Department of Energy
Richland Operations Office (RL)
Surveillance Report

Division: Safety and Engineering Division (SED)

Surveillance Team: Brenda Pangborn (lead), Joe DeMers, Wayne Glines, Rick Jansons, Ed MacAlister, Ed Parsons, Kerry Schierman, Sandra Trine

Surveillance Number: S-11-SED-CHPRC-PFP-002

Date Completed: April 29, 2011

Contractor: CH2MHILL Plateau Remediation Company (CHPRC)

Facility: Plutonium Finishing Plant (PFP)

Title: Planning and Execution of Radiological Work

Guide: 10 CFR 835

Surveillance Scope:

The objective of this surveillance was to evaluate the adequacy of planning and execution of radiological work at PFP. This was a surveillance of the work planning process that included review of the development of radiological work packages, the identification, analysis and control of radiological work hazards, a review of work planning resources, and a review of radiological deficiencies resulting from less than adequate work planning and the associated corrective actions management. This surveillance also included investigation of specific radiological deficiencies anonymously sent to RL.

Surveillance Summary:

The surveillance team reviewed documents that included, among others:

- Contractor work planning documents (b)(5)
  (b)(5)
- Training course materials for both radiological work planners and the line work planners,
- Radiological control procedures and technical basis documents,

- Radiological performance indicators including contractor self assessments, contractor corrective action reports, and RL operational awareness (OA) reports for activities at PFP,
- Historical documents of the PFP, including the Radiological History of the Plutonium Finishing Plant (1954-1997) that described radiological upsets in the facility (dates, locations and contamination values),
- Work packages and associated radiological screening forms, As-Low-As-Reasonably-Achievable (ALARA) Management Worksheets (AMW), and radiological work permits (RWP).

The surveillance team interviewed more than forty (40) personnel involved in the work planning process and execution of work in the field, including:

- Three (3) radiological work planners,
- Eight (8) line work planners,
- Four (4) field work supervisors (FWS),
- Four (4) superintendants,
- Three (3) project managers,
- Two (2) Integration Planners,
- Four (4) radiological control supervisors (RCS),
- Eight (8) lead radiological control technicians (lead RCT),
- One (1) Director of Radiation Protection, Industrial Hygiene, and Occupational Safety (RHS),
- One (1) Director of Environment Safety and Health for CHPRC,
- Two (2) former PFP radiological Control Managers (RCM),
- One (1) Radiological controls mentor, and
- Three (3) engineers or engineering managers, including the Design Authority for High Efficiency Particulate Air (HEPA) filtered ventilation system.

The surveillance team observed the following work planning processes:

- Walk downs of the work area including, scoping walk downs, workability walk downs, and Automated Job Hazard Analysis (AJHA) walk downs,
- Preliminary planning meetings (prior to AJHA meetings),
- AJHA meetings,
- Work Planner schedule status meeting,
- Plan of the Day (POD) meetings,
- Pre-job meetings,
- Post-job meetings,
- Critiques, and
- Observations of work activities (e.g., Chop shop, 242Z…).

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The surveillance team performed a surveillance of the work planning process, looking at the PFP process for planning radiological work. From a review of the contractor procedures, and

interviews of personnel, the basic simplified flow chart of the work planning process used at PFP is shown below:

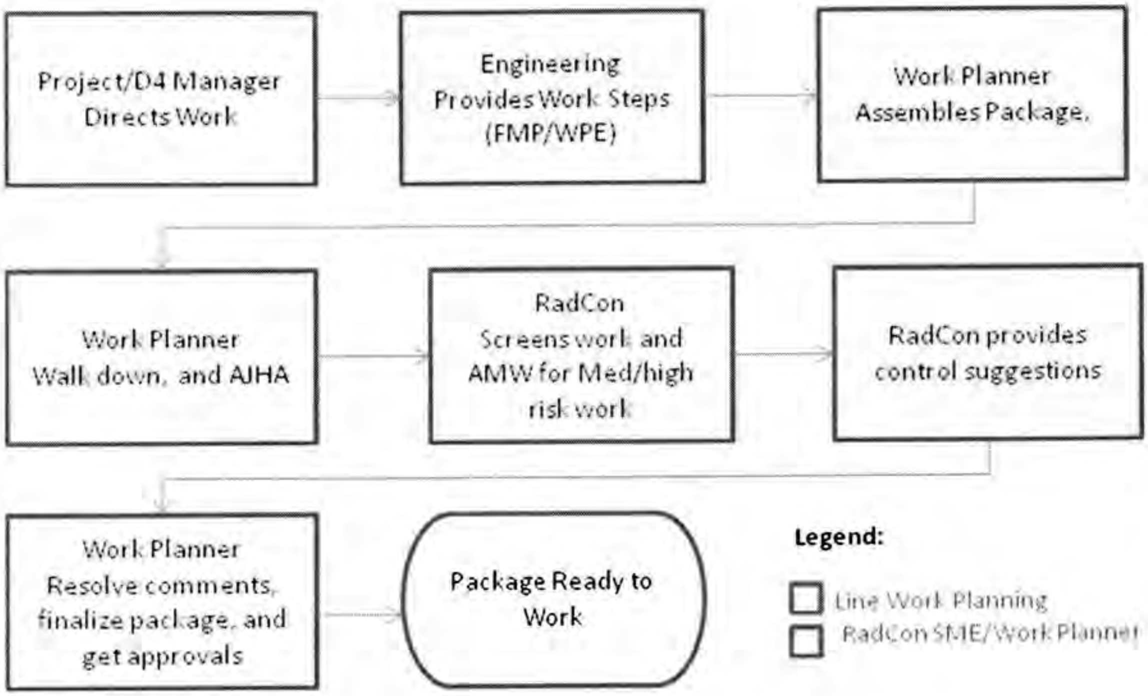

Figure 1 Simplified Work Planning Process Flow Chart

The surveillance team found multiple deficiencies in planning and execution of radiological work and some deficiencies in other technical work performed by the PFP radiation protection organization. Deficiencies in the work planning process included less than adequate involvement of radiation protection early in the work planning process and in radiation protection and some engineering work planning at the activity level. There were inadequate levels of radiological technical staffing, less than adequate training and qualification of radiological work planners, and unclear roles and responsibilities for determining radiation protection controls as implemented in the field. Additionally, the surveillance team identified some deficiencies in other technical aspects of radiation protection program at PFP. Several of the deficiencies identified in this surveillance had ties back to deficiencies in the CHPRC radiological control program.

The deficiencies in radiological work planning also demonstrated weaknesses in implementation of Integrated Safety Management Systems at PFP and CHPRC.

As a result of the deficiencies identified by RL, the contractor brought in additional radiological control staff to shore up PFP's radiological control program. The project developed a living radiological control improvement plan that was adjusted as the RL surveillance team and additional contractor radiological control staff identified more deficiencies for correction.

The surveillance resulted in one (1) concern, twelve (12) findings and four (4) observations.

- **S-11-SED-CHPRC-PFP-002-C01:** The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.
- **S-11-SED-CHPRC-PFP-002-F01:** Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).
- **S-11-SED-CHPRC-PFP-002-F02:** Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.
- **S-11-SED-CHPRC-PFP-002-F03:** The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.
- **S-11-SED-CHPRC-PFP-002-F04:** Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.
- **S-11-SED-CHPRC-PFP-002-F05:** Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.
- **S-11-SED-CHPRC-PFP-002-F06**: PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning; The CHPRC technical basis document for workplace air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.
- **S-11-SED-CHPRC-PFP-002-F07:** The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work.
- **S-11-SED-CHPRC-PFP-002-F08:** The Hanford Combination Neutron Dosimeter (HCND) was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document; CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F09:** Technical errors were identified in five out of nineteen External Dosimetry Investigation Reports (EDIRs) (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F10:** Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

- **S-11-SED-CHPRC-PFP-002-F11:** Less than adequate conduct of operations was observed; Failures to follow procedures contributed to generation of airborne radioactivity and low level uptakes.
- **S-11-SED-CHPRC-PFP-002-F12:** Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.
- **S-11-SED-CHPRC-PFP-002-O01:** Job Specific RWPs, were written broad and generically to cover multiple work packages.
- **S-11-SED-CHPRC-002-O02:** The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.
- **S-11-SED-CHPRC-PFP-002-O03:** Poor practices identified in EDIR review.
- **S-11-SED-CHPRC-PFP-002-O04:** The use of the CHPRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors were identified.

Due to the number and significance of the deficiencies identified, the contractor will be requested to submit a corrective action plan.

Surveillance Results:

Concern: S-11-SED-CHPRC-PFP-002-C01:

The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

Discussion:

RL performed a surveillance of planning and execution of radiological work. The surveillance included interviews of personnel involved in the work planning process, observation of work planning process activities, reviews of work planning documents, procedures and work packages, and investigation of radiological events.

To adequately plan work, the hazards associated with the work must be fully understood. The radiological hazards are the sum of the hazards from the system that is being breeched, the work operation being performed, and the hazards associated with the work location.

Radiological hazards associated with the system include radionuclides present, at what concentrations, and in what chemical form. How is the system being breeched constructed? What is the material of construction, how is the interior of the system designed, what are the potentials for holdup of radioactive materials and radioactive liquids and where in the system?

The radiological hazards associated with work operations relate to how the work operation could spread contamination or generate airborne radioactivity, and how the work operation could affect the engineered airborne radioactivity controls. As an example, a circular saw used on highly contaminated surfaces would generate high airborne radioactivity with turbulent air flow patterns. Normal ventilation is designed for laminar flow, such that it would be significantly less effective in capturing airborne radioactivity from a circular saw.

Radiological hazards associated with the work location must be adequately characterized. This should include an understanding of the history of upset conditions that resulted in spread of contamination, including the levels of radioactive contamination that could be present on exposing surfaces that were contaminated from fires and spills involving radioactive materials.

Once the hazards are understood, the radiological controls are incorporated. These controls may involve elimination or reduction of the hazard by removal of the source term or limiting the amount of source term that is accessible (e.g., decontamination, application of fixatives). These controls also involve proper selection of the work operations (substituting less turbulent work operations where needed), and implementation of engineered controls to keep the hazard away from the worker (use of glove boxes or glove bags, and appropriately engineered ventilation). After reducing the hazards through elimination or reduction of the source term, and applying engineered controls, administrative controls and personal protective equipment and clothing (PPE) are used to protect the workers.

The radiological controls are then implemented using procedures, training and supervision. The sum of the procedures, training and supervision must be adequate to ensure protection of the workers. The higher the hazard and the more complex the work, the more formal the controls are needed.

At PFP the surveillance team observed deficiencies in multiple areas of the work planning process. The radiological hazards of the work were not properly analyzed. The radiological controls for some high hazard work were less than adequate, relying on PPE in lieu of implementing engineering controls. Personnel, who were not qualified, were found making inappropriate technical decisions in the field (i.e., decisions by first line supervision) that resulted in unplanned personnel exposures to airborne radioactivity.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F01:

Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).

Requirements:

10 CFR 835.501(b) specifies "The degree of control shall be commensurate with existing and potential radiological hazards within the area."

10 CFR 835.501(d) specifies "Written authorizations shall be required to control entry and perform work within radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards."

10 CFR 835.1102 (b) specifies "Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, radionuclides present, and the fixed and removable surface contamination levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "…The contractor shall, in the performance of work, ensure that… (5) Before work is performed, the associated hazards are evaluated…"

Discussion:

As discussed in concern S-11-SED-CHPRC-PFP-002-C01 above, radiological work planning needs to understand the hazards associated with the system, work operations and location in order to determine appropriate controls to mitigate the hazards. Multiple examples exist where the hazards were not appropriately analyzed, resulting in airborne radioactivity generation that exceeded the applicable protection factor for the respiratory protection worn and/or spread of contamination:

1. **The hazard associated with using a circular saw to cut a highly internally contaminated glove box was not analyzed, resulting in very high airborne radioactivity that exceeded the respiratory protection factor for airline respirators.**

The work in room 172 of PFP involved cutting up highly internally contaminated glove boxes for disposal. The room is referred to as the chop shop. On December 29, 2010, workers used a circular saw to cut pieces off the back (exposing internals) of Glove box 139-3/4. The airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator worn. The highest level found on the lapel was 7100 Derived Air Concentration (DAC)-hr (0.71 after taking into account the protection factor of the airline respirator). The surveillance team requested a copy of the airborne radioactivity calculations for the work operation that was performed. None was provided.

On January 25, 2011, workers again used a circular saw to size reduce a glove box. The airborne radioactivity levels "jumped". The highest DAC-hr value on workers lapel air sampler was 17000 DAC-hr, 1.7 DAC-hr after adjusting for the protection factor of the airline respirator (10,000). Assuming the jump in airborne radioactivity occurred over a five minute period (time between monitoring the air sample filter), the airborne radioactivity level generated by the circular saw was more than 200,000 DAC. This was the second time the work team used a circular saw for size reducing the glove boxes and exceeded the airborne radioactivity limits of the RWP (see OA 35012).

The surveillance team again requested the work planning documentation that would indicate the project had evaluated the airborne radioactivity hazard associated with use of the circular saw. The contractor could not provide any. The contractor facility radiological control manager acknowledged no airborne radioactivity estimate had been made.

- **Investigation revealed PFP radiological work planners routinely did not perform airborne radioactivity estimates to ensure appropriate controls were selected for the work activity.**

Interviews with the radiological work planners at PFP revealed the facility did not evaluate the potential airborne radioactivity levels for use of the circular saw on contaminated glove boxes. In fact, the radiological work planners acknowledged they had not ever performed airborne radioactivity estimates for work at PFP. The surveillance team reviewed the work planning records for several work packages confirming there were no records of the analysis of the airborne radioactivity hazards for the work reviewed.

After initially requesting the airborne calculations after the December 29, 2010 event, the PFP Director, RHS obtained documentation from another facility on how to perform airborne radioactivity estimates and provided it to the PFP radiological work planners.

A significant contributing factor to this programmatic deficiency was the lack of training and lack of procedures provided by CHPRC that would show the radiological work planner how to analyze the airborne radioactivity hazard to ensure adequate engineered controls and/or respiratory protection are provided (see findings S-11-SED-CHPRC-PFP-002-F05 and S-11-SED-CHPRC-PFP-002-F06). In this case, no respiratory protection had a protection factor high enough for the work. The analysis of the airborne hazard would have demonstrated the need to incorporate engineered controls.

- **The Radiological Hazards Screening Form indicated no airborne radioactivity above 1000 DAC (unmitigated), even though no estimate was performed**

One of the high hazard radiological work screening criteria is "Will predicted airborne radioactivity concentrations exceed 1000 DAC…." This block is marked no, even though no calculation was performed, and there were no limitations in the procedure on work operations (i.e., any power tool was OK to use) or accessible contamination levels within the glove boxes at the locations being cut. There were no bounds on the radiological conditions of the glove boxes provided to the chop shop except, less than 240 grams of plutonium (Pu). Since airborne radioactivity generation depends on the amount of accessible contamination being disturbed and the work activity disturbing the contamination, there is no technical basis for the conclusion that unmitigated DAC values would be below 1000 DAC. This lack of analysis resulted in repetitive generation of much higher levels of airborne radioactivity at the chop shop.

- **Investigation revealed the effectiveness of the point source ventilation used in the chop shop for removing airborne radioactivity during cutting with the circular saw had not been evaluated by PFP engineering.**

The surveillance team interviewed the design authority for HEPA ventilation and requested a copy of the ventilation calculations that would demonstrate the effectiveness of the spot ventilation when using a circular saw. The project could not produce the calculations and acknowledged that they had not been performed.

Interviews indicated that the ventilation engineers were primarily involved in ensuring the PFP HEPA ventilation system and air flow through the plant was not adversely impacted by changes to the system and ensuring HEPA ventilation for tents were adequate to provide appropriate air changes. Some evaluation of point source ventilation had been performed, but not where turbulent air flow patterns were involved. The engineer provided an example of an evaluation of a point source ventilation calculation with typical laminar flow. The work planning process at PFP did not ensure that engineering was adequately utilized in the work planning process. Since DOE identified this deficiency, there has been greater use of engineered ventilation and participation by engineering in its design.

- **Air monitoring in the chop shop with DAC-hr limiting conditions have kept personnel from getting a significant uptake to date, but has not been a cost effective means of performing the work due to multiple shut downs of the work for re-planning.**

To control worker exposures to airborne radioactivity, the project incorporated airborne radioactivity void limits. While this process is more of an emergency response, and has minimized the potential dose consequences to the workers to date, it does not control the generation of airborne radioactivity or prevent airborne that exceeds the respiratory protection factor of equipment worn, and creates a highly inefficient work process.

A review of the contractors work records between December 15, 2010 (the start of cutting operations in the chop shop) and March 16, 2011, indicated that work was performed in room 172 for 40 days. Out of those days of work, cutting of glove boxes occurred during 20 days. Airborne radioactivity levels exceeded the radiological work permit DAC-hr limits during 30% (6 out of 20) of the days where glove box cutting occurred. These events resulted in stopping work operations to re-plan work.

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- **Continued problems in chop shop revealed glove boxes were not adequately prepared for safe size reduction; fixatives were not adequately applied before the boxes were removed from the E-4 ventilation system and sent to the chop shop.**

After shut down of the chop shop on March 16th, work restarted April 20, 2011, with the first intrusive work performed on April 25, 2011. On that day, airborne radioactivity levels increased and personnel stopped work within a half hour. On the next day, airborne radioactivity levels exceeded the limiting conditions of the RWP. At the post job, workers revealed the glove boxes were not being provided to the chop shop in a condition that would permit safe size reduction. The glove box they were working on had bare metal inside, indicating less than adequate application of fixatives, gloves were not properly rolled up and secured (making fixative application less effective), and pie plates were improperly secured (OA 37140). A review of a sample of glove box removal work packages confirmed there were no quality assurance steps in the procedures to verify adequacy of glove box preparation for the chop shop. Additionally, the chop shop work package contained two "size reduction hand-off checklists", one for glove-box 139-5, and one for 139-6. Both check lists showed the "Contamination fixed inside/outside" block left blank, indicating the action was not completed.

2. **The high contamination hazard associated with exposing and cutting a neoprene gasket exposed to historical releases of airborne radioactivity was not recognized or analyzed resulting in four individuals receiving a low level uptake of plutonium.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. Airborne radioactivity was generated when the neoprene gasket was exposed, cut and swipe surveyed (50,000 dpm alpha). Personnel were not wearing respiratory protection.

Historical records indicated several significant spreads of contamination in room 230 and 235 from undetected glove breeches to explosions and resulting fires. Contamination levels between 2000 and 6 x 10^6 dpm alpha are described (FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954 – 1997)). Historical records indicated the contractors partially decontaminated the surfaces and then applied paint to fix the contamination, indicating the likelihood of uncovering contamination when exposing previously inaccessible surfaces. PFP has also experienced a greater hazard of loose surface contamination associated with gaskets. For example, on 10/22/10 open air separation of Glove box 139-1/2, exposed previously inaccessible areas and resulted in a spread of contamination when the gasket between glove boxes swung free. On 3/16/11 airborne radioactivity levels increased above the limiting conditions of the RWP for the chop shop when workers cut an area where a gasket had been removed without application of fixative (OA36431).

- **Less than adequate involvement of PFP engineering in the work planning process resulted in incorrect work instructions.**

Work instruction 2Z-09-06644/M WCN2, step 6.10.2, specified "Cut wallboard/Plexiglas panels surrounding Conveyor HC-4 in room 230C & 235B." The wall was not constructed of wallboard, but had stainless steel plates bolted in place around the Plexiglas windows with neoprene gaskets. The wall had been painted over due to the historical spreads of contamination in the area. The engineer did not provide drawings of the wall construction to the work planner, providing a missed opportunity to plan for the hazard associated with a gasket exposed to contamination being uncovered. The surveillance team requested a copy of the engineering drawing associated with the wall. The drawing identified the existence of the neoprene gasket and steel plates.

- **The AMW did not address the hazards associated with removal of a portion of the wall and Plexiglas windows.**

AMW 5549, rev 0, for work package 2Z-09-6644, dated January 26, 2011, did not address the hazards associated with removing a portion of the wall between rooms 230C and 235B The AMW only addressed breaching radioactive systems.

- **CHPRC review of the work package identified the AMW did not address each task, but did not ensure correction of the deficiency prior to releasing the work.**

During the third week of fieldwork, RL requested the contractor perform compensatory actions to shore up weaknesses in the radiological control program at PFP. One of the actions taken by CHPRC was to bring a team in to review the high risk work packages. During this review on March 6, 2011, the CHPRC task team identified the deficiency in the AMW not addressing each task, but no action was taken to correct the issue prior to releasing the work.

- **When the work team performed their workability walk down, the team determined unbolting the steel plates was easier, and safer, but did not make a change to the procedure.**

During the workability walk down prior to performing the work, the work team decided unbolting (vice cutting) the wall would be safer, but no change to the procedure was made. The field work supervisor, in consultation with the lead RCT, determined respiratory protection was not needed since they were not cutting. Unbolting the steel plates, using the wet method, was started with no airborne generation. It was not until the gasket around the Plexiglas window was disturbed that high contamination levels were found (50,000 dpm/swipe alpha), exceeding the limits in the RWP. One low level nasal smear was found, but in performing additional voluntary bioassays, a total of four individuals were found to have had low level uptakes of plutonium (56 person-mrem committed effective dose)).

Failure to obtain a procedure change was a missed opportunity to identify and analyze the hazard. The deficiencies in conduct of operation, and clearly defined roles and responsibilities are addressed in S-11-SED-CHPRC-PFP-002-F11 and S-11-SED-CHPRC-PFP-002-F03 respectively.

3. **Airborne radioactivity generation hazards for Glove box WT-4 size reduction and glove box floor removal was not adequately analyzed, resulting in high airborne radioactivity that exceeded the supplied airline respiratory protection factor.**

Glove box WT-4 is in the control room of the Americium Recovery Facility (242-Z). The work package, 2Z-10-02068, was for removal of glove boxes WT-3, WT-4, and WT-5. On April 6, 2011, airborne radioactivity was generated that exceeded the limits of the radiological work permit (OA 36771), and the respiratory protection factor for the supplied airline respirator.

The airborne radioactivity was generated during use of a crow bar to pry up and remove a polyethylene liner on the floor of the glove box (show in drawing H-2-24954). The crow bar was used to pry up flashing ("20 GA S STL") used to hold the liner in place, and then to pry up the polyethylene. During the post job, the workers indicated there were some hot spots (4-5 rem/hr) on the floor of the glove box, indicating very high levels of contamination. The airborne radioactivity hazard associated with the activity of scraping on this highly contaminated surface was not analyzed.

4. Inadequate analysis of material compatibility results in a spill of an acidic plutonium material; additionally, a precursor event was not appropriately analyzed.

Work package 2Z-10-0679, involved removing plutonium chemical transfer lines. These lines contained three individual lines inside a protective pipe. The packaging included insertion of a rubber plug to hold the three chemical transfer lines in place within the protective pipe. A red cap was placed over the pipe end to prevent the sharp ends of the pipe cut from damaging the packaging. The cut pipe was "horse tailed" out of the glove bag containment (poly-vinyl-chloride (PVC) sleeve) and sealed using duct tape. A reinforced bag was placed over the horse tail, and sealed with "chem" tape. Then a PVC rigid cap is placed over that and secured with "chem" tape.

The team had successfully made 17 cuts using glove bags (engineered barrier), but found some liquid (described as runny like water) in two cuts made prior to the events described herein.

On 3/30/2011, while performing post job surveys, an RCT identified 600,000 dpm/100cm^2 alpha contamination on the bottom of a packaged pipe end. Even though the contamination was found on the bottom of the pipe, where the PVC rigid cap (sealed with "chem." tape) meets the pipe, the work team did not recognize this as an indicator of a breach of the sealing system. While recovering from this event, a second cut in the system sat with the same packaging system.

On 4/6/2011, the second pipe end was flipped up to drain the pipe into the glove bag. As workers exited the area, six persons were found to have contamination on their PPE. Contamination above the limiting condition of the RWP was found on surfaces in the exit path. The full extent of the spread of contamination was not understood until a recovery team entered. A visible spill of a thick (honey like) brown plutonium substance was found. Contamination in the spill area was as high as 150,000,000 dpm/100cm^2 alpha. The floor in the area contained crevices, complicating clean-up. Disposable surfaces below the work area to protect the floor in case of a spill, were not adequately used during the job. A partial decontamination was performed and the area painted over to fix the contamination.

The work team believes the plutonium acidic material broke through the adhesive in the tape, spilling out of the sleeve onto the floor. RL requested the D&D engineer assigned to the project for the chemical compatibility information for the tape used. The information provided to RL from the manufacturer showed it was not rated for nitric acid (expected chemical form in the pipe). Discussions with the field work supervisor indicated they were not aware of any specific time limitations for satisfactory seal due to the nitric acid that was anticipated.

5. **Inadequate hazards analysis results in workers drilling into the E-3 HEPA ventilation ducting.**

On April 7, 2011, workers, installing anchors in room 235B, inadvertently drilled into the contaminated E-3 HEPA filtered ventilation duct located inside the wall. The E-3 duct is a void in the wall, thus contains no metal. The work planning was less than adequate in that drawings that show the location of the E-3 ventilation were not appropriately used in determining the location of the anchors (OA 36775).

6. **Less than adequate analysis of hazards results in airborne radioactivity release while breaking a bagged Pyrex tank**

On January 27, 2011, a Pyrex tank was removed from glove box 522. The bagged tank was too big to fit into the 55-gallon waste drum. The workers attempted to size reduce the Pyrex tank by padding the tank and hitting it with a pipe wrench. The bag holding the tank was breeched, resulting in high airborne radioactivity and continuous airborne radioactivity monitor (CAM) alarm. (OA 35484)

7. **Deficiencies in analysis of hazards extends beyond radiation protection; A potential fire was narrowly averted when a worker questioned cutting on a pipe containing plutonium contaminated combustible material**

During interviews of personnel, workers reported a near miss that occurred in January of 2011. Work package 2Z-10-07673, Separate Glove box 100C from Glove box 200 in room 235D, specified cutting a hydraulic ram that was filled with plutonium contaminated combustible waste (paper, plastic and miscellaneous step off pad waste). At the pre-job briefing a worker raised a concern regarding the potential for the heat generated by the blade during the cutting reaching temperatures that could ignite the material inside the pipe. When the concern was raised, a mock-up was performed and the mock-up demonstrated the cutting operation started a fire.

The contractor issued a lessons learned praising the workers attentiveness and questioning attitude. However, corrective actions for preventing recurrence of the inadequate hazard analysis were not identified.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F02

Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.

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Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (c), specifies "The contractor shall manage and perform work in accordance with a documented Safety Management System (System)…. Documentation of the System shall describe how the contractor will: (1) Define the scope of work…."

PRC-MP-MS-003, Integrated Safety Management System/Environmental Management System Description (ISMSD), section 3.1 Define Scope of Work, third paragraph, specifies "Work identified in the [work breakdown structure] is further divided into discrete tasks that are individually planned for execution using PRC-PRO-WKM-12115, Work Management, which describes the process for initiating, authorizing, performing, and conducting field work."

PRC-PRO-WKM-12115, Work Management, section 3.2.3, Plan Work, Step 19 states "…State the precise scope of work, including the methods of performing the work…. The scope description must be detailed enough to support the development of effective and accurate hazard controls for the proposed work activity…. Work steps provide the sequence and technical information for the work team to accomplish work that was described in the scope statement. The [field work supervisor] is responsible to direct the work team in a manner that complies with the approved instructions…."

PRC-PRO-WKM-079, section 3.1 Review the work scope, states "1. REVIEW work scope to be sure it is adequately defined…. 2. IF the work scope is not adequately defined, THEN UPDATE work scope in accordance with PRO-WKM-12115 or PRC-PRO-MS-589."

Discussion:

As discussed in the concern above, analysis of hazards includes the hazards associated with the system being breached, the work operations performed, and the location of the work. To appropriately analyze the hazards of the work at the activity level, the work scope must be clearly defined. This means the individuals analyzing the hazards must know the details of how the job will be performed. As specified in PRC-PRO-WKM-12115, the work scope description must be detailed enough to support the development of effective and accurate hazards controls for the proposed work activity.

Less than adequate hazards analysis and implementation of controls is in part a result of less than adequate definition of the work scope. Examples of less than adequate definition of scope from Finding S-11-SED-CHPRC-PFP-002-F01, include:

- **Work scope definition/limitations for size reduction of Glove box 522 Pyrex tanks was not adequate, and therefore adequate controls were not established to prevent an airborne radioactivity release (OA 35484)**

Airborne radioactivity was generated 1/27/11, room 152 when workers attempted to size reduce a Pyrex tank from Glove box 522 by padding it on the outside of its containment bag, and then striking it with a pipe wrench. This work activity was not identified in the work package. The work instruction in (2Z-10-03825) in general, and section 6.4.2.4 (disconnect/removal of Pyrex tanks) in particular, did not identify a need, option, or instructions to size-reduce the Pyrex tank, to fit it into the waste container.

