U.S. Department of Energy
Office of River Protection
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Richland, Washington 99352

05-ESQ-032

Mr. E. S. Aromi, President
and General Manager
CH2M HILL Hanford Group, Inc.
Richland, Washington 99352

Dear Mr. Aromi:

CONTRACT NO. DE-AC27-99RL14047 – ASSESSMENT REPORT A-05-ESQ-TANKFARM-007, INDUSTRIAL HYGIENE (IH) PROGRAM

This letter transmits the results of the U.S. Department of Energy (DOE), Office of River Protection (ORP) assessment of the CH2M HILL Hanford Group, Inc. (CH2M HILL) IH Program. The assessment was conducted from April 25, 2005, through April 29, 2005.

The ORP assessment team concluded the CH2M HILL IH Program complied with applicable DOE and Occupational Safety and Health Administration regulations and standards, and was effective in protecting Tank Farm workers from industrial hazards. The team identified no Findings and noted significant improvement in the IH Program from our last review in October 2003.

The team also evaluated corrective actions implementation, including associated closure documentation, in response to the DOE Independent Oversight and Performance Assurance "Investigation of Worker Vapor Exposure and Occupational Medicine Program Allegations at the Hanford Site" published in April 2004. ORP sampled 57 of the 101 CH2M HILL corrective actions, and verified adequate closure for all items reviewed. Specific Observations and conclusions for all IH program components are provided in the attached report.

The team also reviewed actions CH2M HILL has planned to further improve its IH Program for the remainder of this year and next fiscal year. The team concluded upon effective implementation of those actions CH2M HILL will have established a model IH Program.

If you have any questions, please contact me, or your staff may call Robert C. Barr, Director, Office of Environmental Safety and Quality, (509) 376-7851.

Sincerely,

Roy J. Schepens
Manager

ESQ:RCB

Attachment

cc: See page 2

U.S. DEPARTMENT OF ENERGY
Office of River Protection
Environmental, Safety and Quality

| | |
|---|---|
| ASSESSMENT**:** | Fiscal Year 2005 Review of CH2M HILL Hanford Group, Inc. Industrial Hygiene Program |
| REPORT: | A-05-ESQ-TANK FARM-007 |
| FACILITY: | Tank Farms |
| LOCATION: | Hanford Site, Washington State |
| PERIOD OF PERFORMANCE: | April 25, 2005, through April 29, 2005 |
| ASSESSORS**:** | Charles Olaiya, MS, Lead Assessor<br>Don Alexander, PhD, Assessor<br>Ted Finucane, Certified Industrial Hygiene, Assessor<br>Jim Kapin, Certified Industrial Hygiene, Assessor |
| APPROVED BY: | Robert C. Barr, Director<br>Office of Environmental Safety and Quality |

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# 1.0 EXECUTIVE SUMMARY

## Introduction

This report documents the U.S Department of Energy (DOE), Office of River Protection (ORP) Fiscal Year (FY) 2005 assessment of the CH2M HILL Hanford Group, Inc. (CH2M HILL) Industrial Hygiene (IH) Program. The assessment team (Team), which consisted of three certified industrial hygienists and a PhD chemical engineer, conducted this evaluation from April 25, 2005, to April 29, 2005.

The objectives of this assessment were: 1) to verify the contractor's IH program is in compliance with applicable DOE and Occupational Safety and Health Administration (OSHA) regulations and standards; 2) to verify corrective actions (CA) associated with the tank vapor exposure Findings (Findings from the April 2004 Office of Independent Oversight and Performance Assurance Assessment) were effectively implemented and completed; and 3) to verify the contractor's IH program is improving safe work practices at the Tank Farms.

## Conclusions

The team concluded the CH2M HILL IH Program is effectively implemented and complies with applicable DOE and OSHA regulations and standards, which represents a significant improvement from October 2003, when ORP last evaluated the program. The team identified no Findings and noted a number of areas where the CH2M HILL program elements exceed regulatory requirements. The following are Observations and conclusions from the assessment:

- The CH2M HILL IH program is maturing and improving and should continue to improve with the implementation of program improvements planned for the next year;

- The CH2M HILL IH program is compliant with DOE and OSHA IH regulations, standards and direction;

- CAs associated with the tank vapor exposure Findings (Findings from the April 2004 Office of Independent Oversight and Performance Assurance Assessment) had been implemented and completed;

- The IH program has improved the safety workplace by evolving to a coordinated and integrated program that plans and executes activities;

- CH2M HILL has issued its Technical Basis for IH, a document that provides a technical basis for its IH program based on sampling and analysis of the vapor spaces of the underground waste tanks;

- CH2M HILL has a plan to implement engineering controls in the Tank Farms to elevate, and in some instances provide forced flow for tank exhaust points, thereby minimizing worker exposure to tank vapors. A number of these engineering controls, stack extensions, have been implemented;

- CH2M HILL has planned actions to identify job-specific personal protection equipment (PPE) profiles based on well-defined work zones;

- CH2M HILL has developed an Exposure Assessment Strategy that exceeds minimum regulatory requirements, which is a significant improvement from the previous exposure assessments that were based on ad-hoc monitoring and informal use of direct-reading instruments. CH2M HILL should work with its contractors to improve the turnaround time for the analysis of IH samples; and

- The Occupational Medicine program is transitioned to a responsive, worker-centered program with improved medical services.

Based on contractor actions taken to date and planned actions, ORP has confidence the CH2M HILL IH program will continuously improve during the next year and accomplish the following:

- Fully define workplace hazards associated with tank vapors;

- Implement appropriate controls to address those hazards; and

- Reevaluate the program for ongoing performance improvement.

## 2.0 BACKGROUND

The Hanford Site Tank Farms store and process highly radioactive and chemically hazardous waste, which was generated by past Hanford defense related activities. Sixty percent of the nation's high-level radioactive waste is stored at Hanford in 177 large underground tanks.

The current mission of the Tank Farms is to safely prepare the waste so it can be vitrified into glass logs through a new vitrification treatment plant currently being built at Hanford. This mission includes retrieving waste from single-shell tanks (SST) so they can be closed. Tank Farm activities involve various potential hazards which need to be effectively controlled. These hazards include exposure to external radiation, radiological contamination, hazardous chemicals, and various physical hazards associated with facility operations.

Workers are currently protected against exposure to hazardous vapors through a requirement that all work in the Tank Farm Area be conducted using Supplied-Air Respirators (SAR). However, extensive monitoring and sampling results, which have been taken and analyzed over the past year, indicate worker over-exposures are extremely unlikely, and use of this level of respiratory protection is likely excessive. However, the level of protection is being continued because worker concern remains high. One of the most important overall goals of the CH2M HILL IH program is to develop a consistent strategy to allow the selection of appropriate PPE, including respiratory protection, based on objective information.

Organization

Line management responsibility for the Tank Farms falls under the Manager of the DOE ORP, which manages the prime contract for the Tank Farm project. The ORP Office of Environmental Safety and Quality (ESQ) is responsible for project oversight and this assessment. The Director of ESQ implements an oversight program to assess whether ORP and contractor performance is in accordance with the guiding principles and core functions of a robust integrated safety management system. The ESQ Director reports to the ORP Manager. CH2M HILL is the prime contractor responsible for the safe operation of the Tank Farms.

FY 2004 IH Findings by the DOE Office of Independent Oversight and Performance Assurance

At the direction of the Secretary of Energy, the Office of Independent Oversight and Performance Assurance (OA) conducted an investigation of selected aspects of worker safety and health systems at the DOE Hanford Site from February through April 2004. OA is part of the Secretary of Energy's Office of Security and Safety Performance Assurance. In February 2004, the Secretary of Energy directed OA to evaluate recent allegations of deficient safety and medical practices and to assess past practices and current operations to determine whether additional actions are needed to ensure a safe work environment at the Hanford Site.

The allegations addressed: 1) whether workers were adequately protected against exposure to vapors at the Hanford Site Tank Farms; 2) whether workers received appropriate medical treatment after a perceived exposure; and, 3) whether exposure events were reported properly and accurately. Consequently, OA focused its investigation on vapor management at the Tank Farms and the occupational medicine program and illness/injury reporting practices as they relate to Tank Farm operations. Because the occupational medicine program and injury/illness reporting processes encompass all workers at the Hanford Site, OA also examined whether the allegations might have implications for other Hanford Site workers.

This assessment resulted in 18 Findings. DOE and its contractors prepared an integrated corrective action plan to address these Findings. 129 CAs have been developed and are being tracked. 101 of the 129 CAs reside with the Tank Farms Contractor (TFC). As of April 2005, the contractor had reported completion of all 101 CAs.

## 3.0 OBJECTIVES, SCOPE, AND APPROACH

### 3.1 Objectives

The purpose of this assessment was to conduct an annual review of the TFCs IH program. The objectives of the assessment were:

1. To verify CAs associated with the tank vapor exposure Findings (Findings from the April 2004 Office of Independent Oversight and Performance Assurance Assessment) are effectively implemented and completed;

2. To verify the contractor IH program is in compliance with applicable DOE and OSHA regulations; and

3. To verify the contractor IH program is helping to improve safe work practices at the Tank Farms.

### 3.2 Assessment Scope and Evaluation Criteria

The assessment team performed contractor interviews, attended work planning meetings, performed field and facility investigations, and reviewed corrective action implementation documentation to determine the state of the contractor IH Program.

The following evaluation criteria were used to establish the assessment conclusions, results, and Observations:

- Determine whether the TFCs IH program is performance based and has viable progress measuring tools in place;

- Determine whether the IH program is compliant with DOE and OSHA regulations, standards and requirements;

- Determine whether the contractor program helps workers and managers effectively prepare work plans which identify hazards/potential hazards and actions for mitigation;

- Determine whether program procedures are current and sufficient to implement the program requirements;

- Verify with factual evidence the contractor has completed all 101 CAs resulting from the April 2004 OA assessment Findings;

- Identify whether any assessment conclusions require further corrective action;

- Identify Observations the contractor should take under consideration for future program and work practice improvement;

- Determine whether the contractor has implemented commercial best practices for improving worker safety at construction, maintenance, and operational facilities; and

- Determine whether the contractor IH training and qualifications program is viable.

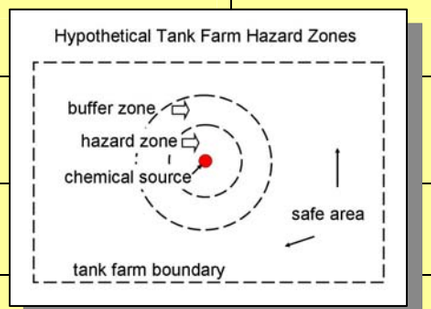
### 3.3 Approach

The assessors evaluated the IH Program procedures, work planning procedures, interviewed those charged with managing and implementing the required IH processes, and examined records pertaining to the subject matter. Assessment efforts focused on evaluating the effectiveness of the OA CAs, and compliance of the TFC program with DOE and OSHA requirements.

The following Table 1, Page 5, summarizes the technical and administrative areas of review, and the specific processes analyzed.

## TABLE 1 – TFC IH PROGRAM OVERVIEW

| | Program Maturity | IH Organization | Primary Focus | Related Activities | Engineering Controls | Admin Controls | PPE | Sampling & Monitoring |
|---|---|---|---|---|---|---|---|---|
| April 2004 | **Reactive.** Assume the worst case is known. | Individualized IH practice | Are there unsafe conditions or locations in the Tank Farms? | | HEPA breather filters; stacks on Double-Shell Tank (DST) exhausters; SST source control (foaming) | Air monitoring zones (AMZ) | No chemical protection required for most operations | Ad hoc personal monitoring; direct-reading instruments to evaluate short-term/Immediately Dangerous to Life or Health exposures |
| | | | | Ammonia, nitrous oxide, dimethyl mercury, mercury found to be present | Continuous Air Monitor cabinet exhaust fans | Tank Farm boundaries set as hazard zones | All Tank Farm activities require supplied air | |
| | **Evaluative.** Emphasis on defining the scope and scale of chemical hazard concerns. | Build a centralized organization | Hazard characterization: define a complete list of chemical hazards | Develop a technical basis for IH | Stack extensions | | | |
| | | | | Define a complete list of chemicals of potential concern (COPC) | | | | |
| April 2005 | | | | Develop enhanced sampling methods to be able to measure all COPCs | | | | Begin to measure all COPCs using enhanced sampling methods |
| | | | Define hazard zone outer boundaries (see figure) | Use the highest level of PPE only where hazards or uncertainties exist | | Posted hazard zones in Tank Farms | Use Powered Air Purifying Respirator or Air Purifying Respirator in Tank Farms outside of hazard zones | |
| | | | Define boundaries between safe areas and buffer zones | Use PPE only where hazards or uncertainties are known to exist | Remote exhauster pilot | | Identify Tank Farms areas where no respiratory protection is needed | Judicious use of Direct-Reading Instruments (DRI) only where short-term hazards exist |
| | **Comprehensive.** Understand with certainty the boundaries and behavior of most chemical hazards. | Evaluate combining all IH services under a unified organization | Evaluate hazard zones for <u>routine</u> operations | Collect IH data in a systematic manner so that all workers in a similarly exposed group (SEG) are represented | Remote exhausters in farms where needed | | PPE specifically selected for each job | Focused personal sampling by SEG |
| | | | Evaluate hazard zones for <u>non-routine</u> operations | Understand how waste transfers and waste disturbance change vapor levels in the workspace | Evaluate further engineered solutions as needed | Posted hazard zones, plus temporary zones as needed | | Evaluate hazards during transfers and retrieval activities |
| | **Proactive.** Use knowledge of chemical behavior and work practices to establish the most effective posture for workers. | World-class, integrated IH team drives a sophisticated hazard evaluation process | Characterize and understand hazards and controls for all routine and non-routine operations | Detailed advance planning for IH activities to answer sophisticated questions in a scientifically valid manner | | | | Well-planned and coordinated sampling and monitoring for all chemical agents and all work activities |



## 4.0 FINDINGS AND OBSERVATIONS

This section contains the significant results of the review. See Appendix B for a detailed description of the basis of Open Issues identified in this review. ORP expects that CH2M HILL will develop CAs for each of the items listed below. In approximately one year, DOE will review extent to which the CAs have been implemented.

| | Expectation | LOI |
|---|---|---|
| 1.1-A | CH2M HILL will understand, with a reasonable degree of scientific certainty, boundary and behavior of chemical hazards. | 1.1 |
| 1.1-B | CH2M HILL will use knowledge of chemical behavior and work practices to establish effective control measures. | 1.1 |
| 1.2-A | CH2M HILL will continue aggressively to implement program improvements with full implementation by April 2006. | 1.2 |
| 2.1-A | CH2M HILL will implement a sophisticated hazard evaluation process that reflects the highest level of professional practice. | 2.1 |
| 2.1-B | CH2M HILL will create a centralized organization with updated, revised procedures. | 2.1 |
| 2.1-C | CH2M HILL will complete an evaluation of overall CH2M HILL IH organization addressing:<br>• Integration of all IH services into one group;<br>• Evaluate staffing requirements; and<br>• Resources management issues, e.g., cross-training Health Physics Technicians (HPT) and Industrial Hygiene Technicians (IHT). | 2.1 |
| 2.1-D | CH2M HILL will incorporate relationships to Engineering and Occupational Medicine in IH Organization Chart. | 2.1 |
| 3.1-A | CH2M HILL will continue implantation of the Technical Basis document, as described in TFC-PLN-65. | 3.1 |
| 3.1-B | CH2M HILL will completely characterize vapor space chemistry. | 3.1 |
| 3.3-A | CH2M HILL will complete Area and Source characterization for Tank Farm Areas where active work is taking place. | 3.3 |
| 4.1-A | CH2M HILL will develop a coordinated plan to maximize use of engineering controls to address Tank Farm vapor issues. | 4.1 |
| 4.1-B | CH2M HILL will complete implementation of stack extension plans. | 4.1 |
| 4.1-C, | CH2M HILL will complete implementation of remote exhauster plans. | 4.1 |
| 5.1-A | CH2M HILL will develop a thorough understanding of Tank Farm hazards, allowing selection of appropriate PPE. | 5.1 |
| 5.1-B, | CH2M HILL will define Hazard Zone, Buffer Zone, and Safe Zone boundaries. | 5.1, 5.2 |

| | Expectation | LOI |
|---|---|---|
| 5.1-C | Hazards and appropriate controls will be characterized by CH2M HILL for all work activities. | 5.1 |
| 5.2-A | CH2M HILL will post hazard zones in all Tank Farms. | 5.2 |
| 5.3-A | CH2M HILL will ensure that IH issues fully integrated in work planning process. | 5.3 |
| 6.1-A | CH2M HILL will implement PPE selection procedures based on Zone definitions. | |
| 6.1-B | CH2M HILL will develop Job-specific PPE profiles based on well-defined work zones that incorporate the following:<br>• No IH-driven PPE requirement in Safe Zone;<br>• Increased IH-driven PPE, as necessary, in Buffer and Hazard Zones; and<br>• Where practical, coordinated with Radiological Control (RadCon) practices. | 6.1 |
| 7.1-A | CH2M HILL will complete implementation of Exposure Assessment Strategy. | 7.1 |
| 7.1-B | CH2M HILL will formalize definition and establish SEGs for various hazards or classes of exposure. | 7.1 |
| 7.1-C | CH2M HILL will establish Occupational Exposure Limits (OEL) for all chemicals identified in Tank Vapors and develop appropriate measurement strategy (DRI and/or sampling) for all COPCs. | 7.1 |
| 7.1-D | CH2M HILL will continue evaluation and categorization of worker exposures using personal sampling and direct-reading instruments, as appropriate. | 7.1 |
| 7.3-A | CH2M HILL will prepare a final list of COPCs as well as the process to keep list current. | 7.3 |
| 7.6-A | CH2M HILL need to work with their IH lab to ensure timely laboratory evaluation of all IH samples (two weeks maximum turn around time). | 7.6 |
| 8.1-A | CH2M HILL will develop a proactive, responsive, worker-centered program with a visible presence of medical providers in Tank Farms and improved communication and increased worker confidence in program. | 8.1 |

## 5.0 RESULTS AND CONCLUSIONS

The contractor worked constructively with the assessment team during the program evaluation. CH2M HILL senior personnel made themselves available throughout the week, and IH program managers accompanied members of the assessment team during field activities. During the assessment, team members met with CH2M HILL personnel from the following organizations: IH, Engineering, Management, Occupational Medicine and Support Services. The team

reviewed a variety of documents, including: work packages; various IH communications to workers; and corrective action documentation associated with the 2004 OA report. The assessors also observed various field activities and interviewed groups of craft personnel, IH Technicians and line managers. The following pages describe in detail the primary IH Observations and conclusions determined by ORP.

## Program Maturity

Elements of the program, including Technical Basis Document and associated efforts to define new OELs, met regulatory requirements. When fully implemented, the overall CH2M HILL IH program will be a model program and should eliminate worker concern regarding their safety with respect to exposures to tank vapors.

Prior to April 2004, the CH2M HILL IH program made the assumption that "worst case" levels of vapor exposure to Tank Farm workers were understood. These assumptions were based on sampling, as well as, historical knowledge showing few, if any, documented exposures above applicable OELs. However, increased concern from workers regarding detection of "vapors" and "odors" caused CH2M HILL to re-evaluate several components of the IH program.

As a result of the program re-evaluation, the following key actions have been taken in the last year:

- The IH organization has been enhanced with the addition of 15 new positions. An IH oversight group was created and placed in Tank Farm Operations;

- Substantial progress has been made to define the scope and scale of chemical hazards to which Tank Farm workers may be exposed;

- The "Technical Basis Document," which characterized tank vapors, represents a "Best Management Practice" and significantly exceeds minimum regulatory requirements;

- Related efforts to establish OELs for the new chemicals found in tank headspace, and the development of new analytical techniques represent "Best Management Practices;"

- New procedures have been developed and are being implemented, including an Exposure Assessment Strategy which implements the DOE "As Low As Reasonably Achievable" (ALARA) principle;

- The Exposure Assessment Plan (TFC-PLN-34) is currently in initial stages of implementation, as are plans to evaluate other source terms (TFC-PLN-67);

- Approximately 4,146 personal samples were collected between April and December 2004. Approximately 3,000 area and source samples were collected (1,790 analyzed by the lab and returned to the IH Department) between September and December, 2004;

- A draft plan is being prepared to evaluate releases from the 05-01 242-A Evaporator Campaign (7T800-05-JAR-001);

- CH2M HILL anticipates using exposure assessment results to establish procedures for determination of appropriate engineering controls, administrative controls, and protective equipment; and

- All workers are required to use supplied-air respirators, a conservative approach, until all the above are completed for the work areas.

