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U.S. DEPARTMENT OF ENERGY, OFFICE OF RIVER PROTECTION VAPOR MANAGEMENT EXPERT PANEL PERIODIC REPORT RECOMMENDATIONS

Second Vapor Management Expert Panel Periodic Report and Recommendations October 2016 through June 2017

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

AOP	abnormal operating procedure
CHAT	chemical hazards awareness training
COPC	chemical of potential concern
CPPO	Chemical Protection Program Office
CTEH	Center for Toxicology and Environmental Health, LLC
CVAP	comprehensive vapors action plan
CVST	chemical vapors solution team
DOE	U.S. Department of Energy
EA	U.S. Department of Energy, Office of Enterprise Assessments
HAMMER	Hazardous Materials Management and Emergency Response
HAMTC	Hanford Atomic Metals Trade Council
HPMC	HPM Corporation
IH	industrial hygiene
IPT	integrated project team
KPP	key performance parameters
NIOSH	National Institute for Occupational Safety and Health
OEL	occupational exposure limit
OMS	Occupational Medical Services
ORP	U.S. Department of Energy, Office of River Protection
PPE	personal protective equipment
R2A2s	roles, responsibilities, authorities, and accountabilities
SCBA	self-contained breathing apparatus
TVAT	tank vapor assessment team
VMEP	Vapor Management Expert Panel
WRPS	Washington River Protection Solutions LLC

1.0 BACKGROUND

This is the second periodic report of the Vapor Management Expert Panel (VMEP). The VMEP was chartered to:

> ...help provide assurance to the Department of Energy Office of River Protection (ORP) that actions committed to following the Tank Vapor Assessment Team's (TVAT) report and actions resulting from any new, emergent issues are being carried out and effective in protecting workers from potential vapor exposures.

The VMEP consists of members selected for their respective expertise in various areas needed to enable assessing progress in implementing the Tank Vapor Assessment Team (TVAT) recommendations and the effectiveness of actions in resolving vapor issues (SRNL-RP-2014-00791, *Hanford Tank Vapor Assessment Report*). VMEP members are listed in Appendix A along with their respective areas of expertise and experience, which include toxicology, occupational medicine, industrial hygiene (IH), occupational safety, toxic gas ventilation and controls, management, regulatory processes, engineering, communications, and risk-informed decision-making.

The VMEP was formed in February 2015. The VMEP is not a consensus group and does not provide consensus recommendations. The VMEP's work scope is established by the U.S. Department of Energy (DOE), Office of River Protection (ORP). Individual members have served as expert resources for various ORP staff on different issues. VMEP meets periodically with ORP and Washington River Protection Solutions LLC (WRPS) representatives individually, in subgroups, and occasionally all together to receive information, receive progress reports, and provide individual feedback. In addition, VMEP has regular conference calls with ORP representatives to stay current and plan and discuss assignments.

This is the second of what are expected to be periodic reports produced by VMEP members covering the period of activity from October 2016 through June 2017. The first VMEP report (*Vapor Management Expert Panel Member Report, February 2015 through September 2016, Implementation of the Tank Vapor Assessment Team's Report Recommendations* [ORP 2016]) was published November 2016 and is available through the Director of the Safety and Health Division of ORP. When the first VMEP report was written, the site's efforts to deal with the vapor issue were proposed to focus on implementing the TVAT recommendations in two phases. The first phase dealt mostly with research, development, testing, and analysis to determine what would be done in the second phase, while implementing a few improvements already determined as needing to be implemented.

The VMEP first periodic report made several observations and recommendations relating to all aspects of the Phase 1 work in anticipation of the completion of and subsequent reporting on the conclusions and decisions resulting from that work. In high summary, that report concluded while considerable work had been done and progress made in many areas to address the recommendations of the TVAT during the Phase 1 effort, much more still needed to be done to resolve both the technical and the nontechnical issues before resolution of and progress on vapor issues could be considered significant and sustainable (ORP 2016).

Several notable events occurred as the Phase 1 work was nearing its end influencing the path of the anticipated two-phase approach. The first was the lawsuit the State of Washington and other interested parties filed early during Phase 1 became more contentious in its focus on its allegations the site was inadequately protecting workers on the site from the effects of vapors, and in turn affected the planned two-phase approach. The second event was, at the request of third parties and its own initiative, the site was subjected to several new independent, external assessments focused on vapor management. These studies included reports from the General Accounting Office, National Institute of Occupational Health and Safety (NIOSH), DOE Office of Enterprise Assessment (EA), DOE Inspector General, VMEP, and Center for Toxicology and Environmental Health, LLC (CTEH). The results of these studies are available through the Director of the Safety and Health Division of ORP. In consideration of the results of these additional assessments, VMEP's recommendations in its first report (ORP 2016) and a full VMEP meeting with WRPS and ORP in late October of 2016, ORP and WRPS revised plans to address vapor issues from the two-phase approach previously reported to a more, comprehensive, overall approach taking into account both what was learned from the Phase 1 TVAT work and the new external assessments.

During this transition period, from about January 2017 to May of 2017, VMEP members had the opportunity to review and comment on several work products describing this new approach. These included draft tables correlating recommendations from the various new third-party assessments with the TVAT recommendations, a draft Hanford vapors integrated safety management strategy, and a draft comprehensive vapor action plan (CVAP). In addition, VMEP members were offered the opportunity to comment on several of the Phase 1 studies as they matured.

This transition period culminated with a full VMEP meeting with representatives and managers from ORP and WRPS on June 13 through 15, 2017, to hear presentations and provide comments on the new approach as well as key results from their Phase 1 work and other matters being followed by various VMEP members as reported in the first VMEP report (ORP 2016). Thus, the major focus of what follows in this second VMEP periodic report is VMEP member observations, comments, and recommendations on the actual progress being made through the more comprehensive, overall approach to vapor management and all its related component parts, as well as recommendations on reaching the potential of that approach.

2.0 OVERALL RESULTS

VMEP members generally agree that considerable progress has been made on vapor issues on many fronts to make sure workers are safe and feel safe since the TVAT report (SRNL-RP-2014-00791) and VMEP's first periodic report (ORP 2016). At the same time, much still remains to be done and progress continues to be slower than many would prefer or consider justified. Resolving many, if not most, of the vapor issues requires reducing the uncertainties underlying many of the technical issues, worker safety, and worker concerns driving both the reality and perception of risks posed by the vapors under different circumstances. These include uncertainties in the sources of the vapors; their composition and toxicity at varying concentrations; quantities involved and how they move in the environment; near-term or potential long-term health effects from varying concentrations of inhaled chemicals; degree and

quality of care expected if exposed; ability to control or manage release of vapors coming from, into, or around the tank farms; and stability and resultant long-term commitment of DOE and contractor management to once and for all resolve the vapor issues.

Reducing these uncertainties in turn requires better understanding and in some cases, new or improved technologies or research, all of which take time and require funding and management resources. Further, all must be accomplished in an environment already stressed by budgetary constraints and pressures to make physical progress cleaning up the tank farms by regulatory deadlines. The issues are complex and even if technical experts agree on new test results or research findings, it takes time and effort for this better understanding to permeate into and be accepted by a skeptical workforce.

Despite these challenges, VMEP members have observed that much has been and continues to be done to reduce key uncertainties, strengthen understanding of them among the different segments of the workforce, and strengthen relationships leading to trust between the workforce and management. VMEP members also observe that these better understandings and improved relationships, although slowly, are appropriately influencing decisions and the decision-making process, including minimizing the potential or need for workers to be in and around the farms, investments in hazard reduction and abatement technologies, detection technologies, training, levels and types of personal protection equipment (PPE), overall control strategies, methods of communication, medical response and monitoring, worker involvement in decision-making, and more.

Most notable to VMEP members since the 2016 report is that the site is moving from a reactive posture to a posture of adopting proactive control strategies in many areas. This proactive posture appears to be reducing the likelihood of harmful exposures as well as the likelihood of exposures capable of causing short-term, reversible symptoms, without lasting harm. Improved monitoring and detection equipment continue to be tested and deployed. Understanding of tank vapor compositions and behaviors are being updated. New and improved PPE is being tested and deployed. Medical response and monitoring has been improved. Changes are underway to strengthen the interfaces with the state-managed workers compensation program to better serve workers. Efforts are underway to get more of the workforce engaged in understanding the issues and contributing to their resolution. Trust and confidence within the workforce can be expected to improve as these tangible efforts continue to be explored and implemented.

The new control strategies being pursued follow a proven, and promising "hierarchy of controls approach," consistent with the principles of integrated safety management, which strive to:

- Reduce the possibility of exposure to strong odors or harmful chemicals
- Increase understanding of various aspects of the "vapor issues"
- Add layers of protection where the possibility of such exposures exists
- Strengthen support for workers who might nonetheless get exposed
- Improve communications and engagement between the workforce and management
- Include self and independent assessment
- Promote commitment to continuous improvement.

Several third-party studies that have occurred since the start of Phase 1 have clearly helped to guide the above improvements. The General Accounting Office, NIOSH, EA, DOE Inspector General, VMEP recommendations, CTEH, and the original TVAT recommendations have all been seriously considered. Moreover, VMEP members support the WRPS and ORP move away from a Phase 1 and Phase 2 approach to instead integrate actions to address all different findings and recommendations from these various third-party reviews, TVAT, and VMEP into the draft CVAP. VMEP members reviewed and commented on an early draft of the CVAP and after a full presentation of it during the onsite meetings in June were encouraged it addresses the key components of the challenge including science, political, regulatory, communication, worker safety, perceived safety, and engagement. Further VMEP members have observed a maturing organization for managing vapors and vapor related issues.

While the new and improved plans WRPS has formulated are positive, the fact remains – much still remains to be developed, further tested, demonstrated, deployed, institutionalized, and in many cases simply completed. Further, lack of resolution of the lawsuit continues to impact communications, introduce additional uncertainties, and drive certain counterproductive and unnecessary conservative behaviors. Some decisions about worker safety made in this air of conservatism are or were not supported by different segments of the workforce as excessive, burdensome, wasteful, or just plain "stupid." Adding to the pressures, the many new workers having recently joined the site work force without years of hands-on Hanford experience apparently still do not know who or what to believe. Questions remain among the entire workforce regarding how safe is safe enough, who decides and how, and what will it take for workers to "feel" safe recognizing the wide range of worker views, understandings, concerns, and perspectives.

