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Third Party Qualified Independent Review: Hanford Tank Farm Respirator Cartridge Testing

Report No 2:
Review of:
Use of Full Face Air Purifying Respirators in AP Tank Farms for Low-Hazard Tasks.
TOC-IH-58345. Rev. 0, January 30, 2017

WRPS's Prime Contract DE-AC27-08RV14800
Subcontract 61636

January 31, 2017

Note:

This is a preliminary report. We reserve the right to amend it as more information and test results become available.

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DISCLAIMERS

This "independent third party" review was conducted by a team of subject matter experts assembled by Stoneturn Consultants (STC) and its subcontractor CPWR: The Center for Construction Research and Training. It was conducted as a result of an agreement between Hanford Atomic Metal Trades Council (HAMTC) and Washington River Protection Solutions (WRPS). STC was selected by HAMTC to perform the review.

The review was based on reports supplied by WRPS and Pacific Northwest National Laboratory (PNNL) and interviews with staff from WRPS, PNNL and leaders and representatives of HAMTC. None of these organizations had a say in the way the review was performed or in the findings and recommendations resulting from it.

This work was based on the evidence presented to us. We did not attempt to verify the accuracy of this information. We did observe the testing apparatus but did not physically observe the conduct of actual field testing, and we did not attempt to re-compute the statistical analyses which had been performed. Therefore we do not in any way warrant the validity of the information that we relied on for the assessment. Nor do we warrant, whether express or implied, any health protection stated or implied as a result of the testing performed by WRPS and PNNL.

Any mention of any commercial product in this report does not in any way constitute any endorsement or recommendation by STC, CPWR or the review team.

INDEPENDENT REVIEW TEAM

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ACRONYMS USED IN THIS REPORT

AOEL. Allowable Occupational Exposure Limit
APR. Air-purifying Respirator
COPC. Chemicals of Potential Concern
CPWR. The Center for Construction Research and Training
FFAPR. Full-face air purifying respirator
HAMTC. Hanford Atomic Metal Trades Council
IH. Industrial hygiene
NIOSH. National Institute for Occupational Safety and Health
OEL. Occupational Exposure Limit
OSH. Occupational safety and health
OSHA. Occupational Safety and Health Administration, US Department of Labor
PAPR. Powered Air-Purifying Respirator
PNNL. Pacific Northwest National Laboratory
RPD. Respiratory Protection Device
SCBA. Self-containing Breathing Apparatus
SEG. Similar Exposure Group
STC. Stoneturn Consultants
TVAT. Tank Vapor Assessment Team
TVIS. Tank Vapor Information Sheet
VCZ. Vapor Control Zone
VTP. Ventilation Tank Primary
WRPS. Washington River Protection Solutions

1. SUMMARY

Review Finding:

This review was performed based on a plan prepared by WRPS in accordance with a systematic approach proposed by our team.

We concur with the plan WRPS has proposed, provided that it is carefully implemented.

In our first report (dated December 11, 2016) we established that a decision to use air-purifying respirators (APR) cannot rely only on the cartridge test results, because there is insufficient testing evidence to make a generalizable finding about cartridge breakthrough.

This WRPS proposal documents that with enhanced engineering, exposure risks have been significantly reduced in the AP Tank Farm. This will be combined with administrative controls to assure that FFAPRs are only used in non-waste intrusive areas and during non-waste disturbing activities, and when used, will be coupled with continued source, area, and personal exposure monitoring. The source, area and personal sampling data presented to us –although not comprehensive -- are within the performance limits of the proposed FFARP and cartridges provided that they are used within an appropriate respiratory protection program where a conservative change-out schedule is followed and workers have the option of using more protective equipment. For details on our assessment see section 4 of this report.

Way Forward:

We encourage WRPS and HAMTC to pursue an agreement to adopt respiratory protection using FFAPR with SCOTT 7422-SC1 and 7422-SDI cartridges in certain areas of the AP Tank Farm where the potential for exposures to vapors and gasses appear to be maintained well below occupational exposure limits (OELs).

As a condition for STC accepting the WRPS proposal, WRPS agrees to implement a comprehensive exposure monitoring strategy which will be developed concurrently with the adoption of FFAPRs in the AP Tank Farm. The basis for this strategy is presented in Section 5 of this report.

It is very important to document all exposures, even if monitoring does not detect any hazardous exposures, in order to assure workers and other stakeholders about the robustness of WRPS's respiratory protection program.

***These are preliminary findings. We reserve the right to amend them as more information and testing data become available*.**

Caution about Possible Odor Breakthrough:

Implementation of respiratory protection using FFAPRs should be accompanied by careful environmental and personal monitoring for applicable chemicals of potential concern (COPCs). This is important to assure that exposures are kept below OELs, since even under these conditions it is possible to experience breakthrough concentrations exceeding odor thresholds for various COPCs. This personal monitoring will also provide a better understanding of exposure potential.

Any breakthrough of odors should represent minimal concentrations of COPCs and *should not represent a health hazard* to workers. Before FFAPRs are put into practice, this condition should be communicated clearly to workers and other stakeholders. Workers should be trained that (1) if they smell an odor they should leave the area immediately and change out their cartridges, and (2) if they consider this a concern they can voluntarily chose to use a more protective RPD. For more on this, see section 4.1.

2. BACKGROUND

2.1 Introduction

A Memorandum of Agreement was established between WRPS and HAMTC dated August 31, 2016, which called for an independent review of the testing of respirator cartridges conducted by WRPS and PNNL. HAMTC selected CPWR as its independent reviewer and CPWR in turn asked STC to take the lead on the review with support from CPWR. This arrangement was agreed to by HAMTC, and STC assembled a team of leading national subject matter experts to conduct the review. The review was done under a contract between STC and WRPS, in which WRPS had no control over the technical work.

