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## **1.0 PURPOSE AND SCOPE**

(6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7)

The Industrial Hygiene program at the tank farms addresses non-ionizing radiological, chemical, biological, ergonomic, and physical hazardous agents that have the potential to adversely impact worker health, regulatory compliance, or company assets. Washington River Protection Solutions, LLC (WRPS) is committed to optimizing management of exposures to these hazards beyond regulatory compliance in accordance with As Low As Reasonably Achievable (ALARA) through development and implementation of a comprehensive plan known as the Exposure Assessment Strategy (EAS).

The overall approach links job hazard analysis, exposure assessment, and medical surveillance to reduce the risk of exposure and prevent adverse health effects. The methods and rationale that the Tank Operations Contractor (TOC) uses to characterize and monitor workers' potential exposures to hazardous agents are described here. The implementing documents for specific hazardous agents are listed in Table 1. The goal of the TOC exposure assessment strategy is to achieve protection of workers by controlling potential exposures to ALARA expectations.

The EAS applies to all TOC activities (including design, construction, operation, maintenance, decontamination, decommissioning, and environmental restoration activities) performed by the TOC and its subcontractors whether inherent to the facility or introduced by work practice.

### **1.1 ALARA**

ALARA is a best management practice. Implementation of ALARA includes several aspects.

- Measure and evaluate exposures when the hazardous agent or potential exposure meets or exceeds the Administrative Control Limit (ACL) based upon accepted evaluative methods of the source baseline hazard assessment.
- Implement the hierarchy of controls when the potential for personal exposure meets or exceeds the Action Level (AL) based upon the ongoing exposure management process within a Similar Exposure Group (SEG).
- Apply ALARA principles to all hazardous agent control procedures that descend from this document.

### **1.2 Objectives of the Exposure Assessment Strategy**

The EAS is part of a comprehensive industrial hygiene program to reduce the risk of work-related disease or illness at TOC facilities. The EAS includes design objectives to:

1. Assess worker potential short term and long term exposure to non-ionizing radiological, chemical, biological, ergonomic, or physical hazardous agents (identified in a job hazards analysis or other suitable qualitative hazard analysis) and other data to screen for exposure potential in accordance with ALARA.
2. Implement the hierarchy of controls in accordance with ALARA.

3. IH review will be conducted for designs of new facilities and modifications to existing facilities in accordance with [TFC-ENG DESIGN C-01](#); operations and procedures; and equipment, product, and service needs.
4. Evaluate workplace and activities by time of activity, workers, supervisors, and managers using field activity observation, Job Hazard Analysis (JHA) and the Employee Job Task Analysis (EJTA) processes.
5. Provide updated baseline surveys of work areas or operations to identify and evaluate potential work related health risks; periodic resurveys and/or exposure monitoring, as appropriate; and documented exposure assessment for chemical, physical, and biological agents, and ergonomic stressors using recognized exposure assessment methods and AIHA accredited industrial hygiene laboratories or equivalent as approved by the IH program manager (e.g., Environmental Protection Agency accredited laboratories).
6. Ensure compliance with worker protection requirements identified in 10 CFR 851.23, "Safety and Health Standards." These include, but are not limited to, 29 CFR 1910, "Occupational Safety and Health Standards;" 29 CFR 1926, "Safety and Health Regulations for Construction;" and American Conference of Governmental Industrial Hygienists (ACGIH), "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices."
7. Document the descriptive and/or inferential statistics of exposure data for each SEG when sufficient data are available.
8. Use existing data about facilities, equipment, materials, and tasks for implementing strategies to identify potential hazards and to prevent or mitigate exposures.
9. Document exposure hazard analysis of jobs and tasks.
10. From exposure data, link similarly exposed individuals into groups (SEGs).
11. Link SEG exposure data to medical monitoring.
12. Trend exposure measurements as an indicator of worker protection performance and to focus worker protection efforts.

## **2.0 ROLES AND RESPONSIBILITIES**

Responsibility for successful implementation of the EAS lies with IH and the supporting organizations.

### **2.1 IH Program Exposure Assessment Strategy Technical Authority**

The IH Program Technical Authority overseeing the EAS must be a Certified Industrial Hygienist (CIH) or meet the requirements found in [TFC-BSM-TQ-STD-01](#). The IH Program Technical Authority should perform or review the following activities:

- Review of designated SEGs
- Overall design of monitoring strategies

- Final interpretation of monitoring data, including statistical analysis
- Judgment of exposures to be acceptable, unacceptable or uncertain
- Identifying health-hazard control strategies.