This VMEP report compiles observations and recommendations of various VMEP members generally supporting and expanding upon the above statements. In summary, this report notes areas of considerable progress as well as remaining barriers and highlight areas where members believe additional attention or focus would be helpful in resolving vapor issues and reducing uncertainties. Major recommendations include the following:

- Continue efforts to minimize the hazard (minimize need for tank farm entries, continue strengthening engineering controls and exploring abatement technologies, maintain momentum toward proactive control strategies).
- As the site moves from reactive to more proactive control strategies for different tank farm configurations and activities, apply a more systematic approach to decision-making regarding the need and conditional operating parameters for new or improved technologies (e.g., thermal oxidizers, enhanced exhausters, or other systems) for hazard elimination or risk reduction. That more systematic approach should include defining how decisions will be made, by whom, and when. Quantitative goals or criteria should be established (and VMEP members have been told they will be) defining the need for or conditions under which the technologies will be deployed and operated (e.g., under certain specified meteorological conditions, to reduce concentrations of a certain chemical of potential concern [COPC] or classes of COPCs from x to y, or other criteria). Recognize that while the use of indicator species (e.g., ammonia, volatile organic compounds, etc.) for the COPCs may prove useful to predicting when to operate control

systems, activate alarms or trigger some other action, they should be recognized as not currently exhaustive or comprehensive or yet being accepted as leading indicators for all the COPCs.

- Better focus the vapor management detection system development realistically considering what decision-making or actions the instrumentation will support (e.g., predictive monitoring, alarms, controls, post-event analysis or support to medical care and monitoring, etc.); ability to integrate, assess, and manage the massive quantity of data being received; and the limitations of what can be measured real-time and the degree to which those chemicals can be accepted as leading indicators of the COPC – a key assumption if the direct reading instruments are to be relied upon for protection.
- Further develop the concept, understanding, awareness, and workforce acceptance of transient effect concentrations to help assure measured and appropriate reactions to odors versus more harmful vapors.
- More work needs to be done working with the healthcare community to integrate and share information that can be helpful for assessing, monitoring, and taking care of exposed individuals (includes communicating results of the annual health trending reports and communicating with exposed individuals regarding exposure events and need or non-need for additional follow-up testing, monitoring or treatment, particularly when concerns arise outside the context of the onsite clinic, such as visits to external health care providers or concerns never reported to the onsite clinic).
- Consider formalizing a role for the new, growing, stronger cadre of IH technicians (supported by a strengthened IH program in general) as emissaries in the field for sharing and interpreting what is known and being learned about regarding vapor issues and providing feedback to WRPS management regarding worker concerns, efficacy of instrumentation, protectiveness of control strategies, opportunities for improvement, etc.
- Improve development of IH and vapor management program plans, including definition and institutionalization of roles, responsibilities, authorities, and accountabilities (R2A2s); organizational relationships; and compatibility with integrated project team (IPT) charters and activities.
- Better consolidate and tell the "story" (both internally to all employees and externally to all stakeholders and the media) of what is being done to resolve the vapor issues, how success will be measured, major obstacles to success, and timeframes that should be expected to achieve success. (The current "story" can be confusing considering CVAP, key performance parameters [KPP], strategy documents, fee incentives or contract term limits and priorities, etc.)
- Continue efforts to get more workers more substantively engaged in, and sharing some responsibility for, resolution of the issues (versus top down communication efforts or just making more information available). Examples of potential efforts at workforce engagement would be placing appropriate labor and worker representatives on teams and organizational groups charged with policy and program development, and where decisions are made on risk acceptance.

- Drawing upon the discussion and recommendations of a former TVAT and current VMEP member, address disposition of the "bolus" concept advanced by the TVAT, which has resulted in significant confusion and possible misrepresentation by various parties as outlined in Section 3.5 of this report.

3.0 OBSERVATIONS ABOUT PROGRESS AND FUTURE OPPORTUNITIES SINCE THE FIRST VAPOR MANAGEMENT EXPERT PANEL PERIODIC REPORT

Observations made since the 2106 VMEP are discussed in the following sections.

3.1 STRATEGY AND CORE PRINCIPLE DEVELOPMENT

In the first VMEP report (ORP 2016), several VMEP members noted that "the entirety of the efforts to address the "vapor issue" still seems lacking in the definition of succinct goals, critical decision points, and decision strategies governing the various initiatives." At that point in time, the overall strategy appeared to be defined around tracking all efforts according to each of the recommendations by the TVAT and dividing the efforts into a Phase 1 and a later Phase 2 defined by the results of the Phase 1 investigations. While at that point even though the Phase 1 report had not been issued and Phase 2 was therefore yet to be defined, it appeared to several VMEP members a much stronger and clearly defined strategy was needed. This strategy would be able to be succinctly communicated; contain a clearly defined purpose of the technology development; and characterization work, involve health effect studies, administrative control strategies, engineering controls, and proactive and engaging communication initiatives. Moreover, while the overall goal of workers being safe and feeling safe was laudable, an integrated and strategic framework of achieving that goal was lacking. During the period between the first VMEP report and now, members of the VMEP recognized considerable progress is now being made based on an inspiring vision for what the tank farms should look like and be managed like in the future. A strategic framework and plan for achieving that vision and integrating the elements of the strategic framework together into a comprehensive and cohesive set of actions has been drafted in the form of a draft CVAP.

The strategy considerations in developing the draft CVAP is demonstrated by Figure 1. Figure 1 was presented to the VMEP by WRPS's chief operating officer and executive leader of the vapors efforts during the June 2017 meeting. The figure clearly summarizes key events and developments feeding into the draft CVAP and the four major areas of activities expected to be implemented over the next 2 years. Most VMEP members believe that if fully implemented with continued consistent discipline and focus, the strategy and plan hold the potential to be very successful as a tool for fully addressing vapor issues. Further, most VMEP members share the belief that WRPS staff are correct when they suggest that "how vapors are managed may just be the WRPS legacy on the site."

Figure 1. Comprehensive Vapors Action Plan Elements and Logic.

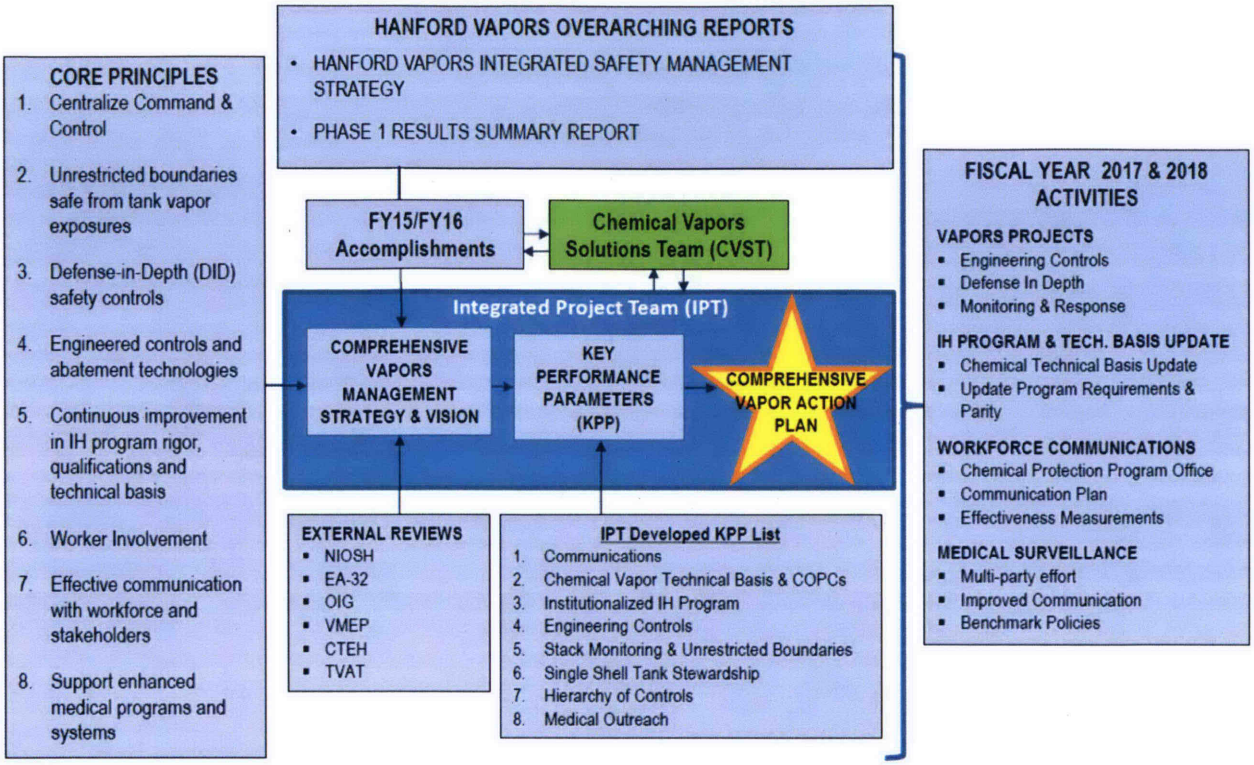
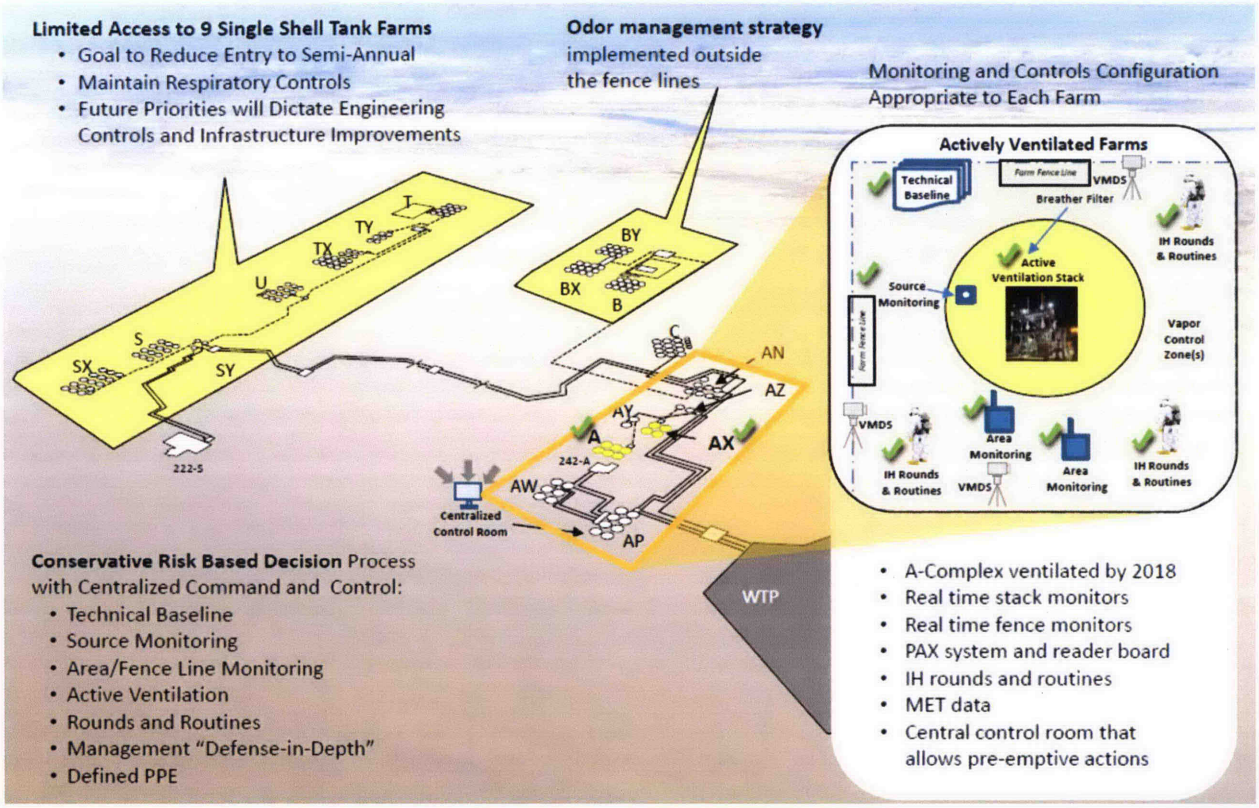