- **Work scope definition for removing Plexiglas windows with radioactively contaminated neoprene gaskets between PFP room 230C and 235B was not adequate.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. The procedure did not adequately define the scope of work.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F03:

The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that...(2) Clear and unambiguous lines of authority and responsibility for ensuring (ES&H) are established and maintained at all organizational levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that... (3) Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities."

Discussion:

The surveillance team interviewed more than 40 individuals involved in work planning, including work planners, radiological work planners, lead radiological control technicians, radiological control supervisors, field work supervisors, project managers, the safety and health manager, a radiation protection corporate mentor, and some radiation protection personnel that left PFP to work elsewhere. Additionally, the team interfaced with workers during observation of work planning processes.

Interviews revealed that there was a lot of frustration felt by both workers and managers that was a result of work planning being performed in the field, instead of being planned up front. Disagreements on the appropriate radiological controls to implement for a work activity resulted in everything from work stoppages, to implementation of inadequate controls.

- **Work packages were built with "flexibility", so the procedure would not tie the work team down as to how the work was performed; Radiological controls were "flexible" to accommodate decisions on how to do the work in the field.**

The work team and management expressed the desire for flexibility in how the work was performed, letting this be "skilled based". Consequently, the radiological work planners specified "flexible" radiological controls in the work packages. This resulted in management abdication of their responsibility for hazards assessment and controls.

Some examples include generic instructions such as:

Chop shop: 2Z-10-05648, room 172 size reduction operations, 6.2.5 "Perform size reduction activities using power tools (i.e., nibbler, sawzall, circular saw, bandsaw) on hood/glove box/ducting.... Move point source ventilation as needed for contamination control during cutting.... Implement contamination control, as needed, using hand held fogging unit...."

2Z-09-3291, Rm 139 Glove Box Removal, section 4.6 "Use wet methods, sleeving and/or HEPA filtered spot ventilation to control contamination, as necessary."

Work package 2Z-10-2115/M, 4.6.4 included the following, "Wet towels, HEPA vacuum, Glove bags/sleeving and or catch bags shall be used as the main engineering controls during the task as necessary."

When RL debriefed the contractor on preliminary findings, RL requested CHPRC to implement compensatory actions to shore up the radiation protection organization at PFP. One of the compensatory actions was to review high risk work packages for adequacy of radiological controls.

- **Roles and Responsibilities for the FWSs, lead RCTs, and other craft work team members are not intended to include radiological hazards analysis; Radiological training programs for these individuals did not include this qualification.**

The absence of specific radiological hazard controls in work instructions/packages resulted in radiological hazard control decisions being done by the field work team. These individuals were not technically qualified to analyze radiological hazards.

While the field work supervisors and lead RCTs have extensive experience in their roles, the surveillance team review of the FWS and RCT training revealed it was less than adequate to qualify them for radiological hazards analysis and control. The FWS training and qualification in radiological subject areas was limited to Radiological Worker II training. Radiological Worker II did not provide qualification on radiological hazard analysis and control selection.

The surveillance team reviewed the RCT training, which is based on the DOE training standards. While the level of training exceeds radiological worker II training, RCT training objectives were not intended or designed to provide qualification on radiological hazards analysis and selection of engineered controls for work. The surveillance team also found that the training for lead RCTs did not include additional hazard analysis and control topics. The training reviewed for FWSs and RCTs did not include appropriate education, training, and skills to discharge these responsibilities, specifically the radiological hazard analysis and selection of engineered controls.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F04

Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.

Requirements:

10 CFR 835.1001 Design and control, (a) specifies "Measures shall be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative controls. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure."

10 CFR 835.1002 Facility design and modifications, (c) specifies "Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used."

10 CFR 835.1003 Workplace controls specifies "During routine operations, the combination of engineered and administrative controls shall provide that…(b) The ALARA process is utilized for personnel exposures to ionizing radiation."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "…The contractor shall, in the performance of work, ensure that…(6) Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures.

Discussion:

Engineering controls are required to be the first line of defense against airborne radioactivity and spread of contamination. Some work teams have appropriately performed work activities using glove bags and glove boxes, to keep the worker from being exposed to the source of contamination.

Examples of poor use of engineering controls include:

- **Less than adequate use of engineering controls at the chop shop**

Work in the chop shop directly exposes personnel to high contamination levels inside glove boxes that are not designed for human entry. The chop shop and the work performed there was not properly designed up front with adequate engineering controls. As a result, airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator multiple times, and the project continually struggled with back fitting radiological controls. The facility did not use the glove box itself and facility ventilation system (E-4) to adequately reduce the hazards prior to disconnection from the E-4 system and transporting the glove boxes to the chop shop, nor designed the chop shop facility for size reducing the glove boxes inside an engineered barrier (glove box or engineered ventilation hood).

- **Less than adequate use of engineered ventilation in general; less than adequate involvement of engineering in the design of spot ventilation.**

Engineered ventilation was not always used. An example included scraping of the polyethylene liner with high dose rates, indicative of high contamination, at the bottom of glove box WT-4 without engineered spot ventilation (see Finding S-11-SED-CHPRC-PFP-002-F01).

Spot ventilation being used at the facility was not always being adequately designed to meet its intended use. Elephant trunks and HEPA filtered vacuums cleaners had been used, but were not always adequate. Examples include the use of an elephant trunk for engineered ventilation while cutting a glove box with a circular saw (see Finding S-11-SED-CHPRC-PFP-002-F01).

As the RL surveillance progressed, more involvement of the ventilation engineer in spot source ventilation design was observed. A corporate mentor had previously brought up the need for PFP to use a "B-box", a spot ventilation used at Rocky Flats. Facility action was not observed by the surveillance team until compensatory actions to shore up the radiological controls at PFP were implemented by the contractor.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F05:

Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.

Requirements:

10 CFR 835.103 Education, Training and Skills, specifies "Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this part shall have the appropriate education, training, and skills to discharge these responsibilities."

(b)(5) [redacted]

identify positions that develop and implement measures necessary to comply with 10 CFR 835. At a minimum, this includes those individuals filling the following positions…. Facility/Project Rad Con technical staff…."

Discussion:

Training and qualification of radiological work planners did not ensure that individuals, who were determining and implementing radiological controls, were appropriately trained and qualified to perform applied radiological hazards analysis. Although these individuals met the educational requirements of CRD 5480.20A and DOE-STD-1107-97, the CHPRC training did not ensure the individuals had all the skills necessary to discharge their assigned responsibilities in the area of applied hazards analysis.

- **The Radiological Control Work Planning training course did not adequately address applied hazards analysis.**

Course number 022801, Planning Radiological Work – Initial, section F, Purpose and Overview, specifies "This course does not attempt to teach radiological work planning…." The course does not teach how to plan work, nor does it provide instruction on how to perform applied hazard analysis.

Some radiological work planners were RCTs that were promoted to work planners. The RCT qualification program also does not teach personnel applied radiological hazards analysis. There was no documented training or demonstration of knowledge on how to perform applied hazard analysis prior to assignment as a radiological work planner.

The primary emphasis of the course 022801 is to teach the radiological work planners how to fill out the radiological hazards screening and ALARA Management Worksheet forms to support the work management process. The course contains general discussion on factors affecting radiological hazards, but does not adequately cover practical application of hazards analysis and selection of controls.

- **Radiological work planner training did not demonstrate how to perform airborne radioactivity estimates based on contamination levels, work operations, and application of airborne radioactivity controls.**

A review of radiological work planning training documents and interviews found that the training did not provide adequate instruction on how to predict airborne concentrations. The training materials directed the trainee to use the facility Technical Evaluation (TE) to predict airborne concentration. The PFP TE did not contain guidance on how to estimate airborne concentrations. The training material did not demonstrate how to perform these airborne radioactivity calculations.

- **Selection of appropriate respiratory protection requires the ability to calculate airborne estimates.**

The radiological work planning course does not show the work planner how to select respiratory protection based on estimated airborne radioactivity levels.

- **Radiological work planning training did not adequately cover limitations of HEPA filtered ventilation as an engineered control.**

Interviews found that staff did not understand the limitations of ventilation as an engineered control. Personnel did not demonstrate understanding that ventilation is typically designed for laminar flow. Ventilation is significantly less effective when generating turbulent air flow patterns, such as those created with a circular saw. This is important to understand, so that radiological work planners do not specify ineffective controls.

The radiological work planner training course did not cover the technical aspects of engineered ventilation or the need to engage engineering in its design.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F06:

PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning; The CHPRC technical basis document for workplace air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.

Requirements:

10 CFR 835.104 Written Procedures specifies, "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

Discussion:

The surveillance team reviewed the CHPRC and PFP list of procedures on line and technical basis documents. PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning. The CHPRC had a technical basis document for workplace air monitoring. This technical basis document included formulas to determine if air sampling is required. The technical basis document did not specifically address estimating airborne radioactivity levels for hazards analysis and work planning.

Airborne radioactivity estimates were needed to complete the Radiological Work Screening process (PRC-PRO-RP-40108, "Radiological Hazard Screening," and Site form A-6004-654). Some CHPRC projects and other Hanford Site contractors had procedures for performing airborne radioactivity calculations for hazards analysis and work planning. After the deficiency in performing airborne radioactivity calculations was identified by RL, PFP obtained another CHPRC project's methodology for performing airborne radioactivity calculations to develop their own instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F07

The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work

Requirements:

CRD O 5480.19 Chg 2 (Supp Rev 4) Conduct of Operations Requirements for DOE Facilities Chapter I, Operations Organization Administration: C. Guidelines; (2) Resources: specifies "The operations supervisor for DOE facilities should be provided with sufficient… personnel to accomplish assigned tasks without requiring excessive overtime by the operations staff. These resources should include technical personnel needed to support the operations. A long-range staffing plan that anticipates personnel losses should be developed and implemented."

Discussion:

In decontamination and decommissioning of a facility, an increased level of radiological risk and potential for rapidly changing conditions are expected. Multiple systems are being breached, facility engineered controls are being deactivated, etc. Planning for appropriate additional staff is critical to effectively handle the increased work and continual changes in facility conditions.

The contractor did not ensure adequate radiological staffing resources at PFP.

- **PFP experienced the loss of the facility RadCon Manager, a key position, in June 2010 and did not permanently replace the manager until March 7, 2011.**

The lack of priority and urgency in filling this key position for a high risk and accelerated project demonstrated less than adequate planning and response to key personnel losses. The high risk and accelerated nature of PFP work should have driven a more expedient permanent replacement for this key role. For approximately 8 months, the project did not have a permanent RadCon Manager.

PFP assigned personnel as temporary radiological control managers. The RHS Director intermittently acted as RadCon manager. However, the RHS Director's other duties combined with the RadCon organization's span of control, made this approach less than adequate. For 5 months (August through December), the facility had a central RadCon staff member acting in a temporary capacity. After the central RadCon staff member went back to the central organization, the radiological control manager position was rotated among the radiological control supervisors. Experience shows personnel in a temporary position are not as effective because staff know they are temporary.

- **There was insufficient radiological technical staff to adequately manage the work planning process.**

The radiological work planner and engineers needs to be an integral part of the work planning team. They need to be there at the start of the work planning, providing input into how the work is performed from a risk assessment perspective. If the work operations are not clearly defined during the planning, hazards assessments may not be accurate, as was observed during the surveillance for some work activities. This contributed to the adverse outcomes realized during work (e.g. RWP voids, high airborne generation, contamination spreads, and radiological uptakes).

At the start of this surveillance, the project had three radiological work planners. This resource level was not adequate to support work planning based on the level of hazards in the facility and the pace of work at PFP. Based on organizational chart reviews and interviews, the three radiological work planners supported approximately twenty-six line work planners.

- **Insufficient numbers of radiological work planners did not permit adequate engagement of the work planner during performance of work.**

The radiological work planners need to be engaged during performance of the work. Field presence by radiological technical support and work planners helps to validate and ensure that radiological controls are implemented as intended. As the level of flexibility in work operations and changing conditions increase, field observations provide for early recognition and correction of potential inadequacies in engineered controls. The shortage of radiological work planners resulted in their limited field presence. Lack of observation of the implementation of controls in the field represents a program weakness and a missed feedback opportunity.

In response to the RL surveillance, the contractor added a radiological engineering manager and additional radiological work planners at PFP.

- **PFP had insufficient numbers of first line radiological control supervisors (RCS) to effectively support radiological work.**

A review of the PFP organizational chart and interviews with the PFP RCS found that approximately 102 RCTs were supervised by five RCS. Interviews indicated the following: One of these RCS had double duty as PFP's acting radiological control manager. One of the RCS was assigned Duty RCS for making personnel assignments, responding to emergencies, and completing other administrative duties. Additionally, the RCSs review completed radiological surveys. As a result, only two RCS were typically available to oversee the ongoing work. The ratio of RCTs to RCS was very high considering the level of radiological hazard associated with the work at PFP.

Since RL identified the overall weaknesses in radiological staffing at PFP, the contractor has increased the number of RCS.

- **Fifty percent of the RCTs at PFP were junior**

Interviews with personnel indicated fifty percent of the RCTs at PFP were junior, meaning they were not qualified to work alone on high risk work activities and required more oversight by the lead RCTs on the work team.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F08:

The HCND was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document; CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).

Requirements:

10 CFR 835, Subpart E-Monitoring of Individuals and Areas, Article 835.401(b) Instruments and equipment used for monitoring shall be... (2) Appropriate for the type(s), levels, and energies of the radiation(s) encountered..."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section F External Dosimetry, paragraph 3, specifies "The contractor shall participate in the development and maintenance of a Hanford site-wide external dosimetry basis document. The contractor's external dosimetry program shall be performed in accordance with this technical basis document."

PNNL-15750 Rev. 1, PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, section 6.3, Selection of Dosimeter Types to Use, specifies "Individuals who are likely to receive Hp(10)n greater than 100 mrem per year should be issued a HCND, which provides a more accurate measurement of neutron dose. In addition, individuals who routinely have Hp(10)n greater than 100 mrem per year reported on an [Hanford Standard Dosimeter (HSD)] should be issued a HCND."

Discussion:

The surveillance team reviewed the CHPRC deficiency reports for PFP. Multiple deficiency reports identified issues with neutron dose over-response from personnel wearing the HSD at PFP that required modifications to personnel dose of record. RL investigated the issue and found it to be programmatic at CHPRC.

The HSD can measure neutron, and is Department of Energy Laboratory Accreditation Program (DOELAP) accredited based on its response to a bare californium neutron source (fast neutron). The HSD over-responds to a moderated neutron flux. Depending on the neutron energy where the individual was exposed, correction factors between 2 and 5 were used. The HCND is a neutron dosimeter which has multiple thermoluminescent dosimeters (TLDs) inside that respond to different neutron energy levels and thus more accurately measure neutron, but costs more.

CHPRC reduced the numbers of personnel monitored with HCND to reduce costs. The HSD costs $45.00 to process, while the HCND costs $68.00 to process (data from DOE Dosimetry point of contact). This cost is less than the contractor's estimated man-hours costs taken to investigate and correct the neutron dose.

In the process of reducing the number of personnel assigned a HCND, individuals who should have been wearing the combination neutron dosimeter were not appropriately monitored in accordance with the Hanford External Dosimetry Technical Basis. In 2010, CHPRC processed 119 EDIRs to correct the neutron reading from a HSD. Many more individual dose records were reviewed for high neutron doses, where doses indicated personnel should have been assigned a HCND, but were not, and the project decided not to make a change in the individual's dose of record.

A review of the CHPRC External Dosimetry Program, PRC-PRO-RP-379, revealed the document is inconsistent with the Hanford External Dosimetry Technical Basis Document. While PNL-MA-842 specifies personnel who routinely have neutron dose, as reported on an HSD, should be issued a HCND, CHPRC has not implemented this in their External Dosimetry Program. PRC-PRO-RP-379, section 3.15, step 5, only specifies to change the dosimeter from a HSD to a HCND if the corrected neutron dose (vice reported dose) is greater than 100 mrem.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F09

Technical errors were identified in five out of nineteen EDIRs.

Requirements:

PRC-PRO-RP-379, External Dosimetry Program, section 3.15, Neutron Correction to HSD Measurements, step 2 specifies "IF calendar year-to-date (CTD) uncorrected neutron exposure is [greater than or equal to] 100 mrem, THEN correct readings using the following correction factors: PFP = 2, ISA = 5, Others = 3." "Note: Justification is required in the project's technical equivalent document if there is a deviation from the given correction factors per project." Step 3 specifies "IF corrected exposure is $\geq$ 100 mrem or if record correction is desired, THEN

NOTIFY DO AND REQUEST an EDIR number, AND COMPLETE AND SUBMIT [EDIR] to correct the recorded dose."

10 CFR 830.122 Quality Assurance Criteria (c) specifies "Criterion 3 Management/Quality Improvement (1) Establish and implement processes to detect and prevent quality problems. (2) Identify, control, and correct items, services, and processes that do not meet established requirements. (3) Identify causes of problems and work to prevent recurrence as a part of correcting the problem. (4) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section J, Radiological Records, paragraph 2, specifies "The contractor shall ensure that permanent radiological records are accurate…."

Discussion:

The surveillance team reviewed 19 out of 119 EDIR that involved adjusting neutron doses from the HSD readings. Technical errors (math errors, wrong radiation type, zeroing dose without adequate technical justification) were identified in five out of 19 (26 percent) of the EDIRs. There were other potential issues in 4 other EDIRs. The following technical errors were identified:

- **Several EDIRs contained math errors.**

EDIR-10-223 divided 20 mrem neutron by a correction factor of 3, and specified the corrected dose as 3 mrem neutron (20 divided by 3 is 6.67, or rounded to the nearest mrem is 7 mrem, not 3 mrem). EDIR-10-077 took 60 mrem neutron divided by a correction factor of 3 and said the resulting dose was 17 mrem neutron. EDIR-10-179 erroneously added the gamma dose to the neutron dose when correcting the neutron dose (520 neutron +53 gamma = 573; 573 divided by 2 = 287). The corrected neutron dose should have been 520 divided by 2 = 260 mrem neutron.

- **One workers dose was corrected twice, but the dose was assigned as neutron vice gamma.**

EDIR-10-060 information from the facility did not specify the type of radiation, nor was a radiation survey record attached. The worker had been taking photographs in PFP A-labs, for a total of 2 hours, and lost his HSD. The EDIR specified general radiation levels in A labs as 0.5 mrem/hr, but did not specify whether that was gamma radiation vice neutron. PFP general area radiation levels are both gamma and neutron in most places, and 0.5 mrem/hr is the typical minimum detectable activity (MDA) of the gamma dose reading instrument. The 0.5 mrem/hr dose rate was likely a gamma reading based on the location, A-Labs. The EDIR should have contained both gamma and neutron dose rates for preparation of the dose estimate. The first time the dose was corrected, a math error was made, 2 hrs times 0.5 mrem per hr, was recorded as 2 mrem neutron. The contractor caught the math error and changed the dose to 1 mrem neutron, but did not catch the error of no radiation type being specified by the facility providing the dose rate data.

- **A neutron dose record indicating 31 mrem neutron was changed to zero (see EDIR-10-176).**

The 31 mrem recorded neutron was corrected by dividing by 3 (10 mrem neutron), but then recorded as zero, without appropriate technical justification. Discussions with PNNL dosimetry program technical personnel indicated recording this corrected neutron dose as zero was not consistent with the Hanford external dosimetry technical basis manual.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F10:

Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

Requirements:

10 CFR 835.403 Air monitoring, specifies "(a) Monitoring of airborne radioactivity shall be performed (1) Where an individual is likely to receive an exposure of 40 or more [Derived-Air Concentration (DAC)]-hours in a year…."

10 CFR 835.402 (c) specifies "For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs (including routine bioassay programs) shall be conducted for: (1) radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year…."

Discussion:

The surveillance team reviewed four (4) quarterly PFP workplace Air Monitoring Tracking and Trending Reports (Calendar year 2010). This review was performed in response to an earlier discovery of the tracking and trending not being performed (OA 33986) and an employee concern at PFP over the sporadic elevations of airborne radioactivity in the plant.

- **PFP Closure Project Workplace Air Monitoring Tracking and Trending reports identify locations with unexplained elevated airborne radioactivity above one DAC-hr.**

The surveillance team verified that Workplace Air Monitoring Tracking and Trending Reports have identified areas with sporadic unexplained elevated airborne radioactivity. As an example, the Third quarter 2010 PFP Closure Project Workplace Air Monitoring Tracking and Trending Report identified six (6) areas with greater than 1 DAC-hr airborne radioactivity. The third quarter 2010 report did not provide any actions taken to ensure unmonitored personnel receive less than 40 DAC-hr (100 mrem internal dose) in a year, or actions taken monitor exposed individuals through bioassay or a DAC-hr tracking program.

- **The third and fourth quarter reports did not contain any trending data for locations with elevated airborne radioactivity.**

Review of the Third and Fourth Air Monitoring Tracking and Trending Reports confirmed they did not include any trending data for the locations with elevated airborne radioactivity. Interviews with radiological control technical staff indicated the staffing shortages were a major contributor to the task not being completed.

After RL expressed concern over the shortage of radiological technical staff at PFP, CHPRC added staffing to shore up the radiological control program. An individual with expertise in airborne radioactivity monitoring programs performed a trending analysis for data from March, 2010 through March 2011 to complete the missing analyses.

- **The PFP administrative trigger level for investigating elevated airborne radioactivity was 1 DAC-hr in a week (50 DAC-hr per year for a 50 week work year), which was inconsistent with 40 DAC-hr in a year regulatory requirement.**

A fixed head air monitor draws airborne radioactivity into it and collects the contamination on a filter. When the filter is counted, the contamination is a direct measure of DAC-hr. The airborne radioactivity could have occurred in a short period of time as a result of a work activity, or be the collection of ambient low level airborne radioactivity. Assuming the airborne radioactivity actually occurs when people are in the area as a result of their activities, 40 DAC-hr per year would be 0.8 DAC-hr per week (for 50 work weeks in a year). It is unclear why the facility has used a higher trigger for investigation than that which ensures compliance with 10 CFR 835.

- **Airborne radioactivity area (ARA) posting at PFP goes up and down daily, it is not clear how the air monitoring program verifies personnel not in respiratory protection receive less than 100 mrem internal dose (40 DAC-hr) in a year when these areas are not posted ARA.**

Interviews with the radiological control technical staff and reviews of the quarterly workplace air monitoring tracking and trending reports revealed the fixed head air monitors run both during the period when the area is not a posted airborne radioactivity area and during airborne radioactivity work. When high fixed head airborne radioactivity levels are reported, the radiological technical staff indicated they sent an e-mail to the radiological control supervisors to determine what work went on in the area. If airborne radioactivity work occurred, this is identified in the report. It is unclear how this process ensures personnel who are not monitored for internal exposure and are not wearing respiratory protection, do not exceed 100 mrem internal dose in a year.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F11:

Less than adequate conduct of operations was observed; Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.

Requirements:

10 CFR 830.122 Quality assurance criteria, (e) Criterion 5 Performance/work processes (1) specifies "Perform work consistent with technical standards, administrative controls and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means."

DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities, Chapter XVI Operations Procedures, B. Discussion, specifies "...operations procedures should be sufficiently detailed to perform the required functions without direct supervision.... Operators should not be expected to compensate for shortcomings in such procedures... C. Guidelines ...7. Procedure Use,... Facility operation should be conducted in accordance with applicable procedures... If procedures are deficient, a procedure change should be initiated...."

Discussion:

The surveillance team observed post job reviews and critiques. A contributing factor to events was poor conduct of operations. The following are examples of personnel not following appropriate requirements for use of procedures:

- **Less than adequate conduct of operations contributed to personnel receiving low level uptakes during removal of a Plexiglas window between PFP rooms 230C and 235B.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, the work team identified the wall surrounding the Plexiglas windows was made of stainless steel sheets bolted in place. The team decided to unbolt the stainless steel plates in lieu of cutting as identified in the procedure. Because of the perceived safer condition, the FWS and lead RCT decided respiratory protection was not needed. The work team did not make an appropriate change to the work package prior to performing the work. An unanalyzed hazard associated with contamination on the gasket around the Plexiglas window resulted in four low level uptakes.

- **Personnel observed not following controls established in the procedure contributed to generation of airborne radioactivity above the respiratory protection factor of the airline respirator at the chop shop.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, airborne radioactivity levels during work in chop shop repetitively exceeded respiratory protection factors of the airline respirator. The facility modified the chop shop work package to add additional radiological work instructions on March 10, 2011. When the chop shop work team commenced work on March 16, 2011, the corporate radiological control mentor identified workers had not implemented several of the radiological control requirements in the procedure. Airborne radioactivity levels exceeded the RWP limits for airborne radioactivity and work was stopped.

- **Personnel did not stop when Pyrex tank did not fit into 55 gallon drum. Unplanned work resulted in airborne radioactivity and spread of contamination (OA 35484).**

The work instruction (2Z-10-03825), for preparation of glove box 522 for removal, did not identify a need, option, or instruction to size reduce a Pyrex tank in the glove box. The Pyrex tank was sleeved out of the glove box, but did not fit into the 55 gallon drum staged for its disposal. When personnel in the field concluded the tank should be size reduced they did not recognize work instructions and controls should have been specified and approved prior to performing the actions they did to size reduce the tank. While attempting to break the Pyrex tank with a pipe wrench, a release of airborne radioactivity occurred when the sleeving around the tank was breeched.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F12

Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.

Requirements:

10 CFR 830.122(c)(1) Establish and implement processes to detect and prevent quality problems.

Form A-6004-634 specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

Discussion:

The AMW documents the radiological considerations, analysis and controls to be incorporated for high and medium risk radiological work. Documentation on the AMW Part II, Radiological Protective Measures/Considerations was not consistently completed per the form's instructions. The AMW form specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

The surveillance team reviewed 7 released complete work packages supplied by PFP; the AMWs associated with these work packages did not fully follow the previously stated instruction. The surveillance team found sections on each AMW where the radiological work planner checked, "Incorporate into work instruction," without any text being bolded for inclusion. Failure to follow the forms instructions, e.g. lack of bold text, potentially contributed to the less than adequate inclusion of intended controls in work instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O01:

Job Specific RWPs were written broad and generically to cover multiple work packages.

Discussion:

As part of the PFP work planning surveillance, the team noted that RWPs were written to cover multiple work packages and were broad and general in nature. An example of this is RWP Z-005, "Perform Glove box Work Activities (As per Listed Work Procedures), Handling/Movement of Radioactive Material, Low Level Waste Handling & Disposal and Minor Decontamination." This RWP had been revised 72 times, covered 6 PFP procedures and 28 work packages.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-002-O02:

The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.

Discussion:

During the surveillance, there were a lot of concerns expressed by workers on the use of plutonium levels for determining when beryllium monitoring was required. The workers expressed concern over the accuracy of the technical basis for the policy and on lack of follow through by facility management in performing beryllium characterization.

During review of FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954-1997), the surveillance team noted on page 20 of the report that a spread of contamination from a plutonium-beryllium source occurred in 1981 in room 236. This source of beryllium was not evaluated by the facility in the development of their beryllium monitoring program.

The additional technical staff brought into PFP had an additional benefit of supporting resolution of worker concerns in the beryllium monitoring program. When the additional source of beryllium contamination was identified by RL, the additional staff reviewed its potential impact on the PFP beryllium monitoring program.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O03:

Poor practices identified in EDIR review.

Discussion:

The following additional poor practices were observed:

- **Poor resolution to a technical issue.**

EDIR-10-077 indicated a technical issue existed with the type of direct reading dosimeters (DRD) used at WRAP. The EDIR specified the cause of "ACES report indicated that estimated dose recorded was grossly underreported for [DRD]", was "DRD do not detect neutron radiation and electronic dosimeters can under respond to lower energy spectra." The resolution states: "Return to monthly dosimeter issuance." This resolution does not address the technical shortfall of the equipment. Therefore, the response was less than adequate. 10 CFR 835 requires monitoring be performed with equipment appropriate for the type and energy of radiation encountered.

- **Gross inconsistencies in whose neutron dose from the HSD gets corrected in the individuals record.**

There were gross inconsistencies in whose neutron dose from the HSD got corrected in the individuals record and whose did not. Examples include: A neutron dose correction of 1 mrem was made in one EDIR, a dose of 31 was zeroed in another, and a HDS dose of 199 mrem (99.5 mrem with PFP correction factor applied), was not corrected at all.

- **Rounding is inconsistent.**

Some EDIRs truncated the fraction of a mrem, while others used normal rounding practices. Had the 99.5 mrem corrected value from the example above used normal rounding practices, the corrected dose would be 100 mrem and the CHPRC procedure would require dose correction.

- **Technical justification for use of inconsistent neutron correction factors for ISA pad work was not documented in the EDIR.**

All 4 EDIR reports for individuals working at ISA (correction factor 5) pad that the surveillance team reviewed had neutron dose and no gamma dose. Two individuals had some entries into CSB also. The correction factor applied to those individuals was 3. There was no documentation that indicated why the facility chose to use the 3 over the 5. The correction factor of 3 resulted in a conservative higher dose in the record.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O04:

The use of the PRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors are identified

Discussion:

As part of the PFP work planning process surveillance, the team observed PFP investigate upset conditions and events using the ALARA post-job review as a fact finding tool. By design, the ALARA post-job review did not provide sufficient fact finding guidance to discover the event details needed to identify failure points and prevent recurrence. The site form (site form A-6004-821) provided questions geared toward evaluating causes not gathering factual details. The contractor should provide a more appropriate and effective process for gathering and identifying facts related to upset conditions.