Because of complaints from workers about adverse health effects associated with work in the Hanford Tank Farms, in the spring of 2016 HAMTC called for a stop work order, and as a result the WRPS implemented a program where all workers in the Tank Farms would work using supplied air, self-contained breathing apparatus (SCBA) until a better respirator (RPD) alternative could be found.

2.2 Selection of APR Cartridge Respirators as Alternatives to SCBA

The initial alternative selected was tight-fitting non-powered air-purifying respirators (APRs). APRs rely on chemical cartridges or canisters that contain sorbents (e.g. activated or impregnated carbon) to remove gases and vapors from the air. In order to determine whether an air purifying RPD approach will work, WRPS selected two cartridges – SCOTT 7422-SC1 and SCOTT 7422-SD1 for initial testing. These were selected because they are compatible with the same full facepieces that workers are currently wearing with NIOSH-approved SCBA. The SCOTT 7422-SD1 has a P100 high-efficiency particulate filter in front of sorbents including activated and impregnated carbons. The P100 filter prevents particles from going through the cartridge while the sorbents remove gasses and vapors. The SCOTT 7422-SC1 does not include the particulate filter and relies solely on cartridge sorbents for removal of gasses and vapors. WRPS hired PNNL to help develop a testing strategy and instrumentation and a protocol for analysis of the data resulting from the testing.[1]

WRPS tested the cartridges in each of the eight double shell tank farms, by placing them in or on top of a vent which releases vapors and gases from the tanks or by drawing such vapors and gasses directly from the tank head spaces, to see if the cartridges prevent vapors and gases known to pose potential health risks (known as Chemical of Potential Concern – COPC) from breaking through over the span of a defined period of time.

2.3 Relevant Findings from our Initial Report on Cartridge Testing in the AP Tank Farm

[1] NPPL. Industrial Hygiene Sampling and Analysis Plan for Respirator Cartridge Testing. TFC-PLN-168, Rev A, June 16, 2016.

One of these tests – in the AP Tank Farm – has been completed, and our review of this test found that: [2]

> "*The method used for testing of cartridges and their measured performance is acceptable for the conditions and exposures at the time of testing in the AP Tank Farm Primary Exhauster Slipstream. However, more testing is needed to determine the performance of the cartridges before they can be applied in respiratory protection in the Tank Farms."*(p.5)
>
> *…*
>
> *"WRPS has not made clear where within the AP Tank Farm use of respiratory protection utilizing the tested cartridges is intended to replace use of self-contained breathing apparatus (SCBA). Consequently, we have no way of assessing whether the proposed chemical cartridge respirators will be sufficiently protective. A precautionary respiratory protection program may require use of SCBA within a defined vicinity near any venting source and during any work activity that may release chemical vapors."* (p. 5)
>
> *…*
>
> *"**4.7 Protection under Real Life Working Conditions***
>
> *We agree that the reliance on SCBA is a solution to be relied on only when a hazard assessment indicates that level of respiratory protection is required. Although very limited in terms of data at this time, the **initial cartridge test results suggest it may be possible adopt the use of APRs with the cartridges tested to manage risks in various locations within the AP Tank Farms**.*
>
> *However, "suggested findings" is not a sufficient standard on which to base the decision to adopt APR. Before that is done, more testing data are needed to provide WRPS and HAMTC a **sufficiently strong evidence base and professional judgement to mutually agree on the assessed risks, protective measures to manage those risks under specified conditions and the type of monitoring that is need to accompany such a transition**."*(p.14)
>
> *…*
>
> ***"5.1 Prerequisites for Moving Towards Negative Pressure Respiratory Protection***
>
> *At the present time, there is insufficient testing data to make these determinations.*
>
> - *A careful delineation of areas where SCBAs are mandatory and areas where APRs are to be used (with the option of still using SCBA being voluntary), much like in RadControl there are 'radiation' and 'high radiation' areas*." (p 14)

2.4 The Basis for This Report

On December 14, the STC Project Director participated in a conference call at the request of WPRS safety and health management. WRPS wanted adopt FFAPR respiratory protection in certain "non-active" areas of AP 10 Tank Farm during periods when no "disturbing work" was

[2]Third Party Qualified Independent Review: Hanford Tank Farm Respirator Cartridge Testing. Report No 1: Review of: Nune SK, Liu J, Freeman CJ, Brouns TM. Analysis of Respirator Cartridge Performance Testing on a Hanford AP Tank Farm Primary Exhauster Slipstream. Pacific Northwest National Laboratory, PNNL 25860, September 2016. Stoneturn Consultants, December 11, 2016. http://hanfordvapors.com/wp-content/uploads/2016/12/STC-Respirator-Cartridge-Testing-Assessment-Report-No-1_V-6.pdf

taking place, and asked if our Assessment Team might consider an expedited review of a proposal to do so. STC offered to include this request in a conference call that had already been scheduled for December 20 if WRPS could submit a reviewable proposal sufficiently in advance to allow an adequate review, and provided that HAMTC had no objection to this approach. On December 15, 2016, the STC Project Director discussed the WRPS request in a conference call with the President of HAMTC, who had no objections to it.

Due to the improvised approach to this review, **this report should be considered to be preliminary and potentially subject to change as we obtain more information**.

