Hanford Challenge

Thank you for the opportunity to comment on the ETF Notice of Construction DE07NWP-003, Rev 2. Please see attached pdf for official comments.

August 24, 2022

Comment submitted electronically
https://nw.ecology.commentinput.com/?id=aStNs

Washington State Department of Ecology
ATTN: Daina McFadden
3100 Port of Benton Blvd
Richland WA 99354

RE: Public Comment on the ETF Notice of Construction DE07NWP-003, Rev 2

Washington State Department of Ecology,

Thank you for the opportunity to comment on the ETF Notice of Construction DE07NWP-003, Rev 2.

Hanford Challenge is a non-profit, public interest, environmental, and worker advocacy organization located in Seattle, WA.[1] Hanford Challenge is an independent 501(c)(3) membership organization incorporated in the State of Washington with a mission to create a future for the Hanford Nuclear Site that secures human health and safety, advances accountability, and promotes a sustainable environmental legacy. Hanford Challenge has members who work at the Hanford Site. Other members of Hanford Challenge work and/or recreate near Hanford, where they may also be affected by hazardous materials emitted into the environment by Hanford. All members have a strong interest in ensuring the safe and effective cleanup of the nation's most toxic nuclear site for themselves and for current and future generations.

Hanford Challenge remains concerned that potentially hazardous working conditions at the waste treatment facility were overlooked by the contractor and the regulators. Secondly, Hanford challenge is concerned that the treatment plan calls for sending ETF waste to an offsite facility (assumption is Perma-Fix Northwest?) to be treated when that waste form will apparently contain very high levels of acetonitrile. Third, we are concerned about the disposal path for this waste. Fourth, Hanford Challenge is concerned that USDOE knew about the acetonitrile issue since at least 2004, but apparently waited until the very last minute to address it with inadequate solutions.

[1] Hanford Challenge mailing address: P.O. Box 28989 Seattle, WA 98118.

Hanford Challenge's comments and questions:

1. **Why did the U.S. Department of Energy ("USDOE") and regulators wait so long to address this acetonitrile issue?** It appears that these issues surrounding acetonitrile were known to USDOE since at least 2004.[2] It is unfortunate that USDOE waited until the last minute to create workarounds like the steam stripper that appear to be insufficient at best and potentially creates a more hazardous working condition. Is there a justification for this delay?

2. **How will DOE Ensure Workers are Protected from Acetonitrile?:** The USDOE surveillance report, "Surveillance of the Washington River Protection Solutions LLC Process Hazard Analysis for Effluent Treatment Facility Acetonitrile Treatment Project, DOE-ASMT-2021-3251, August 27, 2021"[3], highlighted the need for a solution to potential worker exposures to acetonitrile. We appreciate that this surveillance took place and that efforts were made to investigate this worker health and safety hazard after it was identified that it had not been properly evaluated. However, Hanford Challenge believes this surveillance should have had findings and not "opportunities for improvement," because of the omission of significant vapor hazards from acetonitrile that rendered the hazards analysis inadequate to support design. The Permit Modification for ETF should take these opportunities for improvement to heart and ensure that workers are protected.

3. **Why Not Destroy the Acetonitrile?**: It is still unclear to Hanford Challenge why the steam stripper project was selected instead of a treatment technology that oxidatively or catalytically destroys the acetonitrile. We would still like this explained and reconsidered, especially the rationale to concentrate the waste for treatment at Perma-Fix Northwest when acetonitrile is so dangerous in concentrations far smaller than the 23,000 ppm acetonitrile distillate concentration proposed here for treatment.

4. **Do Not Dispose of Acetonitrile at the Integrated Disposal Facility**: We have major concerns with disposing of a concentrated acetonitrile waste form at IDF, due to is explosive and flammable nature. It does not seem worth the risk of starting an underground fire in this landfill, when there are technologies that could destroy the acetonitrile.

[2] See Waste Treatment Plant Effluent Treatability Evaluation, HNF-8306, September 2004.
[3] This report is submitted as part of these comments as additional concerns with acetonitrile as stated by USDOE.

Could you please explain how the steam stripper process was selected when there is no disposal pathway for the concentrated acetonitrile? How could that happen if USDOE needs to get a DOE Order 435.1 exemption before sending off-site? What alternatives are being considered for disposal? Where is the preferred onsite treatment?

5. **What is the Treatment Plan for Acetonitrile?**: It appears that there is still no selected offsite treatment facility, however, other documents indicate that Perma-Fix Northwest is the assumed treatment facility. Could you please explain where you imagine the acetonitrile distillate being treated and how long it would sit in storage while awaiting treatment? Just to note, Hanford Challenge does not believe the acetonitrile distillate should be sent to PFNW for treatment. It poses too great a threat to workers, the public, and the environment.

6. **Better Worker Protections Are Needed**: Please explain what is being done to protect workers from the contents of the process and tanks? Are there design changes planned for the ETF ventilation system? We believe real-time monitoring is necessary to detect dangerous working conditions (i.e. not modeling) and that workers should be required to wear respirators if they are in a work area where there is the potential to be exposed to acetonitrile vapors. Not only should workers have access to respirators, but these respirators should be in good working order and maintained properly. The "improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134)." It is important that rigorous protocols are in place to ensure that all PPE is clean and in good working order, including any respiratory protection equipment. There have been worker exposures at ETF in the recent past that add weight to the recommendations below for respiratory protection (2018).

   Additionally, the NJ Right to Know Hazardous Substance Fact Sheet recommends: “Where the potential exists for exposure over 13 ppm, use a NIOSH approved full facepiece respirator with an organic vapor cartridge. Increased protection is obtained from full facepiece powered-air purifying respirators.” “Where the potential exists for exposure over 200 ppm, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.”

7. **Offsite Impacts**: Where will offsite environmental impacts be evaluated for acetonitrile treatment? There is an incomplete analysis of the plan to concentrate acetonitrile distillate and treat it offsite, without information, such as groundwater impacts, worker health and safety threats, and transportation risks resulting from treating waste at Perma-Fix Northwest in Richland or another offsite treatment facility. Is it possible to treat acetonitrile onsite?

Thank you again for considering our comments.

Sincerely,

Nikolas Peterson, Executive Director

U.S. Department of Energy – Hanford

Surveillance

Surveillance of the Washington River Protection Solutions LLC Process Hazard Analysis for Effluent Treatment Facility Acetonitrile Treatment Project

DOE-ASMT-2021-3251

The attached report documents the results of oversight activities. No formal response is required unless specifically requested by the Contracting Officer in writing. The correction of issues shall be done in accordance with contract requirements.

The information in this report is not considered to constitute a change to the contract. In the event the contractor disagrees with this interpretation, it shall provide notice to the Contracting Officer. If you have any questions, or desire additional information, please contact the Responsible Manager identified in the report or the Contracting Officer.

Assessed Organization:	Washington River Protection Solutions		
Assessment Period:	04/28/2021 - 08/27/2021		
Responsible Organization:	TF PROGRAMS DIVISION		
Lead:	TAMANG, BIBEK		
Responsible Manager:	BANG, RICKY	Approval Date:	08/27/2021

EXECUTIVE SUMMARY

The objective of this surveillance was to assess the Washington River Protection Solutions LLC (WRPS) Process Hazard Analysis (PrHA) procedures, conduct of the acetonitrile treatment project hazard and operability (HAZOP) and its impact on the acetonitrile treatment project cost and schedule. Four opportunities for improvement were identified to ensure that exposure from vapor phase acetonitrile would be below the limits specified in 29 CFR 1910.1000 Table Z-1 and additional follow-up of the delta HAZOP activities necessary to ensure that the identified chemical hazard concerns had been incorporated and documented, as the detailed design activities progress towards completion. The review team could not confirm all actions from the initial HAZOP were tracked to closure, and the HAZOP appeared to focus on flammability hazards while missing vapors hazards. There were no specific analyses performed to demonstrate 29 CFR 1910 was met.