The exposure assessment and tank vapor characterization plans represent significant progress. CH2M HILL plans to continue aggressive implementation of program improvements. By implementing these improvements, the contractor more fully understands the boundary and behavior of chemical hazards in the Tank Farms. This information is being used to establish more effective control measures, including the definition of Hazard Zones, work planning and selection of appropriate PPE. While exposure assessment efforts are being implemented, all Tank Farm workers are required to wear SARs. This approach is effective, in that it ensures workers are not exposed to hazardous vapors. However, this approach introduces new hazards, including slip/trip/fall issues, ergonomic hazards and increased risk of heat stress. As implementation of the CH2M HILL plan is completed, the assessors anticipate a more sophisticated approach will be developed to select PPE based on the understanding of hazards for each job task and work location.

The CH2M HILL IH program met regulatory requirements and provides Tank Farm workers with a safe working environment. When fully implemented, on or about April 2006, the CH2M HILL will be a model program. Full IH program implementation will provide CH2M HILL a better understanding of the boundary and behavior of chemical hazards, with a reasonable degree of scientific certainty. This increased knowledge of chemical behavior will establish more effective control measures for work tasks in the Tank Farms.

## IH Organization and Training

The team concluded the organization of CH2M HILL IH program met regulatory requirements. Additionally, the CH2M HILL plans for training and communication met regulatory requirements. When fully implemented, the CH2M HILL training and communication program will exceed regulatory requirements.

There have been significant improvements in the contractor IH program organization over the past year. Since April 2004, CH2M HILL has centralized management of the Tank Farm IH program. Approximately 15 new positions have been created, under Director of Environmental Health. Six Certified Industrial Hygienists (CIH) are on staff. A comprehensive set of planning documents have been created and implementation is well under way. A great deal of work has been done to characterize the potentially hazardous atmospheres in tank vapor spaces and to assess worker exposure to these vapors. In most cases this extensive planning is still being translated into operational success, as follows:

- The exposure assessment program is well under way, but not yet completed;
- Sampling and monitoring procedures are available for many, but not all COPCs; and
- Many source and area samples have been collected, but not enough to establish control zones within work areas.

CH2M HILL plans to complete implementation of these programs in the next year.

Currently, the three IH field groups report through the Sr. Vice President for Operations, rather than through the newly formed Environmental Health group. The field IH groups must balance on-going, operational responsibilities with development and implementation of new programs. To date, they appear to have been largely successful. A good deal of program development has been accomplished and line management is generally satisfied that operational IH responsibilities are being met. However, CH2M HILL should consider whether the overall IH program would be better served by having all IH personnel report through the Environmental Health group. There is no regulatory requirement for a reorganization or consolidation of the IH groups, but a single, centralized IH group is consistent with typical professional practices. CH2M HILL also should consider the roles of the Engineering and Occupational Medicine groups and how this can be better integrated into the organization.

Once a revised organizational model has been determined, CH2M HILL also should evaluate staffing needs in the IH program. 15 IH personnel have been added over the last year, which is a significant commitment of resources. ORP recommends CH2M HILL develop appropriate metrics and benchmarks based on the situation and develop a resource plan for staffing and equipment which ensures sufficient resources are allocated to achieve and maintain program goals. One potential source of additional personnel may be to cross-train HPTs and IHTs.

Beyond organizational issues, training and risk communication are central to IH program effectiveness. Issues of hazard and risk are inherently difficult to communicate, especially in a complex work environment, as exists in the Tank Farms. The situation facing CH2M HILL is complicated and the result of many years of past practice from a variety of entities.

In summary, the organization of the CH2M HILL IH program met regulatory requirements. CH2M HILL should review its organizational model and develop a resource plan which ensures sufficient IH resources are allocated to achieve long-term program goals. The CH2M HILL plans for training and communication currently meet regulatory requirements. When fully implemented, the CH2M HILL training and communication program will exceed regulatory requirements. However, efforts in excess of regulatory requirements may be necessary to achieve an acceptable level of worker confidence in the program. To achieve this, the impressive scientific efforts of the IH program need to be combined with equally extensive risk communication efforts.

## Vapor Characterization

The CH2M HILL Tank headspace vapor characterization strategy met requirements for characterization of workplace hazards. When fully implemented, the CH2M HILL vapor characterization program will represent a unique professional accomplishment, which is significantly in excess of comparable efforts at hazardous waste sites.

The CH2M HILL technical approach to understanding headspace vapors is documented in the Technical Basis Document (RPP-22491 Revision 0, October 2004). To gain current knowledge of the chemicals which present a hazard to the workers, CH2M HILL conducts an ongoing program to sample and characterize tank headspace vapors. Presently, sampling efforts are focused on the waste tanks in C-Farm. Sampling statistics are provided below:

- Between late May and early September 2004, the headspaces of 11 SSTs in C-Farm were sampled. Sampling data exists for all 16 tanks in this farm;
- In the S-Farm, all tanks have been sampled except for the headspace of S-104;
- In the U-Farm, 12 of the 16 tanks have been sampled;
- To date, samples have been obtained from 119 of the 149 SSTs; and
- Many tanks have been sampled more than once, with some as many as nine times. 70 samples exist for the 16 tanks in C-Farm.

Recent sample results have been compared to samples collected in the 1990s. Results of the sampling indicate limited variability in headspace composition over time (<1 order of magnitude).

- The Burrup[1] report shows the overall average organic vapor variability in same-tank sample pairs, separated by up to five years, is 194% (with a 95% confidence interval);
- This concludes that 95% of the samples would differ by less than a factor of two when measured on different dates; and
- The highest variability was a factor of five.

The CH2M HILL tank sampling program identified approximately 1,826 individual chemicals found in tank headspace vapors (or which can reasonably be anticipated to be found in tank headspace vapors). There are few chemicals which are not related to process wastes. The vast majority can be tied to process waste or degradation products.

[1] Burrup,C.W., J.E. Meacham, B.G. Amidan, S.K. Cooley, and J.L. Huckaby, 2004, Statistical Analysis of Tank Headspace Vapor Data, RPP-21972, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

Beyond determining chemical constituents of headspace vapor, the Technical Basis Document also describes the approach used to evaluate potential hazard of vapor constituents. The "Technical Basis Approach" (Table 1.1 in RPP-22491) outlines the overall process to identify chemicals, classify them according to "Occupational Exposure Limit," and determine if an individual chemical is a COPC. This approach represents a model professional practice and is in excess of minimum regulatory requirements (as found in 29 CFR 1910.1000). For each chemical present or potentially present in headspace vapors, CH2M HILL identifies "Occupational Exposure Limits" and carcinogenicity data.

All chemicals are compared with the lowest identified occupational exposure limit (LOEL).

- If the ratio headspace concentration to LOEL was > 0.1, the chemical was identified as a COPC;

- The 10% criterion is based on the fact that headspace concentrations are generally expected to be within a factor of 10 of the measurement. This is conservative since vapors leaving the tank will be significantly diluted in the worker's breathing zone;

- If the chemical has no OEL, no measured concentration, or the ratio of the concentration to is LOEL <0.1, the chemical is placed in the further evaluation category; and

- Only non-plausible chemicals are placed in the low probability portion of the exposure list.

The CH2M HILL Technical Basis Document (RPP-22491, Revision 0, October 2004) identifies 52 COPCs, 1,538 chemicals requiring further evaluation, and 236 chemicals which are considered low probability of exposure. As of this assessment, an update to the chemical list is being prepared. Seven chemicals will be transferred from the COPC list to the Low Probability list, and an additional 40 chemicals (many representing hydrocarbon fractions) will be added to the COPC list.

Because personal sampling conducted as part of the exposure assessment process may not provide adequate information regarding exposures for a given task, activity or location (because full-shift samples average exposures over the entire sample period, which may contain multiple tasks, activities or locations), CH2M HILL also is supplementing its personal sampling program with a program of area and source term monitoring to determine potential exposures in different geographical areas.

Overall, since April 2004, a total of 1790 Source and Area samples have been taken from tanks and/or areas in the A-Farms, in C-Farm, in SY-Farm, in TX-Farm, and in U-Farm. These samples were analyzed with a Gas Chromatograph/Mass Spectrometer (GC-MS) system, with the following results:

- 29 unique chemicals were found (out of the total 1,826 identified in the Technical Basis document);

- Of the 29 unique chemicals found, 13 are COPCs, as discussed below;

- The chemicals which are a constituent in the tank vapor, that present the greatest worker hazard are ammonia ($NH_3$) and mercury vapor (Hg vapor), and nitrous oxide ($N_2O$); and

- Beyond these two, no other chemical vapor was detected at concentrations greater than 1.0% of its LOEL.

In summary, the team concluded the CH2M HILL vapor characterization program met regulatory requirements. The Technical Basis Document is sufficiently complete to allow work to proceed on worker exposure assessment. However, there are aspects that are still being implemented. Implementation, as outlined in "Industrial Hygiene Chemical Vapor Technical Basis Implementation Plan" (TFC-PLN-65) will be completed within one year. At that time, CH2M HILL will have a complete characterization of tank vapor space composition and chemistry for all tanks where work will be taking place.

**Vapor Exposure – Engineering Controls**

The team observed that CH2M HILL plans to implement engineering controls to minimize worker exposures to Tank Farm vapors met regulatory requirements. When fully implemented, the CH2M HILL engineering control program will exceed regulatory requirements.

The long standing and well established IH hierarchy of hazard mitigation is:

1. Engineering controls;

2. Administrative controls; and

3. The use of appropriate PPE.

Over previous years at the Hanford Site, chemical vapor controls have been based primarily on use of PPE, rather than engineering and administrative controls. This is evidenced by:

- As of April 2004, there were only limited engineering controls in place on Hanford's SSTs. All of these tanks were built between the late 1940's and the 1970's;

- All of the SSTs were passively ventilated with filtered breathers exhausting approximately five feet above the ground level which is directly in worker breathing zones;

- DSTs are actively ventilated, with exhaust stacks which discharge at heights all greater than 10 feet above the ground level;

- The 242-A evaporator exhaust point is well above the ground level; and

- Aside from the elevated emission points on DSTs and the 242-A evaporator, there are few other engineering controls in place to protect workers from exposure to the vapors which could potentially be issued from the source point.

Current efforts place increased focus on engineering controls. These include:

- A plan to extend stack heights extensions for all U-Farm tanks. Several of the tanks have already had their exhausters elevated to points approximately 12 feet;

- An engineering control under evaluation (referenced in Corrective Action C-10-5) is focused at mitigating worker vapor exposures in C-Farm, and possibly also in AN-Farm where historically there have been an unusually large number of odor complaints. This control action is to install active ventilation on those tanks where odor complaints have been particularly numerous, and transport the exhausted vapors from those tanks by a duct extending to approximately 600 feet north of C-Farm where there are currently no Hanford Site facilities;

- Additional areas of engineering focus (referenced in Corrective Action C-10-2, C-10-4) relate to locating and sealing sources of fugitive vapor emissions, principally on SSTs, but also on DSTs; and

- There are various instrument and equipment cabinets that have direct connections to a tank's vapor space. For these situations, active ventilation of these cabinets before any actual worker access is being developed (referenced in Corrective Action C-10-2).

In summary, the team concluded that CH2M HILL plans to implement engineering controls to met regulatory requirements. ORP expects CH2M HILL to complete implementation of stack extension plans, complete implementation of remote exhauster plans, and to develop a coordinated plan to maximize use of engineering controls to address vapor issues. When fully implemented, the CH2M HILL engineering control program will exceed regulatory requirements.

**Vapor Exposure – Administrative Controls**

The CH2M HILL Administrative Control strategy mets regulatory requirements. When fully implemented, the CH2M HILL vapor characterization program will exceed regulatory requirements. After engineering controls, administrative controls are the most important tool to reduce worker exposures to chemical vapors. Key elements include Job Hazard Analysis (JHA), appropriate work planning and established administrative control areas or zones.

JHA is incorporated into work package planning. JHA is routinely conducted as part of the work planning process. Standard analyses are available for routine task. New analyses are generated for more complex tasks. Hazard analyses are developed in conjunction with Operations and Engineering groups and reviewed by radiation control, industrial safety and IH groups. This is the central document for planning of all Tank Farm activities. The assessors reviewed several active and completed Work Packages. The reviewed work tasks ranged from simple, short term, projects (i.e., remove, inspect, and reinstall the pressure differential indicator on the inlet filter for Tank S-102), to complex, multi-worker projects (i.e., removal and replacement of the hose currently in the buried hose transfer conduit running between Tanks BY-105 and BY-106). Each

work packages reviewed adequately covered spanned conceptual planning, to site logistics, to final activity execution.

The Work Packages reviewed showed improvement in consideration of IH worker safety issues from the January 2005 time-period. However, IH provisions have not yet reached the level of sophistication accorded to issues of radiation control. As future redefinitions of chemical exposure hazard levels are completed, it is important that these hazards be re-addressed in the work planning process.

Current Tank Farm work is completed by workers using maximum self-contained breathing apparatus (SCBA) respiratory protection. While providing excellent respiratory protection, these particular PPE introduce several new hazards. For example, from January 1, 2004, to March 30, 2005, about 33% of current workplace injuries can be directly related to the use of SCBAs. These injuries range from muscle strains (from carrying the equipment) to slips, trips, and falls arising from the reduced visibility. Respiratory tract irritations arising from the requirement to breathe air of 0.0% relative humidity level also occur. As discussed previously, a thorough understanding of Tank Farm hazards should be used to develop appropriate controls for all work activities, and not just isolated conditions.

A key aspect of administrative controls is developing procedures which establish appropriate work control zones, including:

- Hazard Zones (areas where maximum PPE are required);

- Buffer Zones (areas where lesser levels of PPE will be required – that is, Powered Air Purifying Respirators or simple Air Purifying Respirators); and

- Safe Zones (areas where the hazard levels are sufficiently minimal and IH driven respiratory protection is not required).

It is important for CH2M HILL to use tank vapor characterization efforts to establish Hazard Zone, Buffer Zone, and Safe Zone boundaries.

In summary, the CH2M HILL Administrative Control strategy met regulatory requirements. Current activities include efforts to develop a thorough understanding of Tank Farm hazards. This information is being used to characterize work-task hazards and define Hazard Zone, Buffer Zone, and Safe Zone boundaries. Zone boundaries should be used in the selection of appropriate PPE, and incorporated into the work planning process. Once these disciplines are mature, the CH2M HILL vapor characterization program will significantly exceed regulatory requirements.

**Vapor Exposure – PPE**

The CH2M HILL Respiratory Protection Program (RPP) met regulatory requirements. When current efforts, as discussed above, are fully implemented, and a rational basis is determined for the selection of respiratory protective equipment, the program will exceed regulatory requirements.

Title 29, Code of Federal Regulations (CFR), Section 1910.134 provides specific requirements for the use of respiratory equipment in the workplace. These include adequate training for workers, fit testing, as well as, a requirement employers evaluate respiratory hazard(s) in the workplace, identification of relevant workplace and user factors, and base respirator selection for these factors. As discussed above, CH2M HILL is conducting an exhaustive determination of workplace chemical hazards. Until complete, respirator selection is limited to SARs. This provides adequate protection, but introduces new work place hazards that must be considered and mitigated.

The current CH2M HILL RPP is based on a simple concept: all workers who perform tasks in a Tank Farm must use either a full face SAR or a SCBA. Therefore, within the fence line of any Tank Farm, every worker is fully protected from exposure to any hazardous chemical vapor. Current and historical sampling and monitoring show this to be conservative. With the exception of ammonia, mercury, and nitrous oxide no chemicals have been detected at greater than 1% of the lowest occupational exposure guideline (LOEG). There are other less burdensome options to control worker exposures to these chemicals. For example, if the exposure assessment process determines respiratory protection is necessary, cartridges are available for each of these chemicals which would enable the use of air-purifying respirators, rather than supplied-air respirators.

The CH2M HILL IH program is evaluating levels of chemical vapor hazards in all Tank Farm areas. Once completed, this information will be used to establish appropriate administrative control zones (Hazard Zone, Buffer Zone, and Safe Zone). Selection of respiratory protective equipment will ultimately be determined based on the assigned zone where work occurs. Timely completion of this effort is paramount. While the use of SARs does provide respiratory protection, it introduces a number of new hazards which can only be mitigated by the worker. SARs are heavy and awkward to use, and there is already evidence of an increase in “slip and fall” type injuries. In addition, use of SARs increases the likelihood of ergonomic or muscular-skeletal injury. Finally, as warm weather approaches, there is a real likelihood that unnecessary use of SARs increases the risk of heat-related illnesses.

In addition to work within perimeter of Tank Farm fence, there are locations outside fence, principally in the 200 East Area, where the possibility of a hazardous chemical vapor exposure could hypothetically occur. At present, the RPP for areas outside of Tank Farms does not mandate any level of respiratory protection. A current air sampling effort is underway to confirm these “outside” areas are free of dangerous chemical vapor exposures.

The assessment team concluded the CH2M HILL RPP exceeds regulatory requirements. CH2M HILL is developing job-specific PPE profiles based on well-defined work zones which incorporate the following:

- No IH-driven PPE requirement in Safe Zone;

- Increased IH-driven PPE, as necessary, in Buffer and Hazard Zones; and

- Where practical, coordinate IH driven designations with radiological control practices.

Once these plans are fully implemented, along with PPE selection based on procedural zone definitions, the CH2M HILL respiratory protection program will significantly exceed regulatory requirements.

**Exposure Assessment**

The team concluded the CH2M HILL exposure assessment strategy met regulatory requirements. When fully implemented, the CH2M HILL exposure assessment program will exceed regulatory requirements.

The IH Technical Basis Document (RPP-22491, Revision 0, October 2004) identifies 52 COPCs, 1,538 chemicals requiring further evaluation, and 236 chemicals which are considered low probability of exposure. However, the inventory list is being revised, as follows: seven chemicals will be transferred from the COPC list to the Low Probability list, and an additional 40 chemicals (many representing hydrocarbon fractions) will be added to the COPC list.

In order to determine actual and potential worker exposure to these chemicals, CH2M HILL has established an active program of personal monitoring that will provide statistically significant estimates of actual chemical vapor exposure to workers.

- From April 1, 2004, to May 12, 2005, 4,146 personnel monitoring samples were collected. These samples were analyzed for a variety of chemical vapors, including 12 of the 52 COPCs;

- As of this report, laboratory analysis indicates no individual sample was in excess of any OEL for any chemical for any worker;

- Review of these samples found that no worker had been exposed to any chemicals to a value that exceeded 1/100 of a threshold value limit (TLV); and

- The team found turnaround times for the analysis of personal monitoring samples excessive. Turnaround times as long as two months were common. This is considered a weakness that requires correction. A turnaround time of two weeks should be achievable.

CH2M HILL plans to use this data to develop exposure models for "Standardized Exposure Groups." The contractor has tentatively identified five SEGs:

- Waste Intrusive Activities – Tank component removal and waste sampling;

- Waste Disturbing Activities – Vent/balance and valve work;

- Non-waste Disturbing Activities – Routine Operations and maintenance;

- Support Activities – Carpenters, painting, and welding; and

- Laboratory – Maintenance and analytical.

Once sufficient data have been collected for each SEG to assure acceptable statistical reliability (for example, that there is a 95% likelihood that exposures to a given chemical for a given task in a given location will be less than a given level), CH2M HILL will be able to assure its workforce that exposures in the assigned SEG are within limits. CH2M HILL expects to complete full implementation of its Exposure Assessment Strategy, as well as, Area and Source characterization plans (e.g., ESHQ-IH-STD-12, "Industrial Hygiene Monitoring and Control Strategies during Tank Retrieval and Transfers") by April 2006.

Because personal sampling may not provide adequate information regarding exposures for a given task, activity or location (because full-shift samples average exposures over the entire sample period, which may contain multiple tasks, activities or locations), CH2M HILL also is supplementing its personal sampling program with area and source monitoring. Source monitoring statistics include:

- Approximately 1,790 area and source samples which were collected between August 2004, and November 2004;

- The area sampling program involved the collection of three consecutive eight-hour samples in order to provide a 24-hour area exposure;

- Source or work area samples were collected at a five foot radius from each breather filter for SSTs, and three additional samples were collected at a distance of 30 feet downwind from stack on DSTs;

- All work area samples collected to date are below the applicable OEL's, with most COPCs not detected at all; and

- All source sample results are below OEL, with the exception of ammonia at the U-Farm and C-Farm breather filters, and elemental Hg at a C-Farm breather filter.