3. HOW THIS REVIEW WAS CONDUCTED

This review was based on the following evidence:

- An email from Kenneth Way, Manager, Industrial Hygiene, WRPS, dated December 19, 2016 that included an undated draft document entitled "Use of Scott Air Purifying Respirator Cartridges 7422-SC1 and 7422-SD1 in low risk AP Farm work activities" and the following attachments:
    - Use of SCOTT Air Purifying Respirator in AP Farm
    - AP Farm Area and Source Sampling Data
    - AP Farm Personal Sampling Data
    - TVISAP 001
    - Respiratory Protection Form
- This evidence was discussed in a team conference call on December 20, and the Team determined it was un-attributable and therefore not verifiable and could not form the basis for a review.
- SCOTT Changeout Calculations SMFM1743816120110540, received via email from Kenneth Way on December 20, 2016 (after our Team conference call on that day).
- A conference call between WRPS executive and OSH management staff and the STC Project Director on December 22, 2016, resulted in WRPS submitting this additional information:
    - WRPS Tank Vapor Information Sheet (TVIS AP-001)
    - Respiratory Protection Form (A-6005-593 (REV 4))
    - Respiratory Protection Form Instructions (A-6005-593i (REV 4))
    - DOE. Hanford Site Respiratory Protection Program http://www.hanford.gov/files.cfm/Hanford_Site_Respiratory_Protection_Program_DOE-0352.pdf
    - WRPS. Industrial Hygiene Sampling Plan. (A600-732 (Rev 3))
    - WRPS. Respiratory Protection. (TFC-ESHQ-S_IH-C-05, REV G-10)
    - Respirator Issuance and Control. (USQ # GCX-2)
- Our Team determined this information was not submitted in a coherent whole suitable for a formal review, and submitted an additional list of questions to WRPS on December 26, 2016. This list is in Attachment 2.
- On December 29, a conference call was held between WRPS executive staff and STC Project Director to see if the review could be expedited. It was decided to schedule a Team visit to meet with WRPS and make a visual inspection of the AP Tank Farm on

January 17-18. The STC Project Director informed the HAMTC President of this plan, who had no objections to it.

- Responses to these questions were provided in an email from Robert Cantwell of WRPS on January 6; however, the information provided could not be verified by the Review Team and was considered unreviewable.
- These issues were discussed in a conference call between WRPS executive staff and the STC Project Director on January 6.
- In preparation for the meetings in Richland, on January 8 the Team submitted a briefing document to WRPS, which is in Attachment 3.
- The Team members who participated in the visit to Richland included Dr. Knut Ringen, Project Director, Dr. Howard Cohen, SME, Dr. James Johnson, SME, Mr. Richard Metzler, SME and Dr. Bruce Lippy, SME. Due to inclement weather, it was not possible to visually inspect the AP Tank Farm, although we had ample opportunity to meet with WRPS executive and HSE staff. The result of the meetings was the preparation by our team a suggested template to enable WRPS to prepare a reviewable plan for the adoption of APR respiratory protection. This template is in Attachment 4.
- On January 26, we received Document No TOC-IH-58345. Rev. 0, January 24, 2017, which together with the other information we had obtained over the past month, formed the basis for this review.

4. FINDINGS

4.1 A Note on Possible Odor Breakthrough

The PNNL test reports of SCOTT 7422-SC1 and 7422-SDI cartridges issued to date found that a number of the COPCs detected at very low concentrations upstream of the cartridges were detected at similar concentrations downstream and likely reflect that the cartridges were not able to adsorb these low concentrations of COPCs.[3,4]

There is no indication that these low concentrations represent a health hazard as they are below their OELs or allowable occupational exposure limits (AOELs). However, collectively they could conceivably result in an odor detected by the wearer. Further, from what we have heard from both WRPS IH staff and from worker representatives in the Tank Farms, there are no reports that odors have been detected when FFAPRs have been used.

Nevertheless, the possibility of this occurring should be taken seriously to prevent undermining of the defense-in-depth intent of WRPS's respiratory protection program. Therefore, before the FFAPRs are put into use, a communications plan to ensure that both workers and other stakeholders understand this possibility should be carefully implemented.

[3]Nune SK, Liu J, Freeman CJ, Brouns TM. Analysis of Respirator Cartridge Performance Testing on a Hanford AP Tank Farm Primary Exhauster Slipstream. Pacific Northwest National Laboratory, PNNL 25860, September 2016
[4]Nune SK, Liu J, Freeman CJ, Brouns TM, Mahoney LS. Analysis of Respirator Cartridge Performance Testing on Hanford Tank SY-102. Pacific Northwest National Laboratory, PNNL 26041, November 2016.

4.2 Section 1: Summary

The proposal that WRPS submitted to us for review was summarized as:
"Testing results from cartridge testing in the AP Farm stack, comparison with manufacturer calculator, and reasonable limiting conditions of use provide an opportunity for Washington River Protection Solutions (WRPS) personnel to use an air purifying respirator during low hazard, non-waste intrusive, and non-waste disturbing work activities where engineered controls are in place and functional in the AP Tank Farm." (TOC-IH-58345. Rev. 0, p.1)

We find that this proposal is **acceptable** provided that it is understood that it is based on a combined consideration of engineering and administrative controls, cartridge test results, low risk activities, properly functioning and fitted SCOTT FFAPR with SC-1 or SD-1 cartridges, and a conservative change-out schedule. *In other words, we could not base this determination on the cartridge test results alone. The testing that has been performed is limited to cartridge performance, and should not be interpreted to infer respiratory protection. Protection comes from using respirators following the overall respiratory protection program.*

Further, this finding is conditioned on WRPS taking into account detailed conditions discussed below. If coupled with enhanced area, source, environmental, and personal monitoring, as presented in section 5 of this report, the WRPS proposal provides adequate documentation on hazard assessment; engineering and administrative controls; cartridge testing to support its proposal to use FFAPR. Each of these conditions are discussed below.