PURPOSE/SCOPE/OBJECTIVE

The purpose of this assessment was to review the Washington River Protection Solutions LLC (WRPS) Process Hazard Analysis (PrHA) procedures, conduct of the acetonitrile treatment project hazard and operability (HAZOP) and its impact on the acetonitrile system design.

The assessment was initiated due to lack of consideration of the acetonitrile toxicological hazards in the original HAZOP, which led to a request from the Tank Farm Programs Division (TPD) manager to review the process to ensure compliance with workers safety and health laws, standards, and practices.

The scope of the assessment included the gathering of design-related information as well as directed inquiries into project HAZOP analysis based on lines of inquiry. Team members also witnessed portions of the delta HAZOP. The projects assessed included Tank Farms Effluent Treatment Facility (ETF) Acetonitrile Project, brine storage tank and acetonitrile distillate load-out project.

AREAS OR ACTIVITIES REVIEWED

Requirements Reviewed:

• TFC-ENG-DESIGN-C-35, Rev. E-8, "Process Hazard Analysis Determination and Technique Screening," issue date Aug 5, 2020, and Rev. E-7, issue date Feb 20, 2019. (Hazards Analysis was conducted on dates spanning the issue date of Rev. E-8)

• TFC-ENG-DESIGN-C-47, Rev. D-2, "Process Hazard Analysis," issue date January 7, 2020

• 29 CFR 1910, "Occupational Safety and Health Standards," Section 1910.1000 Subpart Z, "Air Contaminants"

• 10 CFR 851, "Worker Safety and Health Program"

Records, Designs, or Installations Reviewed:

• RPP-RPT-62702, "Effluent Treatment Facility (ETF) Steam Stripper Hazard and Operability Study (HAZOP) Report," November 2020

• RPP-RPT-63989, "Effluent Treatment Facility (ETF) Steam Stripper Process Vent Lower Flammability Limit (LFL) Calculation Report," February 2021

• RPP-RPT-62821, "Effluent Treatment Facility (ETF) Acetonitrile Steam Stripper Hazardous Area Classification," February 2021

• Line of Inquiry responses from WRPS

• Email from WRPS Nuclear Safety Manager

Personnel Contacted During the Surveillance:
• WRPS ETF Project Engineers/ETF Project Engineering Manager
• WRPS Chief Technology Officer
• WRPS Nuclear Safety Manager
• WRPS Deputy Chief Engineer
• WRPS Chief Engineer

Discussion of Area(s) or Activities Reviewed:

General Activities / Observations:

The U.S. Department of Energy, Office of River Protection (ORP) Chief Engineer reached out to the WRPS Chief Engineer through email and provided notification of the surveillance and the surveillance number in Integrated Contractor Assurance System (iCAS) on April 28, 2021. The ORP TPD surveillance team began to review Process Hazard Analysis requirements and formulate initial lines of inquiry and a draft surveillance plan on May 03, 2021. Virtual meetings were held between ORP and WRPS on May 25, 2021, June 7, 2021 and June 8, 2021.

The ETF Steam Stripper Project was initiated to remove acetonitrile from the Waste Treatment and Immobilization Plant effluent to be processed at ETF during direct-feed low-activity waste. Acetonitrile was expected to be present in the effluent as a product of incomplete combustion of sucrose used as a glass former within Waste Treatment and Immobilization Plant low-activity waste. The acetonitrile would need to be removed in order to ensure the ETF grouted brine waste stream would meet the Resource Conservation and Recovery Act's Land Disposal Restrictions for organic compounds. The steam stripper system was expected to remove the acetonitrile concentration from 59.9 ppm to less than or equal to 1.2 ppm. During the presentation of the acetonitrile distillate load-out scope briefing, WRPS mentioned that a delta HAZOP assessment was being performed to assess the chemical toxicity hazards associated with the acetonitrile for the ETF Steam Stripper Project.

WRPS subcontractor Atkins performed the initial hazard analysis for the ETF Steam Stripper project using the similar process that was used for the Low Activity Waste Pretreatment System project. During the May 25 interview, assessors observed that WRPS was unsure of which procedure was used for the initial hazard analysis, stating that they had received guidance from WRPS Nuclear Safety that the PrHA procedure was not required. WRPS explained that the ETF facility hazard categorization is less than hazardous characterization 3, and is an operating expense funded project and not bounded by DOE O 413.3B, "Program and Project Management for the Acquisition of Capital Assets." Therefore, WRPS was not required to follow their PrHA procedures (TFC-ENG-DESIGN-C-47, and TFC-ENG-DESIGN-C-35) for conducting hazard analysis for the ETF Steam Stripper Project. WRPS Engineering ultimately decided to have Atkins perform a HAZOP. U.S. Department of Energy was not provided with an Atkins HAZOP

procedure to include with the assessment. Upon follow up, WRPS stated that Atkins used the processes outlined in TFC-ENG-DESIGN-C-47, Attachment B, "Process Hazard Analysis Requirements for Less Than Hazard Category 3 Radiological Facilities," and RPP-RPT-57583, "Process Hazard Analysis (PrHA) for LAWPS," as guidance in performing the initial HAZOP study.

Per 10 CFR 851.21, Contractors must establish procedures to identify existing and potential workplace hazards and assess the risk of associated workers injury and illness. This includes requirements for analyzing designs of new facilities and modifications to existing facilities and equipment for potential workplace hazards.

OPPORTUNITY FOR IMPROVEMENT O-01: Recommended modification of WRPS procedure TFC-ENG-DESIGN-C-47 to require conducting a process HAZOP where significant workplace chemical hazards may exist regardless of the facility's radiological inventory or funding source. The application of the process HAZOP methodology for significant chemical hazards addressed the requirements of 29 CFR 1910 and 10 CFR 851 (cited above) and was viewed as a technical rigor improvement that would enhance the overall worker safety posture and ensure compliance with these codes, which did not differentiate between facilities based upon radiological inventory or funding source.

The WRPS procedure TFC-ENG-DESIGN-C-35 stated that a delta PrHA was performed when there are potential effects of proposed changes to existing designs, processes, and operations that have already undergone a full PrHA. WRPS mentioned that the first HAZOP analysis was conducted at 60 percent design, during that time the mass balances were not finalized and the piping design was not mature for most of the systems. As HAZOP was an iterative process, WRPS performed the delta HAZOP assessment once the design was more mature, as well as to find whether any other hazards were missed during the initial HAZOP assessment.
Design engineers also mentioned that the potential toxicity hazard came to light after the initial HAZOP, which in part drove the decision to perform a delta HAZOP.

STRENGTH S-01: The decision to perform the delta HAZOP when the additional hazard was identified, demonstrated a healthy questioning attitude on the part of this design team and speaks highly of the WRPS management team for allowing rework on a schedule critical system design to ensure safety. Regardless of the adverse conditions of this report, this was a good decision and it indicated an underlying healthy safety culture.