The CH2M HILL exposure assessment strategy met regulatory requirements. When fully implemented, the CH2M HILL exposure assessment program will exceed regulatory requirements. CH2M HILL will continue its efforts to formally define SEGs, and continue evaluation of worker exposures using personal sampling and DRIs for future Tank Farm work. This will require development of a measurement strategy (DRIs and/or sampling) for all COPCs. In addition, turnaround times for analysis of personal monitoring samples should be improved.

## Occupational Medicine

The CH2M HILL occupational medicine and medical surveillance program met regulatory requirements. When program improvements are fully implemented, the CH2M HILL exposure assessment program will exceed regulatory requirements.

Medical surveillance is aimed primarily at evaluating individual exposure conditions and preventing occupational diseases. This is accomplished by a program designed by CH2M HILL known as the Employee Job Task Analysis (EJTA). The medical monitoring program, on the other hand, provides employees unobstructed access to medical treatment, recordkeeping and follow-ups on injuries and occupational-related illnesses arising from the workplace. The CH2M HILL programs for these areas are fully developed and comply with OSHA Standards, DOE O 440 and 440.1A, and CH2M HILL standards, procedures and policies.

The assessors observed that the CH2M HILL medical surveillance and monitoring assessment found that AdvanceMed Hanford was open, provided direct access to employee medical information, and encouraged interaction between the employee and the medical staff. These Observations indicate a good working relationship between the CH2M HILL EJTA staff and the Hanford medical personnel. It is important for this relationship to remain healthy and open to ensure accurate medical information is communicated. The assessors also acknowledge a visible presence of medical providers in the Tank Farms which will improve communication and increase worker confidence in the medical monitoring program.

The assessment team concluded the CH2M HILL Occupational Medicine and medical surveillance program met regulatory requirements. When program improvements are fully implemented, the CH2M HILL exposure assessment program will exceed OSHA 29 CFR 1910.120, as well as, the DOE procedures and orders for safety and health.

## CA Responses to OA Findings

ORP reviewed 57 (56%) of the 101 separate CAs developed for the 13 OA Findings assigned to CH2M HILL. In many cases, a CA responds to multiple OA Findings. The assessment team found the contractor's CAs were responsive to the respective Finding (or Findings). Furthermore, the team verified completion of the 57 reviewed CAs through evaluation of the closure documentation. Appendix B provides a detailed listing of the CAs reviewed and verified by specific Finding.

## Overall Conclusions

The overall conclusion of the assessment team is CH2M HILL has made sufficient progress over the past year, and the contractor can achieve full implementation of its IH program goals by April 2006. The following represent the Team's conclusions against the stated assessment objectives:

1. CAs associated with the tank vapor exposure Findings (Findings from the April 2004 Office of Independent Oversight and Performance Assurance Assessment) have been effectively implemented and completed;

2. The contractor IH program is in compliance with applicable DOE and OSHA regulations; and

3. The contractor IH program is helping to improve safe work practices at the Tank Farms.

Additionally, ORP expects that within one year, CH2M HILL will have completed:

- Fully defining workplace hazards associated with tank vapors;
- Implementing appropriate controls to address those hazards;
- Documenting all control activities;
- Training all workers appropriately;
- Performing all work safely; and
- Continuously evaluating the IH program and incorporating improvements.

## Appendix A - Field Surveys and CH2M HILL Employee Interviews

On April 26 through 27, 2005, the assessment team observed Tank Farm Work Planning activities. Several planned tasks were postponed due to weather, equipment problems or planning issues. On Tuesday, April 26, 2005, members of the team reviewed two Tank Farm work activities, and on Wednesday, April 27, 2005, reviewed one work activity.

### Field Surveys

1. In mid-morning of April 26, 2005, the team observed a project in S-Farm involving a total of six CH2M HILL employees. Of the six craft workers involved, four were within the S-Farm fence line, while the other two carried out their tasks just outside the fence line. The four workers in the farm were tasked to excavate some sort of facility, starting their dig immediately adjacent to the fence, just to the west of Tank S-112. Because of timing issues, the six employees involved in this task were not interviewed at the end of their work.

   Each of the four workers inside the S-Farm fence was using a protective B-Level Suit, and a Scott SCBA, the latter equipped with a one-hour air flask. These four workers used hand shovels to dig a shallow trench starting at a point immediately inside the fence line and dug to the east.

   A fifth worker was immediately outside this fence line using a hose and spraying water through the chain link fence to control dust in the area being excavated. The sixth worker was 20 – 25 feet back from the fence, operating the pump supplying water to the hose being used by the fifth worker. The two workers outside the fence line – as well as the members of the Audit Team who were also immediately outside this fence – were using no PPE of any type. Each of these men was wearing street clothes. The physical separation between the four workers in the farm, each using maximum PPE, and the fifth worker immediately outside the fence ranged from one to three feet. The Audit Team noted the differences in the levels of PPE being used by the members of this work team, as a function of the work task location of each.

2. Later on April 26, 2005, the Audit Team observed an evolution in U-Farm. In this case, two CH2M HILL employees were tasked to remove a total of seven tripod mounted air samplers (as well as their supporting tripods) that had been situated around Tank U-106. These air samplers had been set to obtain 24-hour samples of the ambient air adjacent to and downwind of this tank's breather filter. As a technical note, the pumps providing air to these samplers had been changed every eight hours so that each sampler had a charged and flow calibrated pump during the entire sampling period.

   This passively ventilated tank had recently been equipped with a 12-foot vertical extension on its breather filter. Prior to this extension having been installed, this tank's breather filter had been located at a height of approximately five feet above the ground. Also prior to this extension being installed, a similar seven tripod, 24-hour air sampling task had been completed. The goal of these two parallel air sampling efforts was to evaluate the efficacy of the breather filter extension in minimizing the actual measured ground level concentrations

of tank vapors. It appeared likely that these "before the breather filter extension" and "after the breather filter extension" sampling efforts may well be able to provide this sort of information.

The two men tasked to complete this job were using protective B-Level Suits and SCBAs, in this case, equipped with half-hour air flasks. This entire two man task, from leaving the Change Trailer to returning, involved 10 to 15 minutes. These two field workers were supported by a HPT in the Change Trailer. This third man surveyed all the equipment that had been removed from the area around Tank U-106.

3. On the afternoon of April 27, 2005, the team observed a second operation in S-Farm. In this task, four workers (an Electrician, an Instrument Specialist, a Pipefitter, and an Operator) were to replace an in-line flow monitor from one of the systems atop Tank S-106. The flow monitor had been freshly calibrated, and was equivalent to the unit being replaced.

The Work Package for this job called for the system:

1. To be powered down;
2. The older unit removed;
3. The freshly calibrated flow monitor installed;
4. A second portable flow monitor installed in series with this new unit; and
5. The system re-energized.

As soon as this sequence had occurred, the portable in-line flow monitor documented that the entire system was working to specifications, and the system was again:

1. Powered down;
2. The portable in-line monitor removed; and
3. The entire system finally powered up and set to operate normally, as required for this facility.

The workers wore protective B-Level Suits and SCBAs, in this case, equipped with one-hour air flasks. The entire four man task, from leaving the Change Trailer to returning, involved approximately 35 minutes. These four field workers were supported by a HPT in the Change Trailer. This fifth man surveyed all the equipment (the Toolbox, the replaced flow calibrator, etc.) that had been removed from above Tank S-106.

**CH2M HILL Employee Interviews**

On April 27, 2005, the team interviewed three distinctly different sets of CH2M HILL employees. In each case, the names of the interviewees were not obtained to receive candid responses to our questions. A summary of the comments elicited from the members of the three groups are listed below:

## Group Interview #1 –CH2M HILL Craft Workers

1. This group considered that there are several important worker related ergonomic issues that were being ignored by CH2M HILL management. The most important of these issues is the difficulty of having to work with SCBAs. The workers believed the air flask and the associated back-pack on these units weighed approximately 37 lbs, a load that must obviously be carried by the individual who was using the SCBA. This group pointed out that their lifting training had focused on the requirement that handling weights greater than 30 lbs required a minimum of two men, a requirement that seems to be ignored in the case of the SCBA air flask (NOTE – CH2M HILL IH personnel reported SCBA unit actually weighed approximately 27 lbs).

2. The group believed that CH2M HILL management had failed to apply "common sense" in variety of situations at the Site. As an example, the CH2M HILL management had chosen to have Tank Farm workers complete tasks in areas outside the fence lines of various Tank Farms without respiratory protection in spite of what they believed was a significant potential for exposure to hazardous vapors. The area cited to support this allegation was the AX – AY Tank Farm elevated exhaust stack, which is located outside the fence lines of these two farms. Workers in this area were not required to use respiratory protection of any type in spite of their proximity to this source of potentially hazardous vapors.

3. The group was concerned that use of personal dosimetry for hazardous vapors is quite variable and unsystematic. As an example, it was claimed that if a Tank Farm work crew were to include ten men, but only three or four different crafts, only one of the workers of each craft would have his or her breathing zone sampled for potentially toxic vapors.

4. The group stated that the results of any personal sampling never arrive in less than three months and that individual workers who are sampled are never advised of the results of their exposures to toxic vapors.

5. The workers stated they did not have confidence in the results of these personal sampling evaluations, since these lab results are typically completed by analytical labs located at Hanford. They believe results would have greater credibility if they were to be completed by certified outside labs.

6. The workers believe that they are frequently being sent into potentially hazardous areas that have not been adequately characterized as to the potentially toxic vapors that might be present. They acknowledge that in such situations, the workers involved will always be using SCBAs, but in spite of this, they remain concerned.

7. The workers believe that there are few if any detailed work procedures that cover tasks involving disturbing the waste in a tank. They believe that they are being unnecessarily exposed to greater dangers in such waste disturbing operations, in spite of the fact that they will be using SCBAs.

8. The workers are concerned that repetitive use of SCBAs (i.e., a worker using a SCBA for more than three or four days in succession) is harmful. The workers believe that breathing the dry air provided by an SCBA is harmful in a wide, but unspecified, variety of ways.

9. The workers believe that there is a severe shortage of IHTs. They cited that there are more than 500 HPTs, but probably fewer than 50 IHTs.

10. The workers believe that the CH2M HILL IHs rarely if ever enter any Tank Farm.

**Group Interview #2 – CH2M HILL IHTs**

1. This group believed the overall CH2M HILL IH program had been improved significantly over the past year.

2. There are currently approximately 40 IHTs and IHs working for CH2M HILL.

3. The new Tank Farms Industrial Hygiene (TFIH) Database appears to be excessively cumbersome.

4. This group believed that the CH2M HILL IHs regularly communicate the results of every personal sampling effort to the affected Tank Farm worker.

5. These IHTs did not believe that the average Tank Farm worker recognized that not every smell is dangerous, and that certain chemicals can be smelled at concentrations that are both not hazardous and at concentrations below the minimum detectable levels of most field vapor analyzers.

6. The group stated that Tank Farm workers consider IHTs to be CH2M HILL corporate "lackeys." This opinion had been developed because the IHTs advise the workers that certain areas were not dangerous from the perspective of hazardous vapors, and the workers did not believe this judgment.

7. The IHTs believed that the CH2M HILL IHs never enter a Tank Farm.

8. The IHTs considered that IHT training was lacking.

9. The IHTs believed that neither the current Legacy Database nor the new TFIH Database is capable of handling directly logged monitoring results from any field ambient vapor analyzer.

10. The IHTs believed that members of the CH2M HILL Training Group were not as aware of actual situations in Tank Farms as they should be.

11. Many Tank Farm workers believed that chemical vapors that have been in any sort of an ionizing radiation field are more dangerous than identical vapors that have never been radiated.

## Group Interview #3 – CH2M HILL First Line Managers

The assessors were concerned the presence of the Electrician Shop Steward may have suppressed free expression of opinions by the four First Line Managers. Toward the end of the session, one of the four First Line Managers did make a comment that he would likely have been forthcoming much earlier in the session had the Shop Steward not been present, which agitated the Shop Steward.

1. This group trusted both the IHs and the IHTs.

2. The group believed the IH program had taken "hits" because of the recent increased focus on vapor issues.

3. This group never sees CH2M HILL IHs in the Tank Farms.

4. This group believed that there had been insufficient effort on the part of the CH2M HILL management to evaluate the concept of thermal imaging in locating and quantifying fugitive vapor emissions.

5. This group believed that the scientific efforts with respect to identifying and quantifying the vapor issues had not been adequately communicated to the Tank Farm workforce.

6. This group believed that many, or even most, Tank Farm workers believed that there would never be a time when the use of SCBAs or SARs would not be required.

7. This group believed that Tank Farm workers distrust of CH2M HILL management and its IH program had arisen because of very poor communications from the upper levels of management to the workforce.

8. This group stated that a recent evaluation – over the 15 month period from January 1, 2004, to March 30, 2005, – identified that approximately 33% of the injuries to IHTs and HPTs working in Tank Farms had occurred because of the use of SCBAs. According to them, this factor does not seem to be considered in choosing always to use SCBAs in the Tank Farms.

9. One of the First Line Managers believed that all or most of the problems in Tank Farms can be traced to the Union and its adversarial attitude to the CH2M HILL management. This comment provoked a strong response from the Electrician Shop Steward.

10. The Electrician Shop Steward claimed that most or all Tank Farm workers believe that virtually every improvement in their safety has had its origination within the union and NOT from CH2M HILL's management. As an example of this fact, it was claimed that repeated requests from union members to evaluate the mercury and alkyl mercury vapor problems within certain Tank Farms was routinely dismissed by management as a non-issue until recently when a focused evaluation of this factor determined that mercury issues did indeed exist and needed to be evaluated and quantified.

# Appendix B - Lines of Inquiry (LOI)

## Summary of LOI

| Section | # | LOI | Question |
|---|---|---|---|
| 1 - Program Maturity | 1.1 | Management Philosophy | Is CH2M HILL establishing a well formulated and effective management organization approach to deal with the Tank Farm IH needs? |
| | 1.2 | Overall Program Implementation | Have effective IH programs been implemented? |
| 2 - IH Organization and Training | 2.1 | Program Organization | Is the overall CH2M HILL IH program organized in the most effective manner? |
| | 2.2 | Risk Communication | Is there an effective program to communicate issues of hazard and risk to all affected parties? |
| | 2.3 | Chemical Hazard Awareness Training | Are training and work procedures adequate for workers to understand both the hazards of their work tasks, and to take appropriate protective measures for their work environment? |
| | 2.4 | Training of IHTs | Is the training of IHs and IHTs adequate for them to perform their assigned duties? |
| | 2.5 | IH Instrumentation Procedures | Are IH instrumentation procedures adequate to maintain optimal instrument function and provide accurate data? |
| | 2.6 | Validation of IH Procedures | Have IH procedures been adequately validated? |
| 3 - Vapor Characterization | 3.1 | Technical basis for the vapors program | Is the technical basis document adequate to address vapor analysis? |
| | 3.2 | Tank Contents Data | Is there adequate data on tank contents (Tank Waste Information Network System [TWINS], Best Basis Inventory [BBI], etc.)? |
| | 3.3 | Source Term evaluation | Has adequate analysis been conducted of the Source Terms, including evaporators, active and passive ventilation? |
| 4- Exposure Control – Engineering Controls | 4.1 | Engineering control of vapors | Are current and proposed engineering controls of vapors adequate? |
| 5 - Exposure Control– Admin Controls | 5.1 | Effectiveness of safe work practices | Are work practices adequate to ensure worker safety? Do current work practices contribute to workplace injuries? |
| | 5.2 | Hazard Zones | Are procedures in place to establish Hazard Zones in work areas? |
| | 5.3 | Job hazards analysis and work planning | Have job hazards associated with tanks and tank operations been adequately characterized and incorporated into work procedures (Hanford Analytical Service Program)? |
| 6 - Exposure Control - PPE | 6.1 | Respiratory protection program | Is the RPP adequate to control worker exposures? |
| 7 - Exposure Assessment | 7.1 | Exposure assessment strategy | Is the exposure assessment strategy adequate to control worker exposures? |
| | 7.2 | OELs | Have appropriate occupational exposure levels been established for all chemicals identified in Hanford Site tanks? |
| | 7.3 | Risk Ranking of COPCs | Have COPCs been adequately characterized and ranked in order of concern? |
| | 7.4 | IH database for data storage and retrieval | Does the database and the data storage system provide adequate information for establishing reasonable risk assessment strategies? |

| Section | # | LOI | Question |
|---|---|---|---|
| | 7.5 | Proper Use of Direct Reading Instruments | Are Direct Reading Instruments used appropriately to assess worker exposure (How well understood are the sources of error in direct reading instruments, and how are the sources being mitigated?) |
| | 7.6 | Laboratory Analysis | Are laboratory facilities adequate for exposure assessment tasks |
| 8 - Occupational Medicine | 8.1 | Medical Surveillance Program | Is the medical surveillance program adequate for work-related health issues? |

## LOI Section 1 – Program Maturity

The CH2M HILL IH program met regulatory requirements. Certain elements of the program, including the Technical Basis Document and associated efforts to define new OELs, exceed regulatory requirements.

CH2M HILL is required under OSHA regulations (e.g. 29 CFR 1910.134, 29 CFR 1910.1000), as well as DOE O 440.1A, to protect workers from exposure to harmful materials. Effective programs must be based on appropriate assumptions regarding workplace hazards, and must use those assumptions to develop appropriate plans to protect workers.

During this assessment, team members reviewed a variety of documentation, including the 2004 OA report. The assessors observed field and office activities, and discussed organizational and planning activities with CH2M HILL personnel on several occasions. Prior to April 2004, the CH2M HILL IH program made the assumption that "worst case" levels of exposure to Tank Farm vapors by Tank Farm workers were understood. Those assumptions were based on prior IH sampling, as well as, historical knowledge showing few, if any, documented exposures above applicable OELs. In recent years, however, there has been increased concern from Tank Farm workers regarding "vapors" and "odors." As such, IH program assumptions have been challenged by workers, along with outside entities. These specific challenges include:

- Use of DRIs to evaluate worker exposures, without appropriate supporting procedures;
- Lack of documentation of internal threshold levels, such as, 2 ppm for total organics when measured by photoionization detectors (PID);
- The incorrect assumption that nitrous oxides are present only when ammonia is present and that ammonia would be present in greater concentrations than nitrous oxide; and
- The use of AMZs to protect workers from exposures to chemical vapors without issued procedures which describe the requirements and use of the AMZs.

The above concerns initiated the CH2M HILL IH program improvement effort. As a result, the following key actions have been taken:

- The IH organization has been enhanced with the addition of 15 new positions. An IH oversight group was created and placed in Tank Farm Operations. This group has been in place for approximately one year;

- Substantial progress has been made to define the scope and scale of chemical hazards that Tank Farm workers may be exposed;

- The "Technical Basis Document," which characterizes tank vapors, represents a "Best Management Practice" and significantly exceeds minimum regulatory requirements;

- Related efforts to establish OELs for the new chemicals found in tank headspace, and the development of new analytical techniques represent "Best Management Practices;"

- New procedures have been developed and are being implemented, including an Exposure Assessment Strategy which implements the DOE ALARA principle;

- The Exposure Assessment Plan (TFC-PLN-34) is currently in initial stages of implementation, as are plans to evaluate other source terms (TFC-PLN-67);

- Approximately 4,146 personal samples were collected between April and December, 2004. Approximately 3,000 area and source samples were collected (1,790 analyzed by the lab and returned to the IH Department) between September and December, 2004;

- A draft plan is being prepared to evaluate releases from the 05-01 242-A Evaporator Campaign (7T800-05-JAR-001); and

- CH2M HILL anticipates using exposure assessment results to establish procedures for determination of appropriate engineering controls, administrative controls and protective equipment.

- While these are under development, all Tank Farm workers are required to wear SARs.