4.3 Section 5: Hazard Assessment

According to the Hanford Site Respiratory Protection Program, "An APR shall only be used where the hazard has been identified and an exposure assessment has been completed and documented." [5]

The proposal documents that worker exposures are maintained below OELs with the use of engineering and administrative controls. WRPS demonstrated this with personal and area exposure samples compared against source and source environmental data. The cartridge testing is a means to demonstrate that if the worker exposures were unexpectedly as high as the AP Farm exhauster, and workers were wearing an appropriate SCOTT FFAPR equipped with a SC-1 or SD-1 cartridge they would still be protected (up to a hazard exposure reduction of 50 times) for a given service period. WRPS indicated that the head space/exhauster concentrations were used *"to bound such an exposure concern."* [TOC-IH-58345. Rev. 0, p. 2, 5th paragraph]

4.4 Section 6: Implementation of Hazard Controls

Engineering Controls
In the AP Farm, build-up of head space gasses and vapors are controlled through active ventilation, with a single exhaust point. Since the cartridge test was performed in the AP Tank

[5]DOE. Hanford Site Respiratory Protection Program, p. 20.
http://www.hanford.gov/files.cfm/Hanford_Site_Respiratory_Protection_Program_DOE-0352.pdf

Farm Slipstream Exhauster in June, 2016, two important engineering controls have been adopted. First, the height of the exhauster has been extended from 20 feet to 40 feet. Second, the flow-rate of ventilation has been increased from 850 cubic feet per minute (cfm) to 1,500 cfm. The effect of these changes is to significantly reduce the concentration of chemicals in the effluents that are exhausted through the stack. Consequently, the current potential for exposures is greatly reduced compared to the concentrations that were present when the cartridge test took place, and the results from those tests are therefore more conservative today than they were in June.

A redundant stack exhaust system has been installed which can be activated if the primary stack fails or needs maintenance.

Administrative Controls
A Ventilation Tank Primary (VTP) system is monitored by the Shift office and if the ventilation fails the farm area is evacuated.

A Vapor Control Zone (VCZ) has been clearly defined in the vicinity of the exhauster where use of SCBA will continue to be mandatory. Likewise, the area where FFAPRs will be adopted has also been clearly delineated, and FFAPRs will only be used in in that area during non-disturbing periods.

WRPS has used the combination of the cartridge test results and the SCOTT manufacturer's change-out calculator for ammonia to determine cartridge service life. We find the approach it has taken to be conservative.

The option to allow workers to continue to use SCBAs if they chose to do so has been clearly described.

Professional Judgment
With these conditions, we agree that the approach to respiratory protection provides a conservative safety factor.

4.5 Section 7: Implementation of Respiratory PPE in AP Tank Farm

WRPS provided Tank Vapor Information Sheet (TVIS) for the AP Tank Farm (TVIS-Ap-001), attachment 7, identifying similar exposure groups (SEG) for SEG 1, 2, 3, and 4. SEG 1 and 2 represent general tank farm entry with no VCZ entry appropriate for intended use of APRs in accordance with documented plans. SEG 3 and 4 represent higher potential for chemical vapor exposure consistent with the required use of SCBA in accordance with documented plans.

WRPS needs to clarify SEG-2 in terms of what is meant by *"intrusive activities with controlled or restricted pathway."* [TOC-IH-58345. Rev. 0, p. 8]

WRPS should add an item to the Pre-implementation Actions listed on pp. 9-10 addressing communication about possible odor breakthrough. (See 4.1, above)

4.6 Section 8: Monitoring

The WRPS proposal describes plans for source, area and personal monitoring in general terms. WRPS agrees that such monitoring needs to be strengthened. A recent report from the DOE Office of Worker Safety and Health Assessment describes a number of concerns about WRPS's *Industrial Hygiene Exposure Assessment Strategy Procedure* (TFC-PLN-34) which we agree with.[6] To assure that strengthened monitoring is implemented concurrently with the adoption of FFAPR in the AP Tank Farm, we have set out specifications for such monitoring in Section 5 of this report. We consider these specifications to a precondition for our approval of WRPS's proposal.

4.7 Section 10: Engagement with Workforce and Other Stakeholders

We reiterate the importance a focused communications effort on two levels (to include possibility of odor breakthrough):

- For all employees, possibly through required training, aimed specifically at providing rationale and assessment supporting the permissible use of FFAPR under the conditions of this proposal could be a great benefit and might build trust.
- For stakeholders and public communications, the pre-release PowerPoint presentation materials we reviewed in Richland on Jan. 17 were very informative. WRPS should consider updating this presentation to add rational and assessment supporting FFAPR use in AP Farm under the conditions of this proposal.

5. WAY FORWARD

As a condition for STC accepting the WRPS proposal the following actions must be implemented concurrently with the adoption of FFAPRs in the AP Tank Farm, and then continuously monitored, and reported quarterly.

1. **Accelerate development and implementation of an updated IH exposure assessment strategy** that is protective of worker health and establishes stakeholder confidence in the results for acute as well as chronic exposures that might result from short duration high concentration exposures. (Reference TVAT OR 4)
    a. The WRPS Industrial Hygiene Exposure Assessment Strategy Procedure (TFC-PLN-34) will be updated to provide guidance on when and how to document an exposure assessment consistent with the American Industrial Hygiene Association (AIHA) publication A Strategy for Assessing and Managing Occupational Exposures (a referenced document in TFC-PLN-34, REV E-6).
    b. The strategy must include a program of regular sampling with defined durations (e.g. performed twice per shift), and
    c. Monitored results for VOCs, ammonia, and mercury will be reported to the workforce in the daily report.

[6]Office of Worker Safety and Health Assessments, Office of Environment, Safety and Health Assessments Office of Enterprise Assessments, U.S. Department of Energy. Follow-up Assessment of Progress on Actions Taken to Address Tank Vapor Concerns at the Hanford Site. January 2017, pp B9-B10.

2. **Source, area, and personal sampling**
    a. The industrial hygiene sample plans for SEG 1 and SEG 2 (EABO-11047, EABO-11001) will be updated to require IHT monitoring and sampling for every different type of work activity where FFAPRs are used. The data will be recorded and analyzed as gathered to assure that COPCs remain below 10% of the OEL.
    b. Real-time source (stack) concentrations will be sampled in a manner such that the relationship (if any) with area and personal samples are established.
    c. The aggregate of all sampling can be assessed to assure the effectiveness of engineering controls, worker exposures remain below 10% of the OEL, cartridge change schedules are effective, and compared with any periods of odor reports.
    d. At the end of the first quarterly period, initiating with the first use of FFAPR in the AP Tank Farm, WRPS will produce an assessment report providing the data, its analysis, and describe the use of the data for making any adjustments related to the use of FFARPs, and sampling requirements.