The first HAZOP report issued mentioned that in some cases not enough information was available to assess the consequences of a departure from the intended design and operating condition ("deviation"). Actions required to fully determine the consequence of a deviation were captured in the comment section of a deviation and shown in HAZOP worksheets in Appendix A. There were some open action items in the initial HAZOP report that needed to be tracked per TFC-ENG-DESIGN-C-47, Section B.3.6.3, "Tracking and documenting safety issues/actions/commitments." The PrHA procedure states that, "Actions/commitments that are not closed before the final PrHA report is issued require initiation of PERs for tracking according to the requirements of TFC-ESHQ-Q_C-C-01." WRPS mentioned that some open items were rolled into as 60 percent design review comments, some were tracked in ETF Steam Stripper Hazardous Area Calculation report (RPP-RPT-62821), and exposure limit action items were tracked into the delta HAZOP assessment after the mass balance information was available. The WRPS team could not confirm that all open items were being tracked. Assessors could not confirm via

document review that all open items were being tracked.

OPPORTUNITY FOR IMPROVEMENT O-02: The assessors could not confirm that all open items from the original HAZOP were tracked to closure. Because TFC-ENG-DESIGN-C-47 was not required for less than hazard category 3 facilities , this was sited as an opportunity for improvement (OFI), not an adverse condition. Recommended strengthening the procedure to emphasize comprehensive recording and tracking of all open items is a requirement.

The mass and energy balance calculation performed in the RPP-CALC-63989, "ETF Steam Stripper Process Vent LFL Calculation," report indicated that the acetonitrile concentration could reach up to 463,343 ppm in the concentrator condensate tank vent, which is connected to the vessel offgas system and normally under negative pressure with respect to atmosphere, and could reach 49,910 ppm (H-2-839048 SH1) in the vapor leaving the concentrator column, which is estimated to be at 12 inches water gauge positive pressure with respect to the surrounding equipment room in which it was installed. In response to assessor questions on the risk associated with the acetonitrile vapor leakage, WRPS mentioned that the acetonitrile-laden steam would flow from top of the concentrator column to the condenser at atmospheric pressure. The pipe carrying the steam was ASME B.31-3 normal fluid service, double encased from the wall to the column, and included a downcomer with a site glass to detect the leakage in the outer pipe. This pipe did include flanged connections and isolation valves, which represented points of potential leakage. In addition, WRPS mentioned that any leakage from the pipe would be visible from the process floor via the site glass. WRPS engineers stated that due to the high location of pipe inside the facility, the low odor threshold of acetonitrile compared to immediately dangerous to life or health (IDLH), the low pressure relative to the surrounding space, and shiftly leak checks, they believed small leaks of occasional frequency would be caught and would not produce airborne concentrations above IDLH.

WRPS cited an odor threshold pulled from the American Industrial Hygiene Association guidance of 13 ppm. By comparison, assessors found that the U.S. Environmental Protection Agency cited the Journal of Applied Toxicology, which stated an odor threshold for acetonitrile of170 ppm. The acetonitrile threshold of 170 ppm, according to the Centers for Disease Control, is above the 29 CFR 1910 permissible exposure limit of 40 ppm, above the American Conference of Governmental Industrial Hygienists threshold limit value, 8-hour time weighted average (TWA) of 20 ppm, and above the National Institute for Occupational Safety and Health immediately dangerous to life and health concentration of 137 ppm. Odor thresholds can vary greatly between individuals and should not be relied on to determine potentially hazardous exposures. In fact, the American Industrial Hygiene Association, "Odor Threshold for Chemicals with Established Health Standards," table 6.1, "Odor Threshold Values," provides a range of odor values (ppm) for 295 compounds. The range provided for acetonitrile is 13 – 1,161 ppm. In a situation where a range of odor thresholds were provided, selection of the most, rather than the least, conservative value, would possibly have been a better choice to inform a hazards analysis.

WRPS designers stated they performed modelling to observe the effects of a hypothetical spill from the condensate tank but did not perform any modelling or calculations to determine the effect of a vapor leak. Despite having multiple columns and flanged piping connections with very high concentrations of acetonitrile in vapor phase, the WRPS Industrial Hygiene (IH) team only modelled acetonitrile spills in liquid phase. During the June 7 interview with WRPS IH, it was determined that WRPS IH was unaware

of the presence of a vapor-phase contaminant and was not consulted or made aware of this aspect of the design.

WRPS engineers originally stated that acetonitrile in the vapor phase would essentially be at atmospheric pressure, and thus there will be no large motive force that would cause a significant acetonitrile leakage from the flanges/fittings to enter the room. This led WRPS engineering to the assumption that if leakage happens, it would be very minor in the vapor phase. WRPS provided information that the top of the concentration column is pressurized compared to the worker breathing space at approximately 12 inches water column (less than 0.5 psi).

The assessors asked whether analysis had been performed to determine the acceptable level of leakage for system components, in order to inform the specification regarding appropriate construction and leak test methodology. Given the high concentration and (slightly) pressurized system, the design team admitted no analysis had been done to study ambient air contamination in the surrounding space due to vapor phase acetonitrile.

The 29 CFR 1910, subpart Z, "Toxic and Hazardous Substances, 1910.1000 - Air Contaminants" states, "An employee's exposure to any substance in table Z-1, the exposure limit of which is not preceded by a 'C', shall not exceed the 8-hour Time Weighted Average given for that substance in any 8-hour work shift of a 40-hour work week." The table Z-1 limits the acetonitrile concentration to be 40 ppm.

OPPORTUNITY FOR IMPROVEMENT O-03: WRPS did not evaluate or assess whether the concentration of acetonitrile in the worker breathing space, due to leakage from the pressurized portions of the system of vapor phase acetonitrile, would be below the 29 CFR 1910 limits.

WRPS discussed the involvement of industrial safety and IH personnel in the design development and the HAZOP process. WRPS mentioned that for the ETF Steam Stripper Project design review, the IH was involved from the 30 percent design review. The chemical exposure assessment of the design was listed as optional reviewer, not as a required approver compared to industrial safety. IH involvement was always in the form of recommendations included in design review.

Upon a follow-up interview with IH personnel, the U.S. Department of Energy confirmed that the IH had only been involved in 30 percent design review as an optional reviewer, and had not been involved in 60 percent design review nor was informed there was a vapor phase hazard associated with the system. WRPS maintains that ETF IH was involved in the design from 30 percent to 100 percent, but not in the original HAZOP. WRPS further states that it was the IH modeler, not the ETF IH, who was not aware of the vapor phase hazard, because no modeling of the vapor phase hazard was requested. WRPS further states that ETF IH was aware of the vapor-phase concentrations. However, in discussions with engineering, the combination of ASME B31.3 design and certification and operating pressure (low dP) indicated (barring a worker or natural disaster caused accident) that leak rates through gaskets were minute. WRPS states that these factors, coupled with worker proximity to the overhead line, was the decision logic that would be expressed in the future facility exposure assessment.

OPPORTUNITY FOR IMPROVEMENT O-04: Recommended modification of WRPS Design Process and PrHA procedures to specify IH participation at each stage of the design review process, and during HAZOP, such that they would be informed of all aspects of design, and consulted regarding potential

associated industrial hygiene hazards.

In general, the design team and the HAZOP process appeared to have focused primarily on hazards associated with condensed acetonitrile liquid and had not considered the toxicological hazard to workers associated with the high concentration of acetonitrile in vapor phase.
WRPS maintains that the hazard was identified but characterized as improbable. The HAZOP report did not support that conclusion. The HAZOP report did not address the toxicity hazard of acetonitrile. Node 5 identified Pipe Failure/Leak as Occasional with a consequence of Possible Flammable Gas, exposure to personnel, as marginal. Node 5 should also have included the acetonitrile toxicity hazard since personnel could be exposed to flammable gas.