Specifically, the IH Program Technical Authority for EAS responsibilities include:

1. Establishing and directing the exposure assessment program, ensuring that key competencies are in place at the staff level. WRPS IH staff must be qualified as described in [TFC-BSM-TQ-STD-01](#).
2. Developing and managing the qualitative assessments, predictive modeling, and monitoring programs; coordinating with Process Engineering regarding monitoring and modeling performed to support the IH EAS program and ensuring incorporation and update, as necessary.
3. Reviewing qualitative assessments and resulting priorities for monitoring submitted by organizational managers.
4. Providing oversight for qualitative assessments performed by IH within the TOC contractor line organizations (IH Programs, Base Operations, Tank Farm Projects, SST Retrieval & Closure Operations, and 222-S Laboratory), including but not limited to:
  - Data quality review
  - Statistical analysis review
  - Data interpretation
  - Exposure acceptability.
5. Ensuring the EAS is reviewed periodically, seeking input from managers, industrial hygienists, and workers and using other knowledgeable personnel/expertise, as necessary, to refine and improve the EAS.
6. Ensuring feedback receives a prompt response.
7. Ensuring descending documents conform to the expectations of the EAS.
8. Ensuring periodic IH evaluation is performed to assess effectiveness of controls and estimate exposure.
9. Ensuring engineering and administrative controls are recommended on the basis of periodic IH evaluation
10. Ensuring performance of a periodic review of the toxicological literature to incorporate new information related to Occupational Exposure Limit (OELs) and carcinogenicity.
11. Conducting assessments of the EAS and descending documents in accordance with TFC-ESHQ-S\_SAF-P-06.
12. Ensuring the chemicals of potential concern (COPC) list in the most current version of RPP-22491, "Industrial Hygiene Vapor Technical Basis," is updated as necessitated by periodic IH evaluations.

13. On a periodic basis, requesting feedback from the Hanford Site occupational medical contractor, on aggregate general medical monitoring results of SEG members.
14. Ensuring the sharing of information and interaction between the TOC contractor IH program and the Hanford Site occupational medical contractor.

## **2.2 Line Organization Safety and Health Managers**

1. Are responsible for field industrial hygiene under the EAS.
2. Ensuring that the EAS is implemented in their organizations and that it meets requirements as outlined in this plan.
3. Ensuring that IH technicians in their respective organizations are qualified as described in TFC-BSM-TQ-STD-01.
4. Providing appropriate employee education and training to managers, industrial hygienists, and workers.
5. Providing oversight and technical information required for the implementation of the respiratory protection and personal protective equipment (PPE) programs in their respective organizations.
6. Interpreting characterization, workplace, Job Hazard Analysis, historical IH data, and task information to understand potential exposures and develop monitoring strategies.
7. Gathering qualitative potential exposure information.
8. Determining potential for predictive modeling amongst the operations.
9. Proposing and implementing approved quantitative monitoring strategies per SEG.
10. Providing documentation to the IH Program Manager.

## **2.3 Industrial Hygiene Subject Matter Expert (SME)**

- Ensure procedures as implemented in the line organization are compliant with applicable DOE requirements
- Provide technical support
- Participate in scheduled assessments and follow-up as appropriate
- Provide program oversight for line organization implementation.

## **2.4 Industrial Hygienist**

For assigned work activities:

- Develop sampling plans and provide oversight for sampling activities
- Develop written hazard and exposure assessments

- Provide technical support
- Review data and prepare reports.

## **2.5 Engineering**

Engineering, in collaboration with IH will:

- Provide technical support to IH in updating the Industrial Hygiene Chemical Vapor Technical Basis (RPP-22491)
- Involve IH in the design and installation of all engineering controls which may introduce or affect exposure to chemical, biological, physical or ergonomic hazards
- Provide technical support to IH for emission or source sampling campaigns to test specific hypotheses of utility to the EAS.
- Ensure that engineering controls for minimization of potential personal exposure are included in new designs or modifications to existing designs by involving IH in the design process.
- Ensure proper industrial hygiene and safety reviews as outlined in [TFC-ENG-DESIGN-C-01](#).

## **3.0 EXPOSURE ASSESSMENT STRATEGY PROCESS**

Throughout this plan, references to “exposure assessment,” “exposure monitoring,” “exposure estimates,” etc. refer, without exception, to potential exposures.

### **3.1 Baseline Hazard Assessments**

A baseline hazard assessment is a culmination of initial hazard analyses and periodic updates throughout the lifecycle of a facility. The initial baseline is a checklist item as part of the startup and testing process.

Descending implementing documents supporting the EAS must include a process for and the frequency of the periodic update of each baseline hazard assessment established in that document. The frequency of the periodic update is to be determined in accordance with the AIHA publication “A Strategy for Occupational Exposure Assessment.”