The exposure assessment and tank vapor characterization plans represent significant progress. CH2M HILL plans to continue aggressive implementation of these program improvements. By doing so, they will better understand the boundary and behavior of Tank Farm chemical hazards. This information will be used to establish more effective control measures, including the definition of Hazard Zones, work planning and selection of appropriate PPE. While exposure assessment efforts are being implemented, all Tank Farm workers are required to wear SARs. This approach is effective, in that it ensures workers are not exposed to hazardous vapors. However, this approach introduces new hazards, including slip/trip/fall issues, ergonomic hazards and increased heat stress. As implementation of the CH2M HILL plan is completed, the assessors anticipate a more sophisticated approach will be developed to select PPE based on the understanding of hazards for each job task and work location.

When fully implemented, on or about April 2006, the CH2M HILL IH Program will exceed regulatory requirements. When the Contractor implements all of the planned IH Program

improvements, CH2M HILL will have a complete understanding of the boundary and behavior of chemical hazards with a reasonable degree of scientific certainty. This increased knowledge of chemical behavior will enable establishing the best available control measures for each Tank Farm work tasks.

### LOI 1.1 - Management Philosophy

**Question:** Is CH2M HILL establishing a well formulated and effective management organization approach to deal with the Tank Farm IH needs?

**Applicable References:**

| | |
|---|---|
| TFC-PLN-55 | "Industrial Hygiene Safety Management Program Plan," |
| TFC-PLN-67 | "Program Plan for Resolution of Tank Farm Vapor Issues" |
| 29 CFR 1910.134 | Respiratory Protection |
| 29 CFR 1910, Subpart Z | Toxic and Hazardous Substances |
| DOE Order 440.1A | Worker Protection Management for DOE Federal and Contractor Employees |
| | "Tank Farms Industrial Hygiene Assessment," April 19, 2004 |

**Status:** Exceeds Expectations

**One Year Expectations:** 1.1-A, CH2M HILL will understand, with a reasonable degree of scientific certainty, boundary and behavior of chemical hazards.

1.1-B, CH2M HILL will use knowledge of chemical behavior and work practices to establish effective control measures.

**Applicable Corrective Actions from OA report:**

- C-1-10 IH Tech Basis Impact on Management

### LOI 1.2 - Overall Program Implementation

**Question:** "Have effective IH programs been implemented?"

**Applicable References:**

| | |
|---|---|
| TFC-PLN-34 | "Industrial Hygiene Exposure Assessment Strategy," |
| TFC-PLN-67 | "Program Plan for Resolution of Tank Farm Vapor Issues" |
| 7T800-05-JAR-001 | IH Sample Plan at 242-A Evaporator for 05-01 Campaign, February 28, 2005, draft |

**Status:** Meets Expectations

**One Year Expectations** 1.2-A, CH2M HILL will continue to aggressively implement program improvements with full implementation by April 2006

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-1-1 | Initiate Vapor Sampling & Analysis Program |
| C-1-2 | Conduct Program on Vapor Chemistry |
| C-1-3 | Review TWINS & IH Data for Validity |
| C-1-6 | Evaluate Toxicity of Tank Head Space Gases |
| C-1-7 | Continue to Evaluate COPCs |
| C-1-8 | Contract with National Experts for Outside Views |
| C-1-9 | Issue IH Technical Basis Document |

## LOI Section 2 – IH Organization and Training

The team concluded the organization of CH2M HILL IH program met regulatory requirements. Additionally, the CH2M HILL plans for training and communication met regulatory requirements. When fully implemented, the CH2M HILL training and communication program will exceed regulatory requirements. Efforts beyond regulatory requirements will be needed to build an acceptable level of worker confidence in the program.

CH2M HILL is required under the Occupational Health and Safety regulation in Title 29 of the CFR as well as DOE O440.1 and 440.1-A to have an effective IH program to protect workers from health hazards. To be effective, an IH program must be organized appropriately. In addition, effective IH programs must provide quality communication and training to internal and external customers.

The team had several meetings with CH2M HILL IH personnel to discuss current program status as well as program organizational issues. IH personnel provided a variety of documentation for the team's review. The team also met with senior management personnel from CH2M HILL and observed IH personnel in the field on multiple locations.

The team noted significant improvements in the IH program organization over the past year. Since April 2004, CH2M HILL has centralized management of the Tank Farm IH program. Approximately 15 new positions have been created, under the leadership of the Director of Environmental Health. Six CIHs are on staff. A comprehensive set of planning documents has been created and implementation is well under way for many of the plans. A great deal of work has been done to characterize the potentially hazardous atmospheres in tank vapor spaces and to assess worker exposure to these vapors. In many cases this extensive planning is still being translated into operational success:

- The exposure assessment program is well under way, but not yet completed;
- Sampling and monitoring procedures are available for most, but not all COPCs; and
- Many source and area samples have been collected, but not enough to establish control zones within work areas.

It is important for CH2M HILL to complete implementation of these and other related programs.

Currently, the three IH field groups report through the Sr. Vice President for Operations, rather than through the newly formed Environmental Health group. The field IH groups must balance

on-going, operational responsibilities with development and implementation of new programs. To date, they appear to have been largely successful. A good deal of program development has been accomplished and line management is still generally satisfied that operational IH responsibilities are met. The assessment team concluded CH2M HILL should carefully review this organizational model. Specifically, CH2M HILL should consider whether the overall IH program would be better served by having all IH personnel report through the Environmental Health group. There are no regulatory requirements for a reorganization or consolidation of the IH groups, but a single, centralized IH group is consistent with typical professional practices. CH2M HILL should consider the roles of the Engineering and Occupational Medicine groups and how this can be better integrated into the organization.

Once a suitable organizational model has been determined, CH2M HILL should evaluate staffing needs in the IH program through development of appropriate metrics to ensure the availability of resources to complete program development and implementation. Fifteen staff members have been added over the last year. The assessors did not have a specific recommendation for the number of IHs, IHTs and other personnel necessary to develop and implement an effective IH program. However, ORP recommends CH2M HILL develop appropriate metrics and benchmarks based on their situation and develop a resource plan for staffing and equipment which ensures sufficient resources are allocated to achieve and maintain program goals. One potential source of additional personnel may be to cross-train HPTs and IHTs.

Beyond organizational issues, training and risk communication are central to IH program effectiveness. Issues of hazard and risk are inherently difficult to communicate, especially in a work environment when there is significant tension between management and workers. The situation facing CH2M HILL is complicated and the result of many years of past practice from a variety of entities. The end result is a significant amount of distrust of CH2M HILL on the part of many site workers.

The team reviewed CH2M HILL policies and procedures related to training and communication. Assessors attended both chemical hazard awareness training (CHAT) provided in August 2004 and April 2005. The team discussed training and risk communication issues with a variety of workers, supervisors, and managers. To fully implement the IH program, site workers must understand and accept the scientific basis of the program in place, including issues such as exposure assessment that are probabilistic in nature. Interviews with workers in a variety of settings demonstrate a great deal of skepticism with respect to efforts to characterize risks. This is a significant factor driving the current approach to respiratory protection in the Tank Farms.

The contractor has a Communication Strategy in place to actively promote its IH improvement efforts. The strategy addresses four target audiences:

- Internal audience – Management;
- Internal audience – Employees;
- Customers – DOE, OSHA; and

- Stakeholders – General public.

The strategy includes mandatory information, informational materials, as well as, general marketing efforts. Activities include:

- Tailgate sessions;
- Monthly Safety Meetings;
- All Employee Messages;
- 21 other mandatory and optional approaches; and
- Efforts are linked to exposure assessment activities in the 2005 Vapors Communication Plan.

Improving the effectiveness of communication represents a unique challenge. CH2M HILL should continue its efforts to improve risk communication, as well as, assess communication effectiveness and make program changes, as necessary. The impressive scientific efforts of the IH program need to be combined with effective communication.

One significant component of the overall risk communication and chemical safety training program is CHAT. CHAT is a continually evolving program focused on achieving a broad understanding among Tank Farm workers of the various types of hazards which may exist (i.e., chemical intoxication, heat stress, ergonomic factors, etc.). Of particular note is this program's ability to communicate effectively the relationship between odors perceived by workers in proximity of the tanks and the corresponding vapor hazard involved. Although this is admittedly a very difficult area, it is certain that additional effort and improvements in this area are both possible and necessary. For example, the current CHAT class uses the analogy between of the level of hazard of various smells (i.e., smells that are evident, but not toxic, such as the odor of natural gas), and the corresponding levels of hazard associated with various sound levels (i.e., the sound of normal speech [not harmful] versus the sound of a chain saw [potentially harmful]). Such improvement in the general understanding of olfactory sensitivities almost certainly produces beneficial results in terms of the confidence of the Tank Farm work force (to the extent that they are being properly protected from exposure to hazardous vapors).

Beyond CHAT training, which applies to and is a requirement for all workers, IHTs need training commensurate with the significance of their responsibilities. CH2M HILL has improved this area over the past year.

- Procedures implemented in the last year by CH2M HILL include thorough operating instructions for use of the full range of CH2M HILL DRIs (i.e., TFC-ESHQ-S_IH-D-25, documenting the calibration, use, and maintenance of the ThermoElectron TVA-1000B Survey Analyzer);

- IHT Training has significantly improved during the last year, and currently involves two levels of specific operational task training. Upon satisfactory completion of these levels, an IHT will receive Basic and Advanced Qualification ("Qual") Cards;

- The first of these two levels of qualification requirements (Fundamentals of IH) has been implemented, the second (Instrumentation for IHTs) is nearing completion and will be implemented by September 2005; and

- CH2M HILL expects to fully qualify all the IHTs within one year, thereby, ensuring the highest quality of data gathered, and increased workforce confidence in the overall IH program.

In summary, the organization of the CH2M HILL IH program met regulatory requirements. CH2M HILL should review its organizational model and develop a resource plan which ensures sufficient IH resources are allocated to achieve long-term program goals. The CH2M HILL plans for training and communication currently meet regulatory requirements. When fully implemented, the CH2M HILL training and communication program will exceed regulatory requirements. However, efforts in excess of regulatory requirements may be necessary to attain an acceptable level of worker confidence in the program. To achieve this, the scientific efforts of the IH program need to be combined with equally extensive risk communication efforts. Lastly, advanced training for IHTs should be considered.

**LOI 2.1 - Program Organization**

**Question:** Is the overall CH2M HILL IH program organized in the most effective manner?

**Applicable References:**

| | |
|---|---|
| TFC-PLN-27 | Chemical Exposure Program |
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-39 | Risk Management Plan |
| TFC-PLN-43 | Tank Farm Contractor Health and Safety Plan |
| TFC-PLN-46 | Training and Procedures Integrated Document Management System Implementation Plan |
| TFC-PLN-55 | IH Safety Management Program Plan |
| TFC-PLN-64 | IH Instrumentation Plan |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan |
| TFC-PLN-66 | Implementation Plan for the Data Quality Objectives for the Evaluation of Tank Chemical Emissions for the IH Technical Basis |
| TFC-PLN-67 | Program Plan for Resolution of Tank Farm Vapor Issues |

**Status:** Exceeds Expectations

**One Year Expectations**

2.1-A, CH2M HILL will implement a sophisticated hazard evaluation process that reflects the highest level of professional practice.

2.1-B, CH2M HILL will create a centralized organization with updated, revised procedures.

2.1-C, CH2M HILL will complete an evaluation of overall CH2M HILL IH organization addressing:

- Integration of all IH services into one group;
- Evaluate staffing requirements; and
- Resources management issues, e.g. cross-training HPTs and IHTs.

2.1-D, CH2M HILL will incorporate relationships to Engineering and Occupational Medicine in IH Organization Chart

## LOI 2.2 - Risk Communication

**Question:** Is there an effective program to communicate issues of hazard and risk to all affected parties?

**Applicable References:**

Communication Strategy Safety Program – April 18, 2005

**Status:** Meets Expectations

**One Year Expectations**

2.2-A, CH2M HILL will implement an effective Risk Communication program, as evidenced by formal surveys, informal surveys or other equivalent evidence.

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-1-6 | Evaluate Toxicity of Tank Head Space Gases |
| C-1-7 | Continue to Evaluate COPCs |
| C-1-10 | Align Exposure Assess. Strategy (EAS) with Tech Basis |
| C-2-3 | Establish Proper EAS |
| C-2-5 | Use EAS to Collect & Analyze Personal Samples |

## LOI 2.3 - Chemical Hazard Awareness Training

**Question:** Is the CH2M HILL CHAT program adequate for workers to understand BOTH the nature of the hazards and/or non-hazards of their work tasks, and the proper PPE measures to be utilized in their particular work environments?"

**Applicable References:**

TFC-ESHQ-S_IH-C-02 Hazard Communications

| | |
|---|---|
| TFC-ESHQ-S_IH-D-26 | Using Heat Stress Monitors |
| TFC-ESHQ-S_IH-P-09 | IH Personal/Area Monitoring |

**Status:** The current program in this area Exceeds Expectations, with the implementation of plans, this programs will likely Significantly Exceed Expectations

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-1-14 | IH Tech Basis Impact on CHAT |
| C-1-15 | Revise CHAT to be Consistent with C-1-14 |
| C-3-4 | Train Appropriate Personnel as Required |
| C-6-6 | Develop Overall Training Program |
| C-6-7 | Perform Designed Training |
| C-8-2 | Train CH2M HILL & Contractor Personnel on Issues |
| C-13-2 | Relate Lessons Learned to CHAT |

## LOI 2.4 – Training of IHTs

**Question:** Does the formal training, mentoring, and evaluation of the work of IHs and IHTs adequately prepare them to perform their assigned duties?

**Applicable References:**

| | |
|---|---|
| TFC-BSM-TQ-STD-01 | Technical Staff Qualifications Requirement |
| TFC-BSM-TQ-STD-07 | IHT Qualifications Requirements |
| TFC-ESHQ-S_IH-C-02 | Hazard Communications |
| Course #356500 | Heat Stress Monitor Training |
| Course #357830 | IH Fundamentals for IHTs |
| Course #357860 | Using the RAE ppbRAE Survey Analyzer Training |
| Course #357863 | Using Colorimetric Gas Detector Tube Training |
| Course #357864 | Using Industrial Scientific itx Multi-Gas Monitors Training |
| Course #357878 | Using Arizona Instruments Jerome 431-X Gold Foil Mercury Vapor Analyzer Training |
| Course #357879 | Using Gilian Low Flow Personal Sampling Pumps Training |
| Course #357880 | Using the ThermoElectron MIRAN 205B SapphIRe Analyzer Training |
| Course #357884 | 40-hour Fundamentals of IH for IHTs Training |
| Course #357887 | Using Direct Reading Instruments Training |
| Course #357889 | Calibration of Personal Sampling Pumps Training |
| Course #357890 | Using the RAE AreaRAE Analyzer Training |
| Course #357891 | AMZ Training |

| | |
|---|---|
| Course #357892 | Using Multi-Gas Monitors Training |
| Course #357893 | Chain of Custody Training |
| Course #357893 | Using the ThermoElectron TVA-1000B Survey Analyzer Training |
| Course #357894 | Surface Wipe Sampling Training |
| Course #357895 | Personal/Area Exposure Monitoring Training |
| Course #357898 | TFIH Database Training |

PLANNED FUTURE COURSES:

Ergonomics Training
Response to Vapor Smells and Exposures Training
Industrial Noise Training
Non-Ionizing Radiation Training
Personal/Area Monitoring Techniques Training
Source Monitoring Training
Use of Summa Canister Training
Thermal Stress Training

**Status:** The current approach Exceeds Expectations, and with the implementation of the future planned training developments for IHTs, the CH2M HILL training program will likely Significantly Exceed Expectations.

**One Year Expectations** Continue current actions in this area

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-2-6 | Establish Formal IHT Training Program |
| C-3-4 | Train Appropriate Personnel in Procedures |
| C-4-1 | Complete Qualifications of IH Staff |
| C-6-6 | Develop Training Plans to Blend with Work Packages |
| C-6-7 | Perform Training of Affected Individuals |

**LOI 2.5 – IH Instrumentation Procedures**

**Question:** Are the CH2M HILL IH procedures adequate to maintain optimal instrument function and to provide accurate field monitoring data?"

**Applicable References:**

| | |
|---|---|
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-43 | Tank Farm Contractor Health & Safety Plan |
| TFC-PLN-67 | Program Plan for Resolution of Tank Farm Vapor Issues |
| TFC-ESHQ-S_IH-CD-38 | Industrial Instrumentation Evaluation and Procedures |
| TFC-ESHQ-S_IH-D-11 | Use of Colorimetric Indicator Tubes |
| TFC-ESHQ-S_IH-D-12 | Use of IH Pumps |

| | |
|---|---|
| TFC-ESHQ-S_IH-D-15 | Use of the Industrial Scientific itx Analyzer |
| TFC-ESHQ-S_IH-D-20 | Use of the Rae ppmRAE Survey Analyzer |
| TFC-ESHQ-S_IH-D-22 | Use of any Direct Reading Instruments |
| TFC-ESHQ-S_IH-D-24 | Use of the Rae AreaRAE Analyzer |
| TFC-ESHQ-S_IH-D-25 | Use of the ThermoElectron TVA-1000B Survey Analyzer |
| TFC-ESHQ-S_IH-D-26 | Use of Wet Bulb, Globe, Temperature (WBGT) Heat Stress Monitors |
| TFC-ESHQ-S_IH-D-32 | Use of the ThermoElectron MIRAN 205B SapphIRe Infrared Spectrophotometric Analyzer |
| TFC-ESHQ-S_IH-D-34 | Use of Noise Monitors and Noise Dosimetry Instruments |
| TFC-ESHQ-S_IH-D-36 | Use of Gilian Personal Sampling Pumps |
| TFC-ESHQ-S_IH-D-37 | Use of the Arizona Instruments Jerome 431X Mercury Vapor Analyzer |
| TFC-ESHQ-S_IH-D-39 | Use of Manning Ammonia Monitor |
| TFC-ESHQ-S_IH-D-40 | Use of the Lumex Elemental Mercury Analyzer |
| TFC-ESHQ-S_IH-D-XX | IH Equipment Management |
| TFC-ESHQ-S_IH-STD-03 | Exposure Monitoring, Reporting, and Records Management |

**Status:** In general, CH2M HILL Meets Expectations in this area.

**One Year Expectations** Continue current actions in this area

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-2-4 | Establish IH Database to Implement EAS |
| C-2-7 | Establish Formal IH Instrumentation Program |
| C-3-1 | Establish Written Program for IH Instrument Use |
| C-3-2 | Select IH Instruments for COPC Analysis |

**LOI 2.6 – Validation of IH Procedures**

**Question:** Have IH procedures been adequately validated?

**Applicable References:**

| | |
|---|---|
| TFC-ESHQ-S_IH-CD-38 | Industrial Instrumentation Evaluation and Procedures |
| TFC-ESHQ-S_IH-D-XX | IH Equipment Management |

**Status:** In general, CH2M HILL Meets Expectations in this area.

**One Year Expectations** Continue current actions in this area

**Applicable Corrective Actions from OA report:**

C-3-3 Establish Oversight Program for IH Activities

## LOI Section 3 - Vapor Characterization

The CH2M HILL Tank headspace vapor characterization strategy met regulatory requirements. When fully implemented, the CH2M HILL vapor characterization program will represent a unique professional accomplishment, in excess of comparable efforts at hazardous waste sites.

An understanding of the composition of the vapors in the headspaces of Tank Farm tanks is necessary to understand potential hazards to workers and to implement appropriate protective measures, as required by Federal law and DOE Order. Key elements to understanding headspace vapor include developing a suitable technical approach, understanding the solid and liquid phase materials in specific tanks which contribute to headspace vapor, and an understanding of how vapors are released from tanks.

The CH2M HILL technical approach to understanding headspace vapors is documented in the Technical Basis Document (RPP-22491 Revision 0, October, 2004). To gain current knowledge of the chemicals that present a hazard to the workers, CH2M HILL conducts an ongoing program to sample and characterize tank headspace vapors. Currently, sampling efforts are focused in C-Farm.

Since April 2004, a total of 1,790 samples have been taken from tanks and/or areas in the A-Farms, in C-Farm, in SY-Farm, in TX-Farm, and in U-Farm.

Analysis of the data presents unique insight to the chemical hazards present to the worker. At the vapor source (tank exhaust point) ammonia, mercury, and nitrous oxide, the chemicals that present the greatest hazard to the worker, have been found at levels that exceed, and in some cases significantly exceed, their OELs. However, area samples, which were samples taken five feet or greater from the source (tank exhaust point) have ammonia, mercury, and nitrous oxide concentrations well below their OELs, which suggests establishing boundaries at the source is an acceptable control. Since virtually all of these OELs are eight hour Time Weighted Average (TWA) Exposure Limits, it is clear that none represent an immediate or significant hazard. The result of personal samples can be used to support the use of barriers around sources as an effective control. Of over 4,100 personal samples, no sample exceeded 50% of an OEL, even if the work was performed within five feet of the source.