Additionally, the Node 5 Pipe Failure/Leak contradicted the above statement that exposure to acetonitrile vapors was improbable. If flammable gas leaks above 3 percent (30,000 ppm) were occasional, then exposure to acetonitrile vapors (above 40 ppm) should have been classified as at least occasional. The same contradiction applied to the consequences. Flammable gas leaking was categorized as marginal. The HAZOP should have discussed why the flammable gas was marginal and the toxicity of acetonitrile at the flammable gas concentration was low.

Upon discussion with the WRPS Deputy Chief Engineer during follow-up interviews, it was stated that WRPS took an action to perform analysis to determine acceptable leakage criteria and confirm that the hydrostatic leak test method identified in specifications included with the issued procurements was sufficient, or adjust procurement specifications if necessary. Specifically, WRPS committed to the following actions:
1) Verify WRPS has analyzed potential leakage and dilution ventilation to ensure that exposure from vapor phase acetonitrile would be below the limits specified in 29 CFR 1910.1000 Table Z-1.
2) Verify WRPS has conducted additional follow-up delta HAZOP activities necessary to ensure that the identified chemical hazard concerns had been incorporated and documented, as the detailed design activities progress towards completion.

Strengths, Adverse Conditions, and Opportunities for Improvement (OFIs):
Overall, the surveillance performed on the WRPS Hazard Analysis Process of ETF Steam Stripper Project resulted in 1 Strength, 0 Adverse condition, 4 OFIs, and 2 Follow-up Item. Details for those issues are described below.

Strengths:
STRENGTH S-01: The decision to perform the delta HAZOP when the additional hazard was identified demonstrated a healthy questioning attitude on the part of this design team and speaks highly of the WRPS management team for allowing rework on a schedule critical system design to ensure safety. Regardless of the adverse conditions of this report, this was a good decision and it indicated an underlying healthy safety culture.

Adverse Condition:
None.

Opportunities for Improvement:
O-01: Recommended modification of WRPS procedure TFC-ENG-DESIGN-C-47 to require conducting a

process HAZOP where significant workplace chemical hazards might have existed regardless of the facility's radiological inventory or funding source. The application of the process HAZOP methodology for significant chemical hazards addresses the requirements of 29 CFR 1910 and 10 CFR 851 (cited above) and was viewed as a technical rigor improvement that would enhance the overall worker safety posture and ensure compliance with these codes, which did not differentiate between facilities based upon radiological inventory or funding source.
O-02: The assessors could not confirm that all open items from the original HAZOP were tracked to closure. Because TFC-ENG-DESIGN-C-47 was not required for less than hazard category 3 facilities, this was cited as an OFI, not an adverse condition. Recommended strengthening the procedure to emphasize comprehensive recording and tracking of all open items is a requirement.
O-03: WRPS did not evaluate or assess whether the concentration of acetonitrile in the worker breathing space due to leakage from the pressurized portions of the system of vapor phase acetonitrile would be below the 29 CFR 1910 limits.
O-04: Recommend modification of WRPS Design Process and PrHA procedures to specify IH participation at each stage of the design review process, and during HAZOP, such that they would be informed of all aspects of design and consulted regarding potential associated industrial hygiene hazards.

APPROACH

The U.S. Department of Energy, Office of River Protection (ORP) Chief Engineer reached out to the WRPS Chief Engineer through email and provided notification of the surveillance and the surveillance number in Integrated Contractor Assurance System (iCAS) on April 28, 2021. The ORP TPD surveillance team began to review Process Hazard Analysis requirements and formulate initial lines of inquiry and a draft surveillance plan on May 03, 2021. Virtual meetings were held between ORP and WRPS on May 25, 2021, June 7, 2021 and June 8, 2021.
Following approach was taken for the surveillance.
- Interview engineering supervisor
- Review applicable procedures
- Review action tracking and extent of condition documentation as applicable, determine extent of condition
- Witnessed one hazards analysis meeting/briefing
- Write report for management consideration, utilize results to inform contractor oversight and contract administration activities.

CONCLUSIONS

The team which performed the initial HAZOP missed information regarding a potentially significant safety hazard to workers and failed to include IH in the initial HAZOP, which may have helped to avoid this misstep. The assessors could not confirm all actions from the initial HAZOP were tracked to closure, and the HAZOP appeared to focus on flammability hazards while missing vapors hazards. There were no specific analyses performed to demonstrate 29 CFR 1910 was met. The initiation of a delta HAZOP, despite extreme schedule pressure, indicated an underlying healthy safety culture within the organization and was commendable. Despite supporting a schedule critical project, the Engineering and IH teams participated in this review and supported several interviews in a collegial and professional manner, and the assessment team was provided with requested documents in a timely manner. This was much appreciated by the assessment team and further speaks to the healthy safety culture within

the organization.

IDENTIFIED ISSUES

O-01

Opportunity for Improvement: (O-01) Recommended modification of WRPS procedure TFC-ENG-DESIGN-C-47 to require conducting a process HAZOP where significant workplace chemical hazards might have existed regardless of the facility's radiological inventory or funding source.

Description: Recommended modification of WRPS procedure TFC-ENG-DESIGN-C-47 to require conducting a process HAZOP where significant workplace chemical hazards might have existed regardless of the facility's radiological inventory or funding source. The application of the process HAZOP methodology for significant chemical hazards addresses the requirements of 29 CFR 1910 and 10 CFR 851 (cited above) and was viewed as a technical rigor improvement that would enhance the overall worker safety posture and ensure compliance with these codes, which did not differentiate between facilities based upon radiological inventory or funding source.

O-02

Opportunity for Improvement: (O-02) Recommended strengthening the procedure to emphasize comprehensive recording and tracking of all open items is a requirement.

Description: Contrary to the requirements of TFC-ENG-DESIGN-C-47, section B.3.6.3, "Tracking and Documenting Safety Issues/Actions/Commitments," assessors could not confirm that all open items from the original HAZOP were tracked to closure. Because TFC-ENG-DESIGN-C-47 was not required for less than hazard category 3 facilities, this was cited as an OFI, not an adverse condition. Recommended strengthening the procedure to emphasize comprehensive recording and tracking of all open items is a requirement.

O-03

Opportunity for Improvement: (O-03) Recommended modification of WRPS Design Process and PrHA procedures to specify IH participation at each stage of the design review process.

Description: Recommended modification of WRPS Design Process and PrHA procedures to specify IH participation at each stage of the design review process, and during HAZOP, such that they would be informed of all aspects of design, and consulted regarding potential associated industrial hygiene hazards.

O-04

Opportunity for Improvement: (O-04) Recommended modification of WRPS Design Process and PrHA procedures.

Description: Recommended modification of WRPS Design Process and PrHA procedures to specify IH participation at each stage of the design review process, and during HAZOP, such that they would be informed of all aspects of design, and consulted regarding potential associated industrial hygiene hazards.

S-01

Strength/Good Practice: (S-01) WRPS design team demonstrated a healthy questioning attitude by performing the delta HAZOP when additional hazards were identified.

Description: The decision to perform the delta HAZOP when the additional hazard was identified, demonstrated a healthy questioning attitude on the part of this design team and speaks highly of the WRPS management team for allowing rework on a schedule critical system design to ensure safety. Regardless of the adverse conditions of this report, this was a good decision and it indicated an underlying healthy safety culture.