RL Lead Assessor Closure Required: **YES[ ] NO [X]**

Contractor Self-Assessment:

The surveillance team reviewed the contractor's self-assessments and corrective action data base for PFP deficiencies for June, 2010 through April, 2011.

Issues with radiological work control planning and implementation have been previously identified by the CHPRC. On July 13, 2010, CHPRC identified within a conditional report (CR) three Stop Works at PFP related to Procedure Compliance, Entry Requirements and RWP Violations. These formal Stop Works were recorded in CR-2010-2201 to document issues with scope creep, procedure compliance, hazards and controls, pre- job briefs, and duct level entry requirements. As a result of the evaluation of the Stop Work issues, this CR was screened as adverse.

Analysis contained within CR-2010-2201 revealed that multiple issues throughout most aspects of work performance had risen to a level that workers felt the need to implement the formal Stop Work process in order to see that they were adequately addressed. Ten corrective actions were established to resolve these issues.

On October 22, 2010, CR-2010-3327, Contamination Spread in Multiple Rooms during Glove Box Separation Activities, was initiated due to contamination spread during glove box separation activities in room 139 of A Labs. Analysis of this event determined that the work controls were not adequate to handle the potential levels of contamination in areas inaccessible for survey and the configuration of the glove box was such that engineered barriers were considered impractical. Two work control corrective actions were identified in response to this event.

However, the number of radiological work planning events and deficiencies identified during this surveillance, indicates the corrective actions associated with the above issues were not sufficiently effective. This assessment of PFP's radiological work planning corrective action effectiveness aligns with RL's overall evaluation of CHPRC's corrective action management performance (See letter CHPRC-1100939, Integrated Corrective Action Plan).

Contractor Self-Assessment Adequate: **YES [ ]** **NO [X]**

Management Debriefed:

David Del Vecchio, CHPRC
Terry Vaughn, CHPRC
Curtis Bean, CHPRC
Tom Bratvold, CHPRC

Department of Energy Richland Operations Office (RL) Surveillance Report

Division: Safety and Engineering Division (SED) Surveillance Team:

Brenda Pangborn (lead), Joe DeMers, Wayne Glines, Rick Jansons, Ed MacAlister, Ed Parsons, Kerry Schierman, Sandra Trine Surveillance Number: S-11-SED-CHPRC-PFP-002

Date Completed: April 29, 2011

Contractor: CH2MHILL Plateau Remediation Company (CHPRC) Facility: Plutonium Finishing Plant (PFP) Title: Radiological Work Planning Guide: 10 CFR 835

Comment (b)(5)
(b)(5)

Surveillance Scope:

The objective of this surveillance was to evaluate the adequacy of radiological work planning at PFP. This was a (b)(5)

(b)(5) This surveillance also included investigation of specific radiological deficiencies anonymously sent to RL.

Surveillance Summary:

The surveillance team reviewed documents that included, among others:

Contractor work planning documents, (b)(5)
(b)(5)
(b)(5) Training course materials for both radiological work planners and the line work planners, Radiological control procedures and technical basis documents, Radiological performance indicators including contractor self assessments, contractor corrective action reports, and RL operational awareness (OA) reports for activities at PFP, Historical documents of the PFP, including the Radiological History of the Plutonium Finishing Plant (1954-1997) that described radiological upsets in the facility (dates, locations and contamination values), Work packages and associated radiological screening forms, As-Low-As-Reasonably-Achievable (ALARA) Management Worksheets (AMW), and radiological work permits (RWP).

The surveillance team interviewed more than forty (40) personnel involved in the work planning process and execution of work in the field, including:

- Three (3) radiological work planners,
- Eight (8) line work planners,
- Four (4) field work supervisors (FWS),
- Four (4) superintendants,
- Three (3) project managers,
- Two (2) Integration Planners,

- Four (4) radiological control supervisors (RCS),
- Eight (8) lead radiological control technicians (lead RCT),
- One (1) Director of Radiation Protection, Industrial Hygiene, and Occupational Safety (RHS),
- One (1) Director of Environment Safety and Health for CHPRC,
- Two (2) former PFP radiological Control Managers (RCM),
- One (1) Radiological controls mentor, and
- Three (3) engineers or engineering managers, including the Design Authority for High
- Efficiency Particulate Air (HEPA) filtered ventilation

The surveillance team observed the following work planning processes:

- Walk downs of the work area including, scoping walk downs, workability walk downs, and Automated Job Hazard Analysis (AJHA) walk downs,
- Preliminary planning meetings (prior to AJHA meetings),
- AJHA meetings,
- Work Planner schedule status meeting,
- Plan of the Day (POD) meetings,
- Pre-job meetings,
- Post-job meetings,
- Critiques, and
- Observations of work activities (e.g., Chop shop, 242Z...)

The surveillance team performed a (b)(5) looking at the PFP process for (b)(5) From a review of the contractor procedures, and interviews of personnel, the basic simplified flow chart of the work planning process used at PFP is shown below:

Project/D4 Manager Directs Work	Engineering Provides Work Steps (FMP/WPE)	Work Planner Assembles Package,	Work Planner Walk down, and AJHA
RadCon Screens work and AMW for Med/high risk work	RadCon provides control suggestions	Work Planner Resolve comments, finalize package, and get approvals	Package Ready to Work

The surveillance team found multiple deficiencies in (b)(5) planning and (b)(5) PFP radiation protection organization. Deficiencies in the work planning process included less than adequate involvement of radiation protection early in the work planning process (b)(5) activity level. There were inadequate levels of radiological technical staffing, less than adequate training and qualification of radiological work planners, and unclear roles and responsibilities for determining radiation protection controls as implemented in the field. Additionally, the surveillance team identified deficiencies in other technical aspects of radiation protection program at PFP. Several of the deficiencies identified in this surveillance had ties back to deficiencies in the CHPRC radiological control program. The deficiencies in radiological work planning also demonstrated weaknesses in implementation of Integrated Safety Management Systems at PFP and CHPRC. As a result of the deficiencies identified by RL, the contractor brought in additional radiological control staff to shore up PFP's radiological control program. The project developed a living radiological control improvement plan that has been adjusted as the RL surveillance team and additional contractor radiological control staff identified more deficiencies for correction. The surveillance resulted in one (1) concern, twelve (12) findings and four (4) observations.

S-11-SED-CHPRC-PFP-002-C01: The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

S-11-SED-CHPRC-PFP-002-F01: Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and spreads of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).

S-11-SED-CHPRC-PFP-002-F02: Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.

S-11-SED-CHPRC-PFP-002-F03: The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field without adequate hazards analysis, by individuals not qualified to make the decisions. Roles and responsibilities for determining radiological controls were not clearly defined.

S-11-SED-CHPRC-PFP-002-F04: Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.

S-11-SED-CHPRC-PFP-002-F05: Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.

S-11-SED-CHPRC-PFP-002-F06: A CHPRC level or PFP procedure on how to perform airborne radioactivity estimates for airborne radioactivity hazards analysis and work planning did not exist.

S-11-SED-CHPRC-PFP-002-F07: The contractor's radiological staffing resources and long-range staff planning were less than adequate to accommodate personnel loses and planned accelerated decontamination and demolition work.

S-11-SED-CHPRC-PFP-002-F08: The Hanford Combination Neutron Dosimeter (HCND) was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document: CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).

S-11-SED-CHPRC-PFP-002-F09: Technical errors were identified in five out of nineteen External Dosimetry Investigation Reports (EDIRs) (OA 36921).

S-11-SED-CHPRC-PFP-002-F10: Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

S-11-SED-CHPRC-PFP-002-F11: Less than adequate conduct of operations was observed; Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.

S-11-SED-CHPRC-PFP-002-F12: Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.

S-11-SED-CHPRC-PFP-002-O01: Job Specific RWPs, were written broad and generically to cover multiple work packages.

S-11-SED-CHPRC-002-O02: Facilities technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.

S-11-SED-CHPRC-PFP-002-O03: Poor practices identified in EDIR review.

S-11-SED-CHPRC-PFP-002-O04: The use of the CHPRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors were identified.

Due to the number and significance of the deficiencies identified, the contractor will be requested to submit a corrective action plan.

Surveillance Results:

Concern: S-11-SED-CHPRC-PFP-002-C01:

The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

Discussion:

(b)(5) performed a (b)(5) The surveillance included interviews of personnel involved in the work planning process, observation of work planning process activities, reviews of work planning documents, procedures and work packages, and investigation of radiological events.

To adequately plan work, the hazards associated with the work must be fully understood. The radiological hazards are the sum of the hazards from the system that is being breeched, the work operation being performed, and the hazards associated with the work location.

Radiological hazards associated with the system include radionuclides present, at what concentrations, and in what chemical form. How is the system being breeched (b)(5) What is the material of construction, how is the interior of the system designed, what are the potentials for holdup of radioactive materials and radioactive liquids and where in the system.

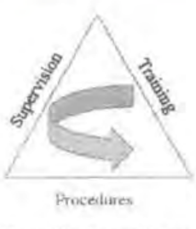
The radiological hazards associated with work operations relate to how the work operation could spread contamination or generate airborne radioactivity, and how the work operation could affect the engineered airborne radioactivity controls. As an example, a circular saw used on highly contaminated surfaces would generate high airborne radioactivity with turbulent air flow patterns. Normal ventilation is designed for laminar flow, such that it would be significantly less effective in capturing airborne radioactivity from a circular saw.

Location.

(b)(5)

Radiological hazards associated with the work location must (b)(5)
(b)(5)
be present on exposing surfaces that were contaminated from fires and spills involving radioactive materials.

Procedures



Once the hazards are understood, the radiological controls are incorporated.

These controls may involve elimination or reduction of the hazard by removal of the source term or limiting the amount of source term that is accessible (e.g., decontamination, application of fixatives). These controls also involve proper selection of the work operations (substituting less turbulent work operations where needed), and implementation of engineered controls to keep the hazard away from the worker (use of glove boxes or glove bags, and appropriately engineered ventilation).

After reducing the hazards through elimination or reduction of the source term, and applying engineered controls, administrative controls and personal protective equipment and clothing (PPE) are used to protect the workers. The radiological controls are then implemented through procedures, training and supervision. The sum of (b)(5) must be adequate to ensure protection of the workers. The higher the hazard and the more complex the work, (b)(5)

At PFP the surveillance team observed deficiencies in multiple areas of the work planning process. The radiological hazards of the work were not properly analyzed. The radiological controls for some high hazard work were less than adequate, relying on PPE in lieu of implementing engineering controls. Personnel, who were not qualified, were found making inappropriate technical decisions in the field (i.e., decisions through (b)(5) that resulted in unplanned personnel exposures to airborne radioactivity.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F01:

Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and (b)(5). Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).

Requirements:

10 CFR 835.501(b) specifies "The degree of control shall be commensurate with existing and potential radiological hazards within the area."

10 CFR 835.501(d) specifies "Written authorizations shall be required to control entry and perform work within radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards."

10 835.1102 (b) specifies "Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, radionuclides present, and the fixed and removable surface contamination levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "...The contractor shall, in the performance of work, ensure that... (5) Before work is performed, the associated hazards are evaluated..."

Discussion:

As discussed in concern S-11-SED-CHPRC-PFP-002-C01 above, radiological work planning needs to understand the hazards associated with the system, work operations and location in order to determine appropriate controls to

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mitigate the hazards. Multiple examples exist where the hazards were not appropriately analyzed, resulting in airborne radioactivity generation that exceeded the applicable protection factor for the respiratory protection worn and/or spread of contamination:

1. The hazard associated with using a circular saw to cut a highly internally contaminated glove box was not analyzed, resulting in very high airborne radioactivity that exceeded the respiratory protection factor for airline respirators.

The work in room 172 of PFP involved cutting up highly internally contaminated glove boxes for disposal. The room is referred to as the chop shop. On December 29, 2010, workers used a circular saw to cut pieces off the back (exposing internals) of Glove box 139-3/4. The airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator worn. The highest level found on the lapel was 7100 Derived Air Concentration (DAC)-hr (0.71 after taking into account the protection factor of the airline respirator). The surveillance team requested a copy of the airborne radioactivity calculations for the work operation that was performed.

On January 25, 2011, workers again used a circular saw to size reduce a glove box. The airborne radioactivity levels "jumped". The highest DAC-hr value on workers lapel air sampler was 17000 DAC-hr, 1.7 DAC-hr after adjusting for the protection factor of the airline respirator (10,000). Assuming the jump in airborne radioactivity occurred over a five minute period (time between monitoring the air sample filter), the airborne radioactivity level generated by the circular saw was more than 200,000 DAC. This was the second time the work team used a circular saw for size reducing the glove boxes and exceeded the airborne radioactivity limits in their RWP (see OA 35012).

The surveillance team again requested the work planning documentation that would indicate the project had evaluated the airborne radioactivity hazard associated with use of the circular saw. The contractor could not provide any. The contractor facility radiological control manager indicated no airborne radioactivity estimate had been made.

Investigation revealed PFP radiological work planners routinely did not perform airborne radioactivity estimates to ensure appropriate controls were selected for the work activity.

Interviews with the radiological work planners at PFP revealed the facility did not evaluate the potential airborne radioactivity levels for use of the circular saw on contaminated glove boxes. In fact, the radiological work planners (b)(5) they had not ever performed airborne radioactivity estimates for work at PFP. The surveillance team reviewed the work planning records for several work packages confirming there were no records of the analysis of the airborne radioactivity hazards for the work reviewed.

After initially requesting the airborne calculations after the December 29, 2010 event, the PFP Director, RHS obtained documentation from another facility on how to perform airborne radioactivity estimates and provided it to the PFP radiological work planners.

A significant contributing factor to this programmatic deficiency was the lack of training and lack of procedures provided by CHPRC that would show the radiological work planner how to analyze the airborne radioactivity hazard to ensure adequate engineered controls and/or respiratory protection are provided (see findings S-11-SED-CHPRC-PFP-002-F05 and S-11SED-CHPRC-PFP-002-F06). In this case, no respiratory protection had a protection factor high enough for the work. The analysis of the airborne hazard would have demonstrated the need to incorporate engineered controls.

The Radiological Hazards Screening Form indicated no airborne radioactivity above 1000 DAC (unmitigated), even though no estimate was performed

One of the high hazard radiological work screening criteria is "Will predicted airborne radioactivity concentrations exceed 1000 DAC...." This block is marked no, even though no calculation was performed, and there were no limitations in the procedure on work operations (i.e., any power tool was OK to use) or accessible contamination levels within the glove boxes at the locations being cut. There were no bounds on the radiological conditions of the glove boxes provided to the chop shop except, less than 240 grams of plutonium (Pu). Since airborne radioactivity generation depends on the amount of accessible contamination being disturbed and the work activity disturbing the contamination, there is no technical basis for the conclusion that unmitigated DAC values would be below 1000 DAC. Clearly, the reality is we have repetitively generated much higher levels of airborne contamination at the chop shop.

Investigation revealed the effectiveness of the point source ventilation used in the chop shop for removing airborne radioactivity during cutting with the circular saw had not been evaluated by PFP engineering.

The surveillance team interviewed the design authority for HEPA ventilation and requested a copy of the ventilation calculations that would demonstrate the effectiveness of the spot ventilation when using a circular saw. The project could not produce the calculations since they had not been performed.

Interviews indicated that the ventilation engineers were primarily involved in ensuring the PFP HEPA ventilation system and air flow through the plant was not adversely impacted by changes to the system and ensuring HEPA ventilation for tents were adequate to provide appropriate air changes. Some evaluation of point source ventilation had been performed, but not where turbulent air flow patterns were involved. The engineer provided an example of an evaluation of a point source ventilation calculation with typical laminar flow. The work planning process at PFP did not ensure that engineering was adequately utilized in the work planning process. Since DOE identified this deficiency, there has been greater use of engineered ventilation and participation by engineering in its design.

Air monitoring in the chop shop with DAC-hr limiting conditions have kept personnel from getting a significant uptake to date, but has not been a cost effective means of performing the work due to multiple shut downs of the work for re-planning.

To control worker exposures to airborne radioactivity, the project incorporated airborne radioactivity void limits. While this process is more of an emergency response, and has minimized the potential dose consequences to the workers to date, it does not control the generation of airborne radioactivity or prevent airborne that exceeds the respiratory protection factor of equipment worn, and creates a highly inefficient work process.

A review of the contractors work records indicated between December 15, 2010 (the start of cutting operations in the chop shop) and March 16, 2011, work was performed in room 172 during 40 days. Out of those days of work, cutting of glove boxes occurred during 20 days. Airborne radioactivity levels exceeded the radiological work permit DAC-hr limits during 30% (6 out of 20) of the days where glove box cutting occurred. These events resulted in stopping work operations to re-plan work.

Continued problems in chop shop revealed glove boxes were not adequately prepared for safe size reduction; fixatives were not adequately applied before the boxes were removed from the E-4 ventilation system and sent to the chop shop.

After shut down of the chop shop on March 16, work restarted April 20, 2011, with the first intrusive work performed on April 25, 2011. On that day, airborne radioactivity levels increased and personnel stopped work within a half hour. On the next day, airborne radioactivity levels exceeded the limiting conditions of the RWP. At the post job workers revealed the glove boxes were not being provided to the chop shop in a condition that would permit safe size reduction. The glove box they were working on had bare metal inside, indicating less than adequate application of fixatives, gloves were not properly rolled up and secured (making fixative application less effective), and pie plates were improperly secured (OA 37140). A review of a sample of glove box removal work packages confirmed there were no quality assurance steps in the procedures to verify adequacy of glove box preparation for the chop shop. Additionally, the chop shop work package contained two "size reduction hand-off checklists", one for glove-box 139-5, and one for 139-6. Both check lists showed the "Contamination fixed inside/outside" block left blank, indicating the action was not completed.

2. The high contamination hazard associated with exposing and cutting a neoprene gasket exposed to historical releases of airborne radioactivity was not recognized or analyzed resulting in four individuals receiving a low level uptake of plutonium.

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. Airborne radioactivity was generated when the neoprene gasket was exposed, cut and swipe surveyed (50,000 dpm alpha). Personnel were not wearing respiratory protection.

Historical records indicated several significant spreads of contamination in room 270 and 235 from undetected glove breeches to explosions and resulting fires. Contamination levels between 2000 and 6 x 10 dpm alpha are described (FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954 – 1997)). Historical records indicated the contractors partially decontaminated the surfaces and then apply paint to fix the contamination, indicating the likelihood of uncovering contamination when exposing previously inaccessible surfaces. PFP has also experienced a greater hazard of loose surface contamination associated with gaskets (e.g., 10/22/10 open air separation of Glove box 139-1/2, exposing previously inaccessible areas resulted in a spread of contamination when gasket between glove boxes swings free; 3/16/11 airborne radioactivity levels increase above limiting conditions of RWP for the chop shop when cutting an area where a gasket had been removed without application of fixative (OA36431).

Comment (b)(5)
(b)(5)

Less than adequate involvement of PFP engineering in the work planning process resulted in incorrect work instructions.

Work instruction 2Z-09-06644/M WCN2, step 6.10.2, specified "Cut wallboard/Plexiglas panels surrounding Conveyor HC-4 in room 230C & 235B." The wall was not constructed of wallboard, but had stainless steel plates bolted in place around the Plexiglas windows with neoprene gaskets. The wall had been painted over due to the historical spreads of contamination in the area. The engineer did not provide drawings of the wall construction to the work planner, providing a missed opportunity to plan for the hazard associated with a gasket exposed to contamination being uncovered. The surveillance team requested a copy of the engineering drawing associated with the wall. It clearly identified the existence of the neoprene gasket and steel plates.

The AMW did not address the hazards associated with removal of a portion of the wall and Plexiglas windows.

AMW 5549, rev 0, for work package 2Z-09-6644, dated January 26, 2011, did not address the hazards associated with removing a portion of the wall between rooms 230C and 235B The AMW only addressed breaching radioactive systems.

CHPRC review of the work package identified the AMW did not address each task, but did not ensure correction of the deficiency prior to releasing the work.

(b)(5) RL requested the contractor perform compensatory actions to shore up weaknesses in the radiological control program at PFP. One of the actions taken by CHPRC was to bring a team in to review the high risk work packages. During this review on March 6, 2011, the CHPRC task team identified the deficiency in the AMW not addressing each task, but no action was taken to correct the issue prior to releasing the work.

When the work team performed their workability walk down, the team determined unbolting the steel plates was easier, and safer, but did not make a change to the procedure.

During the workability walk down prior to performing the work, the work team decided unbolting (vice cutting) the wall would be safer, but no change to the procedure was made. The field work supervisor, in consultation with the lead RCT, determined respiratory protection was not needed since they were not cutting (b)(5) (b)(5) with no airborne generation. It was not until the gasket around the Plexiglas window was disturbed that high contamination levels were found (50,000 dpm/swipe alpha), exceeding the limits in the RWP. One low level nasal smear was found, but in performing additional voluntary bioassays, a total of four individuals were found to have had low level uptakes of plutonium (~~54~~56 person-mrem committed effective dose)).

Comment (b)(5)

Failure to obtain a procedure change was a missed opportunity to identify and analyze the hazard. The deficiencies in conduct of operation, and clearly defines roles and responsibilities are addressed in S-11-SED-CHPRC-PFP-002-F11 and S-11-SED-CHPRC-PFP-002-F03 respectively

Comment (b)(5) (b)(5)

3. Airborne radioactivity generation hazards for Glove box WT-4 size reduction and glove box floor removal was not adequately analyzed, resulting in high airborne radioactivity that exceeded the supplied airline respiratory protection factor.

Glove box WT-4 is in the control room of the Americium Recovery Facility (242-Z). The work package, 2Z-10-02068, was for removal of glove boxes WT-3, WT-4, and WT-5. On April 6, 2011, airborne radioactivity was generated that exceeded the limits of the radiological work permit (OA 36771), and the respiratory protection factor for the supplied airline respirator.

The airborne radioactivity was generated during use of a crow bar to pry up and remove a polyethylene liner on the floor of the glove box (show in drawing H-2-24954). The crow bar was used to pry up flashing ("20 GA S STL") used to hold the liner in place, and then to pry up the polyethylene. During the post job, the workers indicated there were some hot spots (4-5 rem/hr) on the floor of the glove box, indicating very high levels of contamination at that location. The airborne radioactivity hazard associated with the activity of scraping on this highly contaminated surface was not analyzed.

4. Inadequate analysis of material compatibility results in a spill of an acidic plutonium material; additionally, a precursor event was not appropriately analyzed.

Work package 2Z-10-0679, involved removing plutonium chemical transfer lines. These lines contained three individual lines inside a protective pipe. The packaging included insertion of a rubber plug to hold the three chemical transfer lines in place within the protective pipe. A red cap was placed over the pipe end to prevent the sharp ends of the pipe cut from damaging the packaging. The cut pipe was "horse tailed" out of the glove bag containment (poly-vinylchloride (PVC) sleeve) and sealed using duct tape. A reinforced bag was placed over the horse tail, and sealed with "chem" tape. Then a PVC ridged cap is placed over that and secured with "chem" tape.

The team had successfully made 17 cuts using glove bags (engineered barrier), but had started to find some liquid (described as runny like water (1/4 cup) in a couple of cuts made prior to the events described herein.

On 3/30/2011, while performing post job surveys, an RCT identified 600,000 dpm/100cm alpha contamination on the bottom of a packaged pipe end. Even though the contamination was found on the bottom of the pipe, where the PVC rigid cap (sealed with "chem." tape) meets the pipe, the work team did not recognize this as an indicator of a breach of the sealing system. While recovering from this event, a second cut in the system (b)(5) (b)(5)

On 4/6/2011, the second pipe end was flipped up to drain the pipe into the glove bag. As workers exited the area,
(b)(5) six persons were found to have contamination on their PPE [redacted] contamination above the limiting conditions of
(b)(5) the RWP [redacted] was found on surfaces in the exit path. The full extent of the spread of contamination was not understood until a recovery team entered. A visible spill of a thick (honey like) brown plutonium substance was found. Contamination in the spill area was as high as 150,000,000 dpm/100cm alpha. The floor in the area contained crevices, complicating clean-up. Disposable surfaces below the work area to protect the floor in case of a spill, were not adequately used during the job. A partial decontamination was performed and the area painted over to fix the contamination.

The work team believes the plutonium acidic material ate through the adhesive in the tape, spilling out of the sleeve onto the floor. RL requested the D&D engineer assigned to the project for the chemical compatibility information for the tape used. The information provided to RL from the manufacturer showed it was not rated for nitric acid (expected chemical form in the pipe). Discussions with the field work supervisor indicated they were not aware of any specific time limitations for satisfactory seal due to the nitric acid that was anticipated.

5. Inadequate hazards analysis results in workers drilling into the E-3 HEPA ventilation ducting.

On April 7, 2011, workers, installing anchors in room 235B, inadvertently drilled into the contaminated E-3 HEPA filtered ventilation duct located inside the wall. The E-3 duct is a void in the wall, thus contains no metal. The work planning was less than adequate in that drawings that show the location of the E-3 ventilation were not appropriately used in determining the location of the anchors (OA 36775).

6. Less than adequate analysis of hazards results in airborne radioactivity release while breaking a bagged Pyrex tank

On January 27, 2011, a Pyrex tank was removed from glove box 522. The bagged tank was too big to fit into the 55-gallon waste drum. The work team attempted to size reduce the Pyrex tank by padding the tank and hitting it with a pipe wrench. The bag holding the tank was breeched, resulting in high airborne radioactivity and continuous airborne radioactivity monitor (CAM) alarm. (OA 35484)

Comment (b)(5)
(b)(5)

7. Deficiencies in analysis of hazards extends beyond radiation protection; Potential fire was narrowly averted when a worker questioned cutting on a pipe containing plutonium contaminated combustible material

During interviews of personnel, workers reported a near miss that occurred in January of 2011. Work package 2Z-10-07673, Separate Glove box 100C from Glove box 200 in room 235D , specified cutting a hydraulic ram that was filled with plutonium contaminated combustible waste (paper, plastic and miscellaneous step off pad waste). At the pre-job briefing a worker raised a concern regarding the potential for the heat generated by the blade during the cutting reaching temperatures that could ignite the material inside the pipe. When the concern was raised, a mock-up was performed and the mock-up demonstrated the cutting operation started a fire.

The contractor issued a lessons learned praising the workers attentiveness and questioning attitude. However, corrective actions for preventing recurrence of the inadequate hazard analysis were not identified.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F02

Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (c), specifies "The contractor shall manage and perform work in accordance with a documented Safety Management System (System)…. Documentation of the System shall describe how the contractor will: (1) Define the scope of work…."

PRC-MP-MS-003, Integrated Safety Management System/Environmental Management System Description (ISMSD), section 3.1 Define Scope of Work, third paragraph, specifies "Work identified in the [work breakdown structure] is further divided into discrete tasks that are individually planned for execution using PRC-PRO-WKM-12115, Work Management, which describes the process for initiating, authorizing, performing, and conducting field work."

PRC-PRO-WKM-12115, Work Management, section 3.2.3, Plan Work, Step 19 states "…State the precise scope of work, including the methods of performing the work…. The scope description must be detailed enough to support the development of effective and accurate hazard controls for the proposed work activity… . Work steps provide the sequence and technical information for the work team to accomplish work that was described in the scope statement. The [field work supervisor] is responsible to direct the work team in a manner that complies with the approved instructions…."

PRC-PRO-WKM-079, section 3.1 Review the work scope, states "1. REVIEW work scope to be sure it is adequately defined…. 2. IF the work scope is not adequately defined, THEN UPDATE work scope in accordance with PRO-WKM-12115 or PRC-PRO-MS-589."

Discussion:

As discussed in the concern above, analysis of hazards includes the hazards associated with the system being breached, the work operations performed, and the location of the work. To appropriately analyze the hazards of the work at the activity level, the work scope must be clearly defined. This means the individuals analyzing the hazards must know the details of how the job will be performed. As specified in PRC-PRO-WKM-12115, the work scope description must be detailed enough to support the development of effective and accurate hazards controls for the proposed work activity.

Less than adequate hazards analysis and implementation of controls is in part a result of less than adequate definition of the work scope. Examples of less than adequate definition of scope from Finding S-11-SED-CHPRC-PFP-002-F01, include:

Work scope definition/limitations for size reduction of Glove box 522 Pyrex tanks was not adequate, and therefore adequate controls were not established to prevent an airborne radioactivity release (OA 35484)

Airborne radioactivity was generated 1/27/11, room 152 when workers attempted to size reduce a Pyrex tank from Glove box 522 by padding it on the outside of its containment bag, and then striking it with a pipe wrench. This work activity was not identified in the work package. The work instruction in (2Z-10-03825) in general, and section 6.4.2.4 (disconnect/removal of Pyrex tanks) in particular, did not identify a need, option, or instructions to size-reduce the Pyrex tank, to fit it into the waste container.