### **3.2 Exposure Pathways**

Exposure pathways are the way that exposure moves from the source hazard to the potentially exposed employee (e.g., source emission points, routes of exposure, target organs).

Descending implementing documents supporting the EAS must include a process to maintain an adequate accounting of exposure pathways.

### **3.3 Similar Exposed Groups**

SEGs will be identified among groups of employees who experience exposures similar enough that monitoring exposures of any worker in the group provides data useful for predicting

exposures of the remaining workers. SEGs will be established and maintained in accordance with the AIHA publication “A Strategy for Occupational Exposure Assessment.”

Descending implementing documents supporting the EAS must include a structure for the effective description, exposure measurement and evaluation, and effectiveness of SEGs.

### **3.4 Exposure Assessment Strategy Status Communication**

The Safety and Health managers, industrial hygienists, and industrial hygiene technicians will receive a periodic update on implementation of the exposure assessment strategy. Management and employees will receive communication through staff meeting discussion, desk instructions, memos, tailgate meetings, committees, and newsletter articles.

### **3.5 Metrics**

Implementation effectiveness of this exposure assessment strategy will be measured and communicated periodically through metrics established by the IH Programs Technical Authority with concurrence of the IH Programs Manager and may include:

- The number of SEGs with completed exposure assessments
- Judgment decisions regarding appropriateness and completeness of data collected per SEG
- The number of exposures estimated less than the ACL
- The number of exposures greater than or equal to the AL
- The number of exposures greater than or equal to the 8-hour Time Weighted Average (TWA) OEL
- The number of exposures greater than or equal to either the 15-minute Short Term Exposure Limit (STEL) or the 30-minute Excursion Limit
- Recommendations for SEG revisions or EAS improvements.
- Trending of numbers and actions as a result of information received from the occupational medical contractor.
- Changes implemented in the EJTA process due to changes in exposure assessments.

### **3.6 Qualitative Exposure Assessments**

Qualitative exposure assessments are performed by industrial hygienists during the preparation of a Job Hazard Analysis following [TFC-ESHQ-S SAF-C-02](#), an EJTA following [TFC-ESHQ-S IH-C-17](#) or the preparation of a work package when quantitative exposure assessments cannot be performed.

Examples of qualitative exposure assessments may include:

- Extrapolation of source history and characterization or work area concentrations near emission sources to estimate personal potential exposure
- Review of verified and applicable personal monitoring and sampling data
- Predictive physical-chemical modeling based on source characterization and other data (e.g., peer-reviewed evaluations)
- History of activities that Direct Read Instrument (DRI) monitoring shows levels below the detection limit or levels below the ACL over time
- Worker exposure scenarios based on process and work practice knowledge, including short term exposures
- Exposures to new or emerging potential risks.

Qualitative exposure assessments are to be conducted for each hazardous agent in accordance with the model in Attachment A. This model is to be constructed within each descending implementing document supporting the EAS.

Dermal exposure assessments are typically qualitative. Dermal hazard evaluations will be made on a case-by-case basis, and will take into account source composition, potential for source contact, and source contact controls.

### **3.7 Personal Monitoring**

Personal exposure sampling is the best means to quantitatively estimate personal exposure to industrial hygiene hazards that can be quantitatively measured. Documentation of field observations and conditions are to be performed in accordance with [TFC-ESHQ-S IH-C-46](#) and are necessary and critical to the uncertainty discussion, appropriate evaluation, and support of an acceptability judgment. All TOC and subcontractor personal monitoring data shall be validated and entered into the Industrial Hygiene database, and shall be analyzed using appropriate statistical tools/software.

#### **3.7.1 Exposure Monitoring**

Personal exposure monitoring will be performed in accordance with applicable standards and procedures, under the direction of the responsible industrial hygienist, in accordance with applicable organizational implementation plans.

Exposure monitoring using DRIs will be required, where technology for detection exists at the AL, during field activities where the personal exposure model may exceed the respective AL without regard to implemented hazard controls.

#### **3.7.2 Exposure Sampling**

Sampling and analytical methods approved by the National Institute for Occupational Safety and Health (NIOSH) or Occupational Safety and Health Administration (OSHA) shall be used for collection of personal exposure data. Modification to these methods are acceptable if consistent

with industry practice or sound statistical analysis. Laboratory analysis will be performed by AIHA-LAP accredited laboratories. These laboratories should use AIHA-LAP accredited methods (modified methods are acceptable) for the laboratory where possible and feasible.

Exposure sampling will be required during activities where the hazardous agent source exceeds the respective ACL.

### **3.8 Data Collection and Evaluation**

In accordance with [TFC-ESHQ-S IH-C-46](#), data will be collected in the field and entered into the Industrial Hygiene database in accordance with other applicable standards and procedures.