Figure 2 further illustrates the progress made in formulating a vision of how vapor issues will be managed in the future, including tailored strategies for managing them depending on the status, and condition of the farms and the activities within them that may require worker access. It further overlays plans to use odor management, administrative controls, and risk based decision-making in the future. As noted on Figures 1 and 2, the strategy is based on a clear and inspirational vision of creating a comprehensive vapor management program protecting, and being actively embraced by all workers so workers are safe and feel safe. VMEP members endorse this vision and suggest it should be woven into all communications and engagements, both internally with workers and externally with regulators and stakeholders.

Figure 2. Comprehensive Vapors Action Plan Vision for Tank Farms Vapor Management.



A contributing factor to the development of this significantly more cohesive strategy is how WRPS has effectively considered all the third-party studies occurring since the start of Phase 1. The General Accounting Office, NIOSH, EA, DOE Inspector General, VMEP recommendations, CTEH, and original TVAT recommendations have all been considered and integrated into the draft CVAP designed to address the key components of the challenge including science; political; regulatory; communication; and worker safety, perceived safety, and, engagement.

Several members of the VMEP have noted that while more work needs to be done, there are indications the strategy is becoming better understood by the project staff and integrated across project teams. While the R2A2s for these teams and managers need further definition and understanding as noted in in Section 3.2 of this report, VMEP members noted increased understanding of these R2A2s during staff presentations to VMEP. In addition, the IPT has made noteworthy progress in defining KPP's for many of the key elements of work. Once all the related KPPs are completed, they should be used consistently as a metric for progress.

One underpinning to this emerging and positive comprehensive strategy is the notion of broadening the vapors management efforts to the 20 square miles of the east/west plateau. This expansion appropriately recognizes that the vapor management initiatives should go beyond the tank farms, especially considering that in some cases, the problematic vapors appear to be coming into the tank farms from other sources on the plateau such as servicing of sanitary facilities (e.g., "Porta-Potties") and startup of diesel engines. Another underpinning of the emerging control strategies viewed positively by VMEP members is the tailoring of strategies for different tank farm configurations and activities (e.g., passive versus and actively ventilated

farms, sites where waste disturbing activity is taking place versus simply routine monitoring and maintenance, and establishing controls outside fence perimeters).

The draft CVAP and overall strategy through KPP 5 define how the site intends to protect workers outside the fence boundary. In summary, it depends on a combination of stack monitoring, fence line monitoring, and associated worker warning and protective actions to move workers away from the tank farm if increased levels of certain chemicals are detected. As discussed later in this report, several VMEP members note challenges in implementing this strategy due to limitations in what the detectors can detect in real time and the extent to which those chemical releases can be relied upon as leading indicators to warn of COPCs that cannot be measured by the detectors in real-time. VMEP members recommend the strategy for enabling totally unrestricted access outside fence boundaries be further developed and include key assumptions providing the basis for confidence in and conditions under which this strategy will allow totally unrestricted access outside fence boundaries.

The emerging draft Hanford Vapors Integrated Safety Management Strategy document and the draft CVAP are now founded on several very important and logically aligned core principles. Many VMEP members see the articulation of this logic and core principles as important progress. These principles include command and control, boundary definition, engineering and abatement technologies, improvements in the IH and medical programs, worker involvement and effective communication, and the application of effective (defense-in-depth) safety controls based on conservative risk based decisions. VMEP members recommend these core principles should be applied to each activity of the draft CVAP. When these activities are carried out in the context of fully mature KPPs (discussed later), R2A2s documents, and worker engagement the core principles have the potential to be an ongoing, sustainable approach to success.

Several VMEP members have observed that applying the core principles of worker involvement, effective communication, and the use of risk based decision making continue to need more attention. The last VMEP report (ORP 2016) noted progress was being made to inform workers and interested parties about the facts and challenges related to vapors and the strategies and activities related to worker safety. This progress is evidenced by how the worker-training resources of Hazardous Materials Management and Emergency Response (HAMMER) are being better used, the assignment of technical vapor representatives to attend and report back on chemical vapor solutions team (CVST) meetings, shared decision-making regarding use of PPE to access the evaporator building following the stack extension upgrade, increased use of focus groups in conjunction with or instead of just paper surveys, and more. At this point, however, it appears (based on the VMEP's limited input from the Hanford Atomic Metals Trade Council [HAMTC] member supporting VMEP and discussions with the lead WRPS HAMTC safety representative) much of the workforce remains unengaged, uninvolved, or simply "on-the-fence" watching and waiting. VMEP members recommend even more progress in engaging, and ultimately partnering with, more of the workforce in a manner encouraging trust and increasing participation by the full workforce in understanding the issues, airing concerns, and offering solutions as needed.

3.2 OVERALL PROGRAM/PROJECT MANAGEMENT EXECUTION

VMEP members reviewed several draft reports and briefing materials leading up to the June 13 through 15 onsite meeting with ORP and WRPS representatives. It is clear to many VMEP

members from those materials and from presentations made during the meeting that WRPS has made, and continues to make, progress in executing the projects and activities described in the draft CVAP. The WRPS senior managers' verbal description of the differences and relationship between the Operations; Environmental, Safety, Health, and Quality; and IH organizations projects was both logical and expected. However, in the absence of the expanded IH manual revision or a written, comprehensive set of R2A2s, the relationship among these organizations and projects is not clearly defined nor well understood by those responsible for several elements of the execution. Questions like who (which organization Operations; Environmental, Safety, Health, and Quality; or IH) owns the projects, sets the functions and requirements for them, and approves the project completion at turnover, that would be defined in the IH manual or R2A2s, were instead met with unclear answers in some cases.

It was also clear to several VMEP members from presentation and supplemental materials provided that the WRPS organizational interfaces are not well understood or controlled. For example, a contractor IPT has been established with diverse membership for defining draft CVAP activities to be implemented in 2017 and 2018, yet it is not clear where the relationship between the IPT members and the organizations is defined. While the draft CVAP is broken down into the eight KPPs, it is difficult to follow who owns each KPP, where and how all the subprojects and activities are rolled up under them, where the specific results are defined, who is the interface or customer that gets them, and how they will be used to achieve the expected outcome of "being safe and feeling safe." Clarifying R2A2s will also work on improving performance and customer relationships.

The VMEP anticipates the yet undrafted IH manual and chemical vapor program subsection will provide answers and clarification to these observations. However, it is important to note that similar concerns were also in the CTEH and NIOSH external reviews. The draft slide "Integration of Chemical Vapor Management Improvements – Transition from Strategy and Plan Development to a Fully Institutionalized IH Program," presented during the June 2017 meeting, provides a good high-level pathway to the end point. It appears the plan development phase is still underway with much yet to be documented. With all draft CVAP outputs being described as institutionalized by IH, VMEP members recommend these areas be documented in the forthcoming IH manual. It is further recommended required processes and procedures be institutionalized in the IH manual using a detailed and disciplined approach necessary to protect workers from the chemical and radiological risks to which they may be exposed.

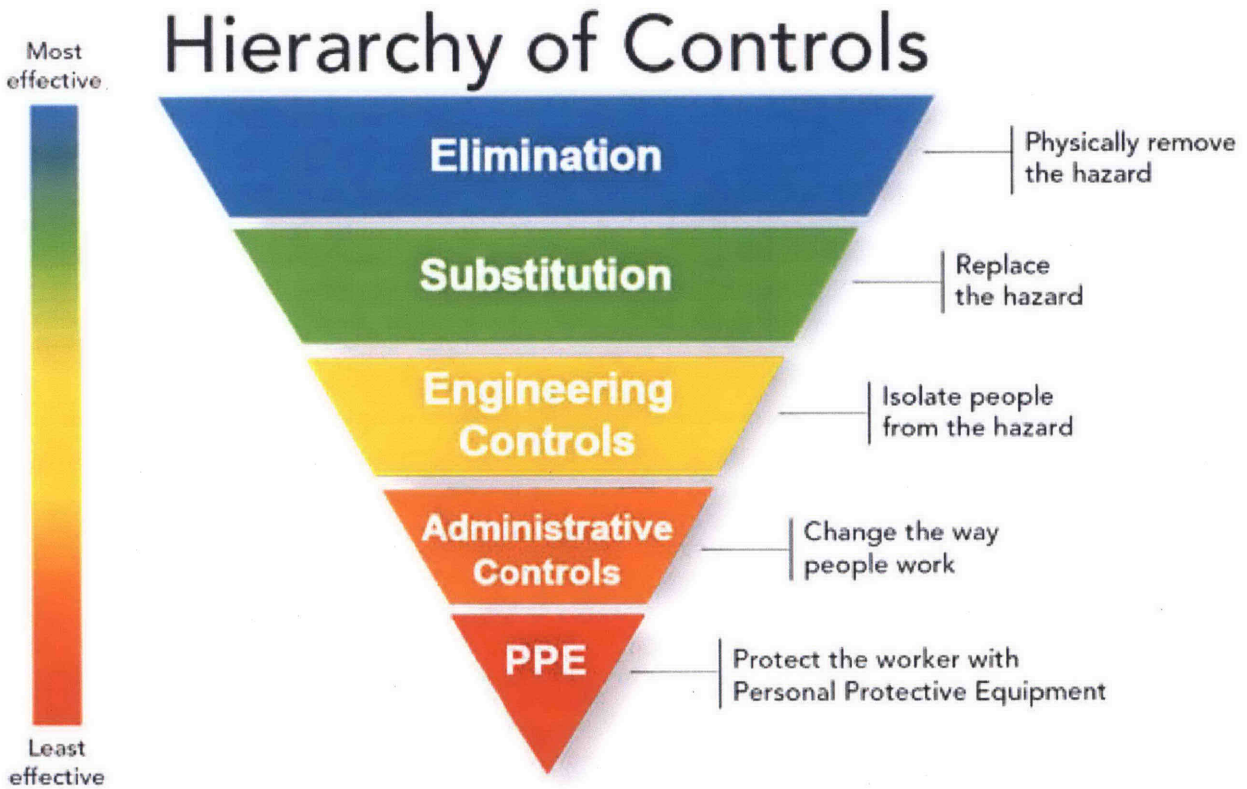
3.3 ENGINEERED CONTROLS

The use of additional or improved engineered controls to help manage vapors has been recommended by the initial TVAT and by subsequent reviews. Efforts to date appear to have been focused in a few key areas. One has been exploring abatement technologies and strategies to remediate the vapors emitted through the ventilation system. Specifically, in this area, at the request of WRPS, Savannah River National Laboratory conducted an evaluation of technologies to abate, or reduce, vapor emissions to below 10 percent of the recognized occupational exposure limits (OEL) (SRNL-STI-2016-00484, *Hanford Tank Farm Vapors Abatement Technology and Vendor Proposals Assessment*). The second major area of considerable effort has been exploring and developing new or improved vapor monitoring and detection system instrumentation, controls and systems to support engineered controls, administrative controls, and hazard