Comment (b)(5)

(b)(5)

Work scope definition for removing Plexiglas windows with radioactively contaminated neoprene gaskets between PFP room 230C and 235B was not adequate.

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. The procedure did not adequately define the scope of work.

Comment (b)(5)

(b)(5)

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F03:

The "flexible" D&D work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field without adequate hazards analysis, by individuals not qualified to make the decisions. Roles and responsibilities for determining radiological controls were not clearly defined.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that...(2) Clear and unambiguous lines of authority and responsibility for ensuring (ES&H) are established and maintained at all organizational levels." DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that... (3) Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities."

Discussion:

The surveillance team interviewed more than 40 individuals involved in work planning, including work planners, radiological work planners, lead radiological control technicians, radiological control supervisors, field work supervisors, project managers, the safety and health manager, a radiation protection corporate mentor, and some radiation protection personnel that left PFP to work elsewhere. Additionally, the team interfaced with workers during observation of work planning processes.

Interviews revealed that there was a lot of frustration felt by both workers and managers that were a result of work planning being performed in the field, instead of being planned up front. Disagreements on the appropriate radiological controls to implement for a work activity resulted in everything from work stoppages, to implementation of inadequate controls.

Work packages were built with "flexibility", so the procedure would not tie the work team down as to how the work was performed; Radiological controls were "flexible" to accommodate decisions on how to do the work in the field.

The work team and management expressed the desire for flexibility in how the work was performed, letting this be "skill of the craft". Consequently, the radiological work planners specified "flexible" radiological controls in the work packages. This resulted in management abdication of their responsibility for hazards assessment and controls.

Some examples include generic instructions such as:

Chop shop: 2Z-10-05648, room 172 size reduction operations, 6.2.5 "Perform size reduction activities using power tools (i.e., nibbler, sawzall, circular saw, bandsaw) on hood/glove box/ducting.... Move point source ventilation as needed for contamination control during cutting.... Implement contamination control, as needed, using hand held fogging unit...."

2Z-09-3291, Rm 139 Glove Box Removal, section 4.6 "Use wet methods, sleeving and/or HEPA filtered spot ventilation to control contamination, as necessary."

Work package 2Z-10-2115/M, 4.6.4 included the following, "Wet towels, HEPA vacuum, Glove bags/sleeving and or catch bags shall be used as the main engineering controls during the task as necessary."

When RL debriefed the contractor on preliminary findings of the surveillance team and requested CHPRC to implement compensatory actions to shore up the radiation protection organization at PFP, one of the compensatory actions was to review high risk work packages for adequacy of radiological controls.

Roles and Responsibilities for the FWSs, lead RCTs, and other craft work team members are not intended to include radiological hazards analysis; Radiological training programs for these individuals did not include this qualification.

The absence of specific radiological hazard controls in work instructions/packages resulted in radiological hazard control decisions being done by the field work team. These individuals were not technically qualified to analyze radiological hazards.

While the field work supervisors and lead RCTs have extensive experience in their roles, the surveillance team review of the FWS and RCT training was less than adequate to qualify them for radiological hazards analysis and control. The FWS training and qualification in radiological subject areas was limited to Radiological Worker II training. Radiological Worker II did not provide qualification on radiological hazard analysis and control selection. The surveillance team reviewed the RCT training, which is based on the DOE training standards. While the level of training exceeds radiological worker II training, RCT training objectives were not intended or designed to provide qualification on radiological hazards analysis and selection of engineered controls for work. The surveillance team also found that the training for lead RCTs did not include additional hazard analysis and control topics. The training reviewed for FWS and RCTS did not include appropriate education, training, and skills to discharge these responsibilities, specifically the radiological hazard analysis and selection of engineered controls.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F04

Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.

Requirements:

10 CFR 835.1001 Design and control, (a) specifies "Measures shall be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative controls. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure."

Comment (b)(5)

(b)(5)

10 CFR 835.1002 Facility design and modifications, (c) specifies "Regarding the control of airborne radioactive material, the design objective shall be under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used."

10 CFR 835.1003 Workplace controls specifies "During routine operations, the combination of engineered and administrative controls shall provide that...(b) The ALARA process is utilized for personnel exposures to ionizing radiation."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "...The contractor shall, in the performance of work, ensure that...(6) Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures.

Discussion:

Engineering controls are the first line of defense against airborne radioactivity and spread of contamination. Some work teams have appropriately performed work activities using glove bags and glove boxes, to keep the worker from being exposed to the source of contamination.

Examples of poor use of engineering controls include:

Less than adequate use of engineering controls at the chop shop

Work in the chop shop directly exposes personnel to high contamination levels inside glove boxes that are not designed for human entry. The chop shop and the work performed there was not properly designed up front with adequate engineering controls. As a result, airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator multiple times, and the project continually struggles with back fitting radiological controls. The facility did not use the glove box itself and facility ventilation system (E-4) to adequately reduce the hazards prior to disconnection from the E-4 system and transporting the glove boxes to the chop shop, nor designed the chop shop facility for size reducing the glove boxes inside an engineered barrier (glove box or engineered ventilation hood).

Less than adequate use of engineered ventilation in general; less than adequate involvement of engineering in the design of spot ventilation.

Engineered ventilation was not always used. An example included scraping of the polyethylene liner with high dose rates, indicative of high contamination, at the bottom of glove box WT-4 without engineered spot ventilation (see Finding S-11-SED-CHPRC-PFP-002-F01).

Spot ventilation being used at the facility was not always being adequately designed to meet its intended use. Elephant trunks and HEPA filtered vacuums cleaners had been used, but were not always adequate. Examples include the use of an elephant trunk for engineered ventilation while cutting a glove box with a circular saw (see Finding S-11-SED-CHPRC-PFP-002-F01).

As the RL surveillance progressed, more involvement of the ventilation engineer in spot source ventilation design was observed. A corporate mentor had previously brought up the need for PFP to use a "B-box", a spot ventilation used at Rocky Flats. Facility action was not observed by the surveillance team until compensatory actions to shore up the radiological controls at PFP were implemented by the contractor.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F05:

Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.

Comment (b)(5)

(b)(5)

Comment (b)(5)

(b)(5)

Requirements:

10 CFR 835.103 Education, Training and Skills, specifies "Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this part shall have the appropriate education, training, and skills to discharge these responsibilities."

CH2M HILL Plateau Remediation Company Radiation Protection Program, CHPRC-00072, Appendix A, Policy and Commitment Basis for 835.103 specifies "CHPRC shall [835.103] identify positions that develop and implement measures necessary to comply with 10 CFR 835. At a minimum, this includes those individuals filling the following positions.... Facility/Project Rad Con technical staff...."

Discussion:

Training and qualification of radiological work planners did not ensure that individuals, who were determining and implementing radiological controls, were appropriately trained and qualified to perform applied radiological hazards analysis.

(b)(5) **The Radiological Control Work Planning training course (b)(5) adequately [redacted] applied (b)(5) hazards analysis.**

Course number 022801, Planning Radiological Work – Initial, section F, Purpose and Overview, specifies "This course does not attempt to teach radiological work planning...." The course does not teach how to plan work, nor does it provide instruction on how to perform applied hazard analysis. Some radiological work planners were RCTs that were promoted to work planners. The RCT qualification program also does not teach personnel applied radiological hazards analysis. There was no documented training that demonstrated knowledge of how to perform applied hazard analysis prior to assignment as a radiological work planner.

The primary emphasis of the course 022801 is to teach the radiological work planners how to fill out the radiological hazards screening and ALARA Management Worksheet forms to support the work management process. The course contains general discussion on factors affecting radiological hazards, but does not adequately cover practical application of hazards analysis and selection of controls.

Radiological work planner training did not demonstrate how to perform airborne radioactivity estimates based on contamination levels, work operations, and application of airborne radioactivity controls.

A review of radiological work planning training documents and interviews found that the training did not provide adequate instruction on how to predict airborne concentrations. The training materials directed the trainee to use the facility Technical Evaluation (TE) to predict airborne concentration. The PFP TE did not contain guidance on how to estimate airborne concentrations. The training material did not demonstrate how to perform these airborne radioactivity calculations.

Selection of appropriate respiratory protection requires the ability to calculate airborne estimates.

The radiological work planning course does not show the work planner how to select respiratory protection based on estimated airborne radioactivity levels.

Radiological work planning training did not adequately cover limitations of HEPA filtered ventilation as an engineered control.

Interviews found that staff did not understand the limitations of ventilation as an engineered control. Personnel did not demonstrate understanding that ventilation is typically designed for laminar flow. Ventilation is significantly less effective when generating turbulent air flow patterns, such as those created with a circular saw. This is important to understand, so that radiological work planners do not specify ineffective controls.

The radiological work planner training course did not cover the technical aspects of engineered ventilation or the need to engage engineering in its design.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F06:

A CHPRC level or PFP procedure on how to perform airborne radioactivity estimates for airborne radioactivity hazards analysis and work planning did not exist.

Requirements:

10 CFR 835.104 Written Procedures specifies, "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

Comment (b)(5)
(b)(5)

Comment (b)(5)
(b)(5)

Discussion:

The surveillance team reviewed the CHPRC and PFP list of procedures on line and technical basis documents. Neither CHPRC nor PFP had a procedure providing instructions on how to predict airborne radioactivity levels.

Airborne radioactivity estimates were needed to complete the Radiological Work Screening process (PRC-PRO-RP-40108, "Radiological Hazard Screening," and Site form A-6004-654). Some projects and other contractors had procedures for performing airborne radioactivity calculations. After the deficiency in performing airborne radioactivity calculations was identified by RL, PFP obtained another projects methodology for performing airborne radioactivity calculations to develop their own instructions.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F07

The contractor's radiological staffing resources (b)(5) were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work

Requirements:

CRD O 5480.19 Chg 2 (Supp Rev 4) Conduct of Operations Requirements for DOE Facilities Chapter I, Operations Organization Administration: C. Guidelines; (2) Resources: specifies "The operations supervisor for DOE facilities should be provided with sufficient... personnel to accomplish assigned tasks without requiring excessive overtime by the operations staff. These resources should include technical personnel needed to support the operations. A long-range staffing plan that anticipates personnel losses should be developed and implemented."

Discussion:

In decontamination and decommissioning of a facility, an increased level of radiological risk and potential for rapidly changing conditions are expected. Multiple systems are being breached, facility engineered controls are being deactivated, etc. Planning for appropriate additional staff is critical to effectively handle the increased work and continual changes in facility conditions.

The contractor did not adequately ensure adequate staffing resources (b)(5) ~~at PFP.~~

Comment (b)(5)
(b)(5)

PFP experienced the loss of the facility RadCon Manager, a key position, in June 2010 and did not permanently replace the manager until March 7, 2011.

The lack of priority and urgency in filling this key position for a high risk and accelerated project demonstrated less than adequate planning and response to key personnel losses. The high risk and accelerated nature of PFP work should have driven a more expedient permanent replacement for this key role. For approximately 8 months, the project did not have a permanent RadCon Manager.

PFP assigned personnel as temporary radiological control managers. The RHS Director intermittently acted as RadCon manager. However, the RHS Director's other duties combined with the RadCon organization's span of control, made this approach less than adequate. For 5 months (August through December), the facility had a central RadCon staff member acting in a temporary capacity. After the central RadCon staff member went back to the central organization, the radiological control manager position was rotated among the radiological control supervisors. Experience shows personnel in a temporary position are not as effective because staff know they are temporary.

There was insufficient radiological technical staff to adequately manage the work planning process.

The radiological work planner and engineers needs to be an integral part of the work team. They need to be there at the start of the work planning, providing input into how the work is performed from a risk assessment perspective. If the work operations are not clearly defined during the planning, hazards assessments may not be accurate, as was observed during the surveillance for some work activities. This contributed to the adverse outcomes realized during work (e.g. RWP voids, high airborne generation, contamination spreads, and radiological uptakes).

At the start of this surveillance, the project had three radiological work planners. This resource level was not adequate to support work planning based on the level of hazards in the facility and the pace of work at PFP. Based on organizational chart reviews and interviews, the three radiological work planners supported approximately twenty-six line work planners.

Insufficient numbers of radiological work planners did not permit adequate engagement of the work planner during performance of work.

The radiological work planners need to be engaged during performance of the work. Field presence by radiological technical support and work planners helps to validate and ensure that radiological controls are implemented as intended. As the level of flexibility in work operations and changing conditions increase, field observations provide for early recognition and correction of potential inadequacies in engineered controls. The shortage of radiological work planners resulted in their limited field presence. Lack of observation of the implementation of controls in the field represents a program weakness and a missed feedback opportunity.

In response to the RL surveillance, the contractor added a radiological engineering manager and additional radiological work planners at PFP.

PFP had insufficient numbers of first line radiological control supervisors (RCS) to effectively support radiological work.

A review of the PFP organizational chart and interviews with the PFP RCS found that approximately 102 RCTs were supervised by five RCS. Interviews indicated the following: One of these RCS had double duty as PFP's acting radiological control manager. One of the RCS was assigned Duty RCS for making personnel assignments, responding to emergencies, and completing other administrative duties. Additionally, the RCSs review completed radiological surveys. As a result, only two RCS were typically available to oversee the ongoing work. The ratio of RCTs to RCS is very high considering the level of radiological hazard associated with the work at PFP.

Since RL identified the overall weaknesses in radiological staffing at PFP, the contractor has increased the number of RCS.

Fifty percent of the RCTs at PFP are junior

Interviews with personnel indicated fifty percent of the RCTs at PFP were junior, meaning they were not qualified to work alone on high risk work activities and required more oversight by the lead RCTs on the work team.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F08:

The HCND was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document: ~~CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual~~ (OA 36921).

Comment (b)(5)
(b)(5)

Requirements:

10 CFR 835, Subpart E-Monitoring of Individuals and Areas, Article 835.401(b) Instruments and equipment used for monitoring shall be... (2) Appropriate for the type(s), levels, and energies of the radiation9s) encountered..."

Comment (b)(5)
(b)(5)

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section F External Dosimetry, paragraph 3, specifies "The contractor shall participate in the development and maintenance of a Hanford site-wide external dosimetry basis document. The contractor's external dosimetry program shall be performed in accordance with this technical basis document."

PNNL-15750 Rev. 1, PNL-MA-842, Hanford External Dosimetry Technical Basis Manual,

Comment (b)(5)
(b)(5)

section 6.3, Selection of Dosimeter Types to Use, specifies "Individuals who are likely to receive Hp(10)n greater than 100 mrem per year should be issued a HCND, which provides a more accurate measurement of neutron dose. In addition, individuals who routinely have Hp(10)n greater than 100 mrem per year reported on an [Hanford Standard Dosimeter (HSD)] should be issued a HCND."

Discussion:

Comment (b)(5)
(b)(5)

The surveillance team reviewed the CHPRC deficiency reports for PFP. Multiple deficiency reports identified issues with neutron dose over-response from personnel wearing the Hanford Standard Dosimeter at PFP that required modifications to personnel dose of record. RL investigated the issue and found it to be programmatic at CHPRC.

CHPRC reduced the numbers of personnel monitored with HCND to reduce costs. In the process, individuals who should have been wearing the combination dosimeter were not appropriately monitored in accordance with the Hanford External Dosimetry Technical Basis. In 2010, CHPRC processed 117 External Dosimetry Investigation Reports to correct the neutron reading from a Hanford Standard Dosimeter.

The HSD can measure neutron, and is Department of Energy Laboratory Accreditation Program (DOE LAP) accredited for its response to a Californium neutron source (Fast neutron). The HSD over-responds significantly to a thermal neutron flux. Depending on the neutron energy where the individual was exposed, correction factors between 2 and 5 are used. The HCND has a neutron dosimeter which has multiple thermoluminescent dosimeters (TLDs) inside that respond to different neutron energy levels and thus more accurately measure neutron, but costs more. However, this cost is less than the contractor's estimated man-hours costs taken to investigate and correct the neutron dose.

(b)(5)

(b)(5) Many more individual dose records were reviewed for high neutron doses, where doses indicated personnel should have been assigned a HCND, but were not, and the project decided not to make a change in the individual's dose of record.

A review of the CHPRC External Dosimetry Program, PRC-PRO-RP-379, revealed the document is inconsistent with the Hanford External Dosimetry Technical Basis Document. While PNL-MA-842 specifies (b)(5) (b)(5) should be issued a HCND, CHPRC has not implemented this in their External Dosimetry Program. PRC-PRO-RP-379, section 3.15, , step 5, only specifies to change the dosimeter to a HCND if the corrected neutron dose is greater than 100 mrem.

Comment (b)(5)
(b)(5)

Comment (b)(5)
(b)(5)

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F09

Technical errors were identified in five out of nineteen EDIRs.

Requirements:

PRC-PRO-RP-379, External Dosimetry Program, section 3.15, Neutron Correction to HSD Measurements, step 2 specifies "If calendar year-to-date (CTD) uncorrected neutron exposure is [greater than or equal to] 100 mrem, then correct readings using the following correction factors:PFP = 2, ISA = 5, Others = 3." "Note: Justification is required in the project's technical equivalent document if there is a deviation from the given correction factors per project."

10 CFR 830.122 Quality Assurance Criteria (c) specifies "Criterion 3 Management/Quality Improvement (1) Establish and implement processes to detect and prevent quality problems. (2) Identify, control, and correct items, services, and processes that do not meet established requirements. (3) Identify causes of problems and work to prevent recurrence as a part of correcting the problem. (4) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section J, Radiological Records, paragraph 2, specifies "The contractor shall ensure that permanent radiological records are accurate (b)(5)

Comment (b)(5)
(b)(5)

Discussion:

The surveillant reviewed 19 out of 120 External Dosimetry Investigation Reports (EDIR) that involved adjusting neutron doses from the Hanford Standard Dosimeter readings. Technical errors (math errors, wrong radiation type, zeroing dose without adequate technical justification) were identified in five out of 19 (26 percent) of the EDIRs. There were other potential issues in 4 other EDIRs. The following technical errors were identified:

Several EDIRs contained math errors.

EDIR-10-223 divided 20 mrem neutron by a correction factor of 3, and specified the corrected dose as three mrem neutron (20 divided by 3 is 6.67, or rounded to the nearest mrem is 7 mrem, not 3 mrem). EDIR-10-077 took 60 mrem neutron divided by a correction factor of three and said the resulting dose was 17 mrem neutron.

EDIR-10-179 erroneously added the gamma dose to the neutron dose when correcting the neutron dose (520 neutron +53 gamma = 573; 573 divided by 2 = 287). The corrected neutron dose should have been 520 divided by 2 = 260 mrem neutron.

One workers dose was corrected twice, but the dose was assigned as neutron vice gamma.

(b)(5) The worker had been taking photographs in PFP A-labs, for a total of 2 hours, and lost his HSD. The EDIR specified general radiation levels in A labs as 0.5 mrem/hr, but did not specify that was gamma radiation vice neutron. PFP general area radiation levels are both gamma and neutron in most places, and 0.5 mrem/hr is the typical minimum detectable activity (MDA) of the gamma dose reading instrument. The 0.5 mrem/hr dose rate was likely a gamma reading based on the location, A-Labs. The EDIR should have contained both gamma and neutron dose rates for preparation of the dose estimate. The first time the dose was corrected, a math error was made, 2 hrs times 0.5 mrem per hr, was recorded as 2 mrem neutron. The contractor caught the math error and changed the dose to 1 mrem neutron, but did not catch the error in no radiation type being specified by the facility providing the dose rate data.

A neutron dose record indicating 31 mrem neutron was changed to zero (see EDIR10-176).

The 31 mrem recorded neutron was corrected by dividing by 3 (10 mrem neutron), but then recorded as zero, without appropriate technical justification.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F10:

Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

Requirements:

10 CFR 835.403 Air monitoring, specifies "(a) Monitoring of airborne radioactivity shall be performed (1) Where an individual is likely to receive an exposure of 40 or more [Derived-Air Concentration (DAC)]-hours in a year...."

10 CFR 835.402 (c) specifies "For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs (including routine bioassay programs) shall be conducted for: (1) radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year...."

Discussion:

The surveillance team reviewed four (4) quarterly PFP workplace Air Monitoring Tracking and Trending Reports (Calendar year 2010). This review was performed in response to an earlier discovery of the tracking and trending not being performed (OA 33986) and an employee concern at PFP over the sporadic elevations of airborne radioactivity in the plant.

PFP Closure Project Workplace Air Monitoring Tracking and Trending reports identify locations with unexplained elevated airborne radioactivity above one DAC-hr;

Comment (b)(5)
(b)(5)

Comment (b)(5)
(b)(5)

Comment (b)(5)
(b)(5)

The surveillance team verified that Workplace Air Monitoring Tracking and Trending Reports have identified areas with sporadic unexplained elevated airborne radioactivity. As an example, the Third quarter 2010 PFP Closure Project Workplace Air Monitoring Tracking and Trending Report identified six (6) areas with greater than 1 DAC-hr airborne radioactivity. The third quarter 2010 report did not provide any actions taken to ensure unmonitored personnel receive less than 40 DAC-hr (100 mrem internal dose) in a year, or actions taken monitor exposed individuals through bioassay or a DAC-hr tracking program.

The third and fourth quarter reports did not contain any trending data for locations with elevated airborne radioactivity.

Review of the Third and Fourth Air Monitoring Tracking and Trending Reports confirmed they did not include any trending data for the locations with elevated airborne radioactivity. Interviews with radiological control technical staff indicated the staffing shortages were a major contributor to the task not being completed.

The PFP administrative trigger level for investigating elevated airborne radioactivity was 1 DAC-hr (in a week), which was inconsistent with 40 DAC-hr in a year [0.77 DAC-hr per week].

A fixed head air monitor draws airborne radioactivity into it and collects the contamination on a filter. When the filter is counted, the contamination is a direct measure of DAC-hr. The airborne radioactivity could have occurred in a short period of time as a result of a work activity, or be the collection of ambient low level airborne radioactivity. Assuming the airborne radioactivity actually occurs when people are in the area as a result of their activities, 40 DAC-hr per year would be 0.77 DAC-hr per week. It is unclear why the facility has used a higher trigger for investigation than that which ensures compliance with 10 CFR 835.

Airborne radioactivity area (ARA) posting at PFP goes up and down regularly, it is not clear how the air monitoring program verifies personnel not in respiratory protection receive less than 100 mrem internal dose (40 DAC-hr) in a year when these areas are not posted ARA.

Interviews with the radiological control technical staff and reviews of the quarterly workplace air monitoring tracking and trending reports revealed the fixed head air monitors run both during the period when the area is not a posted airborne radioactivity area and during airborne radioactivity work. When high fixed head airborne radioactivity levels are reported, the radiological technical staff indicated they sent an e-mail to the radiological control supervisors to determine what work went on in the area. If airborne radioactivity work occurred, this is identified in the report. It is unclear how this process ensures personnel who are not monitored for internal exposure and are not wearing respiratory protection, do not exceed 100 mrem internal dose in a year.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F11:

Less than adequate conduct of operations was observed; Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.

Requirements:

10 CFR 830.122 Quality assurance criteria, (e) Criterion 5 Performance/work processes (1) specifies "Perform work consistent with technical standards, administrative controls and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means."

DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities, Chapter XVI Operations Procedures, B. Discussion, specifies "...operations procedures should be sufficiently detailed to perform the required functions without direct supervision.... Operators should not be expected to compensate for shortcomings in such procedures... C. Guidelines ...7. Procedure Use,... Facility operation should be conducted in accordance with applicable procedures... If procedures are deficient, a procedure change should be initiated...."

Discussion:

The surveillance team observed post job reviews and critiques. A contributing factor to events was poor conduct of operations. The following are examples of personnel not following appropriate requirements for use of procedures:

Less than adequate conduct of operations contributed to personnel receiving low level uptakes during removal of a Plexiglas window between PFP rooms 230C and 235B

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, the work team identified the wall surrounding the Plexiglas windows was made of stainless steel sheets bolted in place. The team decided to unbolt the stainless steel plates in lieu of cutting as identified in the procedure. Because of the perceived safer condition, the FWS and lead RCT decided respiratory protection was not needed. The work team did not make an appropriate change to the work package prior to performing the work. An unanalyzed hazard associated with contamination on the gasket around the Plexiglas window resulted in four low level uptakes.

Personnel observed not following controls established in the procedure contributed to generation of airborne radioactivity above the respiratory protection factor of the airline respirator at the chop shop.

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, airborne radioactivity levels during work in chop shop repetitively exceeded respiratory protection factors of the airline respirator. The facility modified the chop shop work package to add additional radiological work instructions on March 10, 2011. When the chop shop work team commenced work on March 16, 2011, the corporate radiological control mentor identified workers had not implemented several of the radiological control requirements in the procedure. Airborne radioactivity levels exceeded the RWP limits for airborne radioactivity and work was stopped.

Personnel did not stop when Pyrex tank did not fit into 55 gallon drum. Unplanned work resulted in airborne radioactivity and spread of contamination (OA 35484)

The work instruction (2Z-10-03825), for preparation of glove box 522 for removal, did not identify a need, option, or instruction to size reduce a Pyrex tank in the glove box. The Pyrex tank was sleeved out of the glove box, but did not fit into the 55 gallon drum staged for its disposal. When personnel in the field concluded the tank should be size reduced they did not recognize work instructions and controls should have been specified and approved prior to performing the actions they did to size reduce the tank. While attempting to break the Pyrex tank with a pipe wrench, a release of airborne radioactivity occurred when the sleeving around the tank was breeched.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F12

Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.

Requirements:

10 CFR 835.104 Written Procedures specifies, "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

10 CFR 830.122(c)(1) Establish and implement processes to detect and prevent quality problems.

Form A-6004-634 specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

Comment (b)(5)
(b)(5)

Discussion:

The AMW documents the radiological considerations, analysis and controls to be incorporated for high and medium risk radiological work. Documentation on the AMW Part II, Radiological Protective Measures/Considerations was not consistently completed per the form's instructions. The AMW form specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

The surveillance team reviewed 7 released complete work packages supplied by PFP; the AMWs associated with these work packages did not fully follow the previously stated instruction. The surveillance team found sections on each AMW where the radiological work planner checked, "Incorporate into work instruction," without any text being bolded for inclusion. Failure to follow the forms instructions, e.g. lack of bold text, potentially contributed to the less than adequate inclusion of intended controls in work instructions.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Observation: S-11-SED-CHPRC-PFP-002-O01:

Job Specific RWPs were written broad and generically to cover multiple work packages.

Discussion:

Discussion:

As part of the PFP work planning surveillance, the team noted that RWPs were written to cover multiple work packages and were broad and general in nature. An example of this is RWP Z-005, "Perform Glove box Work Activities (As per Listed Work Procedures). Handling/Movement of Radioactive Material, Low Level Waste Handling & Disposal and Minor Decontamination." This RWP had been revised 72 times, covered 6 PFP procedures and 28 work packages. PFP should review the RWP process to ensure that RWPs are adequate, sufficiently specific and conform to best practices. The use of generic RWPs can lead to error likely conditions and worker errors.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Observation: S-11-SED-CHPRC-002-O02:

Facilities technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.

Comment

(b)(5)

Discussion:

During the surveillance, there were a lot of concerns expressed by workers on the use of plutonium levels for determining when beryllium monitoring was required. The workers expressed concern over the accuracy of the technical basis for the policy and on lack of follow through by facility management in performing beryllium characterization.

During review of FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (19541997), the surveillance team noted on page 20 of the report, that a spread of contamination from a plutonium-beryllium source occurred in 1981 in room 236. This source of beryllium was not evaluated by the facility in the development of their beryllium monitoring program.

The additional technical staff brought into PFP had an additional benefit of supporting resolution of worker concerns in the beryllium monitoring program. When the additional source of beryllium contamination was identified by RL, the additional staff reviewed its potential impact on the PFP beryllium monitoring program.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Observation: S-11-SED-CHPRC-PFP-002-O03: Poor practices identified in EDIR review.

Discussion:

The following additional poor practices were observed:

Poor resolution to a technical issue.

EDIR-10-077 indicated a technical issue existed with the type of direct reading dosimeters (DRD) used at WRAP. The EDIR specified the cause of "ACES report indicated that estimated dose recorded was grossly underreported for [DRD]", was "DRD do not detect neutron radiation and electronic dosimeters can under respond to lower energy spectra." The resolution states: "Return to monthly dosimeter issuance." If we are not getting what we need out of our DRD, based on the type and energy of radiation encountered, this technical issue should be addressed. By regulation, we should be monitoring with equipment appropriate for the type and energy of radiation encountered.

Gross inconsistencies in who's neutron dose from the HSD gets corrected in the individuals record

There were gross inconsistencies in who's neutron dose from the HSD got corrected in the individuals record and who's did not. Examples include: A neutron dose correction of 1 mrem was made in one EDIR, a dose of 31 was zeroed in another, and a HDS dose of 199 mrem (99.5 mrem with PFP correction factor applied), was not corrected at all.

Rounding is inconsistent.