IHs shall perform appropriate evaluative methods of collected data and determine the acceptability of potential exposures using recognized, consensus methods in accordance with applicable standards and procedures, including the AIHA publication “A Strategy for Assessing and Managing Occupational Exposures.”

### **3.9 Role of Exposure Assessment in Occupational Medicine and Medical Monitoring**

Personal exposure monitoring data and/or exposure estimates for members of a SEG will be provided to the occupational medical contractor for comparison to the worker’s EJTA. The IH Program manager will receive feedback from the Hanford Site occupational medical contractor if health effects potentially related to one or more of SEG members are seen.

## **4.0 TANK FARM HAZARDS**

### **4.1 Chemical Hazards**

There are several sources of chemical hazards at the tank farms. Sources include:

- Tank waste from spent fuel and weapons production processes stored in the tank farms
- Known or presumed human carcinogens
- Procured chemical products used in various tank farm processes (e.g., paint products, urethane foams, acids, caustics, welding rods, etc.)
- Materials related to legacy facility equipment (e.g., asbestos, lead, and beryllium).

When assessing tank farm chemical hazards, if a chemical’s 10% lower explosive limit is lower than the health or toxicity derived exposure limit of that chemical, the 10% lower explosive limit will be used for the purpose of establishing the exposure limit for determining control measure implementation.

In locations where chemical vapors may accumulate, the flammability level is to be monitored and control measures implemented should the flammability level exceed 10% of the lower explosive limit.

#### **4.2 Physical Hazards**

Typical tank farm physical agents include noise, illumination, and temperature extremes, laser light and non-ionizing radiation.

#### **4.3 Ergonomic Hazards**

Typical tank farm ergonomic hazards stem from non-ergonomically designed tools, work areas, tables or desks, uneven footing, improper lifting or reaching, repeated motions and awkward positions.

#### **4.4 Biological Hazards**

Typical tank farm biological hazards stem from the desert environment of the field work site. These include insects, animals and animal waste, molds, bacteria, and fungi. Exposure assessments will be performed in response to employee concerns, medical requests, and assessments.

#### **4.5 Interpretation and Decision Making**

Employee exposure data will be analyzed periodically to determine:

- Compliance with DOE-established OELs
- Distributions of the SEG exposure data
- Trends in exposure or biological/medical monitoring data for individuals and SEGs
- Recommendations for modification of this exposure assessment strategy or any of its elements
- Lessons learned
- Engineering or other controls that can bring the greatest benefit for exposure reduction.

Program requirements for notification of personal exposure monitoring results are found in [TFC-ESHQ-IH-STD-03](#).

Results of the exposure data analysis will be communicated to employees and management through tailgate slides, committees (e.g., Industrial Hygiene Technical Committee), Environmental, Safety, Health & Quality (ESH&Q) website, or other means. Both personal monitoring results and the distribution of exposures within similarly exposed groups will be provided to the occupational medical contractor through periodic data transmittals.

#### **5.0 DEFINITIONS**

Definitions of terms in this section are taken from AIHA 2006, 29 CFR 1910, and other sources. Some definitions have been adapted in the context of the Tank Farm Exposure Assessment Strategy.

Acceptable exposure. Occupational exposure to a chemical, physical, or biological agent judged to present a minimal risk for illness or disease, when all information, including qualitative and/or quantitative monitoring data supports this judgment.

Action level (AL). The airborne exposure concentration of a chemical contaminant above which exposures will be controlled in accordance with the hierarchy of controls. If an action level is not established by regulation, an action level will be established at 50% of the 8- hour TWA OEL.

Administrative control level (ACL). The airborne exposure concentration (e.g., TWA from personal sampling) of a chemical contaminant below which additional assessment may not be necessary, and above which assessment will be prioritized according to an overall exposure rating. The ACL at the tank farm is set between 10% and 25% of an OEL based upon exposure modeling.

Area sample. An environmental sample collected at a fixed tank farm point that reflects chemical contaminant concentrations or levels of physical or biological agents present at that point. Results from area samples should be interpreted with caution because they do not represent employees' actual exposures to hazardous agents. Area samples are useful to support judgment decisions within an EAS, to test efficiency of controls, to determine sources of vapors and gradients with distance, etc.

Biological monitoring. A technique to provide biological data (e.g., urine, hair, exhaled air, etc.) as an aid in indicating potential exposure to chemicals for which biological exposure indexes (BEIs) have been developed.

Breathing zone. A hemisphere forward of the shoulders from which air is breathed (i.e., an area as close as practicable to the nose and mouth of the employee being monitored). Breathing zone samples provide the best representation of actual exposure.

Ceiling Limit. A peak exposure limit established to describe the concentration that should not be exceeded during any part of the working day.