TEAM MEMBERS

Member	Role
FISCHER, BRIAN L	Team member
PORCARO, ELAINE N	Team member
STEPHAN, CLIFFORD J	Team member
YEARSLEY, LAWRENCE K	Team member

OVERSIGHT DOCUMENTS

10 CFR 851, Worker Safety and Health Program	https://www.law.cornell.edu/cfr/text/10/part-851

FUNCTIONAL AREA(S)

Primary	Secondary	Tertiary
Project Management		

LIST OF ATTACHMENTS/REFERENCES

1. Surveillance of the WRPS PrHA for ETF ACN Treatment Project Draft_BT_tks(v2) (002).docx
2. RPP-CALC-63989_S54413.026-P-001 Rev D.pdf
3. RPP-RPT-62702-00-Record.pdf
4. RPP-RPT-62821 Rev B.pdf
5. TFC-ENG-DESIGN-C-35_Process_Hazard_Analysis_Determination_and_Technique_Screening (002).docx
6. TFC-ENG-DESIGN-C-47_Process_Hazard_Analysis (002).docx

NOTIFICATIONS

PORCARO, ELAINE N

YEARSLEY, LAWRENCE K

STEPHAN, CLIFFORD J

FISCHER, BRIAN L

Surveillance of the Washington River Protection Solutions LLC Process Hazard Analysis for Effluent Treatment Facility Acetonitrile Treatment Project

Report Number and Title:	iCAS # DOE-ASMT-2021-3251, Surveillance of the Washington River Protection Solutions LLC Design Process of Effluent Treatment Facility Acetonitrile Project and its Hazards Assessment.
Divisions Performing the Oversight:	U.S. Department of Energy, Office of River Protection Tank Farm Programs Division (TPD)
Dates of the Oversight:	May 25, 2021 through June 5, 2021

Lead Assessor and Team Members:

Bibek Tamang, Lead Assessor, Tank Farm Programs Division Effluent Treatment Facility Projects

Elaine Porcaro, Assessor, U.S. Department of Energy, Office of River Protection, Chief Engineer

Clifford Stephan, Assessor, Industrial Hygienist

Lawrence Yearsley, Assessor, Industrial Hygienist

Brian Fischer, Safety System Oversight Specialist

Purpose/Objective/Scope:

The purpose of this assessment was to review the Washington River Protection Solutions LLC (WRPS) Process Hazard Analysis (PrHA) procedures, conduct of the acetonitrile treatment project hazard and operability (HAZOP) and its impact on the acetonitrile system design.

The assessment was initiated due to lack of consideration of the acetonitrile toxicological hazards in the original HAZOP, which led to a request from the Tank Farm Programs Division (TPD) manager to review the process to ensure compliance with workers safety and health laws, standards, and practices.

The scope of the assessment included the gathering of design-related information as well as directed inquiries into project HAZOP analysis based on lines of inquiry. Team members also witnessed portions of the delta HAZOP. The projects assessed included Tank Farms Effluent Treatment Facility (ETF) Acetonitrile Project, brine storage tank and acetonitrile distillate load-out project.

Requirements Reviewed:

- TFC-ENG-DESIGN-C-35, Rev. E-8, "Process Hazard Analysis Determination and Technique Screening," issue date Aug 5, 2020, and Rev. E-7, issue date Feb 20, 2019. (Hazards Analysis was conducted on dates spanning the issue date of Rev. E-8)

- TFC-ENG-DESIGN-C-47, Rev. D-2, "Process Hazard Analysis," issue date January 7, 2020

- 29 CFR 1910, "Occupational Safety and Health Standards," Section 1910.1000 Subpart Z, "Air Contaminants"

- 10 CFR 851, "Worker Safety and Health Program"

Records, Designs, or Installations Reviewed:

- RPP-RPT-62702, "Effluent Treatment Facility (ETF) Steam Stripper Hazard and Operability Study (HAZOP) Report," November 2020

- RPP-CALC-63989, "Effluent Treatment Facility (ETF) Steam Stripper Process Vent Lower Flammability Limit (LFL) Calculation Report," February 2021

- RPP-RPT-62821, "Effluent Treatment Facility (ETF) Acetonitrile Steam Stripper Hazardous Area Classification," February 2021

- Line of Inquiry responses from WRPS

- Email from WRPS Nuclear Safety Manager

Personnel Contacted During the Surveillance:

- WRPS ETF Project Engineers/ETF Project Engineering Manager

- WRPS Chief Technology Officer

- WRPS Nuclear Safety Manager

- WRPS Deputy Chief Engineer

- WRPS Chief Engineer

Discussion of Area(s) or Activities Reviewed:

<u>General Activities / Observations</u>:

The U.S. Department of Energy, Office of River Protection (ORP) Chief Engineer reached out to the WRPS Chief Engineer through email and provided notification of the surveillance and the surveillance number in Integrated Contractor Assurance System (iCAS) on April 28, 2021. The ORP TPD surveillance team began to review Process Hazard Analysis requirements and formulate initial lines of inquiry and a draft surveillance plan on May 03, 2021. Virtual meetings were held between ORP and WRPS on May 25, 2021, June 7, 2021 and June 8, 2021.

The ETF Steam Stripper Project was initiated to remove acetonitrile from the Waste Treatment and Immobilization Plant effluent to be processed at ETF during direct-feed low-activity waste. Acetonitrile was expected to be present in the effluent as a product of incomplete combustion of sucrose used as a glass former within Waste Treatment and Immobilization Plant low-activity waste. The acetonitrile would need to be removed in order to ensure the ETF grouted brine waste stream would meet the Resource Conservation and Recovery Act's Land Disposal Restrictions for organic compounds. The steam stripper system was expected to remove the acetonitrile concentration from 59.9 ppm to less than or equal to 1.2 ppm. During the presentation of the acetonitrile distillate load-out scope briefing, WRPS mentioned that a delta HAZOP assessment was being performed to assess the chemical toxicity hazards associated with the acetonitrile for the ETF Steam Stripper Project.

WRPS subcontractor Atkins performed the initial hazard analysis for the ETF Steam Stripper project using the similar process that was used for the Low Activity Waste Pretreatment System project. During the May 25 interview, assessors observed that WRPS was unsure of which procedure was used for the initial hazard analysis, stating that they had received guidance from WRPS Nuclear Safety that the PrHA procedure was not required. WRPS explained that the ETF facility hazard categorization is less than hazardous characterization 3, and is an operating expense funded project and not bounded by DOE O 413.3B, "Program and Project Management for the Acquisition of Capital Assets." Therefore, WRPS was not required to follow their PrHA procedures (TFC-ENG-DESIGN-C-47, and TFC-ENG-DESIGN-C-35) for conducting hazard analysis for the ETF Steam Stripper Project. WRPS Engineering ultimately decided to have Atkins perform a HAZOP. U.S. Department of Energy was not provided with an Atkins HAZOP procedure to include with the assessment. Upon follow up, WRPS stated that Atkins used the processes outlined in TFC-ENG-DESIGN-C-47, Attachment B, "Process Hazard Analysis Requirements for Less Than Hazard Category 3 Radiological Facilities," and RPP-RPT-57583, "Process Hazard Analysis (PrHA) for LAWPS," as guidance in performing the initial HAZOP study.

Per 10 CFR 851.21, Contractors must establish procedures to identify existing and potential workplace hazards and assess the risk of associated workers injury and illness. This includes requirements for analyzing designs of new facilities and modifications to existing facilities and equipment for potential workplace hazards.