The updated sampling strategy coupled with on-going sampling of source, area, and personal samples enables a continuous review and assessment required to support effective protection practices and timely adjustments, if needed, to industrial hygiene program. This level of monitoring should be implemented with the start of FFAPR use in the AP Tank Farm, continue through the first quarter, and shall be reassessed after the first quarter of implementation. An on-going analysis of the data may be used during the period to add enhancements. However, no reductions to the sampling activities will be made during that first quarter. A comprehensive report will describe the relationships of the data and present an assessment with appropriate recommendations. The STC team will independently review the report and provide appropriate findings and recommendations.

These recommendations will build worker confidence that engineering, administrative controls, sampling strategy and monitoring, and use of FFAPR provide effective protection for workers in the AP Tank Farm.

6. CERTIFICATION

I certify that this is a true description of the process and findings of this Review, and that all participating members of the Review Team were in unanimous agreement. Due to scheduling conflicts, Dr. James Platner did not participate in the latter part this review.

_____ Date: January 31, 2017.

Knut Ringen, DrPH, MHA, MPH
Project Director

Attachment 1
REVIEW TEAM

Project Director

Knut Ringen, DrPH, MHA, MPH, Project Director
Dr. Knut Ringen is a principal in Stoneturn Consultants, located in Seattle, WA. He is also the Senior Science Advisor, CPWR: The Center for Construction Research and Training (www.cpwr.com) in Washington, DC, which is a global leader in construction safety and health research, and for which he served as founding director. He has also held senior appointments at the U.S National Academy of Sciences, where he served as study director on major scientific reviews, and the National Institutes of Health.

He chairs the Scientific Committee on Occupational Health in the Construction Industry, International Commission on Occupational Health (ICOH); and is Vice President, Construction Section of the International Social Security Association (ISSA). He was Chairman, Department of Labor's National Advisory Committee on Construction Safety and Health from 1993 to 1997. He is an elected Fellow of the European Academy of Sciences and the Collegium Ramazzini. He received a master degree in health administration from the Medical College of Virginia (now part of VCU) and master degree and a doctorate degree in public health from Johns Hopkins University.

Over the years he has led a number of programs that have made significant changes in safety and health policies in the US and internationally, especially in the construction industry. Since 1996 he has also led an effort to evaluate the health of older construction trades workers in America's nuclear weapons facilities, including over 4,300 former Hanford workers, of whom more than 500 have had experience in the Tank Farms after 1995.

In 2011, the Secretary of Energy's Blue Ribbon Commission on America's Nuclear Future commissioned him to conduct an assessment of the state of safety and health throughout the civilian nuclear fuels cycle, and compare it to other sources of energy, including fossil/hydrocarbon fuels and alternative sources of energy. He has served on a number of National Academies Committees to review respiratory PPE requirements including Committee on Personal Protective Equipment in the Workplace; Committee to Review the NIOSH Personal Protective Technology Program; Committee for the Assessment of the NIOSH Head-and-Face Anthropometric Survey of U.S. Respirator Users.

STC Subject Matter Experts

Howard J. Cohen, PhD, CIH, Subject Matter Expert
Dr. Cohen is located in New Haven, CT. He has worked in industrial hygiene for 40 years, of which the first 17 years for Monsanto and Olin Corporations, and then switching to an academic career at University of New Haven and Yale University. He is widely recognized for his

expertise in the administration of respiratory protection programs and in carbon chemistry used in respirator cartridges and canisters. He has served on many National Academy Committees in the area of personal protective equipment, and was chair of the 2010 Certification Study of Personal Protective Technology. He is a current member of the Committee on Personal Protective Equipment in the Workplace. He has been chair of the ANSI Z88.2 Committee on Respiratory Protection. He has received numerous professional awards for his work. He received his master degree and PhD in industrial health from the University of Michigan.

James S. Johnson, PhD, CIH, QEP, Subject Matter Expert
Dr. Johnson is a nationally recognized respirator subject matter expert who is located in Pleasanton, CA. He has been involved in wide variety of respirator research and program topics such as hazard assessment, proper selection, filter and cartridge performance, fit, fit testing, maintenance, storage and disposal. Before retiring from full-time employment in 2006, he worked in the occupational safety and health program at Lawrence Livermore National Laboratory for 45 years. Since then he has worked as private consultant to government and private sector clients. He also directs, manages and participates on several national consensus standards, e.g. ANSI/ASSE Z 88 on Respiratory Protection and NFPA Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment. He has served on numerous national consensus development and review committees that have driven development of PPE technologies and programs in the US, including the National Academies' Standing Committee on Personal Protective Equipment for Workplace Safety and Health, 2009-2014. He earned a BA in chemistry, a MSH in air pollution and industrial hygiene, and PhD in organic and inorganic chemistry.

William H. Kojola, MS, PhD (ABT), Subject Matter Expert
Bill Kojola retired from full-time employment in 2013. He is an industrial hygienist with more than 40 years of professional experience. He is currently an industrial hygiene consultant to CPWR: The Center for Construction Research and Training, and he is a member of the National Academies' Committee on Personal Protective Equipment in the Workplace. He has served as Industrial Hygienist for the AFL-CIO (1998-2013); Director of Occupational Safety and Health, Laborers Health and Safety Fund of North America (1990-1998); Occupational Safety and Health Specialist, International Brotherhood of Boilermakers (1982-1998); and several other positions. He has served on numerous national expert committees, including the Board of Scientific Councilors of the National Institute for Occupational Safety and Health. He recently served as expert reviewer on the National Academies' *The Use and Effectiveness of Powered Air Purifying Respirators (PAPRs) in Health Care.* He has a BS in biology (cum laude) and MS in genetics from the University of Minnesota, and did doctoral studies in toxicology and industrial hygiene at the University of Illinois.