Chemicals of potential concern. A list of chemicals identified in the tank farm headspaces, and classified according to their carcinogenicity, concentration compared to their OELs, prevalence in tanks and toxicity.

Continuous. With regard to coverage, this means that the IHT is required to be physically present with the work crew through the entire work activity. With regard to monitoring, it means that the IHT must provide uninterrupted direct read instrument monitoring through the entire work activity.

Coverage. Availability of the Industrial Hygiene Technician at the work location with the work crew.

Dermal exposure. Exposure which results from absorption of compounds through skin or eyes. Skin contact with substances exhibiting a relatively high degree of lipophilicity, high molecular weight and low volatility may constitute the principal route of exposure. Such substances are designated by various agencies with a "skin" notation qualifying its OEL.

Descriptive statistics. Parameters used to summarize data that should be calculated routinely for all monitoring data. Typically, statistics include calculations of central tendency (mean, median and geometric mean), spread (range, minimum and maximum, standard deviation, and geometric standard deviation). Other data manipulations, such as log transformation or determination of the percent over the OELs, are also possible. With a programmable calculator, computer spreadsheet, or the Tank Farms Industrial Hygiene Database, these data can be easily determined.

Excursion limit. Excursion limits apply to those chemicals that do not have an established 15 minute STEL or ceiling limits. Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work-day, and under no circumstances should they exceed 5 times the TLV-TWA, provided the TLV-TWA is not exceeded.

Exposure assessment. The systematic collection and analysis of potential exposures in the tank farm work place in view of all exposure determinants, e.g., task frequency, duration, variability, meteorology, etc. Exposure assessment outcomes include judgments about the acceptability of each exposure profile and the institution of appropriate controls, as well as linkages to occupational medicine and epidemiological information for the purposes of risk management and health surveillance.

Exposure monitoring. Personal or area monitoring in accordance with accepted, standardized methods, and the use of accredited labs for samples requiring analysis, to provide data for compliance purposes and exposure profiles.

Exposure profile. A representation, commonly as a matrix or other means, of the most relevant exposure and hazard determinants of a SEG. This representation is an estimate of the exposure intensity and how it varies over time for an SEG. The exposure profile estimate may incorporate quantitative (monitoring data) or qualitative (relying on knowledge, experience and professional judgment) data. It is the vehicle for summarizing and judging exposures to agents at the tank farms. Ideally, exposure profile evaluations should be conducted in collaboration with occupational medicine.

Exposure rating. An estimate of the exposure level relative to an OEL, useful for beginning to characterize an exposure profile. Exposure rating often features assignment of factors, e.g., 1 to 5 or low to high, based on metrics such as toxicity of the chemical, vapor pressure, quantity of source chemical, percent OEL documented from historical data, modeling results, frequency and duration of exposure, number of persons potentially exposed, direct reading instrument data, etc. Exposure ratings are found in the EJTA.

Further information gathering. Prioritized exposure monitoring or the collection of more information so that uncertain exposure judgments can be resolved with higher confidence.

Health effects rating. A relative measure of toxicity.

Health hazard control. Implementation of prioritized control strategies for unacceptable exposures. Prioritization criteria may include the highest exposure concentrations or toxicity, the degree of uncertainty associated with the judgment of unacceptable, large numbers of workers exposed, the most frequent exposures, etc. These controls should emphasize fundamental IH hierarchy, i.e., engineering controls, administrative controls, and personal protective equipment.

Hierarchy of Controls. The hierarchy used for determining the order of implementation of controls for hazards. The hierarchy is 1) elimination or substitution of the hazards where feasible and appropriate, 2) engineering controls where feasible and appropriate, 3) work practices and administrative controls that limit worker exposures, and 4) personal protective equipment.

Intermittent. With regard to coverage, this means that the IHT is required to be present with the work crew on a periodic basis as defined in the sample plan or as requested by the work crew. With regard to monitoring, this means that the IHT must provide periodic direct read instrument monitoring on a periodic basis as defined in the sample plan or as requested by the work crew.

Marker substance. A selected chemical in a mixture assessed as an index to estimate exposure to other components in the mixture. Using a marker substance in this way constitutes surrogate data.

Occupational carcinogen. A chemical substance utilized in the workplace that has been designated in the following sources as a carcinogen or potential carcinogen: (1) National Toxicology Program, Annual Report of Carcinogens (latest edition); (2) International Agency for Research on Cancer (IARC), Monographs (latest editions); (3) OSHA Standard 20 CFR 1910, Subpart Z, "Toxic and Hazardous Substances;" and (4) American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents.

Chemicals considered to be "known" or "probable" carcinogens by IARC or other regulatory/guidance agencies were included in the list of COPCs for prioritized exposure assessment.