OPPORTUNITY FOR IMPROVEMENT O-01: Recommended modification of WRPS procedure TFC-ENG-DESIGN-C-47 to require conducting a process HAZOP where significant workplace chemical hazards may exist regardless of the facility's radiological inventory or funding source. The application of the process HAZOP methodology for significant chemical hazards addressed the requirements of 29 CFR 1910 and 10 CFR 851 (cited above) and was viewed as a technical rigor improvement that would enhance the overall worker safety posture

and ensure compliance with these codes, which did not differentiate between facilities based upon radiological inventory or funding source.

The WRPS procedure TFC-ENG-DESIGN-C-35 stated that a delta PrHA was performed when there are potential effects of proposed changes to existing designs, processes, and operations that have already undergone a full PrHA. WRPS mentioned that the first HAZOP analysis was conducted at 60 percent design, during that time the mass balances were not finalized and the piping design was not mature for most of the systems. As HAZOP was an iterative process, WRPS performed the delta HAZOP assessment once the design was more mature, as well as to find whether any other hazards were missed during the initial HAZOP assessment.

Design engineers also mentioned that the potential toxicity hazard came to light after the initial HAZOP, which in part drove the decision to perform a delta HAZOP.

STRENGTH S-01: The decision to perform the delta HAZOP when the additional hazard was identified, demonstrated a healthy questioning attitude on the part of this design team and speaks highly of the WRPS management team for allowing rework on a schedule critical system design to ensure safety. Regardless of the adverse conditions of this report, this was a good decision and it indicated an underlying healthy safety culture.

The first HAZOP report issued mentioned that in some cases not enough information was available to assess the consequences of a departure from the intended design and operating condition ("deviation"). Actions required to fully determine the consequence of a deviation were captured in the comment section of a deviation and shown in HAZOP worksheets in Appendix A. There were some open action items in the initial HAZOP report that needed to be tracked per TFC-ENG-DESIGN-C-47, Section B.3.6.3, "Tracking and documenting safety issues/actions/commitments." The PrHA procedure states that, "Actions/commitments that are not closed before the final PrHA report is issued require initiation of PERs for tracking according to the requirements of TFC-ESHQ-Q_C-C-01." WRPS mentioned that some open items were rolled into as 60 percent design review comments, some were tracked in ETF Steam Stripper Hazardous Area Calculation report (RPP-RPT-62821), and exposure limit action items were tracked into the delta HAZOP assessment after the mass balance information was available. The WRPS team could not confirm that all open items were being tracked. Assessors could not confirm via document review that all open items were being tracked.

OPPORTUNITY FOR IMPROVEMENT O-02: Contrary to the requirements of TFC-ENG-DESIGN-C-47, section B.3.6.3, "Tracking and Documenting Safety Issues/Actions/Commitments," assessors could not confirm that all open items from the original HAZOP were tracked to closure. Because TFC-ENG-DESIGN-C-47 was not required for less than hazard category 3 facilities, this was sited as an opportunity for improvement (OFI), not an adverse condition. Recommended strengthening the procedure to emphasize comprehensive recording and tracking of all open items is a requirement.

The mass and energy balance calculation performed in the RPP-CALC-63989, "ETF Steam Stripper Process Vent LFL Calculation," report indicated that the acetonitrile concentration could reach up to 463,343 ppm in the concentrator condensate tank vent, which is connected to the vessel offgas system and normally under negative pressure with respect to atmosphere, and could

reach 49,910 ppm (RPP-CALC-63989) in the vapor leaving the concentrator column, which is estimated to be at 12 inches water gauge positive pressure with respect to the surrounding equipment room in which it was installed. In response to assessor questions on the risk associated with the acetonitrile vapor leakage, WRPS mentioned that the acetonitrile-laden steam would flow from top of the concentrator column to the condenser at atmospheric pressure. The pipe carrying the steam was ASME B.31-3 normal fluid service, double encased from the wall to the column, and included a downcomer with a site glass to detect the leakage in the outer pipe. This pipe did include flanged connections and isolation valves, which represented points of potential leakage. In addition, WRPS mentioned that any leakage from the pipe would be visible from the process floor via the site glass. WRPS engineers stated that due to the high location of pipe inside the facility, the low odor threshold of acetonitrile compared to immediately dangerous to life or health (IDLH), the low pressure relative to the surrounding space, and shiftly leak checks, they believed small leaks of occasional frequency would be caught and would not produce airborne concentrations above IDLH.

WRPS cited an odor threshold pulled from the American Industrial Hygiene Association guidance of 13 ppm. By comparison, assessors found that the U.S. Environmental Protection Agency cited the Journal of Applied Toxicology, which stated an odor threshold for acetonitrile of 170 ppm. The acetonitrile threshold of 170 ppm, according to the Centers for Disease Control, is above the 29 CFR 1910 permissible exposure limit of 40 ppm, above the American Conference of Governmental Industrial Hygienists threshold limit value, 8-hour time weighted average (TWA) of 20 ppm, and above the National Institute for Occupational Safety and Health immediately dangerous to life and health concentration of 137 ppm. Odor thresholds can vary greatly between individuals and should not be relied on to determine potentially hazardous exposures. In fact, the American Industrial Hygiene Association, "Odor Threshold for Chemicals with Established Health Standards," table 6.1, "Odor Threshold Values," provides a range of odor values (ppm) for 295 compounds. The range provided for acetonitrile is 13 – 1,161 ppm. In a situation where a range of odor thresholds were provided, selection of the most, rather than the least, conservative value, would possibly have been a better choice to inform a hazards analysis.

WRPS designers stated they performed modelling to observe the effects of a hypothetical spill from the condensate tank but did not perform any modelling or calculations to determine the effect of a vapor leak. Despite having multiple columns and flanged piping connections with very high concentrations of acetonitrile in vapor phase, the WRPS Industrial Hygiene (IH) team only modelled acetonitrile spills in liquid phase. During the June 7 interview with WRPS IH, it was determined that WRPS IH was unaware of the presence of a vapor-phase contaminant and was not consulted or made aware of this aspect of the design.

WRPS engineers originally stated that acetonitrile in the vapor phase would essentially be at atmospheric pressure, and thus there will be no large motive force that would cause a significant acetonitrile leakage from the flanges/fittings to enter the room. This led WRPS engineering to the assumption that if leakage happens, it would be very minor in the vapor phase. WRPS provided information that the top of the concentration column is pressurized compared to the worker breathing space at approximately 12 inches water column (less than 0.5 psi).

The assessors asked whether analysis had been performed to determine the acceptable level of leakage for system components, in order to inform the specification regarding appropriate construction and leak test methodology. Given the high concentration and (slightly) pressurized system, the design team admitted no analysis had been done to study ambient air contamination in the surrounding space due to vapor phase acetonitrile.

The 29 CFR 1910, subpart Z, "Toxic and Hazardous Substances, 1910.1000 - Air Contaminants" states, "An employee's exposure to any substance in table Z-1, the exposure limit of which is not preceded by a 'C', shall not exceed the 8-hour Time Weighted Average given for that substance in any 8-hour work shift of a 40-hour work week." The table Z-1 limits the acetonitrile concentration to be 40 ppm.

OPPORTUNITY FOR IMPROVEMENT O-03: WRPS did not evaluate or assess whether the concentration of acetonitrile in the worker breathing space, due to leakage from the pressurized portions of the system of vapor phase acetonitrile, would be below the 29 CFR 1910 limits.

WRPS discussed the involvement of industrial safety and IH personnel in the design development and the HAZOP process. WRPS mentioned that for the ETF Steam Stripper Project design review, the IH was involved from the 30 percent design review. The chemical exposure assessment of the design was listed as optional reviewer, not as a required approver compared to industrial safety. IH involvement was always in the form of recommendations included in design review.

