ppm
Methylene Chloride		05/19/2004 - 01/11/2007	2	1	0.0006 ppm	25 ppm
n-Butanol	X	05/19/2004 - 02/23/2005	22	0	ND	20 ppm
n-Octane		05/19/2004	1	1	0.001 ppm	300 ppm
n-Pentane		05/19/2004	1	1	0.002 ppm	600 ppm
ortho-xylene		05/19/2004 - 11/10/2005	37	0	ND	100 ppm
Tetrachloroethylene		05/19/2004	1	0	ND	25 ppm
Toluene		05/19/2004 - 11/10/2005	37	0	ND	20 ppm
Xylene, (o, m, & p isomers)		05/19/2004 - 11/10/2005	37	0	ND	100 ppm

SY FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		05/18/2004 - 05/19/2004	2	0	ND	350 ppm
1-Butanol	X	05/22/2005 - 05/14/2006	40	0	ND	20 ppm
Arsenic		07/07/2009 - 07/16/2009	10	0	ND	0.010 mg/m3
Carbon Tetrachloride		05/18/2004 - 05/19/2004	2	0	ND	5 ppm

Hexane		05/18/2004 - 05/19/2004	2	0	ND	50 ppm
Hexanenitrile	X	05/18/2004 - 05/19/2004	2	0	ND	6 ppm
Methyl isobutyl ketone		05/18/2004 - 05/14/2006	100	0	ND	50 ppm
Methylamine		09/27/2006 - 06/13/2007	3	0	ND	5 ppm
Methylene Chloride		05/18/2004 - 05/19/2004	2	1	0.0002 ppm	25 ppm
n-Butanol	X	05/18/2004 - 03/08/2005	60	0	ND	20 ppm
n-Octane		05/18/2004 - 05/19/2004	2	2	0.002 ppm	300 ppm
n-Pentane		05/18/2004 - 05/19/2004	2	2	0.007 ppm	600 ppm
ortho-xylene		05/18/2004 - 05/14/2006	100	4	0.355 ppm	100 ppm
Tetrachloroethylene		05/18/2004 - 05/19/2004	2	0	ND	25 ppm
Toluene		05/18/2004 - 05/14/2006	100	3	0.022 ppm	20 ppm
Xylene, (o, m, & p isomers)		05/18/2004 - 05/14/2006	100	6	1.247 ppm	100 ppm

T FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,3-Butadiene	X	05/07/2007 - 05/24/2007	8	0	ND	1 ppm
1-Butanol	X	05/07/2007 - 05/29/2007	9	6	0.0005 ppm	20 ppm
2-Hexanone	X	05/07/2007 - 05/29/2007	9	2	0.000005 ppm	5 ppm
Hexanenitrile	X	05/07/2007 - 05/29/2007	9	0	ND	6 ppm
Methylamine		05/07/2007 - 05/24/2007	4	0	ND	5 ppm
Methylene Chloride		05/07/2007 - 05/29/2007	9	7	0.007 ppm	25 ppm

TX FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,1,1-Trichloroethane		06/22/2004	1	0	ND	350 ppm
1,3-Butadiene	X	06/28/2007 - 07/25/2007	6	0	ND	1 ppm
1-Butanol	X	06/09/2005 - 03/24/2011	11	3	0.002 ppm	20 ppm
2-Hexanone	X	06/28/2007 - 03/24/2011	4	0	ND	5 ppm
Arsenic		11/03/2009	1	0	ND	0.010 mg/m3
Carbon Tetrachloride		06/22/2004	1	0	ND	5 ppm
Hexane		06/22/2004	1	0	ND	50 ppm
Hexanenitrile	X	06/22/2004 - 03/24/2011	5	0	ND	6 ppm
Methyl isobutyl ketone		06/22/2004 - 02/13/2006	16	0	ND	50 ppm
Methylamine		06/28/2007 - 07/25/2007	3	0	ND	5 ppm