Ricard W. Metzler, MSIE, Subject Matter Expert
Rich Metzler has 39 years of experience directing, managing, and performing assessment activities in the field of occupational safety and health in conformance with National Institute for Occupational Safety and Health (NIOSH) and Mine Safety and Health Administration (MSHA) respiratory protective device (RPD) and mining equipment Federal regulations, Occupational Safety and Health Administration (OSHA) and National Fire Protection Association (NFPA) personal protective equipment and RPD regulations and standards. Experience includes scientific

research and engineering investigations related to product safety standards, laboratory, and field product evaluations including investigations related to product conformance, injuries, or fatalities. Experience includes more than 35 years directing Federal product approval, certification, and research programs including the supporting laboratories. This experience includes both leadership skills and engineering expertise with national and international respiratory protective device design, performance, quality and reliability standards and associated test procedures

CPWR Subject Matter Experts

Bruce Lippy, PhD, CIH, CSP, FAIHA, Director of Safety Research, CPWR, Subject Matter Expert

Dr. Lippy began his career in industrial hygiene in 1978 working for Maryland OSHA, where he routinely trained workers, union groups and contractors about respiratory protection. He was certified in the comprehensive practice of Industrial Hygiene in 1985 (#3023) and as a Safety Professional in 1992 (#11472). He is a member of the National Response team and served at the cleanup of the World Trade Centers. During his two months at the site, he provided hundreds of respirators to the heavy equipment operators on the pile and taught them proper donning, doffing and cleaning of the respirators. He also worked with NIOSH to determine breakthrough of carbon cartridges on the site. He was a co-director and safety officer of the sampling team that opened the anthrax-contaminated AMI Building in Boca Raton, Florida. His duties there included quantitatively fit testing the team members and workers on the site, all of whom wore full-face powered air purifying respirators. As Director of Special Projects with the Operating Engineers National Hazmat Program, he led several teams evaluating innovative personal protective equipment for the Department of Energy, including a level B ensemble that uses liquid air to supply breathing gas and cooling to a garment for over an hour. Under a grant from the Department of Homeland Security, Dr. Lippy created and delivered training to a broad range of responders who would have to put down an Avian Influenza outbreak among poultry in the midwest. He was responsible for the training on proper respiratory protection in the various scenarios. He has spent hundreds of hours wearing respiratory protection on a wide variety of industrial and disaster worksites. Dr. Lippy was awarded a Distinguished Fellow of the AIHA at the 2015 annual conference.

James W. Platner, PhD, MS, CIH, Subject Matter Expert

Jim Platner is located in Annapolis, MD. He served as CPWR's Associate Director for Science & Technology for 16 years before he retired in 2015, following a long career at Cornell University's Industrial and Labor Relations Program, where he was the director of the Occupational Safety and Health Extension Program. He is the co-chair of CPWR's Institutional Review Board for the Protection of Human Subjects in Research, and in addition to his industrial hygiene qualifications, he adds a concern about the ethics of respiratory protection to the team. He has served on a very large number of National Advisory Committees including the National Academies' Committee on Personal Protective Equipment in the Workplace and Committee on Certification of Personal Protective Technologies and on the Board of Scientific Counselors of the National institute for Occupational Safety and Health. He serves as current Chair of the ASTM/SEI Committee on Certification Programs and prior to their merger with ASTM was Chair of the Safety Equipment Institute (SEI) Board of Directors. SEI, which is now a

subsidiary of ASTM International, provides third party certification of personal protective equipment. He received his undergraduate degree in biophysics from Johns Hopkins University and master degree and doctorate degree in radiation biology and toxicology from the University of Rochester Medical School and qualified for the CIH in 1989.

Liaison with HAMTC

Erich J (Pete) Stafford, BS, Former (Ret.) Executive Director, CPWR
Pete Stafford was Executive Director of CPWR – The Center for Construction Research and Training, and also Safety and Health Director for North America's Building Trades Unions, until Dec 31,2016, when he retired after 25 years of service at CPWR. Mr. Stafford has over 30 years of experience in construction safety and health, serves on many construction industry advisory boards and committees, and is the current Chair of OSHA's Advisory Committee on Construction Safety and Health (ACCSH).

Attachment 2:

Additional Questions about Plan to Adopt APR in AP Tank Farm

Submitted to WRPS by Third Party Independent Qualified Review

December 26, 2016

Questions about the Rationale for Adopting use of APR Respirators in the AP Tank Farm

- Was the hazard assessment you used to justify APRs based on the area and personal sampling data you sent us or did you rely on additional historic or current data?
- Were any area or personal samples taken at times in the past when disturbing activities were taking place in the AP Tank Farm, and if so, what were they?
- What is meant by "non-intrusive' limiting conditions?
- Exactly how do you plan to demarcate the “zone” where APRs are permissible?
- What is the shortest distance at any point between the “APR Zone” and any tank venting source in the AP Farm?
- Historically, has there been any report of or complaints about occurrence of high-concentration, short-term vapor plume releases in the AP Farm (what the TVAT report called “bolus” exposure), and if so, when did they take place?
- Have you conducted any air dispersion studies of the AP farm (similar to the study Droppo made in 2004—See PNNL 14767)?
- Why did WRPS select ammonia as its "indicator chemical" for computing the recommended change-out schedule in a situation where there is the potential for multiple chemical exposures?
- Why is the concentration for ammonia of 68.2 ppm that was identified by PNNL in its test of the AP exhauster slipstream on June 24-26, 2016 used as the basis for the computing the manufacturer's change-out recommendation as opposed to the maximum historical ammonia exhauster slipstream concentration of 477% of the OEL (119.25 ppm)?
- In calculating the cartridge change-out why did you not consider NDMA as an indicator chemical and using its maximum historically measured concentrations in area samples of more than 63 times the OEL (as late as on 3/26/2016 it was measured at more than 15 times the OEL according to the area sampling data you provided us)?