It is useful to list the chemical vapors detected in any of these source or area samples. It should be noted these analyses were set to identify <u>any</u> chemical that could be detected by a sophisticated Gas Chromatograph/Mass Spectrometer (GC-MS) system. There was no specific effort to focus on the COPCs. In fact, these samples were among those used to assist in defining the COPCs. In the future, and to the extent that suitable analytical methods can be determined, sampling efforts will focus on COPCs. The following listing shows the chemical vapors whose concentrations were sufficiently high. In other words, their concentrations were greater than the minimum detectable level of the analytical method being used.

| Chemical | # Samples | Detectable | | Max Detected | LOEL |
|---|---|---|---|---|---|
| **$NH_3$** | 146 | 16 | 11.0% | 1,700 ppm | 25 ppm |
| **Hg** | 219 | 21 | 9.6% | $4.5\times10^{-2}$ mg/m$^3$ | 0.025 mg/m$^3$ |
| **$(CH_3)_2$-Hg** | 87 | 24 | 27.6% | $2.0\times10^{-6}$ mg/m$^3$ | 0.010 mg/m$^3$ |
| $N_2O$ | 32 | 18 | 56.3% | 1.1 ppm | 25 ppm |
| 1,1,1-trichloroethane | 38 | 0 | 0.0% | 0.0 ppm | 10 ppm |
| **acetonitrile** | 38 | 7 | 18.4% | 0.122 ppm | 20 ppm |
| acetone | 69 | 7 | 10.1% | 0.187 ppm | 500 ppm |
| **benzene** | 69 | 1 | 1.4% | 0.005 ppm | 0.5 ppm |
| **carbon tetrachloride** | 38 | 1 | 2.6% | 0.001 ppm | 5 ppm |
| chloroform | 23 | 0 | 0.0% | 0.0 ppm | 10 ppm |
| ethanol | 38 | 5 | 13.2% | 0.225 ppm | 1,000 ppm |
| ethyl benzene | 69 | 0 | 0.0% | 0.0 ppm | 100 ppm |
| hexane | 38 | 5 | 13.2% | 0.013 ppm | 50 ppm |
| **hexanenitrile** | 38 | 3 | 7.9% | 0.011 ppm | no OEL |
| 2-butanone | 69 | 3 | 4.3% | 0.075 ppm | 200 ppm |
| **methanol** | 27 | 4 | 14.8% | 0.096 ppm | 200 ppm |
| **dichloromethane** | 38 | 4 | 10.5% | 0.008 ppm | 50 ppm |
| methyl isobutyl ketone | 69 | 1 | 1.4% | 0.004 ppm | 50 ppm |
| **n-butanol** | 69 | 4 | 5.8% | 0.45 ppm | 20 ppm |
| n-octane | 38 | 3 | 7.9% | 0.008 ppm | 300 ppm |
| n-pentane | 38 | 9 | 23.7% | 0.035 ppm | 600 ppm |
| n-propanol | 38 | 2 | 5.3% | 0.138 ppm | 200 ppm |
| **pentanenitrile** | 38 | 3 | 7.9% | 0.013 ppm | no OEL |
| **propanenitrile** | 38 | 2 | 5.3% | 0.138 ppm | no OEL |
| **tetrachloroethylene** | 38 | 1 | 2.6% | 0.003 ppm | 25 ppm |
| tetrahydrofuran | 57 | 1 | 1.8% | 0.017 ppm | 200 ppm |
| toluene | 66 | 2 | 3.0% | 0.075 ppm | 50 ppm |
| m- OR p-xylene | 69 | 1 | 1.4% | 0.004 ppm | 100 ppm |
| o-xylene | 69 | 0 | 0.0% | 0.0 ppm | 100 ppm |

* Chemicals listed in **bold** are COPCs.

Other data points of analytical interest are listed below:

- Between late May and early September 2004, the headspaces of 11 SSTs in C-Farm were sampled, and sampling data exists for all 16 tanks;
- In the S-Farm, only the headspace of S-104 has not been sampled;
- In the U-Farm, 4 of the 16 tanks have not been sampled;
- To date, 119 SSTs have been sampled, 30 SSTs have not; and
- Many tanks have been sampled more than once, some as many as nine times. 70 samples have been taken for the 16 tanks in C-Farm.

Recent sample results have been compared to samples collected in the 1990s. Evidence from tanks sampled on multiple occasions indicate limited variability in headspace composition over time (<1 order of magnitude).

- The Burrup report[2] shows the overall average organic vapor variability in same-tank sample pairs separated by up to five years was 194% (with a 95% confidence interval);

- This means 95% of the samples would differ by less than a factor of two when measured on different dates; and

- The highest variability was a factor of five.

This program of tank sampling has identified approximately 1,826 individual chemicals found in tank headspace vapors or that can reasonably be anticipated to be found in tank headspace vapors. There are few chemicals not related to process wastes. Furthermore, the vast majority can be tied to process waste or degradation products.

- The 1,826 chemicals include 1,200 specific chemicals and 400 tentatively identified mixtures or unknowns;

- As a conservative measure, analytical mixtures were divided into their reported components and assigned the concentration of the mixture itself;

- Approximately 250 chemicals were added to the lists based recommendations of an expert panel. This list included many chemicals detected in headspace vapors as well as some chemicals not found in headspace vapors, but that are typically considered in various regulatory processes because of their toxicity;

- An additional 100 chemicals were added based on their detection in tank liquids, solids, and retained gas samples. These include compounds that would not have been detected because they were not addressed by sampling or analytical methods in use; and

- An additional 21 chemicals were added that were considered likely to exist in the headspace, but that had not yet been identified.

Beyond determining chemical constituents of headspace vapor, the Technical Basis Document also describes the approach used to evaluate potential hazard of vapor constituents. The "Technical Basis Approach" (Table 1.1 in RPP-22491) outlines the overall process to identify chemicals, and classifies them according to OEL to determine if an individual chemical is a COPC. This approach represents a model professional practice and is well in excess of minimum regulatory requirements (29 CFR 1910.1000). For each chemical present or potentially present in headspace vapors CH2M HILL identifies OELs and carcinogenicity data.

[2] Burrup,C.W., J.E. Meacham, B.G. Amidan, S.K. Cooley, and J.L. Huckaby, 2004, Statistical Analysis of Tank Headspace Vapor Data, RPP-21972, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

Where appropriate, OELs established for groups of chemicals, such as hydrocarbon fractions, were used. In many cases, new OELs were developed, based on standard toxicological practice. All OEL assignments were reviewed by external experts.

All chemicals were compared with the LOEL.

- If the ratio headspace concentration to LOEL was > 0.1, the chemical was identified as a COPC;

- The 10% criterion was based on the fact headspace concentrations are generally expected to be within a factor of 10 of the measurement. This is conservative in that vapors leaving the tank will be significantly diluted in the worker's breathing zone;

- If the chemical had no OEL, no measured concentration, or the ratio of the concentration to LOEL is <0.1, the chemical was placed in the further evaluation category; and

- Only non-plausible chemicals were placed in the Low Probability of exposure list.

The Technical Basis document (RPP-22491, Revision 0, October, 2004) identifies 52 COPCs, 1,538 chemicals requiring further evaluation, and 236 chemicals considered low probability of exposure. As of this assessment, an update to this list is being prepared. Seven chemicals will be transferred from the COPC list and added to the Low Probability list, and an additional 40 chemicals (many representing hydrocarbon fractions) will be added to the COPC list.

In order to use the knowledge of headspace vapors and vapor hazards, CH2M HILL catalogues materials present in the tanks. The TWINS, available at http://twinsweb.pnl.gov/data/datamenu.htm, provides web-based access to a variety of tank chemistry information. This database houses recent and historical tank and tank headspace sampling data, and has recently been configured to allow access to IH sampling information, including personal, area and source samples. This information is accessible to CH2M HILL personnel and is actively used as part of the "Technical Basis" process. To the extent the assessors were able to evaluate the issue (the team did not conduct independent sampling, for example), it appears the tank content data is more than adequate and is being continually updated.

Because personal sampling conducted as part of the exposure assessment process may not provide adequate information regarding exposures for a given task, activity or location (because full-shift samples average exposures over the entire sample period, which may contain multiple tasks, activities, or locations), CH2M HILL supplements its personal sampling program by a program of area and source term monitoring to determine potential exposures in different areas.

- Approximately 3,000 total area and source samples were collected between April 1, 2004, to May 12, 2005;

- During this time period, 1,790 area and source samples were collected and analyzed;

- Locations sampled include Tank Farms AN, AW, AZ, C, SY, TX, & U;
- Area samples collect three consecutive eight-hour samples to give a 24-hour area exposure;
- Source or Work Area samples collected at a five foot radius from breather on SST, 3 – 30 feet downwind from stack on DST;
- Extensive modeling of releases have been conducted to determine potential exposures outside of fence lines;
- All work area samples collected to date are below applicable OELs; most COPCs are not detected at all. Methanol was detected (<OEL) in AN, AZ Farms, $N_2O$, Hg was detected in C-Farm;
- All source sample results are below OEL, except for Ammonia at U-Farm Breather filter, C-Farm filter and elemental Hg at C-Farm breather filter; and
- This information will be used to establish control zones, including "Safe Zones," "Boundary Zones," and "Hazard Zones" for work in Tank Farms.

ORP expects the efforts to characterize source terms will continue over the next year and this information will be used to establish "Hazard Zones." This will allow workers to make risk based decisions regarding PPE.

In summary, the CH2M HILL vapor characterization program met regulatory requirements. The Technical Basis document is sufficiently complete to allow work to proceed on worker exposure assessment. However, there are IH aspects which are still being implemented. When fully implemented, the CH2M HILL program will represent a model program. Implementation of the program strategy, as outlined in "Industrial Hygiene Chemical Vapor Technical Basis Implementation Plan" (TFC-PLN-65) will be substantially complete within one year. At that time, CH2M HILL will have a substantially complete characterization of tank vapor space composition and chemistry for tanks.

**LOI 3.1 - Technical basis for the vapors program**

**Question:** Is the technical basis document adequate to address vapor analysis?

**Applicable References:**

| | |
|---|---|
| TFC-PLN-27 | Chemical Exposure Program |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan, |
| RPP-22491 | IH Chemical Vapor Technical Basis |
| RPP-8369 | Chemical Source Terms for Tank Farms Safety Analysis |
| PNNL-14767 | Characterization Of Near-Field Transport And Dispersion Of Vapors Released From Headspace Of Hanford Site Underground |

| | |
|---|---|
| | Tanks |
| PNNL-14831 | Overview of Hanford Site High-Level Waste Tank Gas and Vapor Dynamics |
| RPP-22620, | Sampling and Analysis Plan for Vapor in SST Headspace |
| RPP-21854 | Occurrence and Chemistry of Organic Compounds in Hanford Site Waste Tanks |

**Status:** Significantly Exceed Expectations

**One Year Expectations** 3.1-A, CH2M HILL will continue implantation of the Technical Basis document, as described in TFC-PLN-65

3.1-B, CH2M HILL will completely characterize vapor space chemistry.

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-1-1 | Initiate Structured Vapor Sampling & Analysis Program |
| C-1-9 | Issue IH Technical Basis Document |
| C-1-12 | Establish Mechanism for Review of IH Tech Basis Doc. |

## LOI 3.2 - Tank Contents Data

**Question:** Is there adequate data on tank contents (TWINS, BBI, etc.)?

**Applicable References:**

http://twinsweb.pnl.gov/data/datamenu.htm

**Status:** Exceeds Expectations

**One Year Expectations** Continue current actions in this area

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-1-3 | Review TWINS & IH Data for Validity |
| C-1-13 | Electronically Link TWINS & IH Databases |

## LOI 3.3 - Source Term evaluation

**Question:** Has adequate analysis been conducted of the Source Terms, including evaporators, active and passive ventilation?

**Applicable References:**

| | |
|---|---|
| TFC-PLN-27 | Chemical Exposure Program |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan, |
| RPP-22491 | IH Chemical Vapor Technical Basis |
| RPP-8369 | Chemical Source Terms for Tank Farms Safety Analysis |
| PNNL-14767 | Characterization Of Near-Field Transport And Dispersion Of Vapors Released From Headspace Of Hanford Site |

| | |
|---|---|
| | Underground Tanks |
| PNNL-14831 | Overview of Hanford Site High-Level Waste Tank Gas and Vapor Dynamics |
| RPP-22620, | Sampling and Analysis Plan for Vapor in SST Headspace |
| RPP-21854 | Occurrence and Chemistry of Organic Compounds in Hanford Site Waste Tanks |
| TFC-ENG-CHEM-D-23 | Preparation of Tank Sampling and Analysis Plans |

**Status:** Exceeds Expectations

**One Year Expectations** 3.3-A, CH2M HILL will complete Area and Source characterization for Tank Farm Areas where active work is taking place.

**Applicable Corrective Actions from OA report:**

C-1-5 Evaluate 242-A Evaporator as a Vapor Source

**LOI Section 4 – Vapor Exposure – Engineering Controls**

The team concluded the CH2M HILL plans to implement engineering controls to minimize worker exposures to Tank Farm vapors met regulatory requirements. When fully implemented, the CH2M HILL engineering control program will exceed regulatory requirements.

The long standing and well established IH hierarchy of hazard mitigation is:

- Engineering controls;
- Administrative controls; and
- The use of appropriate PPE.

Over previous years at the Hanford Site, it appears chemical vapor controls have been based primarily on use of PPE, rather than engineering and administrative controls. This is evidenced by:

- As of April 2004, there were only limited engineering controls in place on Hanford's SSTs. All of these tanks were built between the late 1940's and the 1970's;
- All of the SSTs were passively ventilated with filtered breathers exhausting approximately five feet above the ground level which is directly in worker breathing zones;
- However, DSTs are all actively ventilated, with exhaust stacks which discharge at heights all greater than 10 feet above the ground level;
- The 242-A evaporator exhaust point is also well above the ground level; and

- Aside from the elevated emission points on DSTs and the 242-A evaporator, there are few other engineering controls in place to protect workers from exposure to the vapors which could potentially be issued from the source point.

Current efforts place greater focus on engineering controls. These include:

- A plan (referenced in Corrective Action C-10-5) to extend stack heights extensions for all U-Farm tanks. Several of the tanks have already had their exhausters elevated to points approximately 12 feet;

- An engineering control under evaluation (referenced in Corrective Action C-10-5) is focused at mitigating worker vapor exposures in C-Farm, and possibly also in AN-Farm where historically there have been an unusually large number of odor complaints. This control action is to install active ventilation on those tanks where odor complaints have been particularly numerous, and transport the exhausted vapors from those tanks by a duct extending to approximately 600 feet north of C-Farm where there are currently no Hanford Site facilities;

- Additional areas of engineering focus (referenced in Corrective Action C-10-2, C-10-4) relate to locating and sealing sources of fugitive vapor emissions, principally on SSTs, but also on DSTs; and

- There are various instrument and equipment cabinets that have direct connections to a tank's vapor space. For these situations, active ventilation of these cabinets before any actual worker access is being developed (referenced in Corrective Action C-10-2).

In summary, the team concluded the CH2M HILL plans to implement engineering controls met regulatory requirements. ORP expects CH2M HILL to complete implementation of stack extension plans, complete implementation of remote exhauster plans, and to develop a coordinated plan to maximize use of engineering controls to address vapor issues. When fully implemented, the CH2M HILL engineering control program will exceed regulatory requirements.

**LOI 4.1 - Engineering control of vapors**

| | |
|---|---|
| **Question:** | Are current and proposed engineering controls of Tank Farms vapors adequate? |
| **Applicable References:** | |
| RPP-24508 | Project Execution Plan for Stack Relocation Project |
| **Status:** | Current engineering controls Meet Expectations |
| **One Year Expectations** | 4.1-A, CH2M HILL will develop a coordinated plan to maximize use of engineering controls to address Tank Farm vapor issues.<br>4.1-B, CH2M HILL will complete implementation of stack extension plans. |

4.1-C, CH2M HILL will complete implementation of remote exhauster plans.

**Applicable Corrective Actions from OA report:**

| | |
|---|---|
| C-9-1 | Brief Engineering Personnel on Design Requirements |
| C-9-4 | Perform Classroom Training on Tank Structural Matters |
| C-9-5 | Assess Operating Limitations for SSTs and DSTs |
| C-9-8 | Eng Change Order for Connecting AN & AW Vents |
| C-9-10 | Document Analysis for Changes in Ventilation Systems |
| C-9-11 | Develop Lessons Learned for Safety Questions |
| C-9-12 | Develop Lessons Learned for General Engineering |
| C-9-13 | Establish Issue Required Calculations for SSTs |
| C-9-14 | Establish Issue Required Calculations for DSTs |
| C-9-15 | Ensure Tank Pressure Relief is Functional for all Tanks |
| C-9-16 | Perform Technical Evaluation of Tank Pressure Reliefs |
| C-9-18 | Technically Evaluate the C-200 Mobile Retrieval System. |
| C-9-20 | Review Previous Calculations for Tank Modifications |
| C-10-1 | Review Past Unsuccessful Engineering Controls |
| C-10-2 | Evaluate Potential Upgrade for Cabinet Exhaust Vent |
| C-10-4 | Evaluate Potential Vapor Release Sources |
| C-10-5 | Evaluate Potential Long Term Vapor Control Options |
| C-11-1 | Modify Engineering Procedures Tank Farm Projects |
| C-11-2 | Orient Engineering Staff on Tank Farm Modifications |
| C-11-3 | Brief Engineering Staff to Reinforce Design Requirements. |
| C-11-4 | Develop Formal Orientation for all Staff Members |
| C-11-5 | Alter Project Management to Comply With HR Factors |

**LOI Section 5 - Exposure Control – Administrative Controls**

The CH2M HILL Administrative Control strategy met regulatory requirements. After engineering controls, administrative controls are the most important tool to reduce worker exposures to chemical vapors. Key elements include JHA, appropriate work planning and established administrative control areas or zones.

JHA is conducted routinely as part of the work planning process. Standard analyses are available for routine task. New analyses are generated for more complex tasks. Hazard analyses are developed in conjunction with Operations and Engineering groups and reviewed by radiation control, industrial safety and IH groups. The assessment team reviewed a variety of planning documents and found the JHAs to be thorough with clearly defined hazards and mitigations. While IH concerns were generally addressed, it is important for all IH components and concerns to be addressed in work planning. Additionally, participation of the IH group in the work planning process needs to be increased in order to ensure administrative controls based on hazard zones are implemented as required by the exposure assessment process (see below).

JHA is incorporated into work package planning. This is the central document for planning of all Tank Farm activities. The assessors reviewed several active and completed Work Packages. The reviewed work tasks ranged from simple, short term, projects (i.e., remove, inspect, and

reinstall the pressure differential indicator on the inlet filter for Tank S-102), to complex, multi-worker projects (i.e., removal and replacement of the hose currently in the buried hose transfer conduit running between Tanks BY-105 and BY-106). Each of these Work Packages adequately covered spanned conceptual planning, to site logistics, to final activity execution.

The Work Packages reviewed showed considerable improvement in consideration of IH worker safety issues from the January 2005 time-period. However, IH provisions have not yet reached the level of sophistication accorded to issues of radiation control. As future redefinitions of chemical exposure hazard levels are completed, it is important that these hazards be re-addressed in the work planning process.

Current work projects in Tank Farms are completed by workers using maximum SCBA respiratory protection. While providing excellent respiratory protection, these particular PPE introduce several new hazards. For example, from January 1, 2004, to March 30, 2005, there are indications that as many as 33% of current workplace injuries can be directly related to the use of SCBAs. These injuries range from muscle strains (from carrying the equipment) to slips, trips, and falls arising from the reduced visibility. Respiratory tract irritations arising from the requirement to breathe air of 0.0% relative humidity level also occur. As discussed previously, a thorough understanding of Tank Farm hazards should be used to develop appropriate controls for all work activities, and not just isolated conditions.