Occupational disease. A generally chronic and irreversible health effect associated with overexposure to chemical, physical or biological agents in the workplace. Examples include silicosis, bladder cancer, and berylliosis.

Occupational exposure limit. A term used to represent: (1) the concentration or intensity of an airborne agent that is allowable, (2) the time period over which workplace concentrations are averaged to compare with the allowable exposure, and (3) the allowable concentration of a biological exposure index (BEI) in a biological sample. Thus, each OEL consists of an exposure limit and an averaging time, which are set by the sponsor of the OEL and must be used together, as prescribed by DOE. A substance may have several OELs for short term or acute exposures (e.g., 15-minute STEL or 30 minute Excursion Limit), long term or chronic exposures (e.g., 8-hour Time Weighted Average), or not-to-exceed limits (Ceiling Limit).

For the EAS and all work at the tank farms, the most protective OELs have been selected for use from DOE regulated limits (e.g., OSHA permissible exposure limits [PELs], ACGIH Threshold Limit Values [TLVs], specific DOE regulation) or, in absence of a DOE regulated limit, through a collaborative process of industrial hygienists, workers, and toxicologists as outlined in RPP-22491, "Industrial Hygiene Chemical Vapor Technical Basis" (TB).

Occupational illness. A generally transient and reversible health effect associated with overexposure to chemical, physical or biological agents in the workplace. Examples include metal fume fever, heat cramps, occupational asthma, and dermatitis.

OEL averaging time. The time duration over which an average airborne exposure is estimated. One or more of averaging times are set for the majority of OELs: 8 hours (full shift PEL), 15 minutes (STEL), and instantaneous (ceiling limit).

Personal monitoring. The process of measuring the concentration of a hazardous chemical in the breathing zone of an individual using a calibrated personal air pump to collect a sample on appropriate media or a direct reading, data logging monitor worn by the worker in the breathing zone. Larger direct reading instruments, held by others in the breathing zone, can be used to estimate personal exposure, but not for purposes of determining compliance with OELs.

Potential health effect(s). The capability or possibility of a chemical to cause adverse effects in sufficient concentration over a sufficient period of time as a function of its toxicity.

Predictive modeling. A technique, typically based on physical-chemical properties, used to estimate chemical exposure. Models range from simple and uncomplicated to sophisticated, but to be an effective tool for evaluation of worker exposure, model inputs must be realistically conservative to overestimate exposure and risk. Models can also be used to estimate exposure ranges for new tasks or processes.

Professional judgment. The application and appropriate use of knowledge gained from formal education, experience, observation, experimentation, inference, peer review and analogy. It allows an experienced industrial hygienist with incomplete or a minimum amount of data to estimate worker exposure in nearly any scenario.

Overexposure. An exposure exceeding the applicable OEL, when evaluated over the appropriate averaging time. Full-shift overexposure judgments made from partial shift samples are highly uncertain and must be made with great caution.

Qualitative assessment. The estimation of exposure determinants based on integration of available information and professional judgment.

Quantitative assessment. The determination of exposure based on collection and quantitative analysis of data sufficient to adequately characterize exposures.

Screening Level. An airborne concentration level that meets or exceeds 1% of the OEL. As it relates to source sampling, it is the level used to determine those chemicals to be included on the Tank Farms COPC list.

Short Term Exposure Limit (STEL). A time weighted average based typically on 15 minutes of exposure that should not be exceeded at any time during a work-day, even if the 8 hour time weighted average is less than the 8 hour time weighted average OEL.

Similar exposure group (SEG). A group of workers having the same exposure profile for the agent(s) being studied. Depending on the tank farm location and task variabilities, SEGs can be task-based, process-based, job description-based, craft-based, condition-based, etc. For example, a task-based SEG may include an unrelated group of workers who perform a similar defined task; a craft-based SEG may include a group of craft workers performing a variety of tasks throughout the work day or week; a job description-based SEG may include an unrelated group of workers whose job descriptions require them to perform similar tasks of similar frequency, using similar materials and processes throughout the work day and week; a

condition-based SEG may include all workers performing work near an emission source. Individual workers or tasks may be members of more than one SEG.

Subject Matter Expert (SME). A project line organization assigned IH who by training or experience oversees implementation of specific IH programs within the respective line organization.

Surrogate data. The use of quantitative data from assessment of similar chemicals or similar operations to estimate exposure. Using professional judgment, surrogate data must be adjusted for such criteria as relative quantities of the chemicals, controls in place, differences in work practices, frequency and duration of exposure, meteorological differences for outside work, etc.