identification and characterization (RPP-RPT-59729, *Vapor Monitoring and Detection System Pilot-Scale Test Phase 1 Report (FY 2016)*). Lastly, other more traditional engineered control improvements, such as stack extensions and ventilation system upgrades, have been implemented at a few locations, and many potential fugitive emission sources have been remediated. Because a CVST engineering subteam had previously examined possible improvements in engineered controls, this area seemed to have been treated as a lesser priority, or in ad hoc manner, until recently.

VMEP members see the increased attention to engineered controls as a positive step. The effort to better understand, detect, monitor, and react to the COPCs, which may emanate from the tanks is indeed valuable and needed. VMEP members encourage continued, if not increased, attention to technologies for preventing or controlling the release of these COPCs, or simply destroying them. This is consistent with the recent trend to move from reactive to proactive control strategies, and consistent with the concept of hierarchy of controls illustrated on Figure 3 below, which emphasizes reduction of the hazard as the first and most effective control.

Figure 3. Hierarchy of Controls.



New technologies and options have been or are being developed and explored, from vapor destruction technologies to PPE improvements, but it remains to be seen which will be deployed, when, where, and why. Several VMEP members have noted this area could benefit from a more systematic approach to this decision-making, including what new or improved hazard

elimination or engineering controls will be deployed and the basis for those decisions. At this stage of the work, the appropriate role and relative reliance of engineered controls (versus hazard reduction or administrative controls) does not appear to have a clearly defined basis. The magnitude of the hazards being dealt with vary from farm to farm and tank to tank and can be continuous, sporadic, or steady state. Some hazard reduction or control options can be cost-effective and timely in some places, but not justified in others.

The process for how decisions will be made, by whom and when should be documented. The approach should address the dependency, linkage, or integration of the new vapor monitoring and detection system options in implementing or upgrading engineering controls (versus their use in supporting administrative controls or hazard reduction). Quantitative goals or criteria should be established (and VMEP members have been told they would be) defining the need or conditions under which the new or improved technologies will be deployed and operated (e.g., under certain specified meteorological conditions, to reduce concentrations of certain COPC's or classes of COPCs from x to y). Recognize that while the use of indicator species (e.g., ammonia, volatile organic compounds, etc.) for the COPCs may prove useful to predicting when to operate control systems, activate alarms or trigger some other action, they should be recognized as not currently exhaustive or comprehensive or yet being accepted as leading indicators for all the COPCs.

To assist the decision-making process, a crosswalk should be developed of the advantages and disadvantages and the basis for selecting the engineered controls for further development, evaluation, and implementation. For example, to date VMEP members have only seen the tabulation presented in the summary matrix found in RPP-RPT-59729. This does provide such a crosswalk and perspective, at least for a vapor management detection system, and could serve as a model to consider. The VMEP member with particular expertise in this area recommends such a crosswalk of the advantages and disadvantages and the basis for selecting the engineered controls should at least include:

- Operability conditions under Hanford weather, mainly temperature conditions
- Corrosion issues in high humidity corrosive streams
- Condensation problems with warm tank dome space vapors entering systems
- Particulate filter plugging prevention
- Expected change in elevation impact on current dispersion models
- Operability with or without onsite power availability
- Dilution of COPCs in exhaust streams
- Destruction efficiency of COPCs in treatment
- Expected code requirements
- Redundancy requirements
- When information is already available for proposed concepts, a tabulation should compare them.

VMEP members positively note the fiscal year 2016 vapor abatement workshop resulted in recommendations to further evaluate Strobic Air®'s high velocity fans and Nucon International, Inc.'s thermal oxidizer. So far however presentations provided to VMEP have only listed the "engineering" controls without a detailed evaluation of their properties or expected behavior for long-term operation under adverse temperature, humidity, and corrosion inducing conditions. While some of these parameters are being proposed for later stages of the program, if they are not prepared and documented, the VMEP member with particular expertise in this area believes the consequence would be a more haphazard selection and application of the controls without a basis for comparison with current engineered controls.

For example, one type of engineered control "improvement" is stack extension on current exhausters. Presumably, dispersion modeling was used to establish optimum extension height, but no data was presented to the VMEP for selecting the new stack heights. While not an abatement technology, it does reduce the risks of a harmful exposure. It should be noted though that a loss of power effect on flow dynamics through the train has not yet been presented.

The Strobic Air® Tri-Stack® exhaust fan[1] is described as a step up in control from stack extension, by using an additional fan to increase air velocity in the exhaust duct to better dilute the exhaust. Addition of the drive motor, etc. in the line of exhaust may result in some corrosion issues needing to be addressed. As a ventilation device, it would have to meet ASME AG-1, *Code on Nuclear Air and Gas Treatment* or appropriate equivalency. Literature indicates lower temperature limits are higher than known site low temperatures. Moreover, loss of power would result in loss of flow from tank dome space. VMEP members note that even though this technology can reduce the risk of worker exposure there is no elimination of the vapors by adding this technology, and some limitations regarding relying solely on increasing stack heights were also noted in the original TVAT report (ORP 2016).

The Nucon International, Inc. abatement technology is characterized as being able to control relative humidity and temperature problems for optimum operation of high-efficiency particulate air filters by preventing moisture condensation in the mercury and organic mercury control adsorbent bed and destroying identified COPCs at 95 to 99.99 percent efficiency. This technology is purported not to be affected by onsite power loss. It supplies excess electricity beyond its own needs and achieves thermal destruction of COPCs because many of the most hazardous COPCs have a decomposition temperature far below the operating temperature of the engine used. However, there are several potential issues with this technology still needing to be evaluated including potential nuclear safety issues with DOE documented safety analyses, scalability of the pilot to actual tank farms, and viability of the pilot unit to operate consistently in a tank farm environment.

Nucon International, Inc. believes pilot testing of this unit has shown very good "destruction" efficiency as shown in Table 1. These tests were conducted at relatively high concentrations compared to OEL values; however, due to the nature of the chemical processes involved in the operation of the unit, similar or better efficiency should be expected when operation is at lower inlet COPC concentrations.

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[1] http://www.strobicair.com/pdf/TechSpecs/Strobic/Strobic_Air_General_Brochure_12_23_15.pdf.

Table 1. Destruction/Removal Efficiencies for Selected Challenge Agent.

Challenge Agent	Average Inlet Concentration (ppm)	Average Exhaust Concentration (ppm)	Remaining Challenge Agent Concentration (%)	Destruction Efficiency (%)
Ammonia	424.08	7.74	1.83	98.17
Nitrous Oxide – Test 1	888.4	0.08	0.01	≥ 99
Nitrous Oxide – Test 2	1,440.73	0	0	≥ 99
Formaldehyde – Test 1	4.27	0	0	≥ 99
Formaldehyde – Test 2	14.19	0	0	≥ 99
Organics Mixture	304.89	14.55	4.77	95.23
NDMA	10.71	0	0	≥ 99
Mercury[a]	2,247[c] $\mu g/m^3$	0	0	≥ 99

[a] As can be seen from the tabulated data above, Nucon International, Inc. argues that destruction (or removal) efficiencies for all the challenge agents was above 95 percent. This is consistent with the general observation most combustion processes for volatile organic compound control are typically 95 percent efficient or better, depending on the specific mix of volatile organic compounds. The essentially complete mercury removal is consistent with Nucon International, Inc.'s experience with gas phase mercury removal applications. The U.S. Department of Energy, Office of River Protection and other Vapor Management Expert Panel members agree the above data is indeed promising.

$\mu g/m^3$ = microgram per cubic meter.
NDMA = N-nitrosodimethylamine.
ppm = parts per million.

Comparable, quantitative information on the Strobic Air® Tri-Stack® exhaust fan performance or its ability to reduce risks of harmful worker exposure has not been made available to or reviewed by VMEP members. The above descriptions of the two systems are not intended to enable judgments on the relative merits of the two systems. As described earlier, the two systems would work quite differently to reduce risks and each should be judged on its own merits based on a number of parameters not discussed herein but which are being considered by ORP and WRPS.

In summary, several VMEP members believe it would serve the vapor strategy well to continue increasing attention on the installation and use of engineered control systems as major components of the strategy for transitioning from reactive to proactive controls of tank vapors. Clearly defined goals should be set and requirement specifications well developed using a more disciplined approach and/or better documentation of the rationale. In the meantime, VMEP members applaud plans by WRPS to establish success criteria for proposed technologies, to develop down-select criteria establishing fiscal year 2017 abatement technology scope of work and cost estimates, and to develop applicable tank farm abatement requirements to support the down-select.

3.4 DEFENSE-IN-DEPTH AND QUANTITATIVE RISK ANALYSIS

VMEP members support the focus of the comprehensive vapor management strategy on the three areas as proposed including:

- Limiting access to nine single-shell tank farms with maintained respiratory protection controls
- Implementing an odor management strategy outside the fence lines
- Operating with a conservative risk-based decision process with centralized command and control.

A large volume of data (the so called technical baseline) has been and continues to be collected. These data continue to be collected appropriately to support various activities/analyses, including COPC lists and updates, leading indicator identification and monitoring, and to help define engineering controls. VMEP members believe it is positive several external reviews have concluded the technical baseline appears to be scientifically sound. At the same time, however, several VMEP members note it is not clearly defined and articulated to workers how the list of so called defense-in-depth activities currently underway actually serve to increase safety factors. Consequently, several VMEP members suggest the safety advantages and rationale for such activities as source monitoring, active ventilation, fixed or portable exhausters for all double-shell tank farms, defined PPE, cartridge testing to reduce SCBA use, and mobile laboratory deployment need to be better defined.