A key aspect of administrative controls is developing procedures which establish appropriate work control zones, including:

- Hazard Zones (areas where maximum PPE are required);
- Buffer Zones (areas where lesser levels of PPE will be required – that is, Powered Air Purifying Respirators or simple Air Purifying Respirators); and
- Safe Zones (areas where the hazard levels are sufficiently minimal and IH driven respiratory protection is not required).

It is important for CH2M HILL to use tank vapor characterization efforts to establish Hazard Zone, Buffer Zone, and Safe Zone boundaries.

In summary, the CH2M HILL Administrative Control strategy met regulatory requirements. Current activities include efforts to develop a thorough understanding of Tank Farm hazards. This information is being used to characterize work-task hazards and define Hazard Zone, Buffer Zone, and Safe Zone boundaries. Zone boundaries should be used in the selection of appropriate PPE, and incorporated into the work planning process. Once these disciplines are mature, the CH2M HILL vapor characterization program will exceed regulatory requirements.

## LOI 5.1 - Effectiveness of safe work practices

**Question:** Are work practices adequate to ensure worker safety? Do current work practices contribute to workplace injuries?

**Applicable References:**

| | |
|---|---|
| 29 CFR 1910.134 | OSHA Respiratory Protection Standard |
| US DOE Order 440.1A | Worker Protection Management for DOE Federal and Contractor Employees |
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-43 | Tank Farm Contractor Health & Safety Plan |
| TFC-PLN-55 | IH Safety Management Program Plan |
| TFC-ESHQ-S_IH-C-04 | Confined Space Procedures |
| TFC-ESHQ-S_IH-C-05 | Respirator Issuance and Control Processes |
| TFC-ESHQ-S_IH-C-05.1 | Respiratory Protection Systems |
| TFC-ESHQ-S_IH-D-05.2 | Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-D-34 | Managing AMZs |
| TFC-ESHQ-S_IH-P-08 | IH Air Sampling |
| TFC-ESHQ-S_IH-STD-09 | IH Response to Employee Contact with Chemical Waste |
| TFC-ESHQ-S_IH-STD-10 | Carcinogen Control |
| TFC-ESHQ-S_IH-STD-11 | IH Monitoring and Control Strategies During Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-STD-12 | Tank Transfers and Retrievals |

**Status:** The current program in this area Exceeds Expectations

**One Year Expectations**

5.1-A, CH2M HILL will develop a thorough understanding of Tank Farm hazards, allowing selection of appropriate PPE.

5.1-B, CH2M HILL will define Hazard Zone, Buffer Zone, and Safe Zone boundaries.

5.1-C, Hazards and appropriate controls will be characterized by CH2M HILL for all work activities.

**Applicable Corrective Actions from OA Report:**

| | |
|---|---|
| C-2-1 | Align the IH Vapor Monitoring to the IH Tech Basis |
| C-2-3 | Establish Proper EAS |
| C-2-4 | Establish IH Database for DRIs, Samples, etc. |
| C-2-9 | Consider the Application of Radiation Control to IH |

## LOI 5.2 - Hazard Zones

**Question:** Are procedures in place to establish Hazard Zones in work areas?

**Applicable References:**

| | |
|---|---|
| 29 CFR 1910.134 | OSHA Respiratory Protection Standard |
| US DOE Order 440.1A | Worker Protection Management for DOE Federal and Contractor Employees |
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-43 | TFC Health & Safety Plan |
| TFC-PLN-55 | IH Safety Management Program Plan |
| TFC-ESHQ-S_IH-C-04 | Confined Space Procedures |
| TFC-ESHQ-S_IH-C-05.1 | Respiratory Protection Systems |
| TFC-ESHQ-S_IH-D-05.2 | Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-P-08 | IH Air Sampling |
| TFC-ESHQ-S_IH-STD-10 | Carcinogen Control |
| TFC-ESHQ-S_IH-STD-12 | Tank Transfers and Retrievals |

**Status:** Implementation plans to establish Hazard Zones meet regulatory requirements.

**One Year Expectations** 5.1-B, CH2M HILL will define Hazard Zone, Buffer Zone, and Safe Zone boundaries.

5.2-A – CH2M HILL will post hazard zones in all Tank Farmsl

**Applicable Corrective Actions from OA Report:**

C-2-1 Align the IH Vapor Monitoring to the IH Tech Basis
C-2-3 Establish Proper EAS
C-2-4 Establish IH Database for DRIs, Samples, etc.
C-4-1 Complete Qualifications of IH Staff

## LOI 5.3 - Job hazards analysis and work planning

**Question:** Have the Job Hazard Analyses for tasks in Tank Farms been established in a manner that properly characterizes the specific hazard of each procedure? Are these characterizations incorporated into the Work Packages?

**Applicable References:**

| | |
|---|---|
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-43 | TFC Health & Safety Plan |
| TFC-PLN -55 | IH Safety Management Program Plan |

| | |
|---|---|
| TFC-ESHQ-S_IH-C-04 | Confined Space Procedures |
| TFC-ESHQ-S_IH-C-05 | Respiratory Protection |
| TFC-ESHQ-S_IH-C-07 | Heat Stress Control |
| TFC-ESHQ-S_IH-CD-35 | Managing AMZs |
| TFC-ESHQ-S_IH-D-08 | IH Monitoring and Control Strategies During Tank Retrieval and Transfers |
| TFC-ESHQ-S_IH-D-34 | Noise Surveys, Dosimetry, and Octave Band Analysis |
| TFC-ESHQ-S_IH-P-09 | IH Air Sampling, IH Personal/Area Exposure Monitoring |
| TFC-ESHQ-S_IH-P-10 | Chain of Custody & Submitting Samples for Laboratory Analysis |
| TFC-ESHQ-S_IH-STD-09 | IH Response to Employee Contact with Chemical Waste |
| TFC-ESHQ-S_IH-STD-10 | Carcinogen Control |
| TFC-ESHQ-S_IH-STD-11 | IH Monitoring and Control Strategies During Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-STD-12 | Tank Transfers and Retrievals |

**Status:** In the area of Job Hazard Analysis and overall work planning, CH2M HILL has Significantly Exceeded Expectations.

**One Year Expectations** 5.3-A, CH2M HILL will ensure that IH issues fully integrated in work planning process.

**Applicable Corrective Actions from OA Report:**

| | |
|---|---|
| C-6-1 | Modify Planning to Ensure Tasks are well Understood |
| C-6-2 | Modify Planning to Involve Workers Effectively |
| C-6-3 | Modify the JHAs to Ensure the Task is Accurate |
| C-6-4 | Modify the Work Control to Comply with Standards |
| C-6-5 | Modify the Work Permit to Include Integrated JHAs |
| C-6-8 | Integrate Work Planners into the Actual Work Task |
| C-6-9 | Modify Work Planner Qualifications to be Effective |
| C-6-10 | Re-qualify Work Planners with Updated Qualifications |
| C-7-1 | Modify the Work Control to Clarify Roles of JHAs, etc. |
| C-8-3 | Revise Mgmt. Observation Program to Current Standards. |

**LOI Section 6 - Exposure Control – PPE**

The CH2M HILL RPP met regulatory requirements.

Title 29 CFR, Section 1910.134 provides specific requirements for the use of respiratory equipment in the workplace. These include adequate training for workers; fit testing as well as a requirement for employers to evaluate respiratory hazard(s) in the workplace; identification of relevant workplace and user factors, and base respirator selection for these factors. As discussed above, CH2M HILL is conducting an exhaustive determination of workplace chemical hazards.

Until complete, respirator selection is limited to SARs. This provides ample protection, but may in itself introduce new hazards.

CH2M HILL's current RPP is based on the following concept: all workers who perform tasks in a Tank Farm must use either a full face SAR or a SCBA. Therefore, within the fence line of any Tank Farm, every worker is fully protected from exposure to any hazardous chemical vapor, however, current and historical sampling and monitoring show this to be a very conservative approach. With the exception of ammonia and mercury, no chemicals have been detected at greater than 1% of the LOEG. There are other less burdensome options to control worker exposures to these chemicals. For example, if the exposure assessment process determines respiratory protection is necessary, cartridges are available for each of these chemicals allow the use of air-purifying respirators, rather than supplied-air respirators.

The CH2M HILL IH program is evaluating levels of chemical vapor hazards in all Tank Farm areas. Once completed, this information will be used to establish appropriate administrative control zones (Hazard Zone, Buffer Zone, and Safe Zone). Selection of respiratory protective equipment will ultimately be determined based on the assigned zone where work occurs. It is important this effort be completed in a timely fashion. While the use of SARs does provide respiratory protection, it introduces new hazards. SARs are heavy and awkward to use, and there is already anecdotal evidence of an increase in "slip and fall" type injuries. In addition, use of SARs increases the likelihood of ergonomic or muscular-skeletal injury. Finally, as warm weather approaches, there is a real likelihood that unnecessary use of SARs increases the risk of heat-related illnesses.

In addition to work within Tank Farm fence lines, there are locations outside fence lines, principally in the 200 East Area, where the possibility of a hazardous chemical vapor exposure could hypothetically occur. At present, the RPP for areas outside of Tank Farms does not mandate any level of respiratory protection. A current air sampling effort is underway to confirm these "outside" areas are free of dangerous chemical vapor exposures.

The assessment team concludes the CH2M HILL RPP exceeds regulatory requirements. CH2M HILL is currently developing job-specific PPE profiles based on well-defined work zones which incorporate the following:

- No IH-driven PPE requirement in Safe Zone;
- Increased IH-driven PPE, as necessary, in Buffer and Hazard Zones; and
- Where practical, coordinate IH driven designations with radiological control practices.

Once these plans are fully implemented, along with PPE selection based on procedural zone definitions, the CH2M HILL RPP will exceed regulatory requirements.

## LOI 6.1 - Respiratory protection program

**Question:** Is the RPP adequate to control worker exposures?

**Applicable References:**

| | |
|---|---|
| 29 CFR 1910.134 | OSHA Respiratory Protection Standard |
| US DOE Order 440.1A | Worker Protection Management for DOE Federal and Contractor Employees |
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-43 | TFC Health & Safety Plan |
| TFC-PLN-55 | IH Safety Management Program Plan |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan |
| TFC-ESHQ-S_IH-C-04 | Confined Space Procedures |
| TFC-ESHQ-S_IH-C-05 | Respirator Issuance and Control Processes |
| TFC-ESHQ-S_IH-C-05.1 | Respiratory Protection Systems |
| TFC-ESHQ-S_IH-D-05.2 | Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-D-34 | Managing AMZs |
| TFC-ESHQ-S_IH-P-08 | IH Air Sampling |
| TFC-ESHQ-S_IH-STD-09 | IH Response to Employee Contact with Chemical Waste |
| TFC-ESHQ-S_IH-STD-10 | Carcinogen Control |
| TFC-ESHQ-S_IH-STD-11 | IH Monitoring and Control Strategies During Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-STD-12 | Tank Transfers and Retrievals |

**Status:** Exceeds Expectations

**One Year Expectations**

6.1-A, CH2M HILL will implement PPE selection procedures based on Zone definitions.

6.1-B, CH2M HILL will develop Job-specific PPE profiles based on well-defined work zones that incorporate the following:

- No IH-driven PPE requirement in Safe Zone;
- Increased IH-driven PPE, as necessary, in Buffer and Hazard Zones; and
- Where practical, coordinated with RadCon practices.

**Applicable Corrective Actions from OA report:**

C-2-3 Establish Proper EAS
C-2-5 Use EAS to Collect & Analyze Personal Samples
C-5-1 Determine Training Required for RP Issuers
C-5-2 Implement Additional Training for RP Issuers as required.

C-5-3 Revise "Respiratory Protection" for voluntary use of RP
C-5-4 RP Issuers must Complete Formal Training

## LOI Section 7 – Exposure Assessment

The CH2M HILL exposure assessment strategy met regulatory requirements.

A formal program of exposure assessment is necessary to understand the chemical vapor hazards facing Tank Farm workers. DOE O 440.1, as well as standard professional practice, requires CH2M HILL to follow a specific strategy developed by the American IH Association ("AIHA Strategy") for assessing these hazards. Implementation of the AIHA strategy requires two elements: 1) specific knowledge of the chemicals which represent a hazard; and 2) statistically significant personnel monitoring to measure actual exposures to these chemicals. Beyond these elements, programs require efficient tools for managing data, and adequate procedures for collecting real-time and laboratory analysis data.

The Technical Basis document (RPP-22491, Revision 0, October, 2004) identifies 52 COPCs, 1,538 chemicals which require further evaluation and 236 chemicals which are considered low probability of exposure. As of this assessment, an update to this list is being prepared. Seven chemicals will be transferred from the COPC list and added to the Low Probability list, and an additional 40 chemicals (many representing hydrocarbon fractions) will be added to the COPC list.

In order to determine actual and potential worker exposure to these chemicals, CH2M HILL has established an active program of personal monitoring that will provide statistically significant estimates of actual chemical vapor exposure to workers.

- From April 1, 2004, to May 12, 2005, 4,146 personnel monitoring samples were collected. These samples were analyzed for a variety of chemical vapors, including 12 of the 52 COPCs;

- As of this writing, laboratory analyses indicate no individual exceeded the OEL of any chemical for any worker;

- Furthermore, the team's review of these samples found that, with the exception of elemental mercury, no worker had been exposed to any chemical vapor at a concentration that exceeded 1.0% of the least of that chemical's TLV, its Personal Exposure Limit, or its Recommended Exposure Limit. A single personal sample for elemental mercury indicated an exposure at 56.0% of the established TLV-TWA for this vapor; and

- The team found that analysis and turnaround times for personal monitoring samples was excessive. Turnaround times as long as two months were common. The team considers this a weakness that should be corrected. A turnaround time of two weeks should be achievable.

CH2M HILL plans to use this data to develop exposure models for SEGs. The contractor has tentatively identified five SEGs, each associated with a specific type of work activity:

- Waste Intrusive Activities – Tank component removal, waste sampling;
- Waste Disturbing activities – Vent/balance, valve work;
- Non-waste Disturbing Activities – Routine operations and maintenance;
- Support Activities – Carpenters, painting, welding, etc.; and
- Laboratory – Maintenance and analytical.

Once sufficient data have been collected for each tentative SEG (based on location, task and other relevant variables) to assure acceptable statistical reliability (for example that there is a 95% likelihood that exposures to a given chemical for a given task in a given location will be less than a given amount), CH2M HILL can assure its workforce that workers' exposures within the assigned SEG will be within limits. CH2M HILL expects to complete full implementation of its Exposure Assessment Strategy as well as Area and Source characterization plans (e.g. ESHQ-IH-STD-12, "Industrial Hygiene Monitoring and Control Strategies during Tank Retrieval and Transfers") by April 2006.

Personal monitoring to date, listed by the specific Tank Farm involved, and showing the number of samples obtained and analyzed as well as the number of samples having concentration levels sufficiently high to be detectable by the analytical method being used are shown in the following tabulation. In addition, this tabulation shows the chemical or chemicals which for any specific farm were at the greatest concentration, and therefore presented the greatest hazard. It should be noted, however, that no concentration exceeded its established LOEL.

| Farm(s) Designation | # of Samples | Detectable | (%) | Max Hazard | (% LOEL) |
|---|---|---|---|---|---|
| A- & AX-Farms | 63 | 2 | (3.2%) | $N_2O$ | (3.0% LOEL) |
| AN-Farm | 132 | 6 | (4.6%) | Acetonitrile | (<0.1% LOEL) |
| AP-Farm | 65 | 9 | (13.9%) | $N_2O$ | (6.8% LOEL) |
| AW-Farm | 164 | 8 | (4.9%) | Hg | (40.0% LOEL) |
| " | | | | $N_2O$ | (5.1% LOEL) |
| AY- & AZ-Farms | 102 | 4 | (3.9%) | $N_2O$ | (3.1% LOEL) |
| C Farm | 1,859 | 110 | (5.9%) | Hg | (56.0% LOEL) |
| " | | | | $N_2O$ | (8.2% LOEL) |
| S-Farms | 1,459 | 82 | (5.6%) | Hg | (44.0% LOEL) |
| " | | | | $N_2O$ | (7.2% LOEL) |
| TX-Farm | 86 | 7 | (8.1%) | $N_2O$ | (8.1% LOEL) |
| U-Farm | 216 | 10 | (4.6%) | Hg | (52.0% LOEL) |
| " | | | | $N_2O$ | (3.0% LOEL) |
| All Farms | 4,146 | 238 | (5.7%) | --- | --- |

The personal samples obtained and analyzed provided results for a number of chemical vapors. Twelve of the 52 COPCs were analyzed, with only dimethyl mercury from this group missing in the personal samples. The Tank Farm area and/or source samples frequently included this material. A listing of the chemicals analyzed, including the number of samples, the number of detectable samples and the maximum concentration documented is provided in the following tabulation.

| Chemical | # Samples | Detectable | | Max Detected | LOEL |
|---|---|---|---|---|---|
| **$NH_3$** | 349 | 15 | 4.3% | 0.052 ppm | 25 ppm |
| **Hg** | 147 | 20 | 13.6% | 0.014 mg/$m^3$ | 0.025 mg/$m^3$ |
| $N_2O$ | 269 | 119 | 44.2% | 2.06 ppm | 25 ppm |
| 1,1,1-trichloroethane | 20 | 0 | 0.0% | --- | 10 ppm |
| **acetonitrile** | 20 | 3 | 15.0% | 0.0040 ppm | 20 ppm |
| acetone | 319 | 48 | 15.1% | 0.32 ppm | 500 ppm |
| **benzene** | 228 | 2 | 0.9% | 0.004 ppm | 0.5 ppm |
| **carbon tetrachloride** | 20 | 0 | 0.0% | --- | 5 ppm |
| ethanol | 20 | 6 | 30.0% | 0.004 ppm | 1,000 ppm |
| ethyl benzene | 317 | 2 | 0.6% | 0.0004 ppm | 100 ppm |
| hexane | 20 | 1 | 5.0% | 0.001 ppm | 50 ppm |
| **hexanenitrile** | 20 | 0 | 0.0% | --- | no OEL |
| 2-butanone | 317 | 5 | 1.6% | 0.21 ppm | 200 ppm |
| **methanol** | 4 | 0 | 0.0% | --- | 200 ppm |
| **dichloromethane** | 23 | 4 | 17.4% | 0.0006 ppm | 50 ppm |
| methyl isobutyl ketone | 319 | 1 | 0.3% | 0.0005 ppm | 50 ppm |
| **n-butanol** | 318 | 6 | 1.9% | 0.15 ppm | 20 ppm |
| n-octane | 20 | 5 | 25.0% | 0.009 ppm | 300 ppm |
| n-pentane | 20 | 7 | 35.0% | 0.013 ppm | 600 ppm |
| n-propanol | 20 | 2 | 10.0% | 0.0018 ppm | 200 ppm |
| **pentanenitrile** | 20 | 0 | 0.0% | --- | no OEL |
| **propanenitrile** | 20 | 0 | 0.0% | --- | no OEL |
| **tetrachloroethylene** | 20 | 0 | 0.0% | --- | 25 ppm |
| tetrahydrofuran | 319 | 2 | 0.6% | 0.11 ppm | 200 ppm |
| toluene | 319 | 10 | 3.1% | 0.33 ppm | 50 ppm |
| m- OR p-xylene | 319 | 4 | 1.3% | 0.0043 ppm | 100 ppm |
| o-xylene | 319 | 1 | 0.3% | 0.0004 ppm | 100 ppm |
| ALL CHEMICALS | 4,126 | 263 | 6.4% | --- | --- |

* Chemicals listed in **bold** are COPCs.

Because personal sampling conducted as part of the exposure assessment process may not provide adequate information regarding exposures for a given task, activity or location (because full-shift samples average exposures over the entire sample period, which may contain multiple tasks, activities or locations), CH2M HILL also is planning and will continue to supplement its personal sampling program by a program of area and source monitoring to determine potential exposures in different locations.

- Approximately 1,790 area and source samples were collected between August and November, 2004;

- The area sampling program involved the collection of three consecutive eight-hour samples in order to provide a full 24-hour area exposure;

- Source or Work Area samples were collected at a five foot radius from each breather filter for SSTs, three additional samples were collected at a distance of 30 feet downwind from stack on DSTs;

- Extensive modeling of releases has been conducted to determine potential exposures outside of fence lines. These studies have indicated that atmospheric dispersion of the emitted chemical vapors is extremely unlikely to reach hazardous concentration levels outside the fence line of any Tank Farm;

- All work area samples collected to date are below the applicable OELs, most COPCs are not detected at all;

- All source sample results are below OEL, with the exception of ammonia at the U-Farm breather filters and the C-Farm breather filters, and elemental Hg at a C-Farm breather filter; and

- This information will be used to establish control zones, including "Safe Zones," "Boundary Zones" and "Hazard Zones" for work in Tank Farms.