Some EDIRs truncated the fraction of a mrem, while others used normal rounding practices. Had the 99.5 mrem corrected value from the example above used normal rounding practices, the corrected dose would be 100 mrem and the CHPRC procedure would require dose correction.

Technical justification for use of inconsistent neutron correction factors for ISA pad work was not documented in the EDIR.

All 4 EDIR reports for individuals working at ISA (correction factor 5) pad that the surveillance team reviewed had neutron, no gamma dose. Two individuals had some entries into CSB also. The correction factor applied to those individuals was 3. There was no documentation that indicated why the facility chose to use the 3 over the 5. The correction factor of 3 resulted in a conservative higher dose in the record.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Observation: S-11-SED-CHPRC-PFP-002-O04:

The use of the PRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors are identified

Discussion:

As part of the PFP work planning process surveillance, the team observed PFP investigate upset conditions and events using the ALARA post-job review as a fact finding tool. By design, the ALARA post-job review did not provide sufficient fact finding guidance to discover the event details needed to identify failure points and prevent recurrence. The site form (site form A-6004821) provided questions geared toward evaluating causes not gathering factual details. The contractor should provide a more appropriate and effective process for gathering and identifying facts related to upset conditions.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Contractor Self-Assessment:

The surveillance team reviewed the contractor's self-assessments and corrective action data base for PFP deficiencies for June, 2010 through

Issues with radiological work control planning and implementation have been previously identified by the CHPRC. On July 13, 2010, CHPRC identified within a conditional report (CR) three Stop Works at PFP related to Procedure Compliance, Entry Requirements and RWP Violations. These formal Stop Works were recorded in CR-2010-2201 to document issues with scope creep, procedure compliance, hazards and controls, pre-job briefs, and duct level entry requirements. As a result of the evaluation of the Stop Work issues, this CR was screened as adverse.

Analysis contained within CR-2010-2201 revealed that multiple issues throughout most aspects of work performance had risen to a level that workers felt the need to implement the formal Stop Work process in order to see that they were adequately addressed. Ten corrective actions were established to resolve these issues.

On October 22, 2010, CR-2010-3327, Contamination Spread in Multiple Rooms during Glove Box Separation Activities, was initiated due to contamination spread during glove box separation activities in room 139 of A Labs. Analysis of this event determined that the work controls were not adequate to handle the potential levels of contamination in areas inaccessible for survey and the configuration of the glove box was such that engineered barriers were considered impractical. Two work control corrective actions were identified in response to this event.

However, the number of radiological work planning events and deficiencies identified during this surveillance, indicates the corrective actions associated with the above issues were not sufficiently effective. This assessment of PFP's radiological work planning corrective action effectiveness aligns with RL's overall evaluation of CHPRC's corrective action management performance (See letter CHPRC-1100939, Integrated Corrective Action Plan).

Contractor Self-Assessment Adequate: YES [ ] NO [X]

Management Debriefed:

David Del Vecchio, CHPRC

Terry Vaughn, CHPRC

Curtis Bean. CHPRC

Tom Bratvold, CHPRC

Department of Energy
Richland Operations Office (RL)
Surveillance Report

Division: Safety and Engineering Division (SED)

Surveillance Team: Brenda Pangborn (lead), Joe DeMers, Wayne Glines, Rick Jansons, Ed MacAlister, Ed Parsons, Kerry Schierman, Sandra Trine

Surveillance Number: S-11-SED-CHPRC-PFP-002

Date Completed: April 29, 2011

Contractor: CH2MHILL Plateau Remediation Company (CHPRC)

Facility: Plutonium Finishing Plant (PFP)

Title: Planning and Execution of Radiological Work

Guide: 10 CFR 835

Surveillance Scope:

The objective of this surveillance was to evaluate the adequacy of planning and execution of radiological work at PFP. This was a surveillance of the work planning process that included review of the development of radiological work packages, the identification, analysis and control of radiological work hazards, a review of work planning resources, and a review of radiological deficiencies resulting from less than adequate work planning and the associated corrective actions management. This surveillance also included investigation of specific radiological deficiencies anonymously sent to RL.

Surveillance Summary:

The surveillance team reviewed documents that included, among others:

- Contractor work planning documents, (b)(5)
  (b)(5)
- Training course materials for both radiological work planners and the line work planners.
- Radiological control procedures and technical basis documents.

- Radiological performance indicators including contractor self assessments, contractor corrective action reports, and RL operational awareness (OA) reports for activities at PFP,
- Historical documents of the PFP, including the Radiological History of the Plutonium Finishing Plant (1954-1997) that described radiological upsets in the facility (dates, locations and contamination values),
- Work packages and associated radiological screening forms, As-Low-As-Reasonably-Achievable (ALARA) Management Worksheets (AMW), and radiological work permits (RWP).

The surveillance team interviewed more than forty (40) personnel involved in the work planning process and execution of work in the field, including:

- Three (3) radiological work planners,
- Eight (8) line work planners,
- Four (4) field work supervisors (FWS),
- Four (4) superintendants,
- Three (3) project managers,
- Two (2) Integration Planners,
- Four (4) radiological control supervisors (RCS),
- Eight (8) lead radiological control technicians (lead RCT),
- One (1) Director of Radiation Protection, Industrial Hygiene, and Occupational Safety (RHS),
- One (1) Director of Environment Safety and Health for CHPRC,
- Two (2) former PFP radiological Control Managers (RCM),
- One (1) Radiological controls mentor, and
- Three (3) engineers or engineering managers, including the Design Authority for High Efficiency Particulate Air (HEPA) filtered ventilation system.

The surveillance team observed the following work planning processes:

- Walk downs of the work area including, scoping walk downs, workability walk downs, and Automated Job Hazard Analysis (AJHA) walk downs,
- Preliminary planning meetings (prior to AJHA meetings),
- AJHA meetings,
- Work Planner schedule status meeting,
- Plan of the Day (POD) meetings,
- Pre-job meetings,
- Post-job meetings,
- Critiques, and
- Observations of work activities (e.g., Chop shop, 242Z…).

The surveillance team performed a surveillance of the work planning process, looking at the PFP process for planning radiological work. From a review of the contractor procedures, and

interviews of personnel, the basic simplified flow chart of the work planning process used at PFP is shown below:

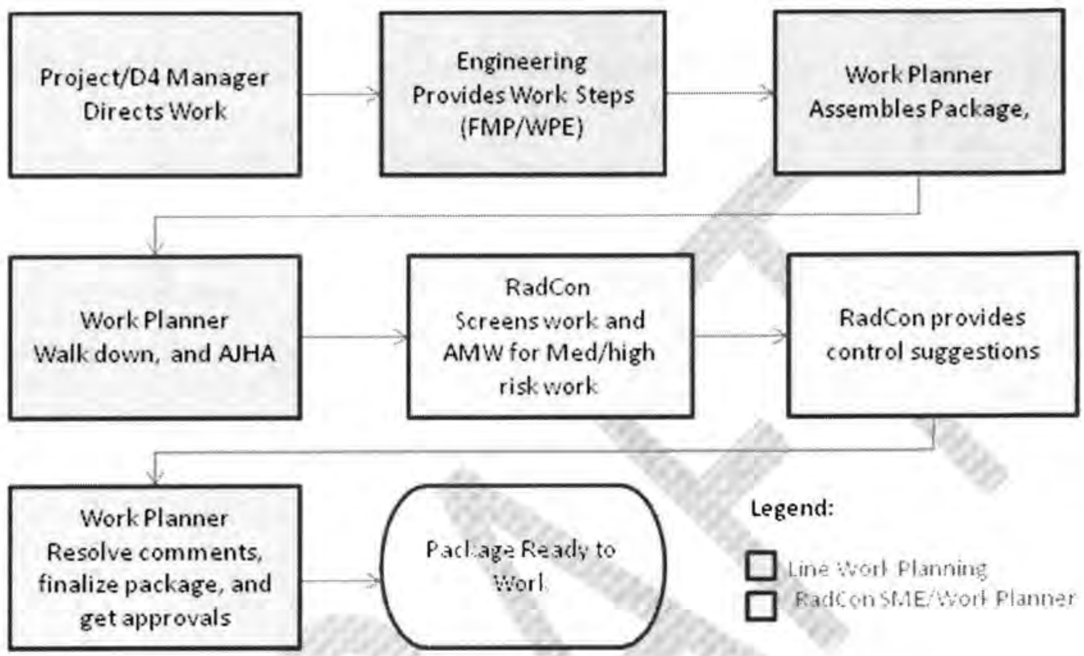

Figure 1 Simplified Work Planning Process Flow Chart

The surveillance team found multiple deficiencies in planning and execution of radiological work and some deficiencies in other technical work performed by the PFP radiation protection organization. Deficiencies in the work planning process included less than adequate involvement of radiation protection early in the work planning process and in radiation protection and some engineering work planning at the activity level. There were inadequate levels of radiological technical staffing, less than adequate training and qualification of radiological work planners, and unclear roles and responsibilities for determining radiation protection controls as implemented in the field. Additionally, the surveillance team identified some deficiencies in other technical aspects of radiation protection program at PFP. Several of the deficiencies identified in this surveillance had ties back to deficiencies in the CHPRC radiological control program.

The deficiencies in radiological work planning also demonstrated weaknesses in implementation of Integrated Safety Management Systems at PFP and CHPRC.

As a result of the deficiencies identified by RL, the contractor brought in additional radiological control staff to shore up PFP's radiological control program. The project developed a living radiological control improvement plan that was adjusted as the RL surveillance team and additional contractor radiological control staff identified more deficiencies for correction.

The surveillance resulted in one (1) concern, twelve (12) findings and four (4) observations.

- **S-11-SED-CHPRC-PFP-002-C01:** The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.
- **S-11-SED-CHPRC-PFP-002-F01:** Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).
- **S-11-SED-CHPRC-PFP-002-F02:** Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.
- **S-11-SED-CHPRC-PFP-002-F03:** The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.
- **S-11-SED-CHPRC-PFP-002-F04:** Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.
- **S-11-SED-CHPRC-PFP-002-F05:** Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.
- **S-11-SED-CHPRC-PFP-002-F06**: PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning; The CHPRC technical basis document for workplace air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.
- **S-11-SED-CHPRC-PFP-002-F07:** The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work.
- **S-11-SED-CHPRC-PFP-002-F08:** The Hanford Combination Neutron Dosimeter (HCND) was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document; CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F09:** Technical errors were identified in five out of nineteen External Dosimetry Investigation Reports (EDIRs) (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F10:** Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

- **S-11-SED-CHPRC-PFP-002-F11:** Less than adequate conduct of operations was observed; Failures to follow procedures contributed to generation of airborne radioactivity and low level uptakes.
- **S-11-SED-CHPRC-PFP-002-F12:** Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.
- **S-11-SED-CHPRC-PFP-002-O01:** Job Specific RWPs, were written broad and generically to cover multiple work packages.
- **S-11-SED-CHPRC-002-O02:** The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.
- **S-11-SED-CHPRC-PFP-002-O03:** Poor practices identified in EDIR review.
- **S-11-SED-CHPRC-PFP-002-O04:** The use of the CHPRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors were identified.

Due to the number and significance of the deficiencies identified, the contractor will be requested to submit a corrective action plan.

Surveillance Results:

Concern: S-11-SED-CHPRC-PFP-002-C01:

The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

Discussion:

RL performed a surveillance of planning and execution of radiological work. The surveillance included interviews of personnel involved in the work planning process, observation of work planning process activities, reviews of work planning documents, procedures and work packages, and investigation of radiological events.

To adequately plan work, the hazards associated with the work must be fully understood. The radiological hazards are the sum of the hazards from the system that is being breeched, the work operation being performed, and the hazards associated with the work location.

Radiological hazards associated with the system include radionuclides present, at what concentrations, and in what chemical form. How is the system being breeched constructed? What is the material of construction, how is the interior of the system designed, what are the potentials for holdup of radioactive materials and radioactive liquids and where in the system?

The radiological hazards associated with work operations relate to how the work operation could spread contamination or generate airborne radioactivity, and how the work operation could affect the engineered airborne radioactivity controls. As an example, a circular saw used on highly contaminated surfaces would generate high airborne radioactivity with turbulent air flow patterns. Normal ventilation is designed for laminar flow, such that it would be significantly less effective in capturing airborne radioactivity from a circular saw.

Radiological hazards associated with the work location must be adequately characterized. This should include an understanding of the history of upset conditions that resulted in spread of contamination, including the levels of radioactive contamination that could be present on exposing surfaces that were contaminated from fires and spills involving radioactive materials.

Once the hazards are understood, the radiological controls are incorporated. These controls may involve elimination or reduction of the hazard by removal of the source term or limiting the amount of source term that is accessible (e.g., decontamination, application of fixatives). These controls also involve proper selection of the work operations (substituting less turbulent work operations where needed), and implementation of engineered controls to keep the hazard away from the worker (use of glove boxes or glove bags, and appropriately engineered ventilation). After reducing the hazards through elimination or reduction of the source term, and applying engineered controls, administrative controls and personal protective equipment and clothing (PPE) are used to protect the workers.

The radiological controls are then implemented using procedures, training and supervision. The sum of the procedures, training and supervision must be adequate to ensure protection of the workers. The higher the hazard and the more complex the work, the more formal the controls are needed.

At PFP the surveillance team observed deficiencies in multiple areas of the work planning process. The radiological hazards of the work were not properly analyzed. The radiological controls for some high hazard work were less than adequate, relying on PPE in lieu of implementing engineering controls. Personnel, who were not qualified, were found making inappropriate technical decisions in the field (i.e., decisions by first line supervision) that resulted in unplanned personnel exposures to airborne radioactivity.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F01:

Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).

Requirements:

10 CFR 835.501(b) specifies "The degree of control shall be commensurate with existing and potential radiological hazards within the area."

10 CFR 835.501(d) specifies "Written authorizations shall be required to control entry and perform work within radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards."

10 CFR 835.1102 (b) specifies "Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, radionuclides present, and the fixed and removable surface contamination levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "...The contractor shall, in the performance of work, ensure that... (5) Before work is performed, the associated hazards are evaluated..."

Discussion:

As discussed in concern S-11-SED-CHPRC-PFP-002-C01 above, radiological work planning needs to understand the hazards associated with the system, work operations and location in order to determine appropriate controls to mitigate the hazards. Multiple examples exist where the hazards were not appropriately analyzed, resulting in airborne radioactivity generation that exceeded the applicable protection factor for the respiratory protection worn and/or spread of contamination:

1. **The hazard associated with using a circular saw to cut a highly internally contaminated glove box was not analyzed, resulting in very high airborne radioactivity that exceeded the respiratory protection factor for airline respirators.**

The work in room 172 of PFP involved cutting up highly internally contaminated glove boxes for disposal. The room is referred to as the chop shop. On December 29, 2010, workers used a circular saw to cut pieces off the back (exposing internals) of Glove box 139-3/4. The airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator worn. The highest level found on the lapel was 7100 Derived Air Concentration (DAC)-hr (0.71 after taking into account the protection factor of the airline respirator). The surveillance team requested a copy of the airborne radioactivity calculations for the work operation that was performed. None was provided.

On January 25, 2011, workers again used a circular saw to size reduce a glove box. The airborne radioactivity levels "jumped". The highest DAC-hr value on workers lapel air sampler was 17000 DAC-hr, 1.7 DAC-hr after adjusting for the protection factor of the airline respirator (10,000). Assuming the jump in airborne radioactivity occurred over a five minute period (time between monitoring the air sample filter), the airborne radioactivity level generated by the circular saw was more than 200,000 DAC. This was the second time the work team used a circular saw for size reducing the glove boxes and exceeded the airborne radioactivity limits of the RWP (see OA 35012).

The surveillance team again requested the work planning documentation that would indicate the project had evaluated the airborne radioactivity hazard associated with use of the circular saw. The contractor could not provide any. The contractor facility radiological control manager acknowledged no airborne radioactivity estimate had been made.

- **Investigation revealed PFP radiological work planners routinely did not perform airborne radioactivity estimates to ensure appropriate controls were selected for the work activity.**

Interviews with the radiological work planners at PFP revealed the facility did not evaluate the potential airborne radioactivity levels for use of the circular saw on contaminated glove boxes. In fact, the radiological work planners acknowledged they had not ever performed airborne radioactivity estimates for work at PFP. The surveillance team reviewed the work planning records for several work packages confirming there were no records of the analysis of the airborne radioactivity hazards for the work reviewed.

After initially requesting the airborne calculations after the December 29, 2010 event, the PFP Director, RHS obtained documentation from another facility on how to perform airborne radioactivity estimates and provided it to the PFP radiological work planners.

A significant contributing factor to this programmatic deficiency was the lack of training and lack of procedures provided by CHPRC that would show the radiological work planner how to analyze the airborne radioactivity hazard to ensure adequate engineered controls and/or respiratory protection are provided (see findings S-11-SED-CHPRC-PFP-002-F05 and S-11-SED-CHPRC-PFP-002-F06). In this case, no respiratory protection had a protection factor high enough for the work. The analysis of the airborne hazard would have demonstrated the need to incorporate engineered controls.

- **The Radiological Hazards Screening Form indicated no airborne radioactivity above 1000 DAC (unmitigated), even though no estimate was performed**

One of the high hazard radiological work screening criteria is "Will predicted airborne radioactivity concentrations exceed 1000 DAC…." This block is marked no, even though no calculation was performed, and there were no limitations in the procedure on work operations (i.e., any power tool was OK to use) or accessible contamination levels within the glove boxes at the locations being cut. There were no bounds on the radiological conditions of the glove boxes provided to the chop shop except, less than 240 grams of plutonium (Pu). Since airborne radioactivity generation depends on the amount of accessible contamination being disturbed and the work activity disturbing the contamination, there is no technical basis for the conclusion that unmitigated DAC values would be below 1000 DAC. This lack of analysis resulted in repetitive generation of much higher levels of airborne radioactivity at the chop shop.

- **Investigation revealed the effectiveness of the point source ventilation used in the chop shop for removing airborne radioactivity during cutting with the circular saw had not been evaluated by PFP engineering.**

The surveillance team interviewed the design authority for HEPA ventilation and requested a copy of the ventilation calculations that would demonstrate the effectiveness of the spot ventilation when using a circular saw. The project could not produce the calculations and acknowledged that they had not been performed.

Interviews indicated that the ventilation engineers were primarily involved in ensuring the PFP HEPA ventilation system and air flow through the plant was not adversely impacted by changes to the system and ensuring HEPA ventilation for tents were adequate to provide appropriate air changes. Some evaluation of point source ventilation had been performed, but not where turbulent air flow patterns were involved. The engineer provided an example of an evaluation of a point source ventilation calculation with typical laminar flow. The work planning process at PFP did not ensure that engineering was adequately utilized in the work planning process. Since DOE identified this deficiency, there has been greater use of engineered ventilation and participation by engineering in its design.

- **Air monitoring in the chop shop with DAC-hr limiting conditions have kept personnel from getting a significant uptake to date, but has not been a cost effective means of performing the work due to multiple shut downs of the work for re-planning.**

To control worker exposures to airborne radioactivity, the project incorporated airborne radioactivity void limits. While this process is more of an emergency response, and has minimized the potential dose consequences to the workers to date, it does not control the generation of airborne radioactivity or prevent airborne that exceeds the respiratory protection factor of equipment worn, and creates a highly inefficient work process.

A review of the contractors work records between December 15, 2010 (the start of cutting operations in the chop shop) and March 16, 2011, indicated that work was performed in room 172 for 40 days. Out of those days of work, cutting of glove boxes occurred during 20 days. Airborne radioactivity levels exceeded the radiological work permit DAC-hr limits during 30% (6 out of 20) of the days where glove box cutting occurred. These events resulted in stopping work operations to re-plan work.

- **Continued problems in chop shop revealed glove boxes were not adequately prepared for safe size reduction; fixatives were not adequately applied before the boxes were removed from the E-4 ventilation system and sent to the chop shop.**

After shut down of the chop shop on March 16th, work restarted April 20, 2011, with the first intrusive work performed on April 25, 2011. On that day, airborne radioactivity levels increased and personnel stopped work within a half hour. On the next day, airborne radioactivity levels exceeded the limiting conditions of the RWP. At the post job, workers revealed the glove boxes were not being provided to the chop shop in a condition that would permit safe size reduction. The glove box they were working on had bare metal inside, indicating less than adequate application of fixatives, gloves were not properly rolled up and secured (making fixative application less effective), and pie plates were improperly secured (OA 37140). A review of a sample of glove box removal work packages confirmed there were no quality assurance steps in the procedures to verify adequacy of glove box preparation for the chop shop. Additionally, the chop shop work package contained two "size reduction hand-off checklists", one for glove-box 139-5, and one for 139-6. Both check lists showed the "Contamination fixed inside/outside" block left blank, indicating the action was not completed.

2. **The high contamination hazard associated with exposing and cutting a neoprene gasket exposed to historical releases of airborne radioactivity was not recognized or analyzed resulting in four individuals receiving a low level uptake of plutonium.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. Airborne radioactivity was generated when the neoprene gasket was exposed, cut and swipe surveyed (50,000 dpm alpha). Personnel were not wearing respiratory protection.

Historical records indicated several significant spreads of contamination in room 230 and 235 from undetected glove breeches to explosions and resulting fires. Contamination levels between 2000 and 6×10^6 dpm alpha are described (FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954 – 1997)). Historical records indicated the contractors partially decontaminated the surfaces and then applied paint to fix the contamination, indicating the likelihood of uncovering contamination when exposing previously inaccessible surfaces. PFP has also experienced a greater hazard of loose surface contamination associated with gaskets. For example, on 10/22/10 open air separation of Glove box 139-1/2, exposed previously inaccessible areas and resulted in a spread of contamination when the gasket between glove boxes swung free. On 3/16/11 airborne radioactivity levels increased above the limiting conditions of the RWP for the chop shop when workers cut an area where a gasket had been removed without application of fixative (OA36431).

- **Less than adequate involvement of PFP engineering in the work planning process resulted in incorrect work instructions.**

Work instruction 2Z-09-06644/M WCN2, step 6.10.2, specified "Cut wallboard/Plexiglas panels surrounding Conveyor HC-4 in room 230C & 235B." The wall was not constructed of wallboard, but had stainless steel plates bolted in place around the Plexiglas windows with neoprene gaskets. The wall had been painted over due to the historical spreads of contamination in the area. The engineer did not provide drawings of the wall construction to the work planner, providing a missed opportunity to plan for the hazard associated with a gasket exposed to contamination being uncovered. The surveillance team requested a copy of the engineering drawing associated with the wall. The drawing identified the existence of the neoprene gasket and steel plates.

- **The AMW did not address the hazards associated with removal of a portion of the wall and Plexiglas windows.**

AMW 5549, rev 0, for work package 2Z-09-6644, dated January 26, 2011, did not address the hazards associated with removing a portion of the wall between rooms 230C and 235B The AMW only addressed breaching radioactive systems.

- **CHPRC review of the work package identified the AMW did not address each task, but did not ensure correction of the deficiency prior to releasing the work.**

During the third week of fieldwork, RL requested the contractor perform compensatory actions to shore up weaknesses in the radiological control program at PFP. One of the actions taken by CHPRC was to bring a team in to review the high risk work packages. During this review on March 6, 2011, the CHPRC task team identified the deficiency in the AMW not addressing each task, but no action was taken to correct the issue prior to releasing the work.

- **When the work team performed their workability walk down, the team determined unbolting the steel plates was easier, and safer, but did not make a change to the procedure.**

During the workability walk down prior to performing the work, the work team decided unbolting (vice cutting) the wall would be safer, but no change to the procedure was made. The field work supervisor, in consultation with the lead RCT, determined respiratory protection was not needed since they were not cutting. Unbolting the steel plates, using the wet method, was started with no airborne generation. It was not until the gasket around the Plexiglas window was disturbed that high contamination levels were found (50,000 dpm/swipe alpha), exceeding the limits in the RWP. One low level nasal smear was found, but in performing additional voluntary bioassays, a total of four individuals were found to have had low level uptakes of plutonium (56 person-mrem committed effective dose)).

Failure to obtain a procedure change was a missed opportunity to identify and analyze the hazard. The deficiencies in conduct of operation, and clearly defined roles and responsibilities are addressed in S-11-SED-CHPRC-PFP-002-F11 and S-11-SED-CHPRC-PFP-002-F03 respectively.

3. **Airborne radioactivity generation hazards for Glove box WT-4 size reduction and glove box floor removal was not adequately analyzed, resulting in high airborne radioactivity that exceeded the supplied airline respiratory protection factor.**

Glove box WT-4 is in the control room of the Americium Recovery Facility (242-Z). The work package, 2Z-10-02068, was for removal of glove boxes WT-3, WT-4, and WT-5. On April 6, 2011, airborne radioactivity was generated that exceeded the limits of the radiological work permit (OA 36771), and the respiratory protection factor for the supplied airline respirator.

The airborne radioactivity was generated during use of a crow bar to pry up and remove a polyethylene liner on the floor of the glove box (show in drawing H-2-24954). The crow bar was used to pry up flashing ("20 GA S STL") used to hold the liner in place, and then to pry up the polyethylene. During the post job, the workers indicated there were some hot spots (4-5 rem/hr) on the floor of the glove box, indicating very high levels of contamination. The airborne radioactivity hazard associated with the activity of scraping on this highly contaminated surface was not analyzed.

4. **Inadequate analysis of material compatibility results in a spill of an acidic plutonium material; additionally, a precursor event was not appropriately analyzed.**

Work package 2Z-10-0679, involved removing plutonium chemical transfer lines. These lines contained three individual lines inside a protective pipe. The packaging included insertion of a rubber plug to hold the three chemical transfer lines in place within the protective pipe. A red cap was placed over the pipe end to prevent the sharp ends of the pipe cut from damaging the packaging. The cut pipe was "horse tailed" out of the glove bag containment (poly-vinyl-chloride (PVC) sleeve) and sealed using duct tape. A reinforced bag was placed over the horse tail, and sealed with "chem" tape. Then a PVC rigid cap is placed over that and secured with "chem" tape.

The team had successfully made 17 cuts using glove bags (engineered barrier), but found some liquid (described as runny like water) in two cuts made prior to the events described herein.

On 3/30/2011, while performing post job surveys, an RCT identified 600,000 dpm/100cm^2 alpha contamination on the bottom of a packaged pipe end. Even though the contamination was found on the bottom of the pipe, where the PVC rigid cap (sealed with "chem." tape) meets the pipe, the work team did not recognize this as an indicator of a breach of the sealing system. While recovering from this event, a second cut in the system sat with the same packaging system.

On 4/6/2011, the second pipe end was flipped up to drain the pipe into the glove bag. As workers exited the area, six persons were found to have contamination on their PPE. Contamination above the limiting condition of the RWP was found on surfaces in the exit path. The full extent of the spread of contamination was not understood until a recovery team entered. A visible spill of a thick (honey like) brown plutonium substance was found. Contamination in the spill area was as high as 150,000,000 dpm/100cm^2 alpha. The floor in the area contained crevices, complicating clean-up. Disposable surfaces below the work area to protect the floor in case of a spill, were not adequately used during the job. A partial decontamination was performed and the area painted over to fix the contamination.

The work team believes the plutonium acidic material broke through the adhesive in the tape, spilling out of the sleeve onto the floor. RL requested the D&D engineer assigned to the project for the chemical compatibility information for the tape used. The information provided to RL from the manufacturer showed it was not rated for nitric acid (expected chemical form in the pipe). Discussions with the field work supervisor indicated they were not aware of any specific time limitations for satisfactory seal due to the nitric acid that was anticipated.

5. **Inadequate hazards analysis results in workers drilling into the E-3 HEPA ventilation ducting.**

On April 7, 2011, workers, installing anchors in room 235B, inadvertently drilled into the contaminated E-3 HEPA filtered ventilation duct located inside the wall. The E-3 duct is a void in the wall, thus contains no metal. The work planning was less than adequate in that drawings that show the location of the E-3 ventilation were not appropriately used in determining the location of the anchors (OA 36775).

6. **Less than adequate analysis of hazards results in airborne radioactivity release while breaking a bagged Pyrex tank**

On January 27, 2011, a Pyrex tank was removed from glove box 522. The bagged tank was too big to fit into the 55-gallon waste drum. The workers attempted to size reduce the Pyrex tank by padding the tank and hitting it with a pipe wrench. The bag holding the tank was breeched, resulting in high airborne radioactivity and continuous airborne radioactivity monitor (CAM) alarm. (OA 35484)

7. **Deficiencies in analysis of hazards extends beyond radiation protection; A potential fire was narrowly averted when a worker questioned cutting on a pipe containing plutonium contaminated combustible material**

During interviews of personnel, workers reported a near miss that occurred in January of 2011. Work package 2Z-10-07673, Separate Glove box 100C from Glove box 200 in room 235D, specified cutting a hydraulic ram that was filled with plutonium contaminated combustible waste (paper, plastic and miscellaneous step off pad waste). At the pre-job briefing a worker raised a concern regarding the potential for the heat generated by the blade during the cutting reaching temperatures that could ignite the material inside the pipe. When the concern was raised, a mock-up was performed and the mock-up demonstrated the cutting operation started a fire.