Given a primary stated objective of being able to declare the tank farms fence lines as an unrestricted vapor safe boundary under appropriate source hazards analyses and controls and normal conditions, a subcontractor, Kenexis Consulting Corporation, was hired to develop the *Design Practice and Philosophy for Chemical Vapor Detection and Alarming* (Kenexis 2017). This draft document starts with defining two analytical cases. The first is a bounding gas release event (acute) and the second is based on typical steady state values (chronic). The system design uses stack monitoring to detect off-normal conditions, which alerts the command and control farm supervisor. Stack vapor dispersion modeling is used to locate optimum placement of detectors and audible/visual alarms (both in the tank farm and at the fence lines). These detectors look for COPCs through direct reading instruments and leading indicator detectors. Using the probability of various meteorological conditions/year, probability of worker exposure based on worker patterns, and the probability of occurrences/year of vapor concentrations above the OEL in the breathing zone, the probability of worker elevated chemical exposure can be calculated and compared to goals. If these goals are not met, further risk reduction actions can be taken. For example, when Kenexis Consulting Corporation applied this quantitative risk assessment to the 241-A Tank Farm, it resulted in a slightly larger vapor control zone and looked at other risk reduction actions. This analytical approach appears sound, but VMEP members recommend it should be peer reviewed. Other challenges with this approach needing to be looked at include:

- Statistical validity of the data
- Fence line detector capability for specific COPCs
- Ability of the workforce to understand buy-in and own the results

- Other peer review concerns.

As an additional observation and recommendation, VMEP members note that the term risk is used throughout presentations provided by WRPS in various contexts and with different meanings. For example, it can refer to programmatic risks; quantitative risks (calculated traditionally as probability times consequence); or personally perceived or qualitative risk factoring in emotions, bias, and possibly misinformed information. Perception of risk will vary by individual, along with how it is defined. Large DOE projects are required to maintain a risk registry (depicting project risk). IH professionals generally use the term referring to health risk. VMEP members recommend risks, risk mitigation, and the various forms of applying mitigation to risk, should be clarified by WRPS

3.5 INDUSTRIAL HYGIENE PROGRAM ENHANCEMENTS

VMEP members note the level of effort to continue to address vapor issues associated with work in the tank farm is very significant. Because much has been done, reflection on what has been learned to inform the basis for worker health experiences is warranted. It is also notable based on actions taken and direct confirmation from ORP managers, there remains commitment to ensure worker protection. The issues of workers experiencing exposures to vapors in the tank farms and reporting responses is not new, but as information is gained an increased understanding of the underlying basis for worker experiences can be used to update understanding on the basic hypotheses. According to a VMEP member who was also on the TVAT, the overarching concept for the TVAT findings remains consistent with the current data. The overarching concept for TVAT recommendations was that ***transient short-term exposures to tank farm vapors of various concentrations coupled with variability in worker response can explain the pattern of reported odor and health experiences.***

The basic concept was that under certain circumstances a transient and significant exposure could occur, which would be readily identifiable (e.g., an abnormal operating procedure [AOP] related to opening a cabinet). While in other cases a worker might encounter an undetected plume or vapor pocket from passive ventilation systems, fugitive sources, or undispersed plumes. While very low-level concentrations near to background levels might occur on a wider basis, areas of transient higher concentrations could also occur and would be consistent with the workers' reports of infrequent, but significant onsets of strong odors and even symptoms. If such transient vapor plumes were present, the expectation would be that for most entries into the tank farm no worker would encounter them, and when encountered, the chances for responses would be – in order of decreasing frequency – an odor, a strong odor, mild symptoms, and strong symptoms. Such responses are real and related to exposures. Based on this description, the chances of having a significant health response would be much smaller than for experiencing odors. This pattern of incidence is consistent with a typical concentration gradient and exposure response. Because responses to odors and symptoms are highly variable in human physiology, the outcome of a worker encountering such an exposure would also be highly variable. Uncertainty in the nature of the exposures could also affect work responses, likely to heighten them.

With increased experience in implementing recommendations and assessing the issues some aspects of this overarching concept can now be further clarified. The meaning of the term "bolus" needs to be clarified. The term was intended to communicate the idea of transient peak exposures from various sources. No specific physical geometry of the vapor was intended in this description. Clearly the shape of a plume would be variable based on conditions.

The most common occurrence from such transient exposures would be significant odors or reversible symptoms and methods to address such concerns need to continue to be refined. This suggestion is supported by observations. For example, it appears that efforts providing clarity on sources of odors have been helpful in addressing worker concerns for situations where an identified odor source resulted in quick resolution of an AOP. For this reason, continued improvement in direct reading instruments to identify sources of emissions is suggested, acknowledging that no detector can measure every chemical in real time at low levels in a complex matrix.

Analysis of health studies and trending reports further suggests significant health effects, beyond reversible symptoms, are not occurring at a high incidence. Verifying this finding to ensure key effects are not being missed has been suggested by the VMEP. Continued engagement with workers to improve education on odors and health responses would be helpful – it is not clear workers are aware of the findings from the current data. The attention to clarifying the relationship between odors, health symptoms, and other health effects needs to continue to be stressed in a manner that has full worker engagement. The VMEP members commend recent WRPS efforts in this regard, particularly making available to Hanford workers through the Chemical Protection Program Office's (CPPO) five-part notebook on *Human Odor Perception and Chemical Exposures* by Dr. Kind of the CTEH (WRPS 2017). VMEP members with particular expertise in this area consider this very well done.

VMEP members agree many of the actions WRPS is taking are moving in a direction that should continue to improve vapor issues by reducing uncertainty in the nature of exposures and consequences. Examples include:

- Enhanced chemical hazards awareness training (CHAT) and efforts to provide presentations on health risks
- Continued efforts to recruit and train IH personnel
- Enhanced and additional communication and information sharing mechanisms
- Effort to continue to provide a suite of approaches to identify and protect from exposures (better direct reading instruments, better rationale for vapor control zones, and focus on engineering controls).

In each of these areas progress is being made, but the definition of what is needed to complete each action item or metrics to measure effectiveness are not completely clear (at least to some VMEP members). While the various activities continue to develop, emphasis is needed to continue to have an approach for effective engagement and communication in what we do and do not know about health experience of the workforce. Increasing the presence of IH professionals in the field is a theme appearing to still need attention.

The concept of continuing to implement a risk-informed control approach is making progress, but needs further development. Progress is being made in the context of defining vapor control zones as a basis for PPE and other strategies. However, there still does not appear to be a dedicated effort to reflect formal risk assessment approaches in weighing vapor exposure and control management options as a routine part of making decisions. One important example of this need is for the rigorous analysis of the data on trends in injuries related to SCBA use versus health effects and symptoms from vapor related incidents without SCBA. A critical analysis of the SCBA injury and health report data related to vapor exposures could be used to assess the contributions of each of these to an overall health risk. Such data on contributions to risk would better inform and support options for respirator cartridge assessments, administrative procedures, and the pace of engineering control development. The goal is to use such data to deploy controls minimizing overall risk. Such an analysis would also be useful for ongoing outreach and engagement on the rationale for actions being taken to address vapor exposure issues.

The site has engaged the Pacific Northwest National Laboratory in the effort to update OELs for the COPC list. During the June visit several of the VMEP members were briefed on the methods being employed. The overall approach being used is consistent with current best practices.

3.6 MEDICAL MONITORING AND SURVEILLANCE

Concern about potential short-term and long-term health effects from exposure to tank vapors continues to be the focus of much media and political attention. As this report is being prepared in July 2017, United States Senator Patty Murray and United States Senator Maria Cantwell inserted a provision in the DOE appropriations bill that would require DOE to establish a new center providing education and advocacy to guide injured Hanford workers to information on compensation programs. Earlier in Spring 2017, Hanford workers provided testimony to State of Washington legislators to pass House Bill 1723 regarding presumptive care for workers' compensation claims stating their claims for illnesses related to tank farm vapors are routinely denied in the worker's compensation system. To-date House Bill 1723 has not passed Washington State legislation.

The Hanford tank farm workers are closely monitored in medical surveillance programs and have been for many years. Generally, annual reports show no difference in health indicators between tank farm workers and other Hanford workers such as administrative staff. As of mid-2016, just over 2,000 workers were enrolled in the tank farm Hazardous Waste Worker Program. These workers receive baseline and annual medical monitoring and are offered an immediate chemical exposure evaluation whenever an "AOP-15" event occurs, which refers to detection of an unusual odor at a tank farm. Workers may also report to the clinic for evaluation upon any health concern or possible exposure, even absent an AOP-15 event. Several external, independent organizations have reviewed the protocols for the onsite clinic over the last 10 years and have concurred with the onsite clinic's protocols based on best available evidence. In the last year, NIOSH, EA, and CTEH have issued recommendations related to managing tank farm vapors at Hanford. The portions of these reports pertaining to medical monitoring and surveillance are highlighted in Appendix B.

A new initiative in 2017 is the detection of leading indicator gases (ammonia, volatile organic compounds, and nitrous oxide) as a surrogate for the complex mixture of COPCs comprising tank vapors. The adequacy of these indicators may need additional documentation. The

indicator gases will be useful for determining whether acute symptoms, such as headache; nausea; and irritation of the eye, nose, or throat are associated with transient tank vapor releases exceeding the usual background levels. This indicator gas approach will not answer questions about the theoretical risk of chronic health effects from long-term exposure to unmeasured COPCs.

As of 2017, aggregate health data specifically related to tank farm workers and associated with self-reported odors and symptoms does not suggest pervasive or systematic chronic health effects associated with exposure to tank farm vapors. See Appendix C for a summary of available data. With no evidence of pervasive chronic health effects associated with vapors, it is very difficult to narrowly direct reading instrument COPC measurements to any particular chemicals on the basis of those most likely to cause health effects. VMEP members with expertise in this area are not recommending highly sensitive direct reading instruments for all the COPCs, but do recommend recognition that the leading indicator gas measurements are not expected to prove or disprove an association of tank vapor exposure with chronic health effects. The current approach of selecting chemicals for integrated IH monitoring priority based on release potential and the nature of their toxicological effects, along with the current ongoing medical surveillance program, is the most appropriate strategy for the program to ensure monitoring of chronic health risks.

Even though, as NIOSH stated in their 2016 report, "the procedures and protocols for responding to health and odor events are technically appropriate and comprehensive," WRPS, ORP, DOE Richland Operations Office, and HPM Corporation (HPMC) Occupational Medical Services (OMS) have worked together in the last year to make program enhancements.