Methylene Chloride		06/22/2004 - 07/19/2007	4	3	0.003 ppm	25 ppm
n-Butanol	X	06/22/2004 - 04/01/2005	9	0	ND	20 ppm
n-Octane		06/22/2004	1	0	ND	300 ppm
n-Pentane		06/22/2004	1	1	0.0006 ppm	600 ppm
ortho-xylene		06/22/2004 - 02/13/2006	16	0	ND	100 ppm
Tetrachloroethylene		06/22/2004	1	0	ND	25 ppm
Toluene		06/22/2004 - 02/13/2006	16	2	0.011 ppm	20 ppm
Xylene, (o, m, & p isomers)		06/22/2004 - 02/13/2006	16	0	ND	100 ppm

TY Farm TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,3-Butadiene	X	08/08/2007	2	0	ND	1 ppm
1-Butanol	X	02/13/2006 - 08/08/2007	6	2	0.0001 ppm	20 ppm
2-Hexanone	X	08/06/2007 - 08/08/2007	2	0	ND	5 ppm
Hexanenitrile	X	08/06/2007 - 08/08/2007	2	0	ND	6 ppm
Methyl isobutyl ketone		02/13/2006 - 02/17/2006	4	0	ND	50 ppm
Methylamine		08/08/2007	1	0	ND	5 ppm
Methylene Chloride		08/06/2007	1	1	0.004 ppm	25 ppm
ortho-xylene		02/13/2006 - 02/17/2006	4	0	ND	100 ppm
Toluene		02/13/2006 - 02/17/2006	4	0	ND	20 ppm
Xylene, (o, m, & p isomers)		02/13/2006 - 02/17/2006	4	0	ND	100 ppm

U FARM TWA

Agent	COPC	Date Range	# Taken	# Above Detection Limit	Highest TWA	OEL
1,3-Butadiene	X	04/13/2007 - 04/23/2007	12	0	ND	1 ppm
1-Butanol	X	05/17/2005 - 09/24/2010	26	14	0.0010 ppm	20 ppm
2-Hexanone	X	04/10/2007 - 09/24/2010	23	1	0.000007 ppm	5 ppm
Carbon disulfide		10/05/2006 - 10/13/2006	4	0	ND	1 ppm
Hexanenitrile	X	04/10/2007 - 09/24/2010	23	0	ND	6 ppm
Methyl isobutyl ketone		06/09/2004 - 02/14/2006	44	0	ND	50 ppm
Methylamine		04/13/2007 - 04/23/2007	6	0	ND	5 ppm
Methylene Chloride		04/10/2007 - 04/27/2007	16	13	0.014 ppm	25 ppm
n-Butanol	X	06/14/2004 - 03/23/2005	40	0	ND	20 ppm
ortho-xylene		06/09/2004 - 02/14/2006	44	2	0.005 ppm	100 ppm

Toluene	06/09/2004 - 02/14/2006	44	1	0.033 ppm	20 ppm
Xylene, (o, m, & p isomers)	06/09/2004 - 02/14/2006	44	0	ND	100 ppm

Business Sensitive

HANFORD INDUSTRIAL HYGIENE DATABASE (HIH2)