Working OEL. An OEL established in the absence of a regulatory OEL, or when there is significant uncertainty about the adequacy of a regulatory OEL. A working OEL is based on existing toxicological and epidemiological data, structural activity relationships, and other data, etc. It includes appropriate safety (uncertainty) factors. Working OELs are derived to allow performance of quantitative exposure assessments, and are sometimes stated in ranges.

Unacceptable exposure. A condition in which a significant risk (occupational disease or illness) is associated with a SEG's exposure profile; the probability of adverse health effects is significant; or there is evidence of adverse health effects associated with exposure to an environmental agent.

Uncertain exposure. A condition in which acceptability of an exposure cannot be determined because of insufficient information regarding exposure, toxicity, concentration, field observations, supporting DRI data, etc.

Uncertainty. The individual or aggregate variability in any measurement, including analytical error, toxicological research, sampling error, interferences, meteorological impacts, unknowns, human error, etc.

## **6.0 SOURCES**

### **6.1 Requirements**

1. American Conference of Governmental Industrial Hygienists (ACGIH), "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices." (2005 or most recent, whichever is most restrictive)
2. 10 CFR 851, "Worker Safety and Health Program."
3. 29 CFR 1910, "Occupational Safety and Health Standards," excluding 29 CFR 1910.1096, "Ionizing Radiation."
4. 29 CFR 1926, "Safety and Health Regulations for Construction."
5. TFC-PLN-55, "Industrial Hygiene Program."
6. "A Strategy for Occupational Exposure Assessment," American Industrial Hygiene Association, Third Edition, 2006.

7. TFC-ESHQ-S\_SAF-P-06, "Safety and Health Assessments."

## **6.2 References**

1. ATS-310, Section 4.5, "222-S Laboratory Complex Chemical Hygiene Plan."
2. HNF-SD-TWR-RPT-001, "Tank Waste Remediation System Resolution of Potentially Hazardous Tank Vapor Issues."
3. Mackerer, C. R., C&C Consulting in Toxicology, "Preliminary Evaluation of Potential Inhalation Hazard From Exposure to Hydrocarbon Vapor Emitted by Underground Waste Storage Tanks at the Hanford Site," Letter Report dated February 8, 2005.
4. Occupational Exposure Sampling Strategy Manual, NIOSH Publication No. 77-173, Leidel, N.A., Busch, K.A., Lynch, J.R. 1977.
5. OSHA Technical Manual.
6. RPP-35562, "Postulated Waste Transfer Abnormal Events for Enhanced Industrial Hygiene Monitoring Consideration."
7. TFC-ENG-DESIGN-C-01, "Development of System and Subsystem Specifications."
8. TFC-ESHQ-IH-STD-03, "Exposure Monitoring, Reporting, and Records Management."
9. TFC-ESHQ-Q\_C-C-01, "Problem Evaluation Request."
10. TFC-ESHQ-S\_CMLI-C-02, "Injury and Illness Events."
11. TFC-ESHQ-S\_IH-C-17, "Employee Job Task Analysis."
12. TFC-ESHQ-S\_IH-C-46, "Industrial Hygiene Reporting and Records Management."
13. TFC-ESHQ-S\_SAF-C-02, "Job Hazard Analysis."
14. TFC-ESHQ-S-STD-24, "Bloodborne Pathogen Exposure Control Standard."
15. TFC-PLN-43, "Treatment, Storage and Disposal Facility Hazardous Waste Operations."
16. TFC-PLN-116, "Subcontractor Oversight."

**Table 1. Industrial Hygiene Hazard Control Documents within the Exposure Assessment Strategy.**

Document Number	Document Title
TFC-ESHQ-S_IH-C-52	Asbestos Exposure Control and Management
TFC-ESHQ-IH-STD-11	Carcinogen Control
TFC-ESHQ-S_IH-C-47	Chemical Management Process
TFC-ESHQ-S_IH-C-49	Chronic Beryllium Disease Prevention Program
TFC-ESHQ-IH-STD-01	Cold Stress
TFC-ESHQ-S_IH-STD-03	Ergonomics
TFC-ESHQ-S_IH-C-53	Occupational Noise Exposure and Hearing Conservation
TFC-ESHQ-S_IH-C-07	Heat Stress Control
TFC-ESHQ-IH-STD-13	Illumination
TFC-ESHQ-IH-STD-02	Laser Safety and Non-ionizing Radiation
TFC-ESHQ-IH-STD-08	Lead Control Program
TFC-ESHQ-S_IH-C-48	Managing Tank Chemical Vapors

## ATTACHMENT A – QUALITATIVE EXPOSURE ASSESSMENT

The assessment is conducted in three stages: 1) Exposure assessment and rating assignment, 2) Hazard assessment and rating assignment, and 3) Uncertainty factor and rating assignment and relative risk determination for prioritizing further information gathering.