The contractor issued a lessons learned praising the workers attentiveness and questioning attitude. However, corrective actions for preventing recurrence of the inadequate hazard analysis were not identified.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F02

Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (c), specifies "The contractor shall manage and perform work in accordance with a documented Safety Management System (System).... Documentation of the System shall describe how the contractor will: (1) Define the scope of work...."

PRC-MP-MS-003, Integrated Safety Management System/Environmental Management System Description (ISMSD), section 3.1 Define Scope of Work, third paragraph, specifies "Work identified in the [work breakdown structure] is further divided into discrete tasks that are individually planned for execution using PRC-PRO-WKM-12115, Work Management, which describes the process for initiating, authorizing, performing, and conducting field work."

PRC-PRO-WKM-12115, Work Management, section 3.2.3, Plan Work, Step 19 states "...State the precise scope of work, including the methods of performing the work.... The scope description must be detailed enough to support the development of effective and accurate hazard controls for the proposed work activity... . Work steps provide the sequence and technical information for the work team to accomplish work that was described in the scope statement. The [field work supervisor] is responsible to direct the work team in a manner that complies with the approved instructions...."

PRC-PRO-WKM-079, section 3.1 Review the work scope, states "1. REVIEW work scope to be sure it is adequately defined.... 2. IF the work scope is not adequately defined, THEN UPDATE work scope in accordance with PRO-WKM-12115 or PRC-PRO-MS-589."

Discussion:

As discussed in the concern above, analysis of hazards includes the hazards associated with the system being breached, the work operations performed, and the location of the work. To appropriately analyze the hazards of the work at the activity level, the work scope must be clearly defined. This means the individuals analyzing the hazards must know the details of how the job will be performed. As specified in PRC-PRO-WKM-12115, the work scope description must be detailed enough to support the development of effective and accurate hazards controls for the proposed work activity.

Less than adequate hazards analysis and implementation of controls is in part a result of less than adequate definition of the work scope. Examples of less than adequate definition of scope from Finding S-11-SED-CHPRC-PFP-002-F01, include:

- **Work scope definition/limitations for size reduction of Glove box 522 Pyrex tanks was not adequate, and therefore adequate controls were not established to prevent an airborne radioactivity release (OA 35484)**

Airborne radioactivity was generated 1/27/11, room 152 when workers attempted to size reduce a Pyrex tank from Glove box 522 by padding it on the outside of its containment bag, and then striking it with a pipe wrench. This work activity was not identified in the work package. The work instruction in (2Z-10-03825) in general, and section 6.4.2.4 (disconnect/removal of Pyrex tanks) in particular, did not identify a need, option, or instructions to size-reduce the Pyrex tank, to fit it into the waste container.

- **Work scope definition for removing Plexiglas windows with radioactively contaminated neoprene gaskets between PFP room 230C and 235B was not adequate.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. The procedure did not adequately define the scope of work.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F03:

The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that…(2) Clear and unambiguous lines of authority and responsibility for ensuring (ES&H) are established and maintained at all organizational levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that… (3) Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities."

Discussion:

The surveillance team interviewed more than 40 individuals involved in work planning, including work planners, radiological work planners, lead radiological control technicians, radiological control supervisors, field work supervisors, project managers, the safety and health manager, a radiation protection corporate mentor, and some radiation protection personnel that left PFP to work elsewhere. Additionally, the team interfaced with workers during observation of work planning processes.

Interviews revealed that there was a lot of frustration felt by both workers and managers that was a result of work planning being performed in the field, instead of being planned up front. Disagreements on the appropriate radiological controls to implement for a work activity resulted in everything from work stoppages, to implementation of inadequate controls.

- **Work packages were built with "flexibility", so the procedure would not tie the work team down as to how the work was performed; Radiological controls were "flexible" to accommodate decisions on how to do the work in the field.**

The work team and management expressed the desire for flexibility in how the work was performed, letting this be "skilled based". Consequently, the radiological work planners specified "flexible" radiological controls in the work packages. This resulted in management abdication of their responsibility for hazards assessment and controls.

Some examples include generic instructions such as:

Chop shop: 2Z-10-05648, room 172 size reduction operations, 6.2.5 "Perform size reduction activities using power tools (i.e., nibbler, sawzall, circular saw, bandsaw) on hood/glove box/ducting.... Move point source ventilation as needed for contamination control during cutting.... Implement contamination control, as needed, using hand held fogging unit...."

2Z-09-3291, Rm 139 Glove Box Removal, section 4.6 "Use wet methods, sleeving and/or HEPA filtered spot ventilation to control contamination, as necessary."

Work package 2Z-10-2115/M, 4.6.4 included the following, "Wet towels, HEPA vacuum, Glove bags/sleeving and or catch bags shall be used as the main engineering controls during the task as necessary."

When RL debriefed the contractor on preliminary findings, RL requested CHPRC to implement compensatory actions to shore up the radiation protection organization at PFP. One of the compensatory actions was to review high risk work packages for adequacy of radiological controls.

- **Roles and Responsibilities for the FWSs, lead RCTs, and other craft work team members are not intended to include radiological hazards analysis; Radiological training programs for these individuals did not include this qualification.**

The absence of specific radiological hazard controls in work instructions/packages resulted in radiological hazard control decisions being done by the field work team. These individuals were not technically qualified to analyze radiological hazards.

While the field work supervisors and lead RCTs have extensive experience in their roles, the surveillance team review of the FWS and RCT training revealed it was less than adequate to qualify them for radiological hazards analysis and control. The FWS training and qualification in radiological subject areas was limited to Radiological Worker II training. Radiological Worker II did not provide qualification on radiological hazard analysis and control selection.

The surveillance team reviewed the RCT training, which is based on the DOE training standards. While the level of training exceeds radiological worker II training, RCT training objectives were not intended or designed to provide qualification on radiological hazards analysis and selection of engineered controls for work. The surveillance team also found that the training for lead RCTs did not include additional hazard analysis and control topics. The training reviewed for FWSs and RCTs did not include appropriate education, training, and skills to discharge these responsibilities, specifically the radiological hazard analysis and selection of engineered controls.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F04

Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.

Requirements:

10 CFR 835.1001 Design and control, (a) specifies "Measures shall be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative controls. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure."

10 CFR 835.1002 Facility design and modifications, (c) specifies "Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used."

10 CFR 835.1003 Workplace controls specifies "During routine operations, the combination of engineered and administrative controls shall provide that...(b) The ALARA process is utilized for personnel exposures to ionizing radiation."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "...The contractor shall, in the performance of work, ensure that...(6) Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures.

Discussion:

Engineering controls are required to be the first line of defense against airborne radioactivity and spread of contamination. Some work teams have appropriately performed work activities using glove bags and glove boxes, to keep the worker from being exposed to the source of contamination.

Examples of poor use of engineering controls include:

- **Less than adequate use of engineering controls at the chop shop**

Work in the chop shop directly exposes personnel to high contamination levels inside glove boxes that are not designed for human entry. The chop shop and the work performed there was not properly designed up front with adequate engineering controls. As a result, airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator multiple times, and the project continually struggled with back fitting radiological controls. The facility did not use the glove box itself and facility ventilation system (E-4) to adequately reduce the hazards prior to disconnection from the E-4 system and transporting the glove boxes to the chop shop, nor designed the chop shop facility for size reducing the glove boxes inside an engineered barrier (glove box or engineered ventilation hood).

- **Less than adequate use of engineered ventilation in general; less than adequate involvement of engineering in the design of spot ventilation.**

Engineered ventilation was not always used. An example included scraping of the polyethylene liner with high dose rates, indicative of high contamination, at the bottom of glove box WT-4 without engineered spot ventilation (see Finding S-11-SED-CHPRC-PFP-002-F01).

Spot ventilation being used at the facility was not always being adequately designed to meet its intended use. Elephant trunks and HEPA filtered vacuums cleaners had been used, but were not always adequate. Examples include the use of an elephant trunk for engineered ventilation while cutting a glove box with a circular saw (see Finding S-11-SED-CHPRC-PFP-002-F01).

As the RL surveillance progressed, more involvement of the ventilation engineer in spot source ventilation design was observed. A corporate mentor had previously brought up the need for PFP to use a "B-box", a spot ventilation used at Rocky Flats. Facility action was not observed by the surveillance team until compensatory actions to shore up the radiological controls at PFP were implemented by the contractor.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F05:

Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.

Requirements:

10 CFR 835.103 Education, Training and Skills, specifies "Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this part shall have the appropriate education, training, and skills to discharge these responsibilities."

(b)(5) [redacted]

identify positions that develop and implement measures necessary to comply with 10 CFR 835. At a minimum, this includes those individuals filling the following positions…. Facility/Project Rad Con technical staff…."

Discussion:

Training and qualification of radiological work planners did not ensure that individuals, who were determining and implementing radiological controls, were appropriately trained and qualified to perform applied radiological hazards analysis. Although these individuals met the educational requirements of CRD 5480.20A and DOE-STD-1107-97, the CHPRC training did not ensure the individuals had all the skills necessary to discharge their assigned responsibilities in the area of applied hazards analysis.

- **The Radiological Control Work Planning training course did not adequately address applied hazards analysis.**

Course number 022801, Planning Radiological Work – Initial, section F, Purpose and Overview, specifies "This course does not attempt to teach radiological work planning…." The course does not teach how to plan work, nor does it provide instruction on how to perform applied hazard analysis.

Some radiological work planners were RCTs that were promoted to work planners. The RCT qualification program also does not teach personnel applied radiological hazards analysis. There was no documented training or demonstration of knowledge on how to perform applied hazard analysis prior to assignment as a radiological work planner.

The primary emphasis of the course 022801 is to teach the radiological work planners how to fill out the radiological hazards screening and ALARA Management Worksheet forms to support the work management process. The course contains general discussion on factors affecting radiological hazards, but does not adequately cover practical application of hazards analysis and selection of controls.

- **Radiological work planner training did not demonstrate how to perform airborne radioactivity estimates based on contamination levels, work operations, and application of airborne radioactivity controls.**

A review of radiological work planning training documents and interviews found that the training did not provide adequate instruction on how to predict airborne concentrations. The training materials directed the trainee to use the facility Technical Evaluation (TE) to predict airborne concentration. The PFP TE did not contain guidance on how to estimate airborne concentrations. The training material did not demonstrate how to perform these airborne radioactivity calculations.

- **Selection of appropriate respiratory protection requires the ability to calculate airborne estimates.**

The radiological work planning course does not show the work planner how to select respiratory protection based on estimated airborne radioactivity levels.

- **Radiological work planning training did not adequately cover limitations of HEPA filtered ventilation as an engineered control.**

Interviews found that staff did not understand the limitations of ventilation as an engineered control. Personnel did not demonstrate understanding that ventilation is typically designed for laminar flow. Ventilation is significantly less effective when generating turbulent air flow patterns, such as those created with a circular saw. This is important to understand, so that radiological work planners do not specify ineffective controls.

The radiological work planner training course did not cover the technical aspects of engineered ventilation or the need to engage engineering in its design.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F06:

PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning; The CHPRC technical basis document for workplace air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.

Requirements:

10 CFR 835.104 Written Procedures specifies, "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

Discussion:

The surveillance team reviewed the CHPRC and PFP list of procedures on line and technical basis documents. PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning. The CHPRC had a technical basis document for workplace air monitoring. This technical basis document included formulas to determine if air sampling is required. The technical basis document did not specifically address estimating airborne radioactivity levels for hazards analysis and work planning.

Airborne radioactivity estimates were needed to complete the Radiological Work Screening process (PRC-PRO-RP-40108, "Radiological Hazard Screening," and Site form A-6004-654). Some CHPRC projects and other Hanford Site contractors had procedures for performing airborne radioactivity calculations for hazards analysis and work planning. After the deficiency in performing airborne radioactivity calculations was identified by RL, PFP obtained another CHPRC project's methodology for performing airborne radioactivity calculations to develop their own instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F07

The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work

Requirements:

CRD O 5480.19 Chg 2 (Supp Rev 4) Conduct of Operations Requirements for DOE Facilities Chapter I, Operations Organization Administration: C. Guidelines; (2) Resources: specifies "The operations supervisor for DOE facilities should be provided with sufficient… personnel to accomplish assigned tasks without requiring excessive overtime by the operations staff. These resources should include technical personnel needed to support the operations. A long-range staffing plan that anticipates personnel losses should be developed and implemented."

Discussion:

In decontamination and decommissioning of a facility, an increased level of radiological risk and potential for rapidly changing conditions are expected. Multiple systems are being breached, facility engineered controls are being deactivated, etc. Planning for appropriate additional staff is critical to effectively handle the increased work and continual changes in facility conditions.

The contractor did not ensure adequate radiological staffing resources at PFP.

- **PFP experienced the loss of the facility RadCon Manager, a key position, in June 2010 and did not permanently replace the manager until March 7, 2011.**

The lack of priority and urgency in filling this key position for a high risk and accelerated project demonstrated less than adequate planning and response to key personnel losses. The high risk and accelerated nature of PFP work should have driven a more expedient permanent replacement for this key role. For approximately 8 months, the project did not have a permanent RadCon Manager.

PFP assigned personnel as temporary radiological control managers. The RHS Director intermittently acted as RadCon manager. However, the RHS Director's other duties combined with the RadCon organization's span of control, made this approach less than adequate. For 5 months (August through December), the facility had a central RadCon staff member acting in a temporary capacity. After the central RadCon staff member went back to the central organization, the radiological control manager position was rotated among the radiological control supervisors. Experience shows personnel in a temporary position are not as effective because staff know they are temporary.

- **There was insufficient radiological technical staff to adequately manage the work planning process.**

The radiological work planner and engineers needs to be an integral part of the work planning team. They need to be there at the start of the work planning, providing input into how the work is performed from a risk assessment perspective. If the work operations are not clearly defined during the planning, hazards assessments may not be accurate, as was observed during the surveillance for some work activities. This contributed to the adverse outcomes realized during work (e.g. RWP voids, high airborne generation, contamination spreads, and radiological uptakes).

At the start of this surveillance, the project had three radiological work planners. This resource level was not adequate to support work planning based on the level of hazards in the facility and the pace of work at PFP. Based on organizational chart reviews and interviews, the three radiological work planners supported approximately twenty-six line work planners.

- **Insufficient numbers of radiological work planners did not permit adequate engagement of the work planner during performance of work.**

The radiological work planners need to be engaged during performance of the work. Field presence by radiological technical support and work planners helps to validate and ensure that radiological controls are implemented as intended. As the level of flexibility in work operations and changing conditions increase, field observations provide for early recognition and correction of potential inadequacies in engineered controls. The shortage of radiological work planners resulted in their limited field presence. Lack of observation of the implementation of controls in the field represents a program weakness and a missed feedback opportunity.

In response to the RL surveillance, the contractor added a radiological engineering manager and additional radiological work planners at PFP.

- **PFP had insufficient numbers of first line radiological control supervisors (RCS) to effectively support radiological work.**

A review of the PFP organizational chart and interviews with the PFP RCS found that approximately 102 RCTs were supervised by five RCS. Interviews indicated the following: One of these RCS had double duty as PFP's acting radiological control manager. One of the RCS was assigned Duty RCS for making personnel assignments, responding to emergencies, and completing other administrative duties. Additionally, the RCSs review completed radiological surveys. As a result, only two RCS were typically available to oversee the ongoing work. The ratio of RCTs to RCS was very high considering the level of radiological hazard associated with the work at PFP.

Since RL identified the overall weaknesses in radiological staffing at PFP, the contractor has increased the number of RCS.

- **Fifty percent of the RCTs at PFP were junior**

Interviews with personnel indicated fifty percent of the RCTs at PFP were junior, meaning they were not qualified to work alone on high risk work activities and required more oversight by the lead RCTs on the work team.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F08:

The HCND was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document; CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).

Requirements:

10 CFR 835, Subpart E-Monitoring of Individuals and Areas, Article 835.401(b) Instruments and equipment used for monitoring shall be... (2) Appropriate for the type(s), levels, and energies of the radiation(s) encountered..."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section F External Dosimetry, paragraph 3, specifies "The contractor shall participate in the development and maintenance of a Hanford site-wide external dosimetry basis document. The contractor's external dosimetry program shall be performed in accordance with this technical basis document."

PNNL-15750 Rev. 1, PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, section 6.3, Selection of Dosimeter Types to Use, specifies "Individuals who are likely to receive Hp(10)n greater than 100 mrem per year should be issued a HCND, which provides a more accurate measurement of neutron dose. In addition, individuals who routinely have Hp(10)n greater than 100 mrem per year reported on an [Hanford Standard Dosimeter (HSD)] should be issued a HCND."

Discussion:

The surveillance team reviewed the CHPRC deficiency reports for PFP. Multiple deficiency reports identified issues with neutron dose over-response from personnel wearing the HSD at PFP that required modifications to personnel dose of record. RL investigated the issue and found it to be programmatic at CHPRC.

The HSD can measure neutron, and is Department of Energy Laboratory Accreditation Program (DOELAP) accredited based on its response to a bare californium neutron source (fast neutron). The HSD over-responds to a moderated neutron flux. Depending on the neutron energy where the individual was exposed, correction factors between 2 and 5 were used. The HCND is a neutron dosimeter which has multiple thermoluminescent dosimeters (TLDs) inside that respond to different neutron energy levels and thus more accurately measure neutron, but costs more.

CHPRC reduced the numbers of personnel monitored with HCND to reduce costs. The HSD costs $45.00 to process, while the HCND costs $68.00 to process (data from DOE Dosimetry point of contact). This cost is less than the contractor's estimated man-hours costs taken to investigate and correct the neutron dose.

In the process of reducing the number of personnel assigned a HCND, individuals who should have been wearing the combination neutron dosimeter were not appropriately monitored in accordance with the Hanford External Dosimetry Technical Basis. In 2010, CHPRC processed 119 EDIRs to correct the neutron reading from a HSD. Many more individual dose records were reviewed for high neutron doses, where doses indicated personnel should have been assigned a HCND, but were not, and the project decided not to make a change in the individual's dose of record.

A review of the CHPRC External Dosimetry Program, PRC-PRO-RP-379, revealed the document is inconsistent with the Hanford External Dosimetry Technical Basis Document. While PNL-MA-842 specifies personnel who routinely have neutron dose, as reported on an HSD, should be issued a HCND, CHPRC has not implemented this in their External Dosimetry Program. PRC-PRO-RP-379, section 3.15, step 5, only specifies to change the dosimeter from a HSD to a HCND if the corrected neutron dose (vice reported dose) is greater than 100 mrem.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F09

Technical errors were identified in five out of nineteen EDIRs.

Requirements:

PRC-PRO-RP-379, External Dosimetry Program, section 3.15, Neutron Correction to HSD Measurements, step 2 specifies "<u>IF</u> calendar year-to-date (CTD) uncorrected neutron exposure is [greater than or equal to] 100 mrem, <u>THEN</u> correct readings using the following correction factors: PFP = 2, ISA = 5, Others = 3." "Note: Justification is required in the project's technical equivalent document if there is a deviation from the given correction factors per project." Step 3 specifies "<u>IF</u> corrected exposure is $\geq$ 100 mrem or if record correction is desired, <u>THEN</u>

NOTIFY DO AND REQUEST an EDIR number, AND COMPLETE AND SUBMIT [EDIR] to correct the recorded dose."

10 CFR 830.122 Quality Assurance Criteria (c) specifies "Criterion 3 Management/Quality Improvement (1) Establish and implement processes to detect and prevent quality problems. (2) Identify, control, and correct items, services, and processes that do not meet established requirements. (3) Identify causes of problems and work to prevent recurrence as a part of correcting the problem. (4) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section J, Radiological Records, paragraph 2, specifies "The contractor shall ensure that permanent radiological records are accurate…."

Discussion:

The surveillance team reviewed 19 out of 119 EDIR that involved adjusting neutron doses from the HSD readings. Technical errors (math errors, wrong radiation type, zeroing dose without adequate technical justification) were identified in five out of 19 (26 percent) of the EDIRs. There were other potential issues in 4 other EDIRs. The following technical errors were identified:

- **Several EDIRs contained math errors.**

EDIR-10-223 divided 20 mrem neutron by a correction factor of 3, and specified the corrected dose as 3 mrem neutron (20 divided by 3 is 6.67, or rounded to the nearest mrem is 7 mrem, not 3 mrem). EDIR-10-077 took 60 mrem neutron divided by a correction factor of 3 and said the resulting dose was 17 mrem neutron. EDIR-10-179 erroneously added the gamma dose to the neutron dose when correcting the neutron dose (520 neutron +53 gamma = 573; 573 divided by 2 = 287). The corrected neutron dose should have been 520 divided by 2 = 260 mrem neutron.

- **One workers dose was corrected twice, but the dose was assigned as neutron vice gamma.**

EDIR-10-060 information from the facility did not specify the type of radiation, nor was a radiation survey record attached. The worker had been taking photographs in PFP A-labs, for a total of 2 hours, and lost his HSD. The EDIR specified general radiation levels in A labs as 0.5 mrem/hr, but did not specify whether that was gamma radiation vice neutron. PFP general area radiation levels are both gamma and neutron in most places, and 0.5 mrem/hr is the typical minimum detectable activity (MDA) of the gamma dose reading instrument. The 0.5 mrem/hr dose rate was likely a gamma reading based on the location, A-Labs. The EDIR should have contained both gamma and neutron dose rates for preparation of the dose estimate. The first time the dose was corrected, a math error was made, 2 hrs times 0.5 mrem per hr, was recorded as 2 mrem neutron. The contractor caught the math error and changed the dose to 1 mrem neutron, but did not catch the error of no radiation type being specified by the facility providing the dose rate data.

- **A neutron dose record indicating 31 mrem neutron was changed to zero (see EDIR-10-176).**

The 31 mrem recorded neutron was corrected by dividing by 3 (10 mrem neutron), but then recorded as zero, without appropriate technical justification. Discussions with PNNL dosimetry program technical personnel indicated recording this corrected neutron dose as zero was not consistent with the Hanford external dosimetry technical basis manual.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F10:

Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

Requirements:

10 CFR 835.403 Air monitoring, specifies "(a) Monitoring of airborne radioactivity shall be performed (1) Where an individual is likely to receive an exposure of 40 or more [Derived-Air Concentration (DAC)]-hours in a year...."

10 CFR 835.402 (c) specifies "For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs (including routine bioassay programs) shall be conducted for: (1) radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year...."

Discussion:

The surveillance team reviewed four (4) quarterly PFP workplace Air Monitoring Tracking and Trending Reports (Calendar year 2010). This review was performed in response to an earlier discovery of the tracking and trending not being performed (OA 33986) and an employee concern at PFP over the sporadic elevations of airborne radioactivity in the plant.

- **PFP Closure Project Workplace Air Monitoring Tracking and Trending reports identify locations with unexplained elevated airborne radioactivity above one DAC-hr.**

The surveillance team verified that Workplace Air Monitoring Tracking and Trending Reports have identified areas with sporadic unexplained elevated airborne radioactivity. As an example, the Third quarter 2010 PFP Closure Project Workplace Air Monitoring Tracking and Trending Report identified six (6) areas with greater than 1 DAC-hr airborne radioactivity. The third quarter 2010 report did not provide any actions taken to ensure unmonitored personnel receive less than 40 DAC-hr (100 mrem internal dose) in a year, or actions taken monitor exposed individuals through bioassay or a DAC-hr tracking program.

- **The third and fourth quarter reports did not contain any trending data for locations with elevated airborne radioactivity.**

Review of the Third and Fourth Air Monitoring Tracking and Trending Reports confirmed they did not include any trending data for the locations with elevated airborne radioactivity. Interviews with radiological control technical staff indicated the staffing shortages were a major contributor to the task not being completed.

After RL expressed concern over the shortage of radiological technical staff at PFP, CHPRC added staffing to shore up the radiological control program. An individual with expertise in airborne radioactivity monitoring programs performed a trending analysis for data from March, 2010 through March 2011 to complete the missing analyses.

- **The PFP administrative trigger level for investigating elevated airborne radioactivity was 1 DAC-hr in a week (50 DAC-hr per year for a 50 week work year), which was inconsistent with 40 DAC-hr in a year regulatory requirement.**

A fixed head air monitor draws airborne radioactivity into it and collects the contamination on a filter. When the filter is counted, the contamination is a direct measure of DAC-hr. The airborne radioactivity could have occurred in a short period of time as a result of a work activity, or be the collection of ambient low level airborne radioactivity. Assuming the airborne radioactivity actually occurs when people are in the area as a result of their activities, 40 DAC-hr per year would be 0.8 DAC-hr per week (for 50 work weeks in a year). It is unclear why the facility has used a higher trigger for investigation than that which ensures compliance with 10 CFR 835.

- **Airborne radioactivity area (ARA) posting at PFP goes up and down daily, it is not clear how the air monitoring program verifies personnel not in respiratory protection receive less than 100 mrem internal dose (40 DAC-hr) in a year when these areas are not posted ARA.**

Interviews with the radiological control technical staff and reviews of the quarterly workplace air monitoring tracking and trending reports revealed the fixed head air monitors run both during the period when the area is not a posted airborne radioactivity area and during airborne radioactivity work. When high fixed head airborne radioactivity levels are reported, the radiological technical staff indicated they sent an e-mail to the radiological control supervisors to determine what work went on in the area. If airborne radioactivity work occurred, this is identified in the report. It is unclear how this process ensures personnel who are not monitored for internal exposure and are not wearing respiratory protection, do not exceed 100 mrem internal dose in a year.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F11:

Less than adequate conduct of operations was observed; Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.

Requirements:

10 CFR 830.122 Quality assurance criteria, (e) Criterion 5 Performance/work processes (1) specifies "Perform work consistent with technical standards, administrative controls and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means."

DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities, Chapter XVI Operations Procedures, B. Discussion, specifies "...operations procedures should be sufficiently detailed to perform the required functions without direct supervision.... Operators should not be expected to compensate for shortcomings in such procedures... C. Guidelines ...7. Procedure Use,... Facility operation should be conducted in accordance with applicable procedures... If procedures are deficient, a procedure change should be initiated...."

Discussion:

The surveillance team observed post job reviews and critiques. A contributing factor to events was poor conduct of operations. The following are examples of personnel not following appropriate requirements for use of procedures:

- **Less than adequate conduct of operations contributed to personnel receiving low level uptakes during removal of a Plexiglas window between PFP rooms 230C and 235B.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, the work team identified the wall surrounding the Plexiglas windows was made of stainless steel sheets bolted in place. The team decided to unbolt the stainless steel plates in lieu of cutting as identified in the procedure. Because of the perceived safer condition, the FWS and lead RCT decided respiratory protection was not needed. The work team did not make an appropriate change to the work package prior to performing the work. An unanalyzed hazard associated with contamination on the gasket around the Plexiglas window resulted in four low level uptakes.

- **Personnel observed not following controls established in the procedure contributed to generation of airborne radioactivity above the respiratory protection factor of the airline respirator at the chop shop.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, airborne radioactivity levels during work in chop shop repetitively exceeded respiratory protection factors of the airline respirator. The facility modified the chop shop work package to add additional radiological work instructions on March 10, 2011. When the chop shop work team commenced work on March 16, 2011, the corporate radiological control mentor identified workers had not implemented several of the radiological control requirements in the procedure. Airborne radioactivity levels exceeded the RWP limits for airborne radioactivity and work was stopped.

- **Personnel did not stop when Pyrex tank did not fit into 55 gallon drum. Unplanned work resulted in airborne radioactivity and spread of contamination (OA 35484).**

The work instruction (2Z-10-03825), for preparation of glove box 522 for removal, did not identify a need, option, or instruction to size reduce a Pyrex tank in the glove box. The Pyrex tank was sleeved out of the glove box, but did not fit into the 55 gallon drum staged for its disposal. When personnel in the field concluded the tank should be size reduced they did not recognize work instructions and controls should have been specified and approved prior to performing the actions they did to size reduce the tank. While attempting to break the Pyrex tank with a pipe wrench, a release of airborne radioactivity occurred when the sleeving around the tank was breeched.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F12

Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.

Requirements:

10 CFR 830.122(c)(1) Establish and implement processes to detect and prevent quality problems.

Form A-6004-634 specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

Discussion:

The AMW documents the radiological considerations, analysis and controls to be incorporated for high and medium risk radiological work. Documentation on the AMW Part II, Radiological Protective Measures/Considerations was not consistently completed per the form's instructions. The AMW form specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

The surveillance team reviewed 7 released complete work packages supplied by PFP; the AMWs associated with these work packages did not fully follow the previously stated instruction. The surveillance team found sections on each AMW where the radiological work planner checked, "Incorporate into work instruction," without any text being bolded for inclusion. Failure to follow the forms instructions, e.g. lack of bold text, potentially contributed to the less than adequate inclusion of intended controls in work instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O01:

Job Specific RWPs were written broad and generically to cover multiple work packages.