Upon a follow-up interview with IH personnel, the U.S. Department of Energy confirmed that the IH had only been involved in 30 percent design review as an optional reviewer, and had not been involved in 60 percent design review nor was informed there was a vapor phase hazard associated with the system. WRPS maintains that ETF IH was involved in the design from 30 percent to 100 percent, but not in the original HAZOP. WRPS further states that it was the IH modeler, not the ETF IH, who was not aware of the vapor phase hazard, because no modeling of the vapor phase hazard was requested. WRPS further states that ETF IH was aware of the vapor-phase concentrations. However, in discussions with engineering, the combination of ASME B31.3 design and certification and operating pressure (low dP) indicated (barring a worker or natural disaster caused accident) that leak rates through gaskets were minute. WRPS states that these factors, coupled with worker proximity to the overhead line, was the decision logic that would be expressed in the future facility exposure assessment.

OPPORTUNITY FOR IMPROVEMENT O-04: Recommended modification of WRPS Design Process and PrHA procedures to specify IH participation at each stage of the design review process, and during HAZOP, such that they would be informed of all aspects of design, and consulted regarding potential associated industrial hygiene hazards.

In general, the design team and the HAZOP process appeared to have focused primarily on hazards associated with condensed acetonitrile liquid and had not considered the toxicological hazard to workers associated with the high concentration of acetonitrile in vapor phase.

WRPS maintains that the hazard was identified but characterized as improbable. The HAZOP report did not support that conclusion. The HAZOP report did not address the toxicity hazard of

acetonitrile. Node 5 identified **Pipe Failure/Leak as Occasional** with a consequence of **Possible Flammable Gas, exposure to personnel,** as marginal. Node 5 should also have included the acetonitrile toxicity hazard since personnel could be exposed to flammable gas.

Additionally, the Node 5 Pipe Failure/Leak contradicted the above statement that exposure to acetonitrile vapors was improbable. If flammable gas leaks above 3 percent (30,000 ppm) were occasional, then exposure to acetonitrile vapors (above 40 ppm) should have been classified as at least occasional. The same contradiction applied to the consequences. Flammable gas leaking was categorized as marginal. The HAZOP should have discussed why the flammable gas was marginal and the toxicity of acetonitrile at the flammable gas concentration was low.

Upon discussion with the WRPS Deputy Chief Engineer during follow-up interviews, it was stated that WRPS took an action to perform analysis to determine acceptable leakage criteria and confirm that the hydrostatic leak test method identified in specifications included with the issued procurements was sufficient, or adjust procurement specifications if necessary. Specifically, WRPS committed to the following actions:

1) Verify WRPS has analyzed potential leakage and dilution ventilation to ensure that exposure from vapor phase acetonitrile would be below the limits specified in 29 CFR 1910.1000 Table Z-1.

2) Verify WRPS has conducted additional follow-up delta HAZOP activities necessary to ensure that the identified chemical hazard concerns had been incorporated and documented, as the detailed design activities progress towards completion.

Strengths, Adverse Conditions, and Opportunities for Improvement (OFIs):

Overall, the surveillance performed on the WRPS Hazard Analysis Process of ETF Steam Stripper Project resulted in 1 Strength, 0 Adverse condition, 4 OFIs, and 2 Follow-up Item. Details for those issues are described below.

Strengths:

STRENGTH S-01: The decision to perform the delta HAZOP when the additional hazard was identified demonstrated a healthy questioning attitude on the part of this design team and speaks highly of the WRPS management team for allowing rework on a schedule critical system design to ensure safety. Regardless of the adverse conditions of this report, this was a good decision and it indicated an underlying healthy safety culture.

Adverse Condition:

None.

Opportunities for Improvement:

O-01: Recommended modification of WRPS procedure TFC-ENG-DESIGN-C-47 to require conducting a process HAZOP where significant workplace chemical hazards might have existed regardless of the facility's radiological inventory or funding source. The application of the

process HAZOP methodology for significant chemical hazards addresses the requirements of 29 CFR 1910 and 10 CFR 851 (cited above) and was viewed as a technical rigor improvement that would enhance the overall worker safety posture and ensure compliance with these codes, which did not differentiate between facilities based upon radiological inventory or funding source.

O-02: Contrary to the requirements of TFC-ENG-DESIGN-C-47, section B.3.6.3, "Tracking and Documenting Safety Issues/Actions/Commitments," assessors could not confirm that all open items from the original HAZOP were tracked to closure. Because TFC-ENG-DESIGN-C-47 was not required for less than hazard category 3 facilities, this was cited as an OFI, not an adverse condition. Recommended strengthening the procedure to emphasize comprehensive recording and tracking of all open items is a requirement.

O-03: WRPS did not evaluate or assess whether the concentration of acetonitrile in the worker breathing space due to leakage from the pressurized portions of the system of vapor phase acetonitrile would be below the 29 CFR 1910 limits.

O-04: Recommend modification of WRPS Design Process and PrHA procedures to specify IH participation at each stage of the design review process, and during HAZOP, such that they would be informed of all aspects of design and consulted regarding potential associated industrial hygiene hazards.

Conclusion:

The team which performed the initial HAZOP did not fully comprehend the magnitude of missing information regarding a potentially significant safety hazard to workers and failed to include IH in the initial HAZOP, which may have helped to avoid this misstep. The assessors could not confirm all actions from the initial HAZOP were tracked to closure, and the HAZOP appeared to focus on flammability hazards while downplaying vapors hazards. There were no specific analyses performed to demonstrate 29 CFR 1910 was met. These items may have been symptoms of a lack of experience in dealing with high concentrations of hazardous chemicals in the absence of radiological risks, which have previously not been present in tank farms in quantities orders of magnitude beyond concentration levels that pose risks to workers.

However, the initiation of a delta HAZOP, despite extreme schedule pressure, indicated an underlying healthy safety culture within the organization and was commendable. Despite supporting a schedule critical project, the Engineering and IH teams participated in this review and supported several interviews in a collegial and professional manner, and the assessment team was provided with requested documents in a timely manner. This was much appreciated by the assessment team and further speaks to the healthy safety culture within the organization.

Because this was the first chemical hazard within the WRPS scope of this magnitude, the team recommended WRPS Engineering and Industrial Hygiene review processes related to evaluation of chemical hazards to determine if additional rigor should be added in such cases.

A follow up surveillance by TPD, ORP Safety and Health Division, and the ORP Chief Engineer was recommended six months to one year to review progress towards evaluating hazards and updating procedures.

Appendices:

Initial lines of inquiry, followed by WRPS responses, are included in Appendix A.

INITIAL LINES OF INQUIRY

1. Procedure TFC-ENG-DESIGN-C-35, attachment A, "PRHA Technique Selection Guidance," section A.2 "Delta HAZOP," "A delta HAZOP uses the full HAZOP methodology but is focused on the potential effects of proposed changes to existing designs, processes, and operations that have already undergone a full HAZOP." What were those proposed changes that initiated the delta HAZOP for ETF Steam stripper Project?

   The steam stripper project fell outside the scope of TFC-ENG-DESIGN-C-35, since ETF was a less than hazard category 3 facility. See excerpt from TFC-ENG-DESIGN-C-35, Rev. E-8, section 1.0, "Purpose and Scope," below quoted to highlight this.

   "This procedure defines the screening process used to determine if a PrHA needs to be conducted on changes to TOC facilities, processes, equipment, and design impacting documents. This procedure also provides a process to determine the appropriate PrHA method to be used when a PrHA is determined to be required."