Additional Questions about your Respiratory Protection Program Plan for AP Tank Farm

<u>AP Tank Farm Respiratory Protection Program</u>

We have seen various documents related to respiratory protection programs and procedures, including the site wide respiratory protection program and the WRPS respiratory protection program dated Dec 12, 2016, but they are generic and applicable to any operation. We have not seen an administrative plan to support use of the AP respiratory protection that is specific to the AP Tank Farm. Such a plan would cover work activities, work initiation, IH program responsibilities, medical evaluation, training, access control, control zones, engineering controls, use of PPE including respirators, source assessment, area monitoring, personal monitoring, enforcement of controls and worker complaints.

- If these questions aren’t answered in an overall work control document please put together a road map that lists these topics and what existing documents address these subjects. Please identify where the documents you have provided fit into this road map.

Personal Sampling Data

We need more details on the IH Personal Air Sampling Summary Counts by Limit Type.

- We are looking for representative personal sampling sheets that describe the work, the location, work environment, how sample was collected, blanks, who did the analysis, laboratory certification, and how the data was entered into the data base provided. Exemplar data sheets will be very useful to help us understand your process.
- The personal sampling data you provided us covers dates ranging from 5/14/2004 – 9/28/2016. How has the environment, workforce, controls, contractor, engineering controls, administrative procedures, etc. changed that would impact data comparison and analysis for hazard assessment? Please provide us with your most current sampling data and supporting paperwork.
- What is the personal sampling plan for 2017?

Area Sampling Data

- For the AP Farm Area data sampling data more information is needed from original sampling sheets that describe the work activities around the area samplers, how the samples were collected, type of samplers, blanks, who did the analysis, laboratory certification, and how was the data entered into the data base provided? Exemplar data sheets will be very useful to help us understand your process.
- The area sampling data you provided us covers dates ranging from 5/26/2005 – 4/28/2016. How has the environment, workforce, controls, contractor, engineering controls, administrative procedures, etc. changed that would impact data comparison and analysis for hazard assessment? Please provide us with your most current area sampling data and supporting paperwork.
- What is the area sampling plan for 2017?

ATTACHMENT 3

Third Party Independent Qualified Review
Hanford Tank Farm Respiratory Cartridge Testing and Application

Background Document for Discussion of Plan to use APRs in AP Farm
Provided to WRPS in Preparation for meetings on January 17-18, 2017
Submitted to WRPS on January 8, 2017

Summary

On December 14 we were asked by WRPS to review a plan to adopt use of APRs in some parts of the AP Tank Farm. Our challenge in reviewing what has been provided is that it has been released in discrete and unconnected pieces in a sequence that does not build into a clear and coherent whole for us.

Given we can only make findings based on the evidence that is presented to us, we have had difficulty completing what should be a straight- forward review. Consequently, we encourage WRPS to prepare a formal implementation plan, with an assigned document number and sign-off by those who are responsible for it. This document should be comprehensive and fully justified by either supporting data or carefully stated professional opinion.

This is not a trivial suggestion. If WRPS management cannot clearly communicate to us what is being planned and provide complete support for those decisions, then effectively communicating it to the workforce, unions and other stakeholders will prove difficult.

We think it is important that WRPS gets past a dual mindset that it has communicated to us many times. On the one hand, we hear that from a technical IH risk perspective, the empirical data support that no respiratory protection is required for entry into and routine work within the AP Tank Farm. We do not think this is a helpful perspective, since it is evident that workers have gotten sick from something that most likely emanates from the tanks episodically, but has not been captured by existing monitoring systems, and may not yet be fully controlled.

On the other hand, we sense that WRPS has taken this risk very seriously, and addressed it in a systematic and logical way, by trying to determine if APR cartridges will stand up to exposure levels found at the source, and if so for how long before breakthrough occurs. It has then developed what appears to be a conservative change-out schedule for the cartridges. Further, we have been told it has made several improvements in administrative and engineering controls to reduce potential for future exposures (e.g., respiratory protection zones/VCZs have been specified; APRs are to be used only in inactive areas and during times when no disturbances take place; vent stacks have been extended to promote diffusion of vapors; area and personal monitoring has been improved). We believe the evidence supporting these statements exists, but not in a single, organized document.

Relevant Findings from our Initial Report on Cartridge Testing in the AP Tank Farm

In our review of the AP Tank Farm Cartridge Test we made several observations that form the basis for considering if APRs could be used: [7]

> "*The method used for testing of cartridges and their measured performance is acceptable for the conditions and exposures at the time of testing in the AP Tank Farm Primary Exhauster Slipstream. However, more testing is needed to determine the performance of the cartridges before they can be applied in respiratory protection in the Tank Farms."*(p.5)
>
> *…*
>
> *"WRPS has not made clear where within the AP Tank Farm use of respiratory protection utilizing the tested cartridges is intended to replace use of self-contained breathing apparatus (SCBA). Consequently, we have no way of assessing whether the proposed chemical cartridge respirators will be sufficiently protective. A precautionary respiratory protection program may require use of SCBA within a defined vicinity near any venting source and during any work activity that may release chemical vapors."* (p. 5)
>
> *…*
>
> *"**4.7 Protection under Real Life Working Conditions***
> *We agree that the reliance on SCBA is a solution to be relied on only when a hazard assessment indicates that level of respiratory protection is required. Although very limited in terms of data at this time, the **initial cartridge test results suggest it may be possible adopt the use of APRs with the cartridges tested to manage risks in various locations within the AP Tank Farms**.*
> *However, "suggested findings" is not a sufficient standard on which to base the decision to adopt APR. Before that is done, more testing data are needed to provide WRPS and HAMTC a **sufficiently strong evidence base and professional judgement to mutually agree on the assessed risks, protective measures to manage those risks under specified conditions and the type of monitoring that is need to accompany such a transition**."*(p.14)
>
> *…*
>
> ***"5.1 Prerequisites for Moving Towards Negative Pressure Respiratory Protection***
> *At the present time, there is insufficient testing data to make these determinations.*
>
> - *A careful delineation of areas where SCBAs are mandatory and areas where APRs are to be used (with the option of still using SCBA being voluntary), much like in RadControl there are 'radiation' and 'high radiation' areas*." (p 14)