Discussion:

As part of the PFP work planning surveillance, the team noted that RWPs were written to cover multiple work packages and were broad and general in nature. An example of this is RWP Z-005, "Perform Glove box Work Activities (As per Listed Work Procedures), Handling/Movement of Radioactive Material, Low Level Waste Handling & Disposal and Minor Decontamination." This RWP had been revised 72 times, covered 6 PFP procedures and 28 work packages.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-002-O02:

The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.

Discussion:

During the surveillance, there were a lot of concerns expressed by workers on the use of plutonium levels for determining when beryllium monitoring was required. The workers expressed concern over the accuracy of the technical basis for the policy and on lack of follow through by facility management in performing beryllium characterization.

During review of FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954-1997), the surveillance team noted on page 20 of the report that a spread of contamination from a plutonium-beryllium source occurred in 1981 in room 236. This source of beryllium was not evaluated by the facility in the development of their beryllium monitoring program.

The additional technical staff brought into PFP had an additional benefit of supporting resolution of worker concerns in the beryllium monitoring program. When the additional source of beryllium contamination was identified by RL, the additional staff reviewed its potential impact on the PFP beryllium monitoring program.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O03:

Poor practices identified in EDIR review.

Discussion:

The following additional poor practices were observed:

- **Poor resolution to a technical issue.**

EDIR-10-077 indicated a technical issue existed with the type of direct reading dosimeters (DRD) used at WRAP. The EDIR specified the cause of "ACES report indicated that estimated dose recorded was grossly underreported for [DRD]", was "DRD do not detect neutron radiation and electronic dosimeters can under respond to lower energy spectra." The resolution states: "Return to monthly dosimeter issuance." This resolution does not address the technical shortfall of the equipment. Therefore, the response was less than adequate. 10 CFR 835 requires monitoring be performed with equipment appropriate for the type and energy of radiation encountered.

- **Gross inconsistencies in whose neutron dose from the HSD gets corrected in the individuals record.**

There were gross inconsistencies in whose neutron dose from the HSD got corrected in the individuals record and whose did not. Examples include: A neutron dose correction of 1 mrem was made in one EDIR, a dose of 31 was zeroed in another, and a HDS dose of 199 mrem (99.5 mrem with PFP correction factor applied), was not corrected at all.

- **Rounding is inconsistent.**

Some EDIRs truncated the fraction of a mrem, while others used normal rounding practices. Had the 99.5 mrem corrected value from the example above used normal rounding practices, the corrected dose would be 100 mrem and the CHPRC procedure would require dose correction.

- **Technical justification for use of inconsistent neutron correction factors for ISA pad work was not documented in the EDIR.**

All 4 EDIR reports for individuals working at ISA (correction factor 5) pad that the surveillance team reviewed had neutron dose and no gamma dose. Two individuals had some entries into CSB also. The correction factor applied to those individuals was 3. There was no documentation that indicated why the facility chose to use the 3 over the 5. The correction factor of 3 resulted in a conservative higher dose in the record.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O04:

The use of the PRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors are identified

Discussion:

As part of the PFP work planning process surveillance, the team observed PFP investigate upset conditions and events using the ALARA post-job review as a fact finding tool. By design, the ALARA post-job review did not provide sufficient fact finding guidance to discover the event details needed to identify failure points and prevent recurrence. The site form (site form A-6004-821) provided questions geared toward evaluating causes not gathering factual details. The contractor should provide a more appropriate and effective process for gathering and identifying facts related to upset conditions.

RL Lead Assessor Closure Required: **YES[ ] NO [X]**

Contractor Self-Assessment:

The surveillance team reviewed the contractor's self-assessments and corrective action data base for PFP deficiencies for June, 2010 through April, 2011.

Issues with radiological work control planning and implementation have been previously identified by the CHPRC. On July 13, 2010, CHPRC identified within a conditional report (CR) three Stop Works at PFP related to Procedure Compliance, Entry Requirements and RWP Violations. These formal Stop Works were recorded in CR-2010-2201 to document issues with scope creep, procedure compliance, hazards and controls, pre- job briefs, and duct level entry requirements. As a result of the evaluation of the Stop Work issues, this CR was screened as adverse.

Analysis contained within CR-2010-2201 revealed that multiple issues throughout most aspects of work performance had risen to a level that workers felt the need to implement the formal Stop Work process in order to see that they were adequately addressed. Ten corrective actions were established to resolve these issues.

On October 22, 2010, CR-2010-3327, Contamination Spread in Multiple Rooms during Glove Box Separation Activities, was initiated due to contamination spread during glove box separation activities in room 139 of A Labs. Analysis of this event determined that the work controls were not adequate to handle the potential levels of contamination in areas inaccessible for survey and the configuration of the glove box was such that engineered barriers were considered impractical. Two work control corrective actions were identified in response to this event.

However, the number of radiological work planning events and deficiencies identified during this surveillance, indicates the corrective actions associated with the above issues were not sufficiently effective. This assessment of PFP's radiological work planning corrective action effectiveness aligns with RL's overall evaluation of CHPRC's corrective action management performance (See letter CHPRC-1100939, Integrated Corrective Action Plan).

Contractor Self-Assessment Adequate: **YES [ ]** **NO [X]**

Management Debriefed:

David Del Vecchio, CHPRC
Terry Vaughn, CHPRC
Curtis Bean, CHPRC
Tom Bratvold, CHPRC

Department of Energy
Richland Operations Office (RL)
Surveillance Report

Division: Safety and Engineering Division (SED)

Surveillance Team: Brenda Pangborn (lead), Joe DeMers, Wayne Glines, Rick Jansons, Ed MacAlister, Ed Parsons, Kerry Schierman, Sandra Trine

Surveillance Number: S-11-SED-CHPRC-PFP-002

Date Completed: April 29, 2011

Contractor: CH2MHILL Plateau Remediation Company (CHPRC)

Facility: Plutonium Finishing Plant (PFP)

Title: Planning and Execution of Radiological Work

Guide: 10 CFR 835

Surveillance Scope:

The objective of this surveillance was to evaluate the adequacy of planning and execution of radiological work at PFP. This was a surveillance of the work planning process that included review of the development of radiological work packages, the identification, analysis and control of radiological work hazards, a review of work planning resources, and a review of radiological deficiencies resulting from less than adequate work planning and the associated corrective actions management. This surveillance also included investigation of specific radiological deficiencies anonymously sent to RL.

Surveillance Summary:

The surveillance team reviewed documents that included, among others:

- Contractor work planning documents, (b)(5) [redacted] (b)(5) [redacted]
- Training course materials for both radiological work planners and the line work planners,
- Radiological control procedures and technical basis documents,

- Radiological performance indicators including contractor self assessments, contractor corrective action reports, and RL operational awareness (OA) reports for activities at PFP,
- Historical documents of the PFP, including the Radiological History of the Plutonium Finishing Plant (1954-1997) that described radiological upsets in the facility (dates, locations and contamination values),
- Work packages and associated radiological screening forms, As-Low-As-Reasonably-Achievable (ALARA) Management Worksheets (AMW), and radiological work permits (RWP).

The surveillance team interviewed more than forty (40) personnel involved in the work planning process and execution of work in the field, including:

- Three (3) radiological work planners,
- Eight (8) line work planners,
- Four (4) field work supervisors (FWS),
- Four (4) superintendants,
- Three (3) project managers,
- Two (2) Integration Planners,
- Four (4) radiological control supervisors (RCS),
- Eight (8) lead radiological control technicians (lead RCT),
- One (1) Director of Radiation Protection, Industrial Hygiene, and Occupational Safety (RHS),
- One (1) Director of Environment Safety and Health for CHPRC,
- Two (2) former PFP radiological Control Managers (RCM),
- One (1) Radiological controls mentor, and
- Three (3) engineers or engineering managers, including the Design Authority for High Efficiency Particulate Air (HEPA) filtered ventilation system.

The surveillance team observed the following work planning processes:

- Walk downs of the work area including, scoping walk downs, workability walk downs, and Automated Job Hazard Analysis (AJHA) walk downs,
- Preliminary planning meetings (prior to AJHA meetings),
- AJHA meetings,
- Work Planner schedule status meeting,
- Plan of the Day (POD) meetings,
- Pre-job meetings,
- Post-job meetings,
- Critiques, and
- Observations of work activities (e.g., Chop shop, 242Z…).

The surveillance team performed a surveillance of the work planning process, looking at the PFP process for planning radiological work. From a review of the contractor procedures, and

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interviews of personnel, the basic simplified flow chart of the work planning process used at PFP is shown below:

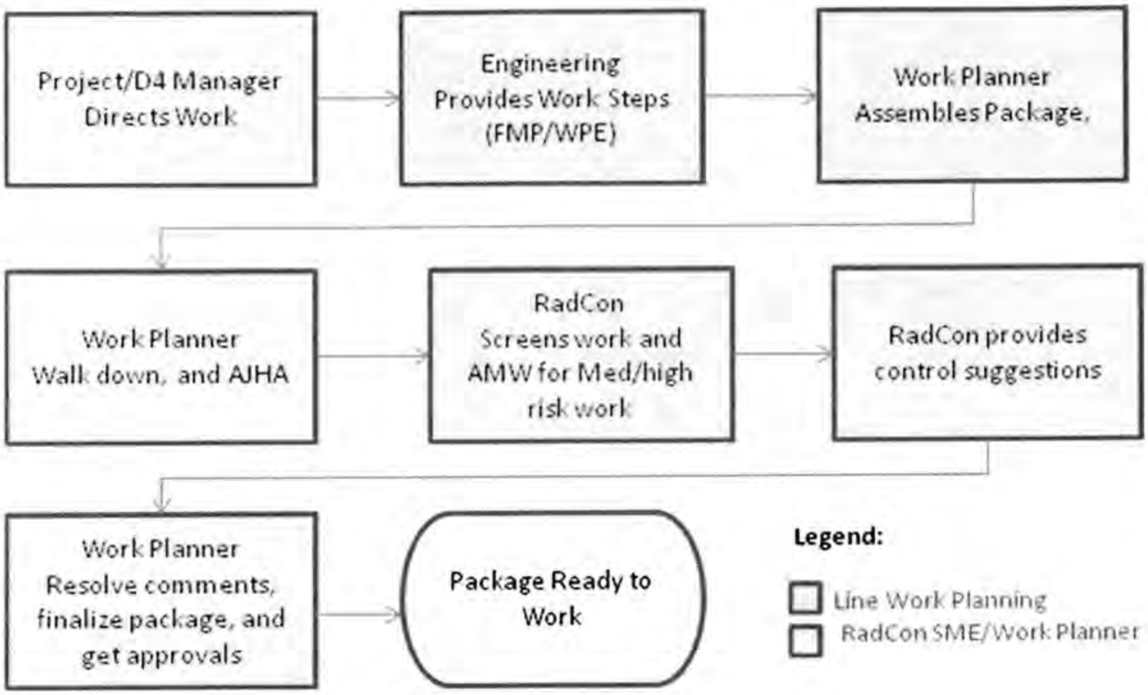

Figure 1 Simplified Work Planning Process Flow Chart

The surveillance team found multiple deficiencies in planning and execution of radiological work and some deficiencies in other technical work performed by the PFP radiation protection organization. Deficiencies in the work planning process included less than adequate involvement of radiation protection early in the work planning process and in radiation protection and some engineering work planning at the activity level. There were inadequate levels of radiological technical staffing, less than adequate training and qualification of radiological work planners, and unclear roles and responsibilities for determining radiation protection controls as implemented in the field. Additionally, the surveillance team identified some deficiencies in other technical aspects of radiation protection program at PFP. Several of the deficiencies identified in this surveillance had ties back to deficiencies in the CHPRC radiological control program.

The deficiencies in radiological work planning also demonstrated weaknesses in implementation of Integrated Safety Management Systems at PFP and CHPRC.

As a result of the deficiencies identified by RL, the contractor brought in additional radiological control staff to shore up PFP's radiological control program. The project developed a living radiological control improvement plan that was adjusted as the RL surveillance team and additional contractor radiological control staff identified more deficiencies for correction.

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The surveillance resulted in one (1) concern, twelve (12) findings and four (4) observations.

- **S-11-SED-CHPRC-PFP-002-C01:** The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.
- **S-11-SED-CHPRC-PFP-002-F01:** Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).
- **S-11-SED-CHPRC-PFP-002-F02:** Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.
- **S-11-SED-CHPRC-PFP-002-F03:** The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.
- **S-11-SED-CHPRC-PFP-002-F04:** Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.
- **S-11-SED-CHPRC-PFP-002-F05:** Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.
- **S-11-SED-CHPRC-PFP-002-F06**: PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning; The CHPRC technical basis document for workplace air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.
- **S-11-SED-CHPRC-PFP-002-F07:** The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work.
- **S-11-SED-CHPRC-PFP-002-F08:** The Hanford Combination Neutron Dosimeter (HCND) was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document; CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F09:** Technical errors were identified in five out of nineteen External Dosimetry Investigation Reports (EDIRs) (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F10:** Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

- **S-11-SED-CHPRC-PFP-002-F11:** Less than adequate conduct of operations was observed; Failures to follow procedures contributed to generation of airborne radioactivity and low level uptakes.
- **S-11-SED-CHPRC-PFP-002-F12:** Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.
- **S-11-SED-CHPRC-PFP-002-O01:** Job Specific RWPs, were written broad and generically to cover multiple work packages.
- **S-11-SED-CHPRC-002-O02:** The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.
- **S-11-SED-CHPRC-PFP-002-O03:** Poor practices identified in EDIR review.
- **S-11-SED-CHPRC-PFP-002-O04:** The use of the CHPRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors were identified.

Due to the number and significance of the deficiencies identified, the contractor will be requested to submit a corrective action plan.

Surveillance Results:

Concern: S-11-SED-CHPRC-PFP-002-C01:

The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

Discussion:

RL performed a surveillance of planning and execution of radiological work. The surveillance included interviews of personnel involved in the work planning process, observation of work planning process activities, reviews of work planning documents, procedures and work packages, and investigation of radiological events.

To adequately plan work, the hazards associated with the work must be fully understood. The radiological hazards are the sum of the hazards from the system that is being breeched, the work operation being performed, and the hazards associated with the work location.

Radiological hazards associated with the system include radionuclides present, at what concentrations, and in what chemical form. How is the system being breeched constructed? What is the material of construction, how is the interior of the system designed, what are the potentials for holdup of radioactive materials and radioactive liquids and where in the system?

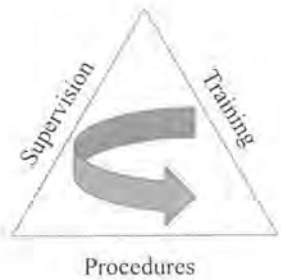
The radiological hazards associated with work operations relate to how the work operation could spread contamination or generate airborne radioactivity, and how the work operation could affect the engineered airborne radioactivity controls. As an example, a circular saw used on highly contaminated surfaces would generate high airborne radioactivity with turbulent air flow patterns. Normal ventilation is designed for laminar flow, such that it would be significantly less effective in capturing airborne radioactivity from a circular saw.

Radiological hazards associated with the work location must be adequately characterized. This should include an understanding of the history of upset conditions that resulted in spread of contamination, including the levels of radioactive contamination that could be present on exposing surfaces that were contaminated from fires and spills involving radioactive materials.

Once the hazards are understood, the radiological controls are incorporated. These controls may involve elimination or reduction of the hazard by removal of the source term or limiting the amount of source term that is accessible (e.g., decontamination, application of fixatives). These controls also involve proper selection of the work operations (substituting less turbulent work operations where needed), and implementation of engineered controls to keep the hazard away from the worker (use of glove boxes or glove bags, and appropriately engineered ventilation). After reducing the hazards through elimination or reduction of the source term, and applying engineered controls, administrative controls and personal protective equipment and clothing (PPE) are used to protect the workers.

The radiological controls are then implemented using procedures, training and supervision. The sum of the procedures, training and supervision must be adequate to ensure protection of the workers. The higher the hazard and the more complex the work, the more formal the controls are needed.

At PFP the surveillance team observed deficiencies in multiple areas of the work planning process. The radiological hazards of the work were not properly analyzed. The radiological controls for some high hazard work were less than adequate, relying on PPE in lieu of implementing engineering controls. Personnel, who were not qualified, were found making inappropriate technical decisions in the field (i.e., decisions by first line supervision) that resulted in unplanned personnel exposures to airborne radioactivity.



RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F01:

Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).

Requirements:

10 CFR 835.501(b) specifies "The degree of control shall be commensurate with existing and potential radiological hazards within the area."

10 CFR 835.501(d) specifies "Written authorizations shall be required to control entry and perform work within radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards."

10 CFR 835.1102 (b) specifies "Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, radionuclides present, and the fixed and removable surface contamination levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "…The contractor shall, in the performance of work, ensure that… (5) Before work is performed, the associated hazards are evaluated…"

Discussion:

As discussed in concern S-11-SED-CHPRC-PFP-002-C01 above, radiological work planning needs to understand the hazards associated with the system, work operations and location in order to determine appropriate controls to mitigate the hazards. Multiple examples exist where the hazards were not appropriately analyzed, resulting in airborne radioactivity generation that exceeded the applicable protection factor for the respiratory protection worn and/or spread of contamination. Contrary to the requirements of Dear 970.5223-1, analysis of hazards was less than adequate as discussed below. Contrary to the requirements of 10 CFR 835, radiological controls were not commensurate with potential hazards generated by the work activities as described below:

1. **The hazard associated with using a circular saw to cut a highly internally contaminated glove box was not analyzed, resulting in very high airborne radioactivity that exceeded the respiratory protection factor for airline respirators.**

The work in room 172 of PFP involved cutting up highly internally contaminated glove boxes for disposal. The room is referred to as the chop shop. On December 29, 2010, workers used a circular saw to cut pieces off the back (exposing internals) of Glove box 139-3/4. The airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator worn. The highest level found on the lapel was 7100 Derived Air Concentration (DAC)-hr (0.71 after taking into account the protection factor of the airline respirator). The surveillance team requested a copy of the airborne radioactivity calculations for the work operation that was performed. None was provided.

On January 25, 2011, workers again used a circular saw to size reduce a glove box. The airborne radioactivity levels "jumped". The highest DAC-hr value on workers lapel air sampler was 17000 DAC-hr, 1.7 DAC-hr after adjusting for the protection factor of the airline respirator (10,000). Assuming the jump in airborne radioactivity occurred over a five minute period (time between monitoring the air sample filter), the airborne radioactivity level generated by the circular saw was more than 200,000 DAC. This was the second time the work team used a circular saw for size reducing the glove boxes and exceeded the airborne radioactivity limits of the RWP (see OA 35012).

The surveillance team again requested the work planning documentation that would indicate the project had evaluated the airborne radioactivity hazard associated with use of the circular saw. The contractor could not provide any. The contractor facility radiological control manager acknowledged no airborne radioactivity estimate had been made.

- **Investigation revealed PFP radiological work planners routinely did not perform airborne radioactivity estimates to ensure appropriate controls were selected for the work activity.**

Interviews with the radiological work planners at PFP revealed the facility did not evaluate the potential airborne radioactivity levels for use of the circular saw on contaminated glove boxes. In fact, the radiological work planners acknowledged they had not ever performed airborne radioactivity estimates for work at PFP. The surveillance team reviewed the work planning records for several work packages confirming there were no records of the analysis of the airborne radioactivity hazards for the work reviewed.

After initially requesting the airborne calculations after the December 29, 2010 event, the PFP Director, RHS obtained documentation from another facility on how to perform airborne radioactivity estimates and provided it to the PFP radiological work planners.

A significant contributing factor to this programmatic deficiency was the lack of training and lack of procedures provided by CHPRC that would show the radiological work planner how to analyze the airborne radioactivity hazard to ensure adequate engineered controls and/or respiratory protection are provided (see findings S-11-SED-CHPRC-PFP-002-F05 and S-11-SED-CHPRC-PFP-002-F06). In this case, no respiratory protection had a protection factor high enough for the work. The analysis of the airborne hazard would have demonstrated the need to incorporate engineered controls.

- **The Radiological Hazards Screening Form indicated no airborne radioactivity above 1000 DAC (unmitigated), even though no estimate was performed**

One of the high hazard radiological work screening criteria is "Will predicted airborne radioactivity concentrations exceed 1000 DAC...." This block is marked no, even though no calculation was performed, and there were no limitations in the procedure on work operations (i.e., any power tool was OK to use) or accessible contamination levels within the glove boxes at the locations being cut. There were no bounds on the radiological conditions of the glove boxes provided to the chop shop except, less than 240 grams of plutonium (Pu). Since airborne radioactivity generation depends on the amount of accessible contamination being disturbed and the work activity disturbing the contamination, there is no technical basis for the conclusion that unmitigated DAC values would be below 1000 DAC. This lack of analysis resulted in repetitive generation of much higher levels of airborne radioactivity at the chop shop.

- **Investigation revealed the effectiveness of the point source ventilation used in the chop shop for removing airborne radioactivity during cutting with the circular saw had not been evaluated by PFP engineering.**

The surveillance team interviewed the design authority for HEPA ventilation and requested a copy of the ventilation calculations that would demonstrate the effectiveness of the spot ventilation when using a circular saw. The project could not produce the calculations and acknowledged that they had not been performed.

Interviews indicated that the ventilation engineers were primarily involved in ensuring the PFP HEPA ventilation system and air flow through the plant was not adversely impacted by changes to the system and ensuring HEPA ventilation for tents were adequate to provide appropriate air changes. Some evaluation of point source ventilation had been performed, but not where turbulent air flow patterns were involved. The engineer provided an example of an evaluation of a point source ventilation calculation with typical laminar flow. The work planning process at PFP did not ensure that engineering was adequately utilized in the work planning process. Since DOE identified this deficiency, there has been greater use of engineered ventilation and participation by engineering in its design.

- **Air monitoring in the chop shop with DAC-hr limiting conditions have kept personnel from getting a significant uptake to date, but has not been a cost effective means of performing the work due to multiple shut downs of the work for re-planning.**

To control worker exposures to airborne radioactivity, the project incorporated airborne radioactivity void limits. While this process is more of an emergency response, and has minimized the potential dose consequences to the workers to date, it does not control the generation of airborne radioactivity or prevent airborne that exceeds the respiratory protection factor of equipment worn, and creates a highly inefficient work process.

A review of the contractors work records between December 15, 2010 (the start of cutting operations in the chop shop) and March 16, 2011, indicated that work was performed in room 172 for 40 days. Out of those days of work, cutting of glove boxes occurred during 20 days. Airborne radioactivity levels exceeded the radiological work permit DAC-hr limits during 30%

(6 out of 20) of the days where glove box cutting occurred. These events resulted in stopping work operations to re-plan work.

- **Continued problems in chop shop revealed glove boxes were not adequately prepared for safe size reduction; fixatives were not adequately applied before the boxes were removed from the E-4 ventilation system and sent to the chop shop.**

After shut down of the chop shop on March 16th, work restarted April 20, 2011, with the first intrusive work performed on April 25, 2011. On that day, airborne radioactivity levels increased and personnel stopped work within a half hour. On the next day, airborne radioactivity levels exceeded the limiting conditions of the RWP. At the post job, workers revealed the glove boxes were not being provided to the chop shop in a condition that would permit safe size reduction. The glove box they were working on had bare metal inside, indicating less than adequate application of fixatives, gloves were not properly rolled up and secured (making fixative application less effective), and pie plates were improperly secured (OA 37140). A review of a sample of glove box removal work packages confirmed there were no quality assurance steps in the procedures to verify adequacy of glove box preparation for the chop shop. Additionally, the chop shop work package contained two "size reduction hand-off checklists", one for glove-box 139-5, and one for 139-6. Both check lists showed the "Contamination fixed inside/outside" block left blank, indicating the action was not completed.

2. **The high contamination hazard associated with exposing and cutting a neoprene gasket exposed to historical releases of airborne radioactivity was not recognized or analyzed resulting in four individuals receiving a low level uptake of plutonium.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. Airborne radioactivity was generated when the neoprene gasket was exposed, cut and swipe surveyed (50,000 dpm alpha). Personnel were not wearing respiratory protection.

Historical records indicated several significant spreads of contamination in room 230 and 235 from undetected glove breeches to explosions and resulting fires. Contamination levels between 2000 and 6×10^6 dpm alpha are described (FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954 – 1997)). Historical records indicated the contractors partially decontaminated the surfaces and then applied paint to fix the contamination, indicating the likelihood of uncovering contamination when exposing previously inaccessible surfaces. PFP has also experienced a greater hazard of loose surface contamination associated with gaskets. For example, on 10/22/10 open air separation of Glove box 139-1/2, exposed previously inaccessible areas and resulted in a spread of contamination when the gasket between glove boxes swung free. On 3/16/11 airborne radioactivity levels increased above the limiting conditions of the RWP for the chop shop when workers cut an area where a gasket had been removed without application of fixative (OA36431).

- **Less than adequate involvement of PFP engineering in the work planning process resulted in incorrect work instructions.**

Work instruction 2Z-09-06644/M WCN2, step 6.10.2, specified "Cut wallboard/Plexiglas panels surrounding Conveyor HC-4 in room 230C & 235B." The wall was not constructed of wallboard, but had stainless steel plates bolted in place around the Plexiglas windows with neoprene gaskets. The wall had been painted over due to the historical spreads of contamination in the area. The engineer did not provide drawings of the wall construction to the work planner, providing a missed opportunity to plan for the hazard associated with a gasket exposed to contamination being uncovered. The surveillance team requested a copy of the engineering drawing associated with the wall. The drawing identified the existence of the neoprene gasket and steel plates.

- **The AMW did not address the hazards associated with removal of a portion of the wall and Plexiglas windows.**

AMW 5549, rev 0, for work package 2Z-09-6644, dated January 26, 2011, did not address the hazards associated with removing a portion of the wall between rooms 230C and 235B The AMW only addressed breaching radioactive systems.

- **CHPRC review of the work package identified the AMW did not address each task, but did not ensure correction of the deficiency prior to releasing the work.**

During the third week of fieldwork, RL requested the contractor perform compensatory actions to shore up weaknesses in the radiological control program at PFP. One of the actions taken by CHPRC was to bring a team in to review the high risk work packages. During this review on March 6, 2011, the CHPRC task team identified the deficiency in the AMW not addressing each task, but no action was taken to correct the issue prior to releasing the work.

- **When the work team performed their workability walk down, the team determined unbolting the steel plates was easier, and safer, but did not make a change to the procedure.**

During the workability walk down prior to performing the work, the work team decided unbolting (vice cutting) the wall would be safer, but no change to the procedure was made. The field work supervisor, in consultation with the lead RCT, determined respiratory protection was not needed since they were not cutting. Unbolting the steel plates, using the wet method, was started with no airborne generation. It was not until the gasket around the Plexiglas window was disturbed that high contamination levels were found (50,000 dpm/swipe alpha), exceeding the limits in the RWP. One low level nasal smear was found, but in performing additional voluntary bioassays, a total of four individuals were found to have had low level uptakes of plutonium (56 person-mrem committed effective dose)).

Failure to obtain a procedure change was a missed opportunity to identify and analyze the hazard. The deficiencies in conduct of operation, and clearly defined roles and responsibilities are addressed in S-11-SED-CHPRC-PFP-002-F11 and S-11-SED-CHPRC-PFP-002-F03 respectively.

3. **Airborne radioactivity generation hazards for Glove box WT-4 size reduction and glove box floor removal was not adequately analyzed, resulting in high airborne radioactivity that exceeded the supplied airline respiratory protection factor.**

Glove box WT-4 is in the control room of the Americium Recovery Facility (242-Z). The work package, 2Z-10-02068, was for removal of glove boxes WT-3, WT-4, and WT-5. On April 6, 2011, airborne radioactivity was generated that exceeded the limits of the radiological work permit (OA 36771), and the respiratory protection factor for the supplied airline respirator.

The airborne radioactivity was generated during use of a crow bar to pry up and remove a polyethylene liner on the floor of the glove box (show in drawing H-2-24954). The crow bar was used to pry up flashing ("20 GA S STL") used to hold the liner in place, and then to pry up the polyethylene. During the post job, the workers indicated there were some hot spots (4-5 rem/hr) on the floor of the glove box, indicating very high levels of contamination. The airborne radioactivity hazard associated with the activity of scraping on this highly contaminated surface was not analyzed.

4. **Inadequate analysis of material compatibility results in a spill of an acidic plutonium material; additionally, a precursor event was not appropriately analyzed.**

Work package 2Z-10-0679, involved removing plutonium chemical transfer lines. These lines contained three individual lines inside a protective pipe. The packaging included insertion of a rubber plug to hold the three chemical transfer lines in place within the protective pipe. A red cap was placed over the pipe end to prevent the sharp ends of the pipe cut from damaging the packaging. The cut pipe was "horse tailed" out of the glove bag containment (poly-vinyl-chloride (PVC) sleeve) and sealed using duct tape. A reinforced bag was placed over the horse tail, and sealed with "chem" tape. Then a PVC rigid cap is placed over that and secured with "chem" tape.

The team had successfully made 17 cuts using glove bags (engineered barrier), but found some liquid (described as runny like water) in two cuts made prior to the events described herein.