Some improvements having come to the attention of the VMEP include:

- Study planned for focused review of medical test results of vapor exposed workers who filed an AOP-15 report compared to a control group
- Education of the workforce to correctly identify the types of odors on the tank farms, including talks from a CTEH consultant, a notebook on odors distributed to managers, and odor modules incorporated with CHAT
- Washington State Department of Labor and Industries ombudsman meetings with Hanford workers who had filed claims to discuss the worker's compensation process
- Faster communication from WRPS to the workforce regarding results of AOP-15 investigations, such as 2 days instead of 30 days
- Regular meetings between HPMC OMS staff and WRPS management
- Increased engagement of the HPMC OMS risk communicator, including being added to the regular agenda of CVST meetings and discussing the meaning of "return to work without restrictions" with CVST attendees and trade groups
- A new WRPS website – http://hanfordvapors.com/ – which improves communication with external health care providers by providing some sampling data
- Enhanced medical protocol following an AOP-15 event, with blood samples 24 to 48 hours post AOP-15 event to allow for comparison to baseline laboratory results.

The proposed study by HPMC OMS will provide valuable data to assess any risk of lung, liver, or kidney disease in vapor exposed workers compared to unexposed Hanford workers. The study design can be described as:

- The exposed group would be Hanford workers evaluated at HPMC following an AOP-15 event, or any HPMC visit for concerns about chemical odors between 2012 and 2016. They will be divided into symptomatic and not symptomatic.
- Control group would be administrative workers with similar test results available.
- Outcome measures would be pulmonary function tests, liver function tests, and kidney function tests.

Questions to address in this study include:

- Is there any difference between asymptomatic and symptomatic workers following a chemical odor concern in terms of pulmonary function tests, liver function tests, or kidney function?
- For the cohort of exposed workers as a whole, is there any difference between the exposed workers and Hanford administrative workers in terms of pulmonary function tests, liver function tests, or kidney function?

A similar study, RPP-30560, *Health Effects Panel Evaluation of Pulmonary Function and Liver Enzyme Levels among Tank Farm Workers*, was conducted in 2006. There are important differences in the 2017 proposed study and the 2006 study. The earlier study did not evaluate workers who complained of smelling tank vapors but rather the group of tank farm workers collectively. The earlier study identified "cases" on the basis of abnormal laboratory results, while the proposed study identifies "cases" based on odors and symptoms.

The proposed study has limitations. The medical tests available do not capture the most commonly reported symptoms. The most common acute symptoms from a vapor event are headache, cough, throat irritation, eye irritation, and occasionally nosebleeds. None of these symptoms is captured in the laboratory data. Workers have concerns that adverse health effects may occur decades in the future. Since this study only evaluates acute events, it cannot answer questions about long-term effects beyond the study period, which is up to 5 years. The medical tests have low specificity and sensitivity for the diseases they are supposed to diagnose. For instance, a worker could have asthma and a normal pulmonary function test if the asthma is well controlled on the day of the test. There is no evidence kidney or liver functions are affected acutely or chronically after a vapor exposure. If there were an acute effect not yet detected, it would be expected to manifest in abnormal laboratory tests 1 to 2 days following the exposure, not within hours when the lab tests are collected. Elevated liver enzymes are nonspecific and could reflect a variety of acute and chronic conditions unrelated to tank vapors. Conversely, some liver or kidney diseases may not result in elevation of the enzymes being tested.

Education of the workforce to correctly identify the types of odors at the tank farms has the potential to reduce the number of AOP-15 events and consequently increase the specificity of the laboratory tests at HPMC OMS as being associated with tank waste sources. This type of education has the potential to make a significant impact on reducing worker concerns when

routine odors emanating from the tanks or odors from other sources such as diesel engines or septic tanks are detected. The notebook on *Human Odor Perception and Chemical Exposures* (WRPS 2017) should also help the workforce overall distinguish and identify odors and understand their varying implications.

A few actions that might increase the effectiveness of medical monitoring and surveillance even more include:

- Increase communication between WRPS and HPMC OMS, particularly regarding exposure data and the outcome of exposure investigations.
- Institute a routine interface between HPMC OMS and the worker's compensation third party administrator (Penser) to share information regarding worker's compensation cases. HPMC OMS can use information from Penser to aid outside medical providers with return to work determinations and to ensure that based on the care rendered (use of prescription medications, use of splints intended to immobilize, etc.), the appropriate Occupational Safety and Health Administration recordability requirements are fulfilled. Having more information about diagnosis and treatment by external providers would allow HPMC OMS to carry out more detailed demographic analysis and/or epidemiology. In addition, HPMC OMS providers could facilitate the interpretation of Hanford exposure data and the implications for potential health effects, either with Penser and/or with external providers directly (Appendix D provides information regarding previous discussions of this issue and relevant recommendations and regulations).
- Publicize the results of the annual health trending report. Some actions already planned include adding a brief worker-oriented description of the results to "CHAT" and presenting the results at CVST meetings. Releasing the results for the public, such as posting the results on a website or releasing the results to the media, could improve public perception of the health status of tank farm workers.
- As a separate effort, members of the VMEP may publish a review article on what is known and unknown related to the health of Hanford tank farm workers. No comprehensive compilation of the existing data, which is reasonably comprehensible, seems to exist currently.

3.7 COMMUNICATION, ENGAGEMENT, AND PARTNERING EFFORTS

As discussed in the original TVAT report (SRNL-RP-2014-00791), the various third-party assessments, and the first VMEP report (ORP 2016), many aspects of the vapor issues are affected by communications, engagement, and partnering. At this point it is difficult to tell the extent to which improvements in this area are hindered by the dynamics of the lawsuit versus the lawsuit being a consequence of problems and challenges in this area. Even though VMEP information and direct observations are limited, progress is apparent in several areas and certain philosophies, strategies, and specific actions are deemed worth discussing and further encouraging.

First, members of VMEP commend WRPS for the progress made since the last VMEP report (ORP 2016) on efforts to inform workers and interested parties about the facts and challenges related to vapors and the strategies and activities related to worker safety. The establishment of

the CPPO and its strategic direction is commendable and will improve the communication flow and worker understanding of the progress being made to address the vapors issues. Several noteworthy examples of progress include:

- CPPO reports
- Tank vapors website
- Weekly reports from Mark Lindholm
- *Human Odor Perception and Chemical Exposures* (WRPS 2017)
- Use of Stoneturn as a third party to assist the labor representatives in assessing cartridge testing methods and interpreting results
- The effort to establish technical vapor representatives to attend and engage in the CVST process and serve as liaison with a broader segment of the workforce.

In addition, many of the VMEP members commend the WRPS team for establishing a clear, positive, and appropriate vision statement articulating the purpose of assuring that workers "are safe and feel safe." VMEP members also support tying this to the sites mission, as the chief operating officer and executive leader of the vapors efforts has done in his CVST legacy statement, where he states "... all workers... are Safe... Feel safe and go home proud of their role to the Hanford Mission."

While significant work has been done to plan and improve communications and worker engagement, many of the VMEP members still have reservations about how effective team participation and feedback alone will be in achieving worker buy-in and ownership necessary to assure workers feel safe and show pride of their work at Hanford.

VMEP members believe offering and obtaining worker feedback or allowing workers to participate on teams, will not, in and of itself, achieve the desired result – workers "feel safe." VMEP members believe that to achieve "feel safe," workers must be actively and substantively engaged in all stages of an effort or project, including discussions regarding risk concerns related to decision-making or inform decisions, such that they can better understand and support or accept leadership's decisions. To feel safe, they must be partnered with management in the development of the work product and (personally or collectively through their surrogates) support or accept the residual risk. WRPS will need to identify the target work product development groups or teams and then engage the Unions or appropriate HAMTC or Building Trades representatives in the meetings or product development efforts.

While HAMTC officials were invited to attend the last VMEP briefing with the hope they could shed more insights on the potential barriers to more effective communications, engagement, and partnering involving the workforce and management they did not attend. Pending litigation, other priorities or other reasons may have affected their ability, desire, or interest in attending. Regardless, achieving the goal of all workers feeling safe is not possible without active and substantive worker participation, buy-in, and ownership on the part of the worker leadership. Special efforts continue to be encouraged to understand barriers to more effective engagement and partnering, beyond communications, involving both Union and contractor leadership, which extends down through their various types and levels of contactor and Union representatives,

ultimately involving the rank and file working levels within the various Unions and contractor organizations.

As noted earlier, VMEP members support recent actions to increase worker engagement through actions such as the assignment of team vapor representatives to not just attend but also participate (engage and partner) in the various CVST and CVST subteam deliberations. Other examples include recent initiatives utilizing HAMMER resources, CHAT, and the goal to make IH technicians knowledgeable, respected, and trusted resources in the field. VMEP members also support the recently defined survey currently being fielded to all workers, but remain skeptical about the effectiveness of this survey unless it is supplemented by worker focus groups at critical stages of projects.

Finally, VMEP members have noted positive progress and improved development in the website, outreach communications, and other efforts being led by CPPO and encourage those efforts to continue.

To help improve worker buy-in and ownership and the state of feeling safe, the following ideas have been offered for consideration by various VMEP members:

- Assure each team and organizational element, including CPPO and the Executive Safety Review Board, has an appropriate number of active and engaged workers who are well respected by other workers and can be "worker champions" for the effort.
- Encourage team members to increase their participation in additional levels of team activity including discussions and decisions associated with risk.
- Establish leading metrics in the areas of participation, engagement, and ownership.
- Establish methods to measure worker perceptions following risk training, communications, etc.
- Assure the communication principles taught to key site personnel by Dr. Vincent T. Covello, a nationally and internationally recognized trainer; researcher; consultant; expert in crisis, conflict, change, and risk communications; and founder and director of the Center for Risk Communication, are used not just by supervisors but also by managers in other key functional areas (e.g., industrial, HPMC, CPPO, senior management, etc.).
- Utilize message mapping in all areas and functions. Lead with the "what is known" followed by additional study. Take full advantage of the tremendous, leading-edge work that has been accomplished over the last few years on hazard characterization, data gathering, and risk mitigation.
- Build on existing leadership/management field presence efforts (e.g., management observation program) to increase frequent and substantive engagement, in the field setting, between workers and leadership/management.
- Test a new process for more collaborative and informed decision-making that could produce more broadly understood and accepted outcomes. For example, convene an extended workshop of the CVST (or some subgroup) in which they would be presented major decision considerations involving risks and challenges related to key decisions

needing to be made. Then ask, "What decision should be made?" It would be important to be clear that a consensus does not have to be reached. The discussions, which would need to be facilitated and documented, are what is most important. Time needs to be allowed to have a rich discussion. The same approach could be used for selected groups of leaders. Consider using an electronic key pad approach allowing each participant to vote on each key question, with the results instantly displayed on a graphic presentation. Worker views could then be kept confidential but the total result shared with the entire group.