   Changes that do not require a PrHA screening are:

   • "Changes that are performed outside of Hazard Category 2 or 3 nuclear facilities and can have no effect on Hazard Category 2 or 3 nuclear facilities (defined in Section 5.0 of this procedure)."

Although the steam stripper project was not covered by TFC-ENG-DESIGN-C-35, the design team performed a HAZOP and a delta HAZOP utilizing the TFC-ENG-DESIGN-C-35 procedure as guidance. The delta HAZOP was performed to capture changes in the design since 60 percent when the initial full HAZOP was performed. The delta HAZOP went through each of the original nodes as there had been design evolution in each node since the 60 percent full HAZOP. This allowed confirmation that the design evolution, which is part of every project, had not invalidated the original HAZOP conclusions and allowed an opportunity to identify any new hazards detailed design may have introduced. As an example, attachment # is a piping and instrumentation diagram sheet highlighted to show features that were not part of the 60 percent design, as well as a side-by-side comparison of some 60 percent media next to the 100 percent media with "changes" highlighted.

2. Procedure TFC-ENG-DESIGN-C-47, section 4.3, "PrHA Meeting Planning." – Was a review on PrHAs on similar facilities, processes, equipment, operations, and designs for significant Lessons Learned performed for inclusion in the PrHA Process Orientation? Please provide that document.

TFC-ENG-DESIGN-C-47 does not apply to less than hazard category 3 facilities, including ETF. TFC-ENG-DESIGN-C-47 was used as a guide only. A power point presentation was not prepared for this HAZOP. The attached outline was discussed with participants for orientation.

3. Procedure TFC-ENG-DESIGN-C-47, section 4.5, "Hazard Identification." – What were the hazards (sources of danger) potentially present in the proposed new or modified designs, processes, or operations identified during the initial PrHA process? Was the Hazard Identification Checklist completed? Please provide the checklist. Why was the acetonitrile toxicity/flammability hazards not identified during this process?

This was not a PrHA as those do not apply to less than hazard category 3 facilities. TFC-ENG-DESIGN-C-47 was used as a guide only and that did not include the use of the Hazard Identification Checklist. The flammability and toxicity hazards were discussed during the HAZOP. However, the design agent had not yet finished their Henry's Law calculations and was not prepared to make a definitive determination on the concentrations of acetonitrile in the head space of vessels. Based on some scoping work done by Meacham and Yarbrough, the concentration of acetonitrile in the head space of the concentrate tank was assumed to be above the LFL.

4. Procedure TFC-ENG-DESIGN-C-47, section B.3.6.3, "Tracking and documenting safety issues/actions/commitments." – Were there any actions/commitments that were not closed before the final PrHA report was issued? Were there any problem evaluation requests (PER) for tracking according to the requirements of TFC-ESHQ-Q_C-C-01, "Problem Evaluation Request"?

Actions were tracked using the design review comment process. The actions were converted to 60 percent comments and tracked via the comment closeout process. Attachment # is a copy of the review comment record (RCR) form and RCR Tracking Database.

5. RPP-RPT-62702, section 4.2, "Open Items" (13 open items). In some cases not enough information was available to assess consequences of a deviation such as potential for contaminants in the boiler feed water from the verification tank and, or the available safeguards associated with vendor packages was unknown, such as what safeguards are in place to protect vendor boiler elements. Actions required to fully determine the consequence of a deviation or identify safeguards that were part of a vendor package were captured in the comment section of a deviation and shown in HAZOP worksheets, in appendix A. Tracking these open items to closure was the responsibility of the design team. How was WRPS tracking these open items? Was there any PER/iCAS issued to track the open issues?

Actions were tracked using the design review comment process. The actions were converted to 60 percent comments and tracked via the comment closeout process. Attached is a copy of the RCR form that was created (see above). As an example, Item 41 addresses the vendor package question.

6. Procedure TFC-ENG-DESIGN-C-47, section B.3.6.3, "Tracking and documenting safety issues/actions/commitments." – Safety issues/concerns identified during PrHA meetings that

constitute an unrecognized imminent worker impact should be immediately communicated to TOC safety program management and a PER generated in accordance TFC-ESHQ-Q_C-C-01. If so, were there any PERs/iCAS generated for safety issues related to Acetonitrile toxicity/flammability hazards? Please provide the PER/iCAS number?

TFC-ENG-DESIGN-C-47 does not apply to less than hazard category 3 facilities, as such this is not a PrHA. There were not any "unrecognized imminent worker impact" items identified. This system was not yet installed, or operating so no "imminent worker impact" was possible at this time.

7. Were there any additional hazards identified during the delta HAZOP assessment for ETF Steam Stripper Project? What were the cost and schedule impacts for implementing the controls to mitigate those hazards? –

Please see the HAZOP summary email below. There were 2 additional hazards identified for additional evaluation that had not yet been complete. If these were required to be implemented, the cost and schedule impacts were expected to be low.

From: Severson, Brian D <Brian_D_Severson@rl.gov>
Sent: Tuesday, May 4, 2021 3:11 PM
To: Subramanian, Karthik <karthik_subramanian@rl.gov>; Lehrman, Scott D <scott_d_lehrman@rl.gov>
Cc: Beaumier, Cynthia W <cynthia_w_beaumier@rl.gov>
Subject: RE: Hazop

All,

The Haz-Op was conducted over four days. It started with a delta analysis of the steam stripper process. The primary focus was the toxicity hazards associated with the Acetonitrile and Acrylonitrile. Days two and three focus on the Acetonitrile Distillate Storage Tank (ADST) and associated piping. Day 4 focused on the Acetonitrile Distillate Load Out (ADLO). Days 2 thru 4 were a comprehensive Haz-Op, as these systems had not been looked at previously. There was a lot of good discussion and actions coming out of the four sessions. See below for a high level summary of each session. For information I have attached the Haz-Op worksheet used for the ADLO evaluation.

Steam Stripper
The outcome was fairly benign. ACN concentrations in the process are too low to be of concern upstream of the concentrator column. Major impacts to the design coming out of the Haz-Op are:

1. Need to consider bollards around the two condensate tanks located inside 2025E.
2. Evaluate the need for local air monitoring for ACN in the North end of 2025E.

ADST
Main concerns are flammable gas accumulation and inhalation exposure to workers. There were a number of actions that came out of the two meetings. They are mainly centered around:

1. Defining operational parameters of the ADST and recirculation system
2. Determining anticipated concentrations of ACN vapors in the ADST head space, and around the pad in the event of leaks, and whether they will exceed 25% of the LFL.

ADLO

The conceptual design is in its early stages, which prevents a really detailed Haz-Op from being performed. Main hazards specifically associated with the acetonitrile were flammable gas accumulation and inhalation exposure to workers. Dermal exposure of the ACN is a lesser concern. The 2.3% ACN distillate has no acute dermal toxicity per the GHS classification system.

1. More detailed IH modeling needed
    a. ACN vapor concentration from a filled tote with the cap off
    b. ACN Vapor concentration from a ruptured tote with a spill volume of 300 gallons
2. Determine detailed ventilation needs to keep worker exposure below the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) 8hr Time Weighted Average (TWA) of 20 ppm.
3. Evaluate cooling distillate as transferred to the load out station, or the ADST contents entirely to reduce vapor emissions.

The next steps will be to:

1. Request additional IH modeling
2. Close out open actions
3. Fold results of the Haz-Op in to the Mod-Traveler and SOW.

Thanks

Brian