Until March 2004, IH information, including personal, source and area monitoring data, was managed in what was referred to as the "Legacy Database." This is currently being phased out in favor of the TFIH Database. Both of these databases incorporate all the relevant data for work activities in Tank Farms. A typical record in either database will include:

- Name of the worker;

- The worker's task;

- Start and finish time for this task (with the calculated elapsed time involved in the work task); and

- Results of all the personal samples obtained and analyzed.

Data is manually entered into the database from field notes taken by the IHT or field representative. As with any manual data entry system, there is the potential for error. Observed problems involved an incorrect entry of the task being undertaken by the Tank Farm worker, an incorrect calculation of the duration of the personal sampling exposure, and some variation is the recorded personal sampling exposure data. In general, and despite the errors identified above, the current use of the Legacy Database represents a good approach to documenting Tank Farm operations on behalf of CH2M HILL's management.

Presently, the newer TFIH Database is nearing completion in its development, and when this new system/approach is put into practice, virtually all the problems identified above will have been corrected. The TFIH Database will provide a very complete set of data on the various measured hazards associated with various Tank Farm operations, from very routine ones to significant waste disturbing processes. These data will certainly be capable of being used as the basic information in a powerful relational data management system that should provide CH2M HILL with better data for both establishing and confirming its future worker exposure assessment strategy.

Much of the data collected by IHTs in the field comes from DRIs. The array of DRIs being used in Tank Farms includes instruments that can assess ambient levels of: ammonia ($NH_3$), volatile organic chemicals (VOCs), nitrous oxide ($N_2O$), combustible gases, oxygen deficiencies, nitrous oxide ($N_2O$), and elemental mercury (Hg). Most of these instruments are well suited to providing real time ambient concentrations of their respective analytes.

There is, however, a potential source of error in one particular category of DRI. PID functions as a survey analyzer, providing an approximate concentration for any chemical vapor (typically VOCs) that can be ionized by a 10.6 ev lamp. Readings from this instrument are affected by humidity. Because this instrument is calibrated in dry air and used at ambient humidity levels, there is the potential for a reading that is depressed. This problem is potentially significant because these instruments have achieved a very wide use at the Hanford Site. CH2M HILL should evaluate the sensitivity of their instruments to humidity and develop appropriate measures to correct or adjust readings.

As mentioned above, standard analytical methods are not available for many of the chemicals found in the Hanford Tanks. CH2M HILL is developing new methods as needed in order to evaluate concentrations. In addition, an active program is underway to evaluate use of DRIs where possible to evaluate levels of COPCs. Timeliness of analysis is an area of concern. Sampling events were identified where laboratory analysis took over six months. The lag between submitting media for lab analysis and the time when the final analysis is available should be less than six months, two weeks is maximum laboratory processing time for commercial IH labs. CH2M HILL should make appropriate arrangements to have results for typical IH samples within two weeks.

In addition to the DRIs used for determining ambient concentrations of potentially hazardous vapors, CH2M HILL has available for use by the IHTs instruments that can monitor heat stress levels (WBGT analyzers), and personal noise dosimeters.

In summary, the team concluded that the CH2M HILL exposure assessment strategy met regulatory requirements. When fully implemented, the CH2M HILL exposure assessment program will exceed regulatory requirements. CH2M HILL should continue its efforts to formally define SEGs and continue evaluation and categorization of worker exposures using personal sampling and DRIs for future Tank Farm work and future waste disturbing activities. This will require development of a measurement strategy (DRIs and/or sampling) for all COPCs. In addition, turnaround times for analysis of personal monitoring samples should be improved.

## LOI 7.1 - Exposure Assessment Strategy

**Question:** "Is the CH2M HILL exposure assessment strategy adequate to control worker exposures?"

**Applicable References:**

| | |
|---|---|
| 29 CFR 1910.134 | OSHA Standards relative to Respiratory Protection |
| US DOE Order 440.1A | Worker Protection Management for DOE Federal and Contractor Employees |
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-43 | TFC Health & Safety Plan |
| TFC-PLN-55 | IH Safety Management Program Plan |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan |
| TFC-PLN-66 | Implementation Plan for the Data Quality Objectives for the Evaluation of Tank Chemical Emissions for the IH Technical Basis |
| TFC-PLN-67 | Program Plan for Resolution of Tank Farm Vapor Issues |
| TFC-ESHQ-S_IH-C-04 | Confined Space Procedures |
| TFC-ESHQ-S_IH-C-05 | Respirator Issuance and Control Processes |
| TFC-ESHQ-S_IH-C-05.1 | Respiratory Protection Systems |
| TFC-ESHQ-S_IH-D-05.2 | Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-D-08 | Use of Colorimetric Indicator Tubes |
| TFC-ESHQ-S_IH-D-27 | Tank Vapor Space Monitoring |
| TFC-ESHQ-S_IH-D-32 | MIRAN 205B Series SapphIRe Instrument Operations |
| TFC-ESHQ-S_IH-D-34 | Managing AMZs |
| TFC-ESHQ-S_IH-P-08 | IH Air Sampling |
| TFC-ESHQ-S_IH-P-09 | Chain of Custody & Submitting Samples for Laboratory Analysis |
| TFC-ESHQ-S_IH-STD-09 | IH Response to Employee Contact with Chemical Waste |
| TFC-ESHQ-S_IH-STD-10 | Carcinogen Control |
| TFC-ESHQ-S_IH-STD-11 | IH Monitoring and Control Strategies During Tank Retrievals and Transfers |
| TFC-ESHQ-S_IH-STD-12 | Tank Transfers and Retrievals |

**Status:** The current approach Significantly Exceeds Expectations

**One Year** 7.1-A. CH2M HILL will complete implementation of Exposure Assessment Strategy.

**Expectations** 7.1-B, CH2M HILL will formalize definition and established SEGs for various hazards or classes of exposure.
7.1-C, CH2M HILL will establish OELs for all chemicals identified in Tank Vapors and develop appropriate measurement strategy (DRI and/or sampling) for all COPCs
7.1-D, CH2M HILL will continue evaluation and categorization of worker exposures using personal sampling and DRIs, as appropriate

**Applicable Corrective Actions from OA Report:**

| | |
|---|---|
| C-1-10 | Align EAS with the IH Technical Basis Document |
| C-2-1 | Align the IH Vapor Monitoring to the IH Tech Basis |
| C-2-2 | Ensure IH Procedures align with Vapor Monitoring Program |
| C-2-3 | Establish Proper EAS |
| C-2-4 | Establish IH Database for DRIs, Samples, etc. |
| C-2-5 | Use EAS to Collect & Analyze Personal Samples |
| C-13-1 | Revise Procedures to Deal with a Vapor Exposure Event |

## LOI 7.2 – Occupational Exposure Levels

**Question:** Have appropriate occupational exposure levels been established for all chemicals identified in Hanford Site tanks?

**Applicable References:**

| | |
|---|---|
| TWS05.011 | Assignment of Working OEL to Identify Toxicologically Important Waste Tank Headspace Chemicals |
| | Preliminary Evaluation of Potential Inhalation Hazard from Exposure to Hydrocarbon Vapors Emitted by Underground Waste Storage Tanks at the Hanford Site |
| TFC-PLN-27 | Chemical Exposure Program |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan, |
| RPP-22491 | IH Chemical Vapor Technical Basis |
| RPP-8369 | Chemical Source Terms for Tank Farms Safety Analysis |
| PNNL-14767 | Characterization Of Near-Field Transport And Dispersion Of Vapors Released From Headspace Of Hanford Site Underground Tanks |
| PNNL-14831 | Overview of Hanford Site High-Level Waste Tank Gas and Vapor Dynamics |
| RPP-22620, | Sampling and Analysis Plan for Vapor in SST Headspace |
| RPP-21854 | Occurrence and Chemistry of Organic Compounds in Hanford Site Waste Tanks |

**Status:** Significantly Exceeds Expectations

**One Year Expectations** Continue current actions in this area

**Applicable Corrective Actions from OA Report:**

| | |
|---|---|
| C-1-6 | Evaluate Toxicity of Tank Head Space Gases |
| C-1-7 | Continue to Evaluate COPCs |
| C-1-8 | Contract with National Experts for Outside Views |
| C-2-3 | Establish Proper EAS |

## LOI 7.3 - Risk Ranking of COPCs

**Question:** Have COPC been adequately characterized and ranked in order of concern?

**Applicable References:**

| | |
|---|---|
| TFC-PLN-27 | Chemical Exposure Program |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan, |
| RPP-22491 | IH Chemical Vapor Technical Basis |

**Status:** Exceeds Expectations

**One Year Expectations** 7.3-A, CH2M HILL will prepare a final list of COPCs as well as the process to keep list current.

**Applicable Corrective Actions from OA Report:**

| | |
|---|---|
| C-1-6 | Evaluate Toxicity of Tank Head Space Gases |
| C-1-7 | Continue to Evaluate COPCs |
| C-1-8 | Contract with National Experts for Outside Views |
| C-2-3 | Establish Proper EAS |

## LOI 7.4 IH Database for Data Storage and Retrieval

**Question:** "Does the current Legacy Database, as well as its future replacement, the TFIH Database, provide adequate information for quantifying exposure hazards and establishing a reasonable risk assessments strategy?"

**Applicable References:**

| | |
|---|---|
| 29 CFR 1910.134 | OSHA Standards relative to Respiratory Protection |
| US DOE Order 440.1A | Worker Protection Management for DOE Federal and Contractor Employees |
| TFC-PLN-34 | IH Exposure Assessment Strategy |
| TFC-PLN-43 | TFC Health & Safety Plan |
| TFC-PLN-55 | IH Safety Management Program Plan |
| TFC-PLN-65 | IH Chemical Vapor Technical Basis Implementation Plan |
| TFC-PLN-66 | Implementation Plan for the Data Quality Objectives for the Evaluation of Tank Chemical Emissions for the IH Technical Basis |

| | |
|---|---|
| TFC-PLN-67 | Program Plan for Resolution of Tank Farm Vapor Issues |
| TFC-ESHQ-S_IH-STD-03 | Exposure Monitoring, Reporting, and Records Management |

**Status:** Assuming that the full implementation and use of the TFIH Database is accomplished as scheduled, CH2M HILL will have Significantly Exceeded Expectations.

**One Year Expectations** Continue current actions in this area

**Applicable Corrective Actions from OA Report:**

| | |
|---|---|
| C-1-13 | Electronically Ling TWINS and IH Databases |
| C-2-4 | Establish IH Database to Implement EAS |
| C-3-3 | Establish a Record Keeping Program for Oversight |

## LOI 7.5 Proper Use of DRI

**Question:** "Are Direct Reading Instruments (DRIs) used appropriately to assess worker exposures; and, in this context, how well understood are the sources of errors that occur in DRIs when they are used in the field, and how are these sources of error being mitigated?"

**Applicable References:**

| | |
|---|---|
| TFC-PLN-64 | IH Instrumentation Plan |
| TFC-ESHQ-S_IH-CD-38 | Industrial Instrumentation Evaluation and Procedures |
| TFC-ESHQ-S_IH-D-11 | Use of Colorimetric Indicator Tubes |
| TFC-ESHQ-S_IH-D-12 | Use of IH Pumps |
| TFC-ESHQ-S_IH-D-15 | Use of the Industrial Scientific itx Analyzer |
| TFC-ESHQ-S_IH-D-20 | Use of the Rae ppmRAE Survey Analyzer |
| TFC-ESHQ-S_IH-D-22 | Use of any DRIs |
| TFC-ESHQ-S_IH-D-24 | Use of the Rae AreaRAE Analyzer |
| TFC-ESHQ-S_IH-D-25 | Use of the ThermoElectron TVA-1000B Survey Analyzer |
| TFC-ESHQ-S_IH-D-26 | Use of WBGT Heat Stress Monitors |
| TFC-ESHQ-S_IH-D-32 | Use of the ThermoElectron MIRAN 205B SapphIRe Infrared Spectrophotometric Analyzer |
| TFC-ESHQ-S_IH-D-34 | Use of Noise Monitors and Noise Dosimetry Instruments |
| TFC-ESHQ-S_IH-D-36 | Use of Gillian Personal Sampling Pumps |
| TFC-ESHQ-S_IH-D-37 | Use of the Arizona Instruments Jerome 431X Mercury Vapor Analyzer |
| TFC-ESHQ-S_IH-D-39 | Use of Manning Ammonia Monitor |
| TFC-ESHQ-S_IH-D-40 | Use of the Lumex Elemental Mercury Analyzer |

TFC-ESHQ-S_IH-D-XX IH Equipment Management

**Status:** With the exception of the indicated PID based survey analyzer, the CH2M HILL Meets Expectations.

**One Year Expectations** Continue current actions in this area

**Applicable Corrective Actions from OA Report:**

C-2-7 Establish a Formal IH Instrument Program
C-2-8 Document Error Sources in IH related DRIs

**LOI 7.6 - Laboratory Analysis**

**Question:** Are laboratory facilities adequate for exposure assessment tasks

**Applicable References:**

**Status:** Exceeds Expectations

**One Year Expectations** 7.6-A, CH2M HILL need to work with their IH lab to ensure timely laboratory evaluation of all IH samples (two weeks maximum turn-around time)

**LOI Section 8 – Occupational Medicine**

The CH2M HILL occupational medicine and medical surveillance program met regulatory requirements. When program improvements are fully implemented, the CH2M HILL exposure assessment program will exceed regulatory requirements.

Operators of hazardous waste sites are required under 29 CFR 1910.120 (f), "Hazardous Waste Operations and Emergency Response (HAZWOPER)," to develop medical surveillance and monitoring programs for workers. Medical surveillance is also required 29 CFR 1910.134, 29 CFR 1910.1003, and other OSHA regulations. Medical surveillance is aimed primarily at evaluating individual exposure conditions and preventing occupational diseases. This is accomplished by a program designed by CH2M HILL known as the EJTA.

The medical monitoring program, on the other hand, provides employees unobstructed access to medical treatment, recordkeeping and follow-ups on injuries and occupational-related illnesses arising from the workplace. The CH2M HILL programs for these areas are fully developed and comply with OSHA Standards, DOE O 440 and 440.1A, and CH2M HILL standards, procedures, and policies.

One key Observation made during the CH2M HILL medical surveillance and monitoring assessment was the openness, direct access to information, and interactions with the medical personnel at AdvanceMed Hanford. These Observations indicate a good working relationship between the CH2M HILL EJTA staff and the Hanford medical personnel. It is important for this relationship to remain open to ensure accurate medical information is continuously communicated. The assessors also acknowledged a visible presence of medical providers in the

Tank Farms which will improve communication and increase worker confidence in the medical monitoring program.

The assessment team concluded the CH2M HILL Occupational Medicine and medical surveillance program met regulatory requirements. When program improvements are fully implemented, the CH2M HILL exposure assessment program will exceed OSHA 29 CFR 1910.120, as well as, the DOE procedures and orders for safety and health.

**LOI 8.1 - Medical Surveillance Program**

**Question** **Is the medical surveillance program adequate for work-related health issues?**

**Applicable References:**

**Status:** Exceeds Expectations

**One Year Expectations** 8.1-A, CH2M HILL will develop a proactive, responsive, worker-centered program with a visible presence of medical providers in Tank Farms and improved communication and increased worker confidence in program.

**Applicable Corrective Actions from OA Report:**

| | |
|---|---|
| C-12-1 | Review Case Files for Accuracy |
| C-12-2 | Tailor the Event Reporting Form to Tank Farm Needs |
| C-12-3 | Acquire an Employee to Perform Case Mgmt. Duties |
| C-12-4 | Establish Annual Review of Injuries/Illnesses |

**LOI 9 – Corrective Action Response to OA Findings**

The following provides information regarding CH2M HILL's 101 corrective action responses to OA's 13 Findings. Note, four of the 101 tabulated CAs were applicable to three different Findings (C-6-1, C-6-3, C-6-6, and C-6-7,), and eleven of these CAs were applicable to two different Findings (C-2-3, C-2-5, C-2-6, C-2-7, C-2-8, C-3-1, C-6-2, C-6-4, C-6-5, C-6-9, and C-6-10).

The comments section of the following tabulation identifies each of the CAs which were reviewed and/or discussed by the assessment team. In every case, each of the CAs was determined "acceptable," which means each CA is directly responsive to the OA Finding. Additionally, ORP verified, for each CA reviewed, it has adequate documentation signifying completion of the corrective action. In the case of C-4-1, the overall Training Description is complete, but not all of the IHTs have yet achieved the Advanced Qual Card.

The CAs associated with Finding C-12 were not reviewed by team, since these four CAs were reviewed previously by ESQ as part of the Computerized Accident/Incident Reporting System

(CAIRS). Overall, the team reviewed 57 (56%) of the individual 101 CAs assigned to CH2M HILL.

| Finding # | CA # | Initiated | Completed | Comments |
|---|---|---|---|---|
| C-1 | C-1-1 | 05/23/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-1-2 | 05/01/04 | 09/13/04 | Reviewed by the Audit Team |
| | C-1-3 | 05/01/04 | 08/23/04 | Reviewed by the Audit Team |
| | C-1-4 | 05/01/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-1-5 | 04/26/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-1-6 | 04/12/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-1-7 | 04/22/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-1-8 | 06/30/04 | 10/25/04 | Reviewed by the Audit Team |
| | C-1-9 | 05/01/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-1-10 | 10/15/04 | 10/31/04 | Reviewed by the Audit Team |
| | C-1-12 | 05/01/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-1-13 | 05/10/04 | 03/15/05 | Reviewed by the Audit Team |
| | C-1-14 | 10/15/04 | 10/31/04 | Reviewed by the Audit Team |
| | C-1-15 | 10/15/04 | 12/31/04 | Reviewed by the Audit Team |
| C-2 | C-2-1 | 10/31/04 | 12/31/04 | Reviewed by the Audit Team |
| | C-2-2 | 10/31/04 | 02/28/05 | Reviewed by the Audit Team |
| | C-2-3* | 10/31/04 | 03/15/05 | Reviewed by the Audit Team |
| | C-2-4 | 06/23/04 | 11/15/04 | Reviewed by the Audit Team |
| | C-2-5* | 07/19/04 | 02/15/05 | Reviewed by the Audit Team |
| | C-2-6* | 06/01/04 | 02/18/05 | Reviewed by the Audit Team |
| | C-2-7* | 11/15/04 | 12/30/04 | Reviewed by the Audit Team |
| | C-2-8* | 05/17/04 | 01/30/05 | Reviewed by the Audit Team |
| | C-2-9 | 09/17/04 | 10/01/04 | |
| C-3 | C-2-3* | 10/31/04 | 03/15/05 | Reviewed by the Audit Team |
| | C-2-5* | 07/19/04 | 02/15/05 | Reviewed by the Audit Team |