CHEMICAL AGENT AND FACILITY REPORT SORTED BY FACILITY AND DECREASING EXPOSURE LEVEL

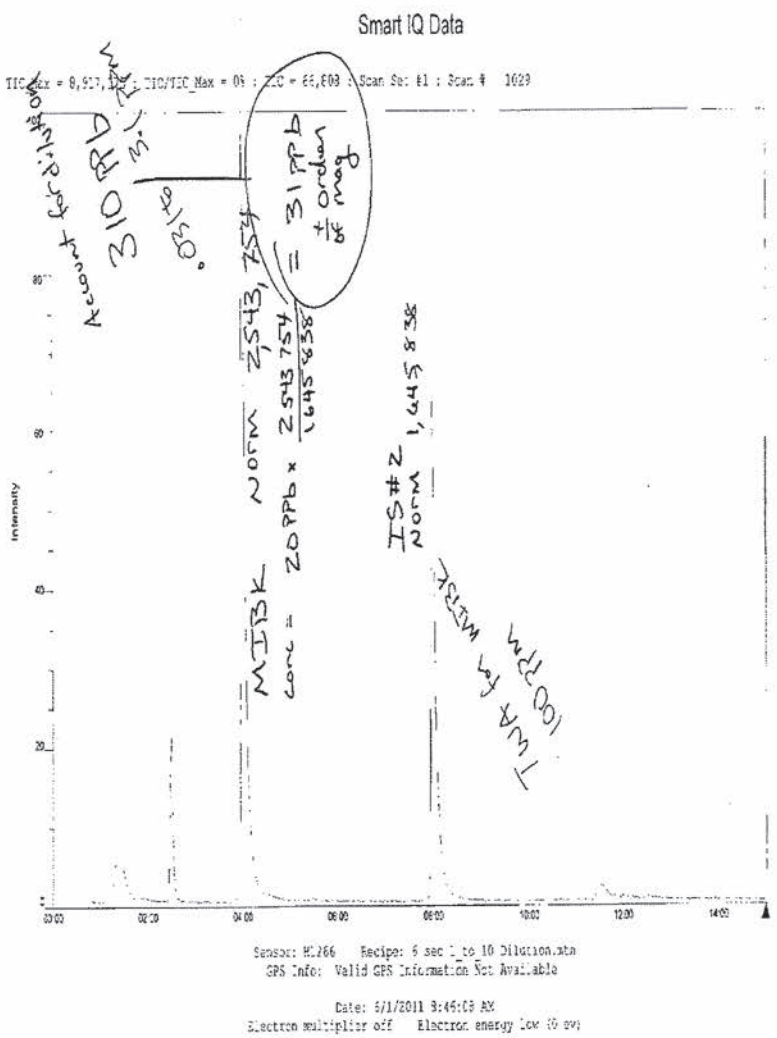
Company:
11/15/2002 02-2896b 200E/
Sample Result Substance Name Work Activity Specific Location Sample Type
Other operation not previously listed
Sample No.
Individual Sample Results
Sample Date Survey # Building Task Code TWA Exposure Limit
< 0 mg/m3 MERCURY Monitored sample collection 216-S-10 pond AREA
Sp-2
02-2896b~15
< 0 mg/m3 MERCURY Monitored sample collection 216-S-10 pond AREA
Sp-2
02-2896b~12
< 0 mg/m3 MERCURY Monitored sample collection 216-S-10 pond AREA
Sp-2
02-2896b~9
< 0 mg/m3 MERCURY Monitored sample collection 216-S-10 pond AREA
Sp-2
02-2896b~6
< 0 mg/m3 MERCURY Monitored sample collection 216-S-110 pond AREA
Sp-2
02-2896b~3
11/11/2002 02-2896f 200E/ < 1.85 mg/m3
Sample Result Substance Name Work Activity Specific Location Sample Type
Other operation not
previously listed
Sample No.
TLV_PEL = 0.025
Individual Sample Results
Sample Date Survey # Building Task Code TWA Exposure Limit
PERSONAL
NORMAL 8-HR
REP
02-2896f~1A1 < 0.00008 mg/m3 MERCURY Radiological surveys BZ
11/11/2002 02-2896f 200E/ < 1.85 mg/m3
Sample Result Substance Name Work Activity Specific Location Sample Type
Other operation not
previously listed
Sample No.
TLV_PEL = 0.025

44

ORP-51376, Rev. 0
(11-ESQ-195)