Issues the Implementation Plan Should Address

If the following topics are addressed in an organized manner in a single document with the rationale and supporting evidence, our team should be able to quickly draft a report on our findings and recommendations associated with the WRPS proposal to use APRs in the low risk AP Farm VCZ under the stipulated conditions. We hope WRPS can provide this document prior to our travel to Richland on January 16, and during our visit we encourage WRPS to deliver a thorough briefing on these topics.

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[7]Third Party Qualified Independent Review: Hanford Tank Farm Respirator Cartridge Testing. Report No 1: Review of: Nune SK, Liu J, Freeman CJ, Brouns TM. Analysis of Respirator Cartridge Performance Testing on a Hanford AP Tank Farm Primary Exhauster Slipstream. Pacific Northwest National Laboratory, PNNL 25860, September 2016. Stoneturn Consultants, December 11, 2016. http://hanfordvapors.com/wp-content/uploads/2016/12/STC-Respirator-Cartridge-Testing-Assessment-Report-No-1_V-6.pdf

1. Hazard assessment
    a. WRPS will present evidence/data and other professional assessments with rationale to define its hazard assessment.
    b. WRPS will present its data and assessments on how exposures will be kept below 50 times the OEL in the VCZ where it is proposed that workers use APRS, given the historically high tank/exhauster concentrations that have exceeded this level.
2. Engineering controls
    a. WRPS will describe the engineering controls at the AP Farm.
    b. WRPS will present evidence/data and other professional assessments with rationale as to the effectiveness of the engineering controls.
    c. WRPS will describe on-going monitoring/evaluations of those controls to assure their effectiveness.
    d. WRPS will describe how management and labor are informed and jointly participate in the above topics.
3. Administrative controls
    a. WRPS will describe the administrative controls at the AP Farm.
    b. WRPS will present evidence/data and other professional assessments with rationale as to the effectiveness of the administrative controls.
    c. WRPS will describe on-going monitoring/evaluations of those controls to assure their effectiveness.
    d. WRPS will describe how management and labor are informed and jointly participate in the above topics.
4. Personal and area sampling
    a. WRPS will present its assessment showing the relevance of the data in supporting the engineering and administrative controls.
    b. WRPS will show how the data are connected to the VCZ where APRs will be used.
5. Respirator program (RP)
    a. WRPS will describe how the above topics are addressed in the RP.
    b. WRPS will describe how labor and management will reach a common understanding of the RP.
6. Future Actions in AP Tank Farm
    a. WRPS will describe what topics noted in 1-5 are planned to continue, how will those not continuing be completed/closed out, and what actions will be required for the ongoing actions?

Related Issues

In addition, we propose related topics for discussion which will help us with future reviews.

7. Historic information
    a. What kind of respiratory protection requirements were in place in the AP Farm prior to mandatory SCBA application?
8. Application to other Tank Farms
    a. How will the lessons learned about these topics during implementation in the AP Farm be applied to future work activities at other Tank Farm sites?
9. Building confidence in WRPS' actions

a. How will labor representatives and other relevant stakeholders be involved in these activities to better understand what is being done and to build their confidence in these actions and results?

For questions or clarification about the content of this document please contact Dr. Knut Ringen at 206-696-2224 or knutringen@msn.com.

ATTACHMENT 4

TEMPLATE FOR APR USE
Submitted to WRPS on January 18, 2017

Document number:_____

USE OF FULL FACE AIR PURIFYING RESPIRATORS IN AP TANK FARMS FOR LOW-HAZARD TASKS

1. SUMMARY AND RECOMMENDATION

2. OBJECTIVE

Evaluate and provide recommendation for the use of full face air purifying respirators (FFAPR) for low hazard, non-waste intrusive work tasks within the AP Tank Farm.

3. EFFECTIVE DATES

This plan is in effect from xxxx until xxxxxx

4. BACKGROUND

Why this plan is needed….why SCBA was introduced….problems with SCBA….agreement with HAMTC…available data suggests that APRs can be used in low hazard tasks as a defense in depth against unanticipated exposures

5. HAZARD ASSESSMENT

- **a. Chemical Composition**
- **b. Historic and recent exposure data**
- **c. Professional judgment**

6. IMPLEMENTATION OF HAZARD CONTROLS

- **a. Engineering Controls (Stack height and flow rates)**
- **b. Administrative Controls (Respiratory protection zones/tasks/periods)**
- **c. PPE (justification for APR)**
  - **i. Cartridge testing**
  - **ii. Change-out schedule determination**
  - **iii. Option to use SCBA**

7. IMPLEMENTATION OF RESPIRATORY PPE IN AP TANK FARM

- **a. Technical Basis**
- **b. Respiratory Protection**
  - **i. SCBA**
  - **ii. APR**

c. **Pre-implementation Actions (those listed on p. 6)**

8. **MONITORING (after implementation of APR)**
   a. **Source**
   b. **Area**
   c. **Personal**

9. **REPORTING OF ADVERSE EVENTS (reportable and recordable associated with PPE use)**

10. **ENGAGEMENT WITH WORKFORCE AND OTHER STAKEHOLDERS**
    a. **Employee involvement**
    b. **Communication with Stakeholders**

11. **CERTIFICATION**

ATTACHMENTS