- Develop a concise assessment (by panel or DOE with outside review) of the state of the science around vapors. Summarize data developed over the recent years covering issues such as monitoring data and the probability of a bolus, health effects studies, health studies, summary of AOP-15s, additional staffing, integrated worker/management teams, data collection, controls, training, communications, etc., leading to assuring a safe environment.

Several months ago, VMEP members proposed several ideas on how VMEP or an alternative group could become more involved directly to evaluate and improve worker engagement and communications. ORP evaluated the proposal and discussed it with WRPS. It was determined that WRPS was already looking to contract with a private firm to do an independent effectiveness review of communications effectiveness and safety conscious work environment evaluation in the June/July timeframe and that this evaluation was in the initial planning phases. ORP indicated it would like to have one to two VMEP members participate in the review. VMEP members support this idea and look forward to engaging in the effort.

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APPENDIX A
VAPOR MANAGEMENT EXPERT PANEL MEMBERSHIP

Name	Affiliation	Specialization/Expertise
Keith Klein (Chair) Richland, Washington	Longenecker & Associates; former Manager DOE Richland Operations Office; former member of Environmental Management Advisory Board (EMAB); electrical and nuclear engineering	Hanford technologies, challenges, and dynamics; community liaison and continuity; labor relations; engineering and technology; program management
Dr. Andrew Maier (Vice Chair) Cincinnati, Ohio	Prof., University of Cincinnati College of Medicine, NIOSH Toxicology Fellow	TVAT continuity, occupational and environmental health, chemical risk assessment, toxicology/exposure levels, industrial hygiene
John Henshaw Sanibel, Florida	Cardno Chemrisk, former OSHA Administrator, former President of American Hygiene Association	TVAT continuity; OSHA regulatory; industrial hygiene, safety, and environmental health; risk management and communication
Tom Fitzsimmons Seattle, Washington	Consultant, former Director of Washington State Department of Ecology; former Chief of Staff to Governors Chris Gregoire and Gary Locke	Regulatory experience; understanding of Olympia, understanding of Hanford; liaison with state entities
Dr. Debra Cherry Seattle, Washington	Physician, Harborview/Occupational and Environmental Health Clinic; Associate Professor, Environmental and Occupational Health Sciences at University of Washington	Physician; care provider at Harborview Occupational and Environmental Clinic (follow-up care/case management expertise); liaison with other medical specialties and local health care providers
George Jackson Richland, Washington	Former Fluor Hanford executive, engineer	Facility operations and safety; Hanford experience; senior management and facility operations experience with Rockwell, Burns and Roe, Westinghouse
Dr. Joseph Iannelli (former VMEP)	Professor and Executive Director, Engineering and Computer Science, Washington State University	Computational fluid dynamics (gaseous), engineering, technology, meteorology, modeling, plumes/bolus behavior, liaison with universities, and national laboratories as needed; institutional credibility with state

APPENDIX A
VAPOR MANAGEMENT EXPERT PANEL MEMBERSHIP

Name	Affiliation	Specialization/Expertise
J. Louis Kovach Columbus, Ohio	Nucon International; former President of International Society of Nuclear Air Treatment; Chairman, ASME Technology Subcommittee of Committee on Nuclear Air and Gas Treatment; Visiting Scientist, Harvard T.H. Chan School of Public Health	Recognized expert in research, design, analysis, construction, and proof testing of gaseous and liquid phase treatment, filter, and control systems, including toxic vapor and particulate controls, instrumentation, modeling, source term/accident analysis; consultant to industry, national laboratories, and various federal and international agencies; prior experience with Hanford tank waste
Paul Kruger (Executive Director) Columbia Falls, Montana	Former government and industry executive positions in environment, safety, health, quality assurance, and training	Experience with both DOE and Hanford contractors, labor/worker relations, worker compensation programs, and employee concern programs

ASME = American Society of Mechanical Engineers.
DOE = U.S. Department of Energy.
NIOSH = National Institute for Occupational Safety and Health.
OSHA = Occupational Safety and Health Administration.
TVAT = Tank Vapor Assessment Team.

APPENDIX B
MEDICAL SURVEILLANCE AND MONITORING RECOMMENDATIONS FROM OTHERS, 2016 AND 2017

I. CURRENT PRACTICE FROM NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH REPORT AND OTHER SOURCES

As of mid-2016, just over 2,000 workers were enrolled in the tank farm Hazardous Waste Worker Program. These workers receive baseline and annual medical monitoring and are offered an immediate chemical exposure assessment whenever an Abnormal Operating Procedure 15 (AOP-15) occurs.

National Institute for Occupational Safety and Health (NIOSH) report *Review of Hanford Tank Farm Worker Safety and Health Programs* (2016) included a concise summary of the HPM Corporation (HPMC) medical protocol for AOP-15 events:

> The procedures and protocols for responding to health and odor events are positive developments and appear technically appropriate and comprehensive...If a Hanford worker reports to HPMC OMS that exposure to tank farm vapors may have occurred (with or without health symptoms), an "Exposure Response Team" (ERT) is activated. This team includes the Site Occupational Medical Director, Clinic Director, Principal Manager, Nursing Director, a Certified Industrial Hygienist, Emergency Preparedness Specialist and Nurse Case Manager. The team functions as a medical resource/liaison to the employee's personal provider(s); workers' compensation physician(s); and the safety, health and IH staff in the field who responded to the event at the tank farms when it occurred.
>
> Medical protocols for workers who report a possible exposure to tank farm vapors have been developed, in part, on a review of COPCs within the tank headspaces. Based on these, workers are offered the following:
>
> - pulmonary function test (PFT);
> - chest x-ray (CXR);
> - liver function tests (LFTs), including alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), and prothrombin time (PT);
> - kidney function tests, including blood urea nitrogen (BUN) and creatinine (CR);
> - complete blood count (CBC) with differential to evaluate overall health;
> - urinalysis to screen for kidney disorders, liver problems, diabetes or other metabolic conditions;
> - mercury in blood and urine;
> - urinary S-phenyl mercapturic acid (S-PMA), a biomarker for exposures to benzene; and

- other tests that the provider feels are indicated.

In addition, 100 milliliters (ml) of urine and 30 ml of blood are obtained and preserved for 45 days in the event exposure data or other information indicate a need for additional tests.

Individuals may be referred by HPMC OMS for further evaluation or triaged to a higher level of care, if indicated. Employees with minimal or no symptoms and a normal exam may be returned to work with or without restrictions while the results of lab tests and environmental exposure monitoring are still pending. If any results are found to be of concern, the lab will call HPMC OMS, who can immediately notify the employee.

All Hanford workers who report a possible exposure to tank farm vapors are contacted the following work day by the HPMC OMS Nurse Case Manager or another Registered Nurse to inquire as to his/her wellbeing. In addition, workers are scheduled to return to the clinic within five working days for follow up and lab review with the provider, during which individuals receive copies of their medical test results verbally and in writing. Workers are also encouraged to report for additional medical evaluation at other times if necessary."

Since report *Vapor Management Expert Panel Member Report, February 2015 through September 2016, Implementation of the Tank Vapor Assessment Team's Report Recommendations* (ORP 2016), external reviews have resulted in several recommendations related to medical monitoring and surveillance. Key points are highlighted in the following sections.

II. NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH NOVEMBER 2016 REPORT, EXCERPTS

The *Review of Hanford Tank Farm Worker Safety and Health Programs* (NIOSH 2016) states:

> To help address ongoing worker concerns with the workers' compensation program, organize meetings with tank farm workers and the Washington State Department of Labor and Industries' workers' compensation ombudsman in a forum where workers can ask questions and discuss their concerns.

In interviews with NIOSH, workers described an "onerous and dysfunctional workers' compensation system" as well as distrust and misunderstanding regarding the process for medical triage and physician determinations of work-relatedness. NIOSH 2016 also states:

> Provide a thorough explanation of the return-to-work policy to all workers. This explanation should include addressing confusion about the return-to-work policy after reporting an exposure but before receiving results of medical tests.
>
> Provide to all workers a more thorough explanation of the policy concerning return-to-work following a reported exposure and before the results of all medical tests are available. Provide this information not only to workers who report to HPMC for evaluation, but to all tank farm workers during general meetings.

Conduct a focused review of tank farm worker medical surveillance data to maximize the usefulness of current medical surveillance and screening activities and to help establish the most appropriate occupational medical care for tank farm workers.

III. U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE CORRECTIVE ACTION PLAN, 2017 (17-DEP-0004)

- Assess HPMC communication protocols (medical evaluation, return to work after exposure)
- Review HPMC protocols for tank farm surveillance and acute exposure (consider former worker and *Energy Employees Occupational Illness Compensation Program Act* trends, contaminants of potential concern updates)
- Complete a review of Hanford workers reporting tank farm vapor exposure to HPMC
- Expand Hanford workers' awareness of the existence and role of the Washington State Department of Labor & Industries Office of the Ombudsman for Injured Workers of Self-Insured Businesses.

IV. CENTER FOR TOXICOLOGY AND ENVIRONMENTAL HEALTH, LLC REPORT, NOVEMBER 2016

The *Critical Assessment of the Technical Basis and Implementation of the WRPS Hanford Site Waste Tank Farm Industrial Hygiene Program* (CTEH 2016) states:

> The Abnormal Operating Procedure (TF-AOP-015) process needs to be revised to remove implication that an odor is abnormal and that actions need to be taken when odors are encountered. Even though the document currently attempts to qualify odors of concern as "stronger than normal," it is entirely too subjective and leads to confusion in the workforce.
>
> Reporting the result of a TF-AOP-015 investigation back to the workforce is reported to take as long as 30 days or more. This breeds distrust as the workers think they have been impacted by the event and are not getting results in a timely fashion. Consider creating a short event report that is quickly published and then proceed with whatever investigation is required.
>
> The recognition of an odor and occurrence of an instantaneous injury are not typical in biology except in the case of immediate exposure to a dangerous, high-concentration chemical environment. Many people often confuse specific physiological stress responses, designed to aid in escape, with signs of onset of a toxic, injurious reaction. The role of these rapid changes as a primal defense mechanism is discussed in this report. Human exposure to adverse odors has been shown to cause measurable changes in breathing, heart rate, blood pressure, and digestive processes. However, these changes can result in symptoms including lightheadedness, headache, and breathlessness, as well as nausea and, in some cases, nose bleeds.