* Corrective Action that applied to more than one Finding

| Finding # | CA # | Initiated | Completed | Comments |
|---|---|---|---|---|
| C-3 | C-2-7* | 11/15/04 | 12/30/04 | Reviewed by the Audit Team |
| | C-2-8* | 05/17/04 | 01/30/05 | Reviewed by the Audit Team |
| | C-3-1* | 07/19/04 | 10/30/14 | Reviewed by the Audit Team |
| | C-3-2 | 09/13/04 | 12/01/04 | Reviewed by the Audit Team |
| | C-3-3 | 10/15/04 | 12/01/04 | Reviewed by the Audit Team |
| | C-3-4 | 11/01/04 | 12/30/04 | Reviewed by the Audit Team |
| C-4 | C-2-6* | 06/01/04 | 02/18/05 | Reviewed by the Audit Team |
| | C-3-1* | 07/19/04 | 10/30/14 | Reviewed by the Audit Team |
| | C-4-1 | 07/19/04 | 03/18/05 | Reviewed by the Audit Team: Training Description is in place; however, the Advanced Qualification Level has not yet been achieved by all of the IHTs. |
| C-5 | C-5-1 | 09/22/04 | 10/29/04 | |
| | C-5-2 | 09/22/04 | 12/30/04 | |
| | C-5-3 | 09/01/04 | 10/01/04 | Reviewed by the Audit Team |
| | C-5-4 | 01/02/05 | 03/15/05 | |

| | | | | |
|---|---|---|---|---|
| C-6 | C-6-1* | 08/30/04 | 10/28/04 | Reviewed by the Audit Team |
| | C-6-2* | 08/30/04 | 10/28/04 | Reviewed by the Audit Team |
| | C-6-3* | 08/30/04 | 10/28/04 | Reviewed by the Audit Team |
| | C-6-4* | 08/30/04 | 10/28/04 | |
| | C-6-5* | 08/30/04 | 10/28/04 | |
| | C-6-6* | 10/28/04 | 11/18/04 | Reviewed by the Audit Team |
| | C-6-7* | 11/29/04 | 01/21/05 | |
| | C-6-8 | 08/01/04 | 08/16/04 | |
| | C-6-9* | 10/28/04 | 01/14/05 | |
| | C-6-10* | 01/17/05 | 03/15/05 | |
| C-7 | C-6-1* | 08/30/04 | 10/28/04 | |
| | C-6-3* | 08/30/04 | 10/28/04 | Reviewed by the Audit Team |
| | C-6-6* | 10/28/04 | 11/18/04 | Reviewed by the Audit Team |
| | C-6-7* | 11/29/04 | 01/21/05 | |
| | C-6-9* | 10/28/04 | 01/14/05 | |
| | C-6-10* | 01/17/05 | 03/15/05 | |
| | C-7-1 | 08/30/04 | 10/28/04 | Reviewed by the Audit Team |
| C-8 | C-6-1* | 08/30/04 | 10/28/04 | |
| | C-6-2* | 08/30/04 | 10/28/04 | |
| | C-6-3* | 08/30/04 | 10/28/04 | Reviewed by the Audit Team |
| | C-6-4* | 08/30/04 | 10/28/04 | |
| | C-6-5* | 08/30/04 | 10/28/04 | |
| | C-6-6* | 10/28/04 | 11/18/04 | Reviewed by the Audit Team |
| | C-6-7* | 11/29/04 | 01/21/05 | |
| | C-8-1 | 08/30/04 | 10/28/04 | |
| | C-8-2 | 06/02/04 | 07/01/04 | |
| | C-8-3 | 06/02/04 | 07/01/04 | |
| C-9 | C-9-1 | 06/02/04 | 06/28/04 | |
| | C-9-3 | 06/02/04 | 06/28/04 | |
| | C-9-4 | 06/02/04 | 06/30/04 | |

* Corrective Action that applied to more than one Finding

| Finding # | CA # | Initiated | Completed | Comments |
|---|---|---|---|---|
| C-9 | C-9-5 | 06/02/04 | 06/30/04 | Reviewed by the Audit Team |
| | C-9-6 | 06/02/04 | 08/23/04 | Reviewed by the Audit Team |
| | C-9-7 | 06/02/04 | 09/30/04 | Reviewed by the Audit Team |
| | C-9-8 | 06/02/04 | 06/30/04 | |
| | C-9-9 | 06/02/04 | 08/30/04 | |
| | C-9-10 | 06/02/04 | 06/30/04 | |
| | C-9-11 | 06/02/04 | 06/17/04 | |
| | C-9-12 | 06/02/04 | 06/29/04 | Reviewed by the Audit Team |
| | C-9-13 | 06/02/04 | 11/16/04 | |
| | C-9-14 | 06/02/04 | 11/16/04 | |
| | C-9-15 | 06/02/04 | 06/16/04 | |
| | C-9-16 | 06/02/04 | 06/23/04 | |
| | C-9-17 | 06/02/04 | 06/15/04 | |

| | | | | |
|---|---|---|---|---|
| | C-9-18 | 06/02/04 | 06/07/04 | |
| | C-9-19 | 06/02/04 | 06/30/04 | |
| | C-9-20 | 06/02/04 | 09/15/04 | |
| | C-9-21 | 06/02/04 | 06/28/04 | |
| C-10 | C-10-1 | 07/23/04 | 08/31/04 | |
| | C-10-2 | 07/23/04 | 08/31/04 | Reviewed by the Audit Team |
| | C-10-3 | 07/23/04 | 08/26/04 | Reviewed by the Audit Team |
| | C-10-4 | 05/01/04 | 10/15/04 | Reviewed by the Audit Team |
| | C-10-5 | 07/23/04 | 09/15/04 | Reviewed by the Audit Team |
| C-11 | C-11-1 | 07/23/04 | 09/15/04 | Reviewed by the Audit Team |
| | C-11-2 | 07/23/04 | 10/27/04 | |
| | C-11-3 | 07/23/04 | 07/29/04 | |
| | C-11-4 | 07/23/04 | 09/09/04 | |
| | C-11-5 | 07/23/04 | 08/23/04 | |
| C-12 Program | C-12-1 | 08/01/04 | 09/30/04 | NOT Reviewed – Ref: Paul Hernandez, CAIRS |
| Program | C-12-2 | 08/01/04 | 09/30/04 | NOT Reviewed – Ref: Paul Hernandez, CAIRS |
| Program | C-12-3 | 08/01/04 | 10/29/04 | NOT Reviewed – Ref: Paul Hernandez, CAIRS |
| Program | C-12-4 | 08/01/04 | 09/30/04 | NOT Reviewed – Ref: Paul Hernandez, CAIRS |
| C-13 | C-13-1 | 10/01/04 | 11/30/04 | Reviewed by the Audit Team |
| | C-13-2 | 10/01/04 | 11/30/04 | Reviewed by the Audit Team |

* Corrective Action applies to more than one Finding.

## APPENDIX C – REFERENCES

Principal references used in the oversight. Additional documents may be referenced in Appendix B – LOI.

### Tank Farm Contractor Plans

- TFC-PLN-24, "Chronic Beryllium Disease Prevention Program," NK Butler, effective October 7, 2003;
- TFC-PLN-27, "Chemical Exposure Program," R. J. Fogg, effective February 11, 2003;
- TFC-PLN-34, "Industrial Hygiene Exposure Assessment Strategy," M. L. Zabel, effective March 16, 2005;
- TFC-PLN-39, "Risk Management Plan," W. A. Kitchen, effective April 21, 2004;
- TFC-PLN-43, "Tank Farm Contractor Health and Safety Plan," Revision A-3, M. L. Zabel, effective December 31, 2004;
- TFC-PLN-46, "Training and Procedures Integrated Document Management System Implementation Plan," T. Erickson, effective July 25, 2004;
- TFC-PLN-55, "Industrial Hygiene Safety Management Program Plan," T. J. Anderson, effective October 19, 2004;
- TFC-PLN-64, "Industrial Hygiene Instrumentation Plan," M. W. Jones, effective December 31, 2004;
- TFC-PLN-65, "Industrial Hygiene Chemical Vapor Technical Basis Implementation Plan," W. E. Ross, effective March 3, 2005;
- TFC-PLN-66, "Implementation Plan for the Data Quality Objectives for the Evaluation of Tank Chemical Emissions for the Industrial Hygiene Technical Basis," W. E. Ross, effective March 7, 2005; and
- TFC-PLN-67, "Program Plan for Resolution of Tank Farm Vapor Issues" W. E. Ross, effective March 17, 2005.

### Safety - IH Procedures

- TFC-ESHQ-S_IH-C-02, Revision A-7, "Hazard Communication" Effective Date March 23, 2005, T. J. Anderson;
- TFC-ESHQ-S_IH-C-04, Revision A-4, "Confined Space", Effective Date December 22, 2004, R. J. Fogg;

- TFC-ESHQ-S_IH-C-05, Revision C-17, "Respiratory Protection", Effective Date January 21, 2005, O. McAfee;
- TFC-ESHQ-S_IH-C-07, Revision A-2, "Heat Stress Control", Effective Date May 4, 2004, R. J. Fogg;
- TFC-ESHQ-S_IH-C-17, Revision A-1, "Occupational Medical Qualification and Monitoring", Effective Date March 16, 2005, M. J. Sorrels;
- TFC-ESHQ-S_IH-CD-05.1, Revision B-2, "Respirator Issuance and Control Processes", Effective Date March 28, 2005, O. McAfee;
- TFC-ESHQ-S_IH-CD-35, Revision A, "Managing Air Monitoring Zones", Effective Date June 30, 2005, M. L. Zabel;
- TFC-ESHQ-S_IH-CD-38, Revision A, "Evaluation and Procurement of Industrial Hygiene Monitoring Instruments", Effective Date October 15, 2004, O. McAfee;
- TFC-ESHQ-S_IH-D-05.2, Revision A-1, "3M Breathe Easy Powered Air Purifying Respirator Test and Maintenance", Effective Date July 13, 2004, M. L. Zabel;
- TFC-ESHQ-S_IH-D-08, Revision A-4, "Industrial Hygiene Monitoring and Control Strategies During Tank Retrieval and Transfers", Effective Date January 11, 2005, M. L. Zabel;
- TFC-ESHQ-S_IH-D-11, Revision A-1, "Use of Colorimetric Indicator Tubes", Effective Date September 6, 2005, J. W. Jabara;
- TFC-ESHQ-S_IH-D-12, Revision A-1, "Use and Calibration of Industrial Hygiene Pumps", Effective Date September 6, 2005, J. W. Jabara;
- TFC-ESHQ-S_IH-D-13, Revision B, "Collecting Wipe and Bulk Samples", Effective Date January 11, 2005, O. McAfee;
- TFC-ESHQ-S_IH-D-14, Revision B-1, "Calibration and Use of Multi-Gas Monitors", Effective Date September 6, 2005, J. W. Jabara;
- TFC-ESHQ-S_IH-D-15, Revision A-1, "Using the itx Multi-Gas Monitor", Effective Date September 6, 2005, J. W. Jabara;
- TFC-ESHQ-S_IH-D-20, Revision A-1, "Operation of ppbRAE Volatile Organic Compound Monitor", Effective Date September 6, 2005, J. W. Jabara;
- TFC-ESHQ-S_IH-D-22, Revision A-1, "Using Direct Reading Instruments", Effective Date September 6, 2005, J. W. Jabara;

- TFC-ESHQ-S_IH-D-24, Revision A-1, "Operation of AreaRAE Multi-Gas Monitor", Effective Date September 6, 2005, J. W. Jabara

- TFC-ESHQ-S_IH-D-25, Revision A, "Using the TVA 1000B Toxic Vapor Analyzer", Effective Date October 25, 2004, J. W. Jabara;

- TFC-ESHQ-S_IH-D-26, Revision A, "Using Heat Stress Monitors", Effective Date November 1, 2004, J. W. Jabara;

- TFC-ESHQ-S_IH-D-27, Revision A, "Tank Vapor Source Monitoring", Effective Date October 28, 2004, O. McAfee;

- TFC-ESHQ-S_IH-D-32, Revision A-1, "MIRAN 205B Series SapphIRE Instrument Operation", Effective Date March 28, 2005, J. W. Jabara;

- TFC-ESHQ-S_IH-D-34, Revision A, "Noise Surveys, Dosimetry, and Octave Band Analysis", Effective Date June 30, 2005, J. W. Jabara;

- TFC-ESHQ-S_IH-D-35, Revision A-5, "Managing Air Monitoring Zones", Effective Date October 25, 2004, M. L. Zabel;

- TFC-ESHQ-S_IH-D-36, Revision A-2, "Using the Gilian LFS-113 Dual Mode Low Flow Air Sampler with Multiple Sorbent Tubes:, Effective Date April 12, 2005, J. W. Jabara;

- TFC-ESHQ-S_IH-D-37, Revision B, "Using the Jerome 431-X Mercury Vapor Analyzer", Effective Date December 7, 2004, J. W. Jabara;

- TFC-ESHQ-S_IH-D-39, Revision A-1, "Calibration and Use of the Manning EC-P2 Ammonia Monitor", Effective Date September 6, 200, J. W. Jabara;

- TFC-ESHQ-S_IH-D-40, Revision A-1, "Using the Lumex RA 915+ Mercury Analyzer", Effective Date June 30, 2005, J. W. Jabara;

- TFC-ESHQ-S_IH-P-09, Revision A-1, "Industrial Hygiene Personal/Area Exposure Monitoring", Effective Date December 8, 2004, O. McAfee;

- TFC-ESHQ-S_IH-P-10, Revision A-3, "Chain of Custody and Submitting Samples for Laboratory Analysis", Effective Date April 12, 2005, M. T. Hughey; and

- TFC-ESHQ-S_IH-STD-03, Revision A-4, "Ergonomics", Effective Date December 9, 2004, R. J. Fogg.

## Safety- IH Standards

- TFC-ESHQ-IH-STD-02, Revision A, "Laser Safety and Nonionzing Radiation", Effective Date November 30, 2004, K. H. Jaten;
- TFC-ESHQ-IH-STD-03, Revision A, "Exposure Monitoring, Reporting, and Records Management", Effective Date November 30, 2004, T. J. Anderson;
- TFC-ESHQ-IH-STD-04, Revision A, "Asbestos Control - Facility Management/General Industry", Effective Date February 17, 2005, T. J. Anderson;
- TFC-ESHQ-IH-STD-05, Revision A, "Asbestos Control – Construction Industry", Effective Date February 17, 2005, T. J. Anderson;
- TFC-ESHQ-IH-STD-06, Revision A, "Hearing Conservation Program", Effective Date October 28, 2004, T. J. Anderson;
- TFC-ESHQ-IH-STD-08, Revision A, "Lead Control Program", Effective Date October 7, 2004, T. J. Anderson;
- TFC-ESHQ-IH-STD-09, Revision A-1, "Industrial Hygiene Response to Vapor Concerns", DRAFT, M. T. Hughey;
- TFC-ESHQ-IH-STD-10, Revision A-1, "Industrial Hygiene Response to Employee Contact with Chemical Waste", Effective Date September 6, 2005, M. T. Hughey;
- TFC-ESHQ-IH-STD-11, Revision A, "Carcinogen Control", Effective Date February 3, 2005, T. J. Anderson;
- TFC-ESHQ-IH-STD-12, Revision A, "Industrial Hygiene Monitoring and Control Strategies During Tank Retrieval and Transfers", Effective Date March 7, 2005, M. L. Zabel; and
- TFC-ESHQ-S_IS-C-02, Revision B-1, "Personal Protective Equipment", Effective Date April 4, 2005, L. M. Calderon.

## Other References

- "Investigation of Worker Vapor Exposure and Occupational Medicine Program Allegations at the Hanford Site," April 2004**;**
- "Tank Farms Industrial Hygiene Assessment," April 19, 2004;
- "Vapor Program Communication Plan" DRAFT, March 17, 2005;
- "Management Assessment Industrial Hygiene Safety Management Program FY2004-ESHQ-M-0176," August 12, 2004;

- "Investigation of Allegations Involving Occupational Medical Services and Tank Farm Vapor Exposures at the Hanford Site (OIG Case No. I04RL003)," June 1, 2004;
- "Assessment Report FY2004-CH2M-I-0001, Independent Assessment of the CH2M HILL Hanford Group, Inc. Field Implementation of the Industrial Hygiene Vapor Monitoring Program," November 3, 2003;
- RPP-22491, "Industrial Hygiene Chemical Vapor Technical Basis," October 7, 2004;
- "Vapor Solutions Level 0 Logic," March 29, 2005;
- "Map IH Program OA Corrective Actions;"
- "Vapor Solutions Project Response to Enhancement Recommendations OA Corrective Action Plan Matrix (OCM)," March 21, 2005;
- "Corrective Action Plan to the U.S. Department of Energy – Office of Independent Oversight and Performance Assurance (OA) Investigation of Worker Vapor Exposure and Occupational Medicine Program Allegations at the Hanford Site," April 2004;
- "DOE O 440.1a, Attachment 2, Section 18, Industrial Hygiene," Date Unknown;
- TFC-ESHQ-IH-STD-19, "Cold Stress," DRAFT, M. T. Hughey;
- ESHQ-Q_C-C-01 PROBLEM EVALUATION REQUEST system;
- IH MANUAL HIERARCHY PPT. updated April 11, 2005 by W. Robbins;
- IH MANUAL HIERARCHY PPT. updated March 2005 by J. Robinson; and
- TANK FARM IH database Equipment Maintenance Report by S. Jungfleisch.

**Training References**

FUNDAMENTALS QUALIFICATION

- Using DRI (Course No. 357887);
- Gas Detector Tube Sampling (357863);
- Sampling Pump Calibration (357889);
- Personal/Area Exposure Monitoring (357895);

- Tank Farm IH Database (357898);
- Surface Wipe Sampling (357894); and
- Chain of Custody (357893).

INSTRUMENTATION QUALIFICATION

- MIRAN SapphIRe 205B (357880);
- Gilian Sample Pump (357879); and
- Jerome Mercury Meter (357878).

QUALIFICATION CARDS/PROCEDURES

- IH Technician Training and Qualification Requirements, TFC-BSM-TQ-STD-07, Revision B, effective March 18, 2005;
- Technical Staff Qualification Requirements, TFC-BSM-TQ-STD-01, Revision C-2, effective February 15, 2005;
- Qualification Card for Fundamentals for IH Technicians (357830);
- Qualification Card for Instrumentation for IH Technicians (357835); and
- Qualification Card and Guide for IH Profession (350882).

CONTINUING TRAINING

- Heat Stress Monitor Use (2QTR05), (356500); and
- Confined Space Monitoring/Documentation (4QTR05), (357897).

ITEM REPORTS FOR TRAINING COMPLETED

- OA Percent Complete – April 11, 2005 Status Report;
- 357884 40 hour IHT Fundamentals Report;
- 357887 Using DRI Report;
- 357863 Gas Detector Tube Sampling Report;
- 357895 Personal/Area Exposure Monitoring Report;

- 357889 Sampling Pump Calibration Report;
- 357898 TFIHDB Report;
- 357893 Chain of Custody Report;
- 357894 Surface Wipe Sampling Report;
- 357880 MIRAN Report;
- 357878 Jerome Report; and
- 357879 Gilian Report

## APPENDIX D – ACRONYMS

| | |
|---|---|
| AIHA | American Industrial Hygiene Association |
| ALARA | As low as reasonably achievable |
| AMZ | Air monitoring zone |
| BBI | Best Basis Inventory |
| CA | Corrective Action |
| CAIRS | Computerized Accident/Incident Reporting System |
| CFR | Code of Federal Regulations |
| CHAT | Chemical hazard awareness training |
| CH2M HILL | CH2M HILL Hanford Group, Inc. |
| CIH | Certified Industrial Hygiene |
| COPC | Chemicals of potential concern |
| DOE | U.S. Department of Energy |
| DRI | Direst Reading Instruments |
| DST | Double-Shell Tank |
| EAS | Exposure Assess Strategy |
| EJTA | Employee Job Task Analysis |
| ESQ | Office of Environmental Safety and Quality |
| FY | Fiscal Year |
| GC-MS | Gas Chromatograph/Mass Spectrometer |
| HPT | Health Physics Technician |
| IH | Industrial Hygiene |
| IHT | Industrial Hygiene Technician |
| JHA | Job Hazard Analysis |
| LOEG | Lowest Occupational Exposure Guidelines |
| LOEL | Lowest Identified Occupational Exposure Limit |
| LOI | Lines of Inquiry |
| OA | Office of Independent Oversight and Performance Assurance |
| OEL | Occupational Exposure Limit |
| ORP | DOE Office of River Protection |
| OSHA | Occupational Safety and Health Administration |
| PID | Photoionization Detectors |
| PPE | Personal Protective Equipment |
| RadCon | Radiological control |
| RPP | Respiratory protection program |
| SAR | Supplied air respirators |
| SCBA | Self contained breathing apparatus |
| SEG | Similarly Exposed Group |
| SST | Single-Shell Tank |
| TFC | Tank Farm Contractor |
| TFIH | Tank Farms Industrial Hygiene |
| TLV | Threshold Limit Value |
| TWA | Time-Weighted Average |
| TWINS | Tank Waste Information Network System |
| VOC | Volatile Organic Chemicals |
| WBGT | Wet Bulb, Globe, Temperature |

## APPENDIX E – ASSESSMENT TEAM SIGNATURES

The assessor signatures for this report are provided on the next page.

**U.S. Department of Energy, Office of River Protection**

# SIGNATURE PAGE

# REVIEW OF CH2M HILL INDUSTRIAL HYGIENE PROGRAM

## April 25 Through 29, 2005

**Oversight:** A-05-ESQ-TANK FARM-007

Submitted by

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