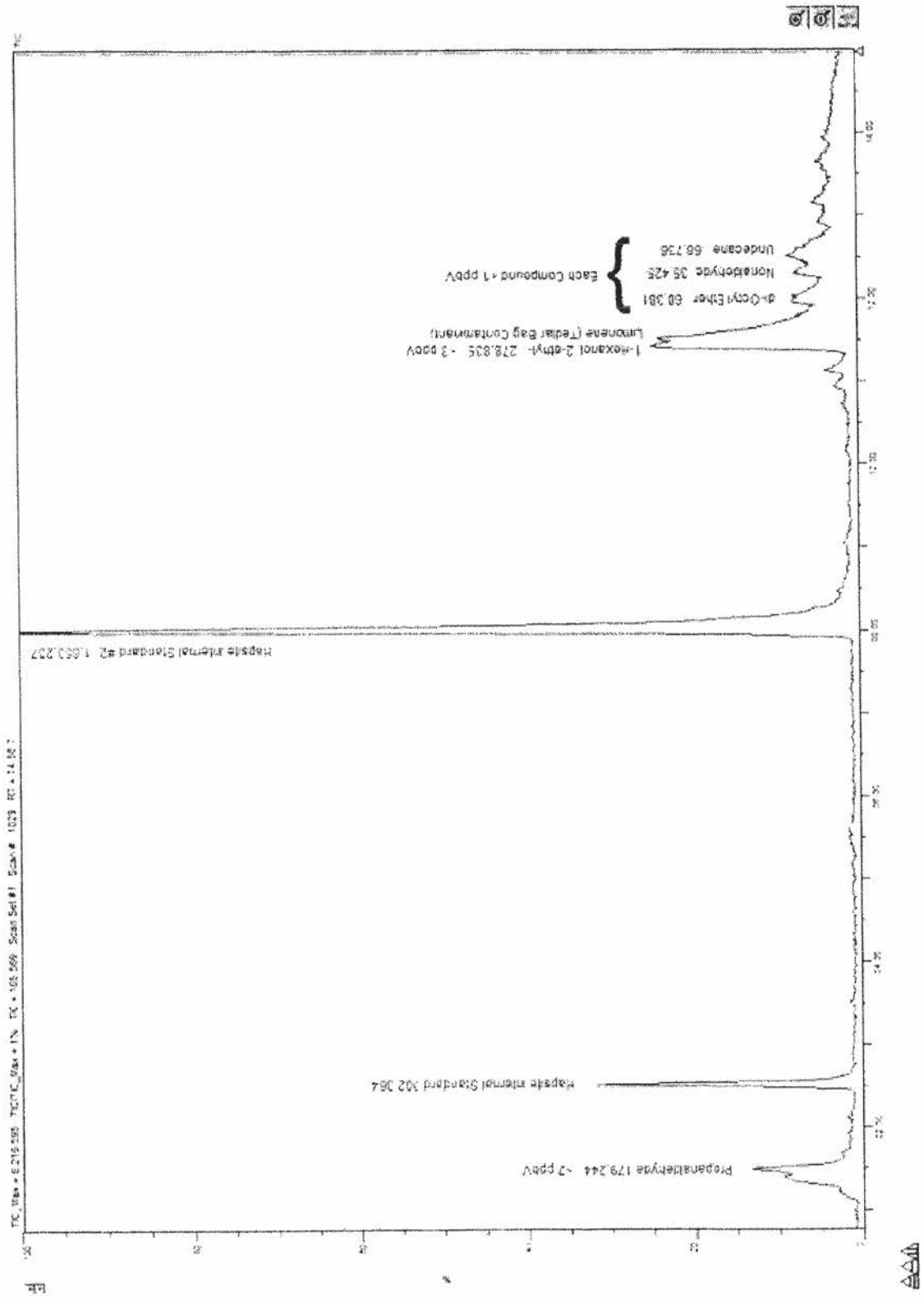
Individual Sample Results
Sample Date Survey # Building Task Code TWA Exposure Limit
PERSONAL
NORMAL 8-HR
REP
02-2896f~1A1R < 0.00008 mg/m3 MERCURY Geological survey BZ
Report printed on 6/30/2011 and includes sample results from 1/1/2000 to 12/31/2006. IH Chemical Agent Report Page 1 of 3

APPENDIX C
Examples of VOC Results from HAPSITE Gas Chromatograph /Mass Spectrophotometer



E Mail Description:

Please find attached a PDF of the annotated Hapsite GC-MS run of your Tedlar bag.
Only one compound was found Methyl Isobutyl Ketone (also called Hexone) CAS# 108-10-1
The estimated concentration is 31 PPB x 10 for dilution → 310 PPB ± one order of magnitude
Thus, the sample contains MIBK within the range of 0.031 PPM to 31 PPM
The OSHA 8hour TWA for this compound is 100 PPM
It has a sweet, nail polish odor when dilute, becoming more strongly solvent-like as the concentration increases.


Propanaldehyde 179.244 ~7 ppbV
Heptafluorobutyric Acid 302.364
Heptafluorobutyric Acid Standard #2 1,653,237
1-Hexanol, 2-ethyl- 278.835 ~3 ppbV
Limonene (Tedlar Bag Contaminant)
4-Octyl Ether 60.381
Nonaldehyde 35.425
Undecane 66.736
Each Compound ~1 ppbV