V. OFFICE OF ENTERPRISE ASSESSMENTS FOLLOW-UP ASSESSMENT OF PROGRESS ON ACTIONS TAKEN TO ADDRESS TANK VAPOR CONCERNS AT THE HANFORD SITE, JANUARY 2017, KEY EXCERPTS

1. Re case management and identification of recordable illnesses

HPMC does not have direct access to WC medical data from outside medical providers and therefore may not receive all pertinent information from Penser related to treatment, because outside medical providers sometimes do not provide all treatment information to Penser. This arrangement creates an obstruction in the flow of injury/illness information from a treating physician through Penser, through HPMC, to the actual employer (WRPS) such that they can conduct effective case management and determine recordability/reportability in accordance with the Occupational Safety and Health Administration (OSHA) and the DOE injury reporting process. Effective case management refers to following cases and working with outside medical providers who provide direct care to aid in expeditious return to work, and to ensure that based on the care rendered (use of prescription medications, use of splints intended to immobilize, etc.), the appropriate OSHA recordability requirements are fulfilled. ...The unusual limitation of access to the WC data not only impedes a company's responsibility for case management for its employees, but also contributes significantly to the distrust that exists between the workforce, the contractor WC representatives, and the RL/Penser processes.

With respect to the individual HPMC/worker interface, the HPMC exposure protocol is not fully effective. In one case, a symptomatic employee exposed to ammonia vapors with objective findings (changes to pre- and post-bronchodilator pulmonary function tests) was returned to the workplace without restrictions by HPMC after administering prescription medication. Returning the employee to the workplace without restriction supported WRPS management's perception that no significant exposure occurred. Even though this employee continued to interact with the HPMC medical practitioner daily, the symptoms worsened until the worker had to be taken from the workplace directly to the Kadlec Emergency Department on the third day after the event. HPMC's existing protocol does not mandate physician evaluation of such cases or immediate hospital transfer of exposed employees with symptoms causing distress. Although this case does not negate the sound occupational medicine usually demonstrated by HPMC, it demonstrates a weakness in the process.

EA's evaluation of this case noted that three months after the exposure event, while the employee was still under a personal physician's care, WRPS classified this as a first aid case, and Penser had not completed the WC determination. The WRPS IH data documented the employee exposures below 10% of OEL. The lack of medical information available to WRPS to associate the employee's time away from work with the exposure event resulted in WRPS classifying this as a first aid case instead of a lost-time recordable case.

2. Re worker's comp

Although the availability and evaluation of IH monitoring data are part of an evolving process with the addition of new monitoring technologies, the RM8 action associated with communicating the proper interpretation and use of sampling data for chemicals and vapors to medical providers is listed as "complete" in the WRPS IP, not an ongoing activity

...these actions do not address the education of external medical providers of WC cases to help them determine work-relatedness. Educating treating physicians to the requirements of OSHA recordability and the need to provide information on the level of care (prescription medications, splints intending to immobilize, etc.) so that employers can properly categorize and record the injury/illness to comply with OSHA regulations would significantly improve the process.

Penser does pass IH data to L&I-approved medical providers who render care and make WC determinations (i.e., determining whether an injury/illness is work-related). The raw IH data usually does not have a cover letter explaining the meaning and limitations of such data with respect to work-relatedness. Therefore, raw IH data stating that toxicants were below 10% of the OEL should not be used to determine work-relatedness of an injury or illness because the context of the sampling results is not known. Additionally, the process does not include an explanation of the time between the event and the sampling data, the inability to sample for all toxicants in the COPCs (as well as others), and the effect of synergy among toxicants... RL professionals who determine WC claims may not fully understand the limitations of IH data collected from an event. Additionally, the treating physicians external to HPMC are not provided an explanation of the limitations on use of IH data.

Based on EA's interviews, communication between the WRPS WC point of contact and the RL WC Manager appears to be non-existent.

3. Re communication between HPMC and workers

The TVAT stated that risk communication to the workforce required improvement. Two aspects of that effort have not been fully effective: the individual HPMC/worker interface, and the dissemination of information to the workforce by knowledgeable medical professionals.

Ensure summary reports from HPMC evaluating laboratory results related to group health status in present Tank Farm workers (the health trending reports) are flowed down to the workforce.

HPMC should reassess communication protocols to ensure that workers fully understand the medical evaluation activities when workers report symptoms from vapor exposures. Consider the following actions:

- Describe the purpose of the tests being performed.
- Describe the limitations of the tests and procedures for determining potential long-term effects.

- Better utilize the dedicated risk communicator to have regular, scheduled interactions with the workforce regarding vapor-related activities.

4. Re HPMC protocols

HPMC should reassess the laboratory test panel for acute exposures and annual monitoring of Tank Farm workers. Consider the following actions:

- Draw samples acutely and 24-48 hours post-event to allow for post-event comparison.
- Eliminate tests that replicate parameters in other laboratory tests.
- Implement a heavy metal screening if such elements may be present in an exposure from certain activities (e.g., filter changeout).
- Routinely reassess the content of exposure laboratory evaluation, recognizing that medical evaluation is an evolving process

APPENDIX C
AGGREGATE DATA REGARDING HEALTH OF TANK FARM WORKERS

Aggregate data regarding the health of tank farm workers already been compiled includes:

- Abnormal Operating Procedure 15 incidents and worker evaluations at the time of the incidents, with active followup of exposed workers and linkages to retrospective and prospective annual exams (Phillips 2016; S-15-SHD-TANKFARM-001, *Health Surveillance of Vapor Exposure Concerns*)
- Tank farm worker annual surveillance exams and annual health trending reports summary of results (HPMC 2016)
- Worker's compensation claims data for exposure claims related to tank farm vapors (there are few relative to the overall number of claims for all types of injuries across Hanford for the period October 1, 2012, through June 30, 2016) (NIOSH 2016, *Review of Hanford Tank Farm Worker Safety and Health Programs*)
- Return to work exams after exposure incidents (generally cleared to return without restrictions)[1]
- Recordable injury and illness rate (low for tank farms according to data presented in an internal report spreadsheet assembled by U.S. Department of Energy, Office of River Protection staff and provided to the Vapor Management Expert Panel in September 9, 2016[2])
- Health effects panel evaluation of tank farm workers in 2006, with national leaders in occupational medicine from prestigious universities as authors (found no pattern of occupational disease) (RPP-30560, *Health Effects Panel Evaluation of Pulmonary Function and Liver Enzyme Levels among Hanford Tank Farm Workers*).

Aggregate data from Hanford workers over the decades does *not* suggest any pattern of chronic disease emerging later in life. Long-term studies include:

- Cohort mortality studies (Schubauer-Berigan et al. 2015, "Cancer Mortality through 2005 among a Pooled Cohort of U.S. Nuclear Workers Exposed to External Ionizing Radiation"[3])
- Former worker surveillance exams (DOE and EHSS 2015).

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[1] Internal Report, *DART Case Rate Comparison, General Industry vs. DOE vs. WRPS, 2010–June 2016.* (DART stands for days away, restricted, or transferred. Report reflects how many workplace injuries and illnesses required employees to miss work, perform restricted work activities, or transferred to another job.)

[2] Internal Report, *TRC Case Rate Comparison, General Industry vs. DOE vs. WRPS, 2010 – June 2016.* (TRC stands for total recordable cases. Recordable criteria include any work-related injury or illness resulting in loss of consciousness, days away from work, restricted work, or transfer to another job or requires medical treatment beyond first aid; and any work-related diagnosed case of cancer, chronic irreversible diseases, fractured or cracked bones or teeth, and punctured eardrums.)

[3] Though many Hanford cohort mortality studies have been published, this is the most recent one known to the authors of this report.

In fact, Hanford historically has lower rates of recordable injuries and illnesses than comparable U.S. Department of Energy sites[4], and former Hanford workers live longer than the general population (Schubauer-Berigan et al. 2015) and experience fewer cancer deaths (DOE and EHSS 2015). Even though tank farm worker surveillance ***has*** identified a few abnormalities, such as newly detected signs of asthma on breathing tests, the rate of abnormal breathing tests among tank farm workers has been the same for the last 5 years, and tank farm workers have demonstrated better lung function on average than a comparison group (the Washington Closure Hanford workers, who do not work on tank farms) (Phillips 2016; S-15-SHD-TANKFARM-001).

[4] http://energy.gov, "Illness and Injury Dashboard."

APPENDIX D
REGULATIONS AND RECOMMENDATIONS REGARDING THE HPM CORPORATION OCCUPATIONAL MEDICAL SERVICES/PENSER INTERFACE

The Vapor Management Expert Panel has been encouraging improved communication between Penser, HPM Corporation Occupational Medical Services, and Washington River Protection Solutions LLC since 2015. Collectively, the safety department, the workers compensation facilitator, and the occupational medicine provider need to share information in order to track diagnoses and impact of injuries and illnesses and report to the U.S. Department of Energy within a specified timeframe.

Limits in scope-of-work and privacy concerns have been cited as contractual and legal barriers to communication between contractors; however, these barriers are not necessary. In fact, federal regulations mandate that U.S. Department of Energy contactors make health information from outside insurers available to the onsite occupational medicine provider, as cited below:

> 10 CFR 851 Appendix A (j) The occupational medicine provider must include measures to identify and manage the principal preventable causes of pre-mature morbidity and mortality affecting worker health and productivity.
>
> (1) The contractor must include programs to prevent and manage these causes of morbidity when evaluations demonstrate their cost effectiveness.
>
> (2) Contractors must make available to the occupational medicine provider appropriate access to information from health, dis-ability, and other insurance plans (de-identified as necessary) in order to facilitate this process.

Report *Office of Enterprise Assessments Follow-up Assessment of Progress on Actions Taken to Address Tank Vapor Concerns at the Hanford Site* (DOE 2017) stated:

> ...HPMC does not have direct access to WC medical data from outside medical providers and therefore may not receive all pertinent information from Penser related to treatment, because outside medical providers sometimes do not provide all treatment information to Penser. This arrangement creates an obstruction in the flow of injury/illness information from a treating physician through Penser, through HPMC, to the actual employer (WRPS) such that they can conduct effective case management and determine recordability/reportability in accordance with the Occupational Safety and Health Administration (OSHA) and the DOE injury reporting process... The unusual limitation of access to the WC data not only impedes a company's responsibility for case management for its employees, but also contributes significantly to the distrust that exists between the workforce, the contractor WC representatives, and the RL/Penser processes...

The Vapor Management Expert Panel Health Effects Workshop in March 2016 had this item on the agenda, which included a recommendation:

> Health effects data flows and communication
>
> - Are all pertinent medical records provided to those who are charged with making medical care or causality decisions?
> - Do medical personnel receive IH and exposure assessment data including appropriate uses and limitations in the most appropriate format to support their roles?
> - Can a Medical Assessment Tool be developed as a tool for medical providers?

Recommendation:

> ...increase effectiveness of information and operational flows related to medical and exposure information among health related providers and ultimately to the workers.