### *Exposure Assessment*

For each SEG/stressor pair, the frequency and duration of exposure will be evaluated and assigned a numeric rating between 1 and 5 according to the logic shown in Table A-1.

**Table A-1. Frequency/Duration Rating (FDR).**

Frequency/Duration Rating	Frequency/Duration Description
1	Short duration, infrequent contact
2	Short duration, frequent contact
3	Moderate duration, moderate frequency
4	Full shift exposure, but infrequently
5	Full shift exposure, every shift

Control mechanisms, such as point source ventilation should also be considered and assigned a numeric rating, according to the logic shown in Table A-2.

**Table A-2. Control Rating (CR).**

Control Mechanism Rating	Control Mechanism Description*
1	Exposure potential estimated to be below AL without control implementation.
2	Exposure potential estimated to be below AL with implementation of only engineering controls.
3	Exposure potential estimated to be below AL with addition of administrative controls.
4	Exposure potential estimated to be below AL with addition of personal protective equipment.
5	Controls do not reduce exposure potential to less than AL.

Available exposure monitoring and sampling data should also be considered during this step, and assigned a numeric rating, based on the levels with respect to the Occupational Exposure Limit (OEL), as shown in Table A-3.

**Table A-3. Exposure Concentration Level Rating (LR).**

Exposure Concentration Rating	Exposure Level Description
1	<1% OEL
2	≥ 1% OEL and < ACL
3	≥ ACL and < AL
4	≥ AL and < OEL
5	≥ OEL

**ATTACHMENT A – QUALITATIVE EXPOSURE ASSESSMENT (cont.)**

If no monitoring data are available, the rating will be assigned based on knowledge of the source characteristics, and observed work practices and conditions as determined by the IH. The overall Exposure Rating (ER) is the mean of the Frequency/Duration Rating (FDR), Control Rating (CR), and Level Rating (LR).

$$ER = (FDR + CR + LR)/3$$

***Hazard Assessment***

The industrial hygienist should assess potential hazards posed by each stressor. This assessment will include a review of Material Safety Data Sheets, company documents and publicly-available literature. Based on the results of this review, each stressor should be assigned a Hazard Rating (HR) between 1 and 5, as shown in Table A-4.

**Table A-4. Hazard Rating.**

<b>Rating</b>	<b>Example</b>
1	Little or no known effects
2	Non-severe reversible effects
3	Severe reversible effects
4	Severe irreversible effects
5	Life threatening, disabling, debilitating

***Uncertainty Factor***

Uncertainty in the exposure or health ratings is another factor to be considered. Consideration must be given to the uncertainty of the ER and the HR. A numeric rating is assigned based on the description in Table A-5.

**Table A-5. Uncertainty Rating (UR).**

<b>Rating</b>	<b>Uncertainty Description*</b>
1	Certain – The exposure profile and health effects are well-understood. For example, the exposure judgment is based on representative quantitative data or conservative models.
2	Uncertain – There is enough information to make a judgment, but further information gathering is warranted to verify the exposure assessment. For example, quantitative exposure data are needed to verify the exposure assessment when the exposure rating is based on no monitoring data or the measured exposure is >10% of the OEL.
3	Highly Uncertain – The exposure acceptability judgment was made in the absence of significant information on the exposure profile and/or health effects.

**ATTACHMENT A – QUALITATIVE EXPOSURE ASSESSMENT (cont.)*****Risk Ranking***

Risk is a function of both exposure and hazard and how well each is understood or known to be true. To obtain a relative ranking of exposures, based on potential risk of adverse health effects, the ER is multiplied by the HR and the UR for each stressor in each SEG. The resulting numerical value is a risk rank and reflects the relative risk of exposure of that specific SEG to the specific stressor involved. Available resources can then be allocated according to company risk tolerance to address quantitative monitoring and sampling needs.

$$\text{Risk Rank} = \text{ER} * \text{HR} * \text{UR}$$

ATTACHMENT A – QUALITATIVE EXPOSURE ASSESSMENT (cont.)

Exposure Assessment/Risk Ranking Worksheet

Operation:

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Hazardous Agent:

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Data and Assumptions:

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Frequency-Duration Rating	0					
Control Rating	0					
Level Rating	0					
Overall Exposure Rating		0.0				
Hazard Rating		0				
Uncertainty Rating		0				
<b>Risk Rank</b>		<b>0.0</b>				

References:

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Risk Rank	Monitoring	Personal Sampling	Source Sampling
If RR > 28	Required	Required	Required
If RR > 20 < 27.5	Recommended	Required	Required
If RR < 20	At discretion of IH	Recommended	Recommended