On 3/30/2011, while performing post job surveys, an RCT identified 600,000 dpm/100cm^2 alpha contamination on the bottom of a packaged pipe end. Even though the contamination was found on the bottom of the pipe, where the PVC rigid cap (sealed with "chem." tape) meets the pipe, the work team did not recognize this as an indicator of a breach of the sealing system. While recovering from this event, a second cut in the system sat with the same packaging system.

On 4/6/2011, the second pipe end was flipped up to drain the pipe into the glove bag. As workers exited the area, six persons were found to have contamination on their PPE. Contamination above the limiting condition of the RWP was found on surfaces in the exit path. The full extent of the spread of contamination was not understood until a recovery team entered. A visible spill of a thick (honey like) brown plutonium substance was found. Contamination in the spill area was as high as 150,000,000 dpm/100cm^2 alpha. The floor in the area contained crevices, complicating clean-up. Disposable surfaces below the work area to protect the floor in case of a spill, were not adequately used during the job. A partial decontamination was performed and the area painted over to fix the contamination.

The work team believes the plutonium acidic material broke through the adhesive in the tape, spilling out of the sleeve onto the floor. RL requested the D&D engineer assigned to the project for the chemical compatibility information for the tape used. The information provided to RL from the manufacturer showed it was not rated for nitric acid (expected chemical form in the pipe). Discussions with the field work supervisor indicated they were not aware of any specific time limitations for satisfactory seal due to the nitric acid that was anticipated.

5. **Inadequate hazards analysis results in workers drilling into the E-3 HEPA ventilation ducting.**

On April 7, 2011, workers, installing anchors in room 235B, inadvertently drilled into the contaminated E-3 HEPA filtered ventilation duct located inside the wall. The E-3 duct is a void in the wall, thus contains no metal. The work planning was less than adequate in that drawings that show the location of the E-3 ventilation were not appropriately used in determining the location of the anchors (OA 36775).

6. **Less than adequate analysis of hazards results in airborne radioactivity release while breaking a bagged Pyrex tank**

On January 27, 2011, a Pyrex tank was removed from glove box 522. The bagged tank was too big to fit into the 55-gallon waste drum. The workers attempted to size reduce the Pyrex tank by padding the tank and hitting it with a pipe wrench. The bag holding the tank was breeched, resulting in high airborne radioactivity and continuous airborne radioactivity monitor (CAM) alarm. (OA 35484)

7. **Deficiencies in analysis of hazards extends beyond radiation protection; A potential fire was narrowly averted when a worker questioned cutting on a pipe containing plutonium contaminated combustible material**

During interviews of personnel, workers reported a near miss that occurred in January of 2011. Work package 2Z-10-07673, Separate Glove box 100C from Glove box 200 in room 235D, specified cutting a hydraulic ram that was filled with plutonium contaminated combustible waste (paper, plastic and miscellaneous step off pad waste). At the pre-job briefing a worker raised a concern regarding the potential for the heat generated by the blade during the cutting reaching temperatures that could ignite the material inside the pipe. When the concern was raised, a mock-up was performed and the mock-up demonstrated the cutting operation started a fire.

The contractor issued a lessons learned praising the workers attentiveness and questioning attitude. However, corrective actions for preventing recurrence of the inadequate hazard analysis were not identified.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F02

Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (c), specifies "The contractor shall manage and perform work in accordance with a documented Safety Management System (System)…. Documentation of the System shall describe how the contractor will: (1) Define the scope of work…."

PRC-MP-MS-003, Integrated Safety Management System/Environmental Management System Description (ISMSD), section 3.1 Define Scope of Work, third paragraph, specifies "Work identified in the [work breakdown structure] is further divided into discrete tasks that are individually planned for execution using PRC-PRO-WKM-12115, Work Management, which describes the process for initiating, authorizing, performing, and conducting field work."

PRC-PRO-WKM-12115, Work Management, section 3.2.3, Plan Work, Step 19 states "…State the precise scope of work, including the methods of performing the work…. The scope description must be detailed enough to support the development of effective and accurate hazard controls for the proposed work activity… . Work steps provide the sequence and technical information for the work team to accomplish work that was described in the scope statement. The [field work supervisor] is responsible to direct the work team in a manner that complies with the approved instructions…."

PRC-PRO-WKM-079, section 3.1 Review the work scope, states "1. REVIEW work scope to be sure it is adequately defined…. 2. IF the work scope is not adequately defined, THEN UPDATE work scope in accordance with PRO-WKM-12115 or PRC-PRO-MS-589."

Discussion:

As discussed in the concern above, analysis of hazards includes the hazards associated with the system being breached, the work operations performed, and the location of the work. To appropriately analyze the hazards of the work at the activity level, the work scope must be clearly defined. This means the individuals analyzing the hazards must know the details of how the job will be performed. As specified in PRC-PRO-WKM-12115, the work scope description must be detailed enough to support the development of effective and accurate hazards controls for the proposed work activity.

Less than adequate hazards analysis and implementation of controls is in part a result of less than adequate definition of the work scope. Contrary to the requirements above, scope of work was not always clearly defined. Examples of less than adequate definition of scope from Finding S-11-SED-CHPRC-PFP-002-F01, include:

- **Work scope definition/limitations for size reduction of Glove box 522 Pyrex tanks was not adequate, and therefore adequate controls were not established to prevent an airborne radioactivity release (OA 35484)**

Airborne radioactivity was generated 1/27/11, room 152 when workers attempted to size reduce a Pyrex tank from Glove box 522 by padding it on the outside of its containment bag, and then striking it with a pipe wrench. This work activity was not identified in the work package. The work instruction in (2Z-10-03825) in general, and section 6.4.2.4 (disconnect/removal of Pyrex tanks) in particular, did not identify a need, option, or instructions to size-reduce the Pyrex tank, to fit it into the waste container.

- **Work scope definition for removing Plexiglas windows with radioactively contaminated neoprene gaskets between PFP room 230C and 235B was not adequate.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. The procedure did not adequately define the scope of work.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F03:

The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that…(2) Clear and unambiguous lines of authority and responsibility for ensuring (ES&H) are established and maintained at all organizational levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that… (3) Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities."

Discussion:

Contrary to the requirements above, for clearly defined roles and responsibilities, these roles and responsibilities were not clearly defined in the area of who determined the radiological controls implemented for work..

The surveillance team interviewed more than 40 individuals involved in work planning, including work planners, radiological work planners, lead radiological control technicians, radiological control supervisors, field work supervisors, project managers, the safety and health manager, a radiation protection corporate mentor, and some radiation protection personnel that left PFP to work elsewhere. Additionally, the team interfaced with workers during observation of work planning processes.

Interviews revealed that there was a lot of frustration felt by both workers and managers that was a result of work planning being performed in the field, instead of being planned up front. Disagreements on the appropriate radiological controls to implement for a work activity resulted in everything from work stoppages, to implementation of inadequate controls.

- **Work packages were built with "flexibility", so the procedure would not tie the work team down as to how the work was performed; Radiological controls were "flexible" to accommodate decisions on how to do the work in the field.**

The work team and management expressed the desire for flexibility in how the work was performed, letting this be "skilled based". Consequently, the radiological work planners specified "flexible" radiological controls in the work packages. This resulted in management abdication of their responsibility for hazards assessment and controls.

Some examples include generic instructions such as:

Chop shop: 2Z-10-05648, room 172 size reduction operations, 6.2.5 "Perform size reduction activities using power tools (i.e., nibbler, sawzall, circular saw, bandsaw) on hood/glove box/ducting…. Move point source ventilation as needed for contamination control during cutting…. Implement contamination control, as needed, using hand held fogging unit…."

2Z-09-3291, Rm 139 Glove Box Removal, section 4.6 "Use wet methods, sleeving and/or HEPA filtered spot ventilation to control contamination, as necessary."

Work package 2Z-10-2115/M, 4.6.4 included the following, "Wet towels, HEPA vacuum, Glove bags/sleeving and or catch bags shall be used as the main engineering controls during the task as necessary."

When RL debriefed the contractor on preliminary findings, RL requested CHPRC to implement compensatory actions to shore up the radiation protection organization at PFP. One of the compensatory actions was to review high risk work packages for adequacy of radiological controls.

- **Roles and Responsibilities for the FWSs, lead RCTs, and other craft work team members are not intended to include radiological hazards analysis; Radiological training programs for these individuals did not include this qualification.**

The absence of specific radiological hazard controls in work instructions/packages resulted in radiological hazard control decisions being done by the field work team. These individuals were not technically qualified to analyze radiological hazards.

While the field work supervisors and lead RCTs have extensive experience in their roles, the surveillance team review of the FWS and RCT training revealed it was less than adequate to qualify them for radiological hazards analysis and control. The FWS training and qualification in radiological subject areas was limited to Radiological Worker II training. Radiological Worker II did not provide qualification on radiological hazard analysis and control selection. The surveillance team reviewed the RCT training, which is based on the DOE training standards. While the level of training exceeds radiological worker II training, RCT training objectives were not intended or designed to provide qualification on radiological hazards analysis and selection of engineered controls for work. The surveillance team also found that the training for lead RCTs did not include additional hazard analysis and control topics. The training reviewed for FWSs and RCTs did not include appropriate education, training, and skills to discharge these responsibilities, specifically the radiological hazard analysis and selection of engineered controls.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F04

Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.

Requirements:

10 CFR 835.1001 Design and control, (a) specifies "Measures shall be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative controls. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure."

10 CFR 835.1002 Facility design and modifications, (c) specifies "Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used."

10 CFR 835.1003 Workplace controls specifies "During routine operations, the combination of engineered and administrative controls shall provide that…(b) The ALARA process is utilized for personnel exposures to ionizing radiation."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "…The contractor shall, in the performance of work, ensure that…(6) Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures.

Discussion:

Engineering controls are required to be the first line of defense against airborne radioactivity and spread of contamination. Some work teams have appropriately performed work activities using glove bags and glove boxes, to keep the worker from being exposed to the source of contamination.

Contrary to the requirements of 10 CFR 835, engineering controls were not adequately incorporated for some work projects. Examples of poor use of engineering controls include:

- **Less than adequate use of engineering controls at the chop shop**

Work in the chop shop directly exposes personnel to high contamination levels inside glove boxes that are not designed for human entry. The chop shop and the work performed there was not properly designed up front with adequate engineering controls. As a result, airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator multiple times, and the project continually struggled with back fitting radiological controls. The facility did not use the glove box itself and facility ventilation system (E-4) to adequately reduce the hazards prior to disconnection from the E-4 system and transporting the glove boxes to the chop shop, nor designed the chop shop facility for size reducing the glove boxes inside an engineered barrier (glove box or engineered ventilation hood).

- **Less than adequate use of engineered ventilation in general; less than adequate involvement of engineering in the design of spot ventilation.**

Engineered ventilation was not always used. An example included scraping of the polyethylene liner with high dose rates, indicative of high contamination, at the bottom of glove box WT-4 without engineered spot ventilation (see Finding S-11-SED-CHPRC-PFP-002-F01).

Spot ventilation being used at the facility was not always being adequately designed to meet its intended use. Elephant trunks and HEPA filtered vacuums cleaners had been used, but were not always adequate. Examples include the use of an elephant trunk for engineered ventilation while cutting a glove box with a circular saw (see Finding S-11-SED-CHPRC-PFP-002-F01).

As the RL surveillance progressed, more involvement of the ventilation engineer in spot source ventilation design was observed. A corporate mentor had previously brought up the need for PFP to use a "B-box", a spot ventilation used at Rocky Flats. Facility action was not observed by the surveillance team until compensatory actions to shore up the radiological controls at PFP were implemented by the contractor.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F05:

Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.

Requirements:

10 CFR 835.103 Education, Training and Skills, specifies "Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this part shall have the appropriate education, training, and skills to discharge these responsibilities."

(b)(5)

identify positions that develop and implement measures necessary to comply with 10 CFR 835. At a minimum, this includes those individuals filling the following positions…. Facility/Project Rad Con technical staff…."

Discussion:

Training and qualification of radiological work planners did not ensure that individuals, who were determining and implementing radiological controls, were appropriately trained and qualified to perform applied radiological hazards analysis. Although these individuals met the educational requirements of CRD 5480.20A and DOE-STD-1107-97, contrary to 10 CFR 835.103, the CHPRC training did not ensure the individuals had all the skills necessary to discharge their assigned responsibilities in the area of applied hazards analysis.

- **The Radiological Control Work Planning training course did not adequately address applied hazards analysis.**

Course number 022801, Planning Radiological Work – Initial, section F, Purpose and Overview, specifies "This course does not attempt to teach radiological work planning…." The course does not teach how to plan work, nor does it provide instruction on how to perform applied hazard analysis.

Some radiological work planners were RCTs that were promoted to work planners. The RCT qualification program also does not teach personnel applied radiological hazards analysis. There was no documented training or demonstration of knowledge on how to perform applied hazard analysis prior to assignment as a radiological work planner.

The primary emphasis of the course 022801 is to teach the radiological work planners how to fill out the radiological hazards screening and ALARA Management Worksheet forms to support the work management process. The course contains general discussion on factors affecting radiological hazards, but does not adequately cover practical application of hazards analysis and selection of controls.

- **Radiological work planner training did not demonstrate how to perform airborne radioactivity estimates based on contamination levels, work operations, and application of airborne radioactivity controls.**

A review of radiological work planning training documents and interviews found that the training did not provide adequate instruction on how to predict airborne concentrations. The training materials directed the trainee to use the facility Technical Evaluation (TE) to predict airborne concentration. The PFP TE did not contain guidance on how to estimate airborne concentrations. The training material did not demonstrate how to perform these airborne radioactivity calculations.

- **Selection of appropriate respiratory protection requires the ability to calculate airborne estimates**.

The radiological work planning course does not show the work planner how to select respiratory protection based on estimated airborne radioactivity levels.

- **Radiological work planning training did not adequately cover limitations of HEPA filtered ventilation as an engineered control.**

Interviews found that staff did not understand the limitations of ventilation as an engineered control. Personnel did not demonstrate understanding that ventilation is typically designed for laminar flow. Ventilation is significantly less effective when generating turbulent air flow patterns, such as those created with a circular saw. This is important to understand, so that radiological work planners do not specify ineffective controls.

The radiological work planner training course did not cover the technical aspects of engineered ventilation or the need to engage engineering in its design.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F06:

PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning; The CHPRC technical basis document for workplace

air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.

Requirements:

10 CFR 835.104 Written Procedures specifies, "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

Discussion:

The surveillance team reviewed the CHPRC and PFP list of procedures on line and technical basis documents. PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning. The CHPRC had a technical basis document for workplace air monitoring. This technical basis document included formulas to determine if air sampling is required. The technical basis document did not specifically address estimating airborne radioactivity levels for hazards analysis and work planning. Contrary to the requirements of 10CFR835.104, CHPRC did not have adequate procedures for airborne radioactivity estimates for hazards analysis and work planning, consistent with the education, training and skills of the individuals performing the hazards analysis.

Airborne radioactivity estimates were needed to complete the Radiological Work Screening process (PRC-PRO-RP-40108, "Radiological Hazard Screening," and Site form A-6004-654). Some CHPRC projects and other Hanford Site contractors had procedures for performing airborne radioactivity calculations for hazards analysis and work planning. After the deficiency in performing airborne radioactivity calculations was identified by RL, PFP obtained another CHPRC project's methodology for performing airborne radioactivity calculations to develop their own instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F07

The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work

Requirements:

CRD O 5480.19 Chg 2 (Supp Rev 4) Conduct of Operations Requirements for DOE Facilities Chapter I, Operations Organization Administration: C. Guidelines; (2) Resources: specifies "The operations supervisor for DOE facilities should be provided with sufficient... personnel to accomplish assigned tasks without requiring excessive overtime by the operations staff. These resources should include technical personnel needed to support the operations. A long-range staffing plan that anticipates personnel losses should be developed and implemented."

Discussion:

In decontamination and decommissioning of a facility, an increased level of radiological risk and potential for rapidly changing conditions are expected. Multiple systems are being breached, facility engineered controls are being deactivated, etc. Planning for appropriate additional staff is critical to effectively handle the increased work and continual changes in facility conditions.

Contrary to the requirements above, the contractor did not ensure adequate radiological staffing resources at PFP.

- **PFP experienced the loss of the facility RadCon Manager, a key position, in June 2010 and did not permanently replace the manager until March 7, 2011.**

The lack of priority and urgency in filling this key position for a high risk and accelerated project demonstrated less than adequate planning and response to key personnel losses. The high risk and accelerated nature of PFP work should have driven a more expedient permanent replacement for this key role. For approximately 8 months, the project did not have a permanent RadCon Manager.

PFP assigned personnel as temporary radiological control managers. The RHS Director intermittently acted as RadCon manager. However, the RHS Director's other duties combined with the RadCon organization's span of control, made this approach less than adequate. For 5 months (August through December), the facility had a central RadCon staff member acting in a temporary capacity. After the central RadCon staff member went back to the central organization, the radiological control manager position was rotated among the radiological control supervisors. Experience shows personnel in a temporary position are not as effective because staff know they are temporary.

- **There was insufficient radiological technical staff to adequately manage the work planning process.**

The radiological work planner and engineers needs to be an integral part of the work planning team. They need to be there at the start of the work planning, providing input into how the work is performed from a risk assessment perspective. If the work operations are not clearly defined during the planning, hazards assessments may not be accurate, as was observed during the surveillance for some work activities. This contributed to the adverse outcomes realized during work (e.g. RWP voids, high airborne generation, contamination spreads, and radiological uptakes).

At the start of this surveillance, the project had three radiological work planners. This resource level was not adequate to support work planning based on the level of hazards in the facility and the pace of work at PFP. Based on organizational chart reviews and interviews, the three radiological work planners supported approximately twenty-six line work planners.

- **Insufficient numbers of radiological work planners did not permit adequate engagement of the work planner during performance of work.**

The radiological work planners need to be engaged during performance of the work. Field presence by radiological technical support and work planners helps to validate and ensure that radiological controls are implemented as intended. As the level of flexibility in work operations and changing conditions increase, field observations provide for early recognition and correction of potential inadequacies in engineered controls. The shortage of radiological work planners resulted in their limited field presence. Lack of observation of the implementation of controls in the field represents a program weakness and a missed feedback opportunity.

In response to the RL surveillance, the contractor added a radiological engineering manager and additional radiological work planners at PFP.

- **PFP had insufficient numbers of first line radiological control supervisors (RCS) to effectively support radiological work.**

A review of the PFP organizational chart and interviews with the PFP RCS found that approximately 102 RCTs were supervised by five RCS. Interviews indicated the following: One of these RCS had double duty as PFP's acting radiological control manager. One of the RCS was assigned Duty RCS for making personnel assignments, responding to emergencies, and completing other administrative duties. Additionally, the RCSs review completed radiological surveys. As a result, only two RCS were typically available to oversee the ongoing work. The ratio of RCTs to RCS was very high considering the level of radiological hazard associated with the work at PFP.

Since RL identified the overall weaknesses in radiological staffing at PFP, the contractor has increased the number of RCS.

- **Fifty percent of the RCTs at PFP were junior**

Interviews with personnel indicated fifty percent of the RCTs at PFP were junior, meaning they were not qualified to work alone on high risk work activities and required more oversight by the lead RCTs on the work team.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F08:

The HCND was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document; CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).

Requirements:

10 CFR 835, Subpart E-Monitoring of Individuals and Areas, Article 835.401(b) Instruments and equipment used for monitoring shall be... (2) Appropriate for the type(s), levels, and energies of the radiation(s) encountered..."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section F External Dosimetry, paragraph 3, specifies "The contractor shall participate in the development and maintenance of a Hanford site-wide external dosimetry basis document. The contractor's external dosimetry program shall be performed in accordance with this technical basis document."

PNNL-15750 Rev. 1, PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, section 6.3, Selection of Dosimeter Types to Use, specifies "Individuals who are likely to receive Hp(10)n greater than 100 mrem per year should be issued a HCND, which provides a more accurate measurement of neutron dose. In addition, individuals who routinely have Hp(10)n greater than 100 mrem per year reported on an [Hanford Standard Dosimeter (HSD)] should be issued a HCND."

Discussion:

The surveillance team reviewed the CHPRC deficiency reports for PFP. Multiple deficiency reports identified issues with neutron dose over-response from personnel wearing the HSD at PFP that required modifications to personnel dose of record. RL investigated the issue and found it to be programmatic at CHPRC.

Contrary to 10 CFR 835.401(b), some individuals that met the regulatory criteria for monitoring, a dose of 100 mrem in a year, were assigned a HSD, in lieu of the HCND. The HSD is not appropriate for monitoring neutrons with the range of energy levels of neutrons at PFP.

The HSD can measure neutron, and is Department of Energy Laboratory Accreditation Program (DOELAP) accredited based on its response to a bare californium neutron source (fast neutron). The HSD over-responds to a moderated neutron flux. Depending on the neutron energy where the individual was exposed, correction factors between 2 and 5 were used. At PFP, the energy levels of the neutrons vary depending on location. The HCND is a neutron dosimeter which has multiple thermoluminescent dosimeters (TLDs) inside that respond to different neutron energy levels and thus more accurately measure neutron dose, but costs more.

CHPRC reduced the numbers of personnel monitored with HCND to reduce costs. The HSD costs $45.00 to process, while the HCND costs $68.00 to process (data from DOE Dosimetry point of contact). This cost is less than the contractor's estimated man-hours costs taken to investigate and correct the neutron dose.

In the process of reducing the number of personnel assigned a HCND, individuals who should have been wearing the combination neutron dosimeter were not appropriately monitored in accordance with 10 CFR 835.401(b) and the Hanford External Dosimetry Technical Basis.

In 2010, CHPRC processed 119 EDIRs to correct the neutron reading from a HSD. Many more individual dose records were reviewed for high neutron doses, where doses indicated personnel should have been assigned a HCND, but were not, and the project decided not to make a change in the individual's dose of record.

Contrary to the requirements of DOE/RL-2002-12, the CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual. A review of the CHPRC External Dosimetry Program, PRC-PRO-RP-379, revealed the document is inconsistent with the Hanford External Dosimetry Technical Basis Document. While PNL-MA-842 specifies personnel who routinely have neutron dose, as reported on an HSD, should be issued a HCND, CHPRC has not implemented this in their External Dosimetry Program. PRC-PRO-RP-379, section 3.15, step 5, only specifies to change the dosimeter from a HSD to a HCND if the corrected neutron dose (vice reported dose) is greater than 100 mrem.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F09

Technical errors were identified in five out of nineteen EDIRs.

Requirements:

PRC-PRO-RP-379, External Dosimetry Program, section 3.15, Neutron Correction to HSD Measurements, step 2 specifies "IF calendar year-to-date (CTD) uncorrected neutron exposure is [greater than or equal to] 100 mrem, THEN correct readings using the following correction factors: PFP = 2, ISA = 5, Others = 3." "Note: Justification is required in the project's technical equivalent document if there is a deviation from the given correction factors per project." Step 3 specifies "IF corrected exposure is ≥ 100 mrem or if record correction is desired, THEN NOTIFY DO AND REQUEST an EDIR number, AND COMPLETE AND SUBMIT [EDIR] to correct the recorded dose."

10 CFR 830.122 Quality Assurance Criteria (c) specifies "Criterion 3 Management/Quality Improvement (1) Establish and implement processes to detect and prevent quality problems. (2) Identify, control, and correct items, services, and processes that do not meet established requirements. (3) Identify causes of problems and work to prevent recurrence as a part of correcting the problem. (4) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section J, Radiological Records, paragraph 2, specifies "The contractor shall ensure that permanent radiological records are accurate…."

Discussion:

The surveillance team reviewed 19 out of 119 EDIR that involved adjusting neutron doses from the HSD readings. Contrary to the requirements of DOE/RL-2002-12, technical errors (math errors, wrong radiation type, zeroing dose without adequate technical justification) were identified in five out of 19 (26 percent) of the EDIRs. There were other potential issues in 4 other EDIRs. The following technical errors were identified:

- **Several EDIRs contained math errors.**

EDIR-10-223 divided 20 mrem neutron by a correction factor of 3, and specified the corrected dose as 3 mrem neutron (20 divided by 3 is 6.67, or rounded to the nearest mrem is 7 mrem, not 3 mrem). EDIR-10-077 took 60 mrem neutron divided by a correction factor of 3 and said the resulting dose was 17 mrem neutron. EDIR-10-179 erroneously added the gamma dose to the neutron dose when correcting the neutron dose (520 neutron +53 gamma = 573; 573 divided by 2 = 287). The corrected neutron dose should have been 520 divided by 2 = 260 mrem neutron.

- **One workers dose was corrected twice, but the dose was assigned as neutron vice gamma.**

EDIR-10-060 information from the facility did not specify the type of radiation, nor was a radiation survey record attached. The worker had been taking photographs in PFP A-labs, for a total of 2 hours, and lost his HSD. The EDIR specified general radiation levels in A labs as 0.5 mrem/hr, but did not specify whether that was gamma radiation vice neutron. PFP general area radiation levels are both gamma and neutron in most places, and 0.5 mrem/hr is the typical minimum detectable activity (MDA) of the gamma dose reading instrument. The 0.5 mrem/hr dose rate was likely a gamma reading based on the location, A-Labs. The EDIR should have contained both gamma and neutron dose rates for preparation of the dose estimate. The first time the dose was corrected, a math error was made, 2 hrs times 0.5 mrem per hr, was recorded as 2 mrem neutron. The contractor caught the math error and changed the dose to 1 mrem neutron, but did not catch the error of no radiation type being specified by the facility providing the dose rate data.

- **A neutron dose record indicating 31 mrem neutron was changed to zero (see EDIR-10-176).**

The 31 mrem recorded neutron was corrected by dividing by 3 (10 mrem neutron), but then recorded as zero, without appropriate technical justification. Discussions with PNNL dosimetry program technical personnel indicated recording this corrected neutron dose as zero was not consistent with the Hanford external dosimetry technical basis manual.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F10:

Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all

occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

Requirements:

10 CFR 835.403 Air monitoring, specifies "(a) Monitoring of airborne radioactivity shall be performed (1) Where an individual is likely to receive an exposure of 40 or more [Derived-Air Concentration (DAC)]-hours in a year…." Monitoring per the definition in 10 CFR 835, includes analysis of the data.

10 CFR 835.402 (c) specifies "For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs (including routine bioassay programs) shall be conducted for: (1) radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year…."

Discussion:

Contrary to the requirements above, airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

The surveillance team reviewed four (4) quarterly PFP workplace Air Monitoring Tracking and Trending Reports (Calendar year 2010). This review was performed in response to an earlier discovery of the tracking and trending not being performed (OA 33986) and an employee concern at PFP over the sporadic elevations of airborne radioactivity in the plant.

- **PFP Closure Project Workplace Air Monitoring Tracking and Trending reports identify locations with unexplained elevated airborne radioactivity above one DAC-hr.**

The surveillance team verified that Workplace Air Monitoring Tracking and Trending Reports have identified areas with sporadic unexplained elevated airborne radioactivity. As an example, the Third quarter 2010 PFP Closure Project Workplace Air Monitoring Tracking and Trending Report identified six (6) areas with greater than 1 DAC-hr airborne radioactivity. The third quarter 2010 report did not provide any actions taken to ensure unmonitored personnel receive less than 40 DAC-hr (100 mrem internal dose) in a year, or actions taken monitor exposed individuals through bioassay or a DAC-hr tracking program.

- **The third and fourth quarter reports did not contain any trending data for locations with elevated airborne radioactivity.**

Review of the Third and Fourth Air Monitoring Tracking and Trending Reports confirmed they did not include any trending data for the locations with elevated airborne radioactivity.

Interviews with radiological control technical staff indicated the staffing shortages were a major contributor to the task not being completed.

After RL expressed concern over the shortage of radiological technical staff at PFP, CHPRC added staffing to shore up the radiological control program. An individual with expertise in airborne radioactivity monitoring programs performed a trending analysis for data from March, 2010 through March 2011 to complete the missing analyses.

- **The PFP administrative trigger level for investigating elevated airborne radioactivity was 1 DAC-hr in a week (50 DAC-hr per year for a 50 week work year), which was inconsistent with 40 DAC-hr in a year regulatory requirement.**

A fixed head air monitor draws airborne radioactivity into it and collects the contamination on a filter. When the filter is counted, the contamination is a direct measure of DAC-hr. The airborne radioactivity could have occurred in a short period of time as a result of a work activity, or be the collection of ambient low level airborne radioactivity. Assuming the airborne radioactivity actually occurs when people are in the area as a result of their activities, 40 DAC-hr per year would be 0.8 DAC-hr per week (for 50 work weeks in a year). It is unclear why the facility has used a higher trigger for investigation than that which ensures compliance with 10 CFR 835.

- **Airborne radioactivity area (ARA) posting at PFP goes up and down daily, it is not clear how the air monitoring program verifies personnel not in respiratory protection receive less than 100 mrem internal dose (40 DAC-hr) in a year when these areas are not posted ARA**.

Interviews with the radiological control technical staff and reviews of the quarterly workplace air monitoring tracking and trending reports revealed the fixed head air monitors run both during the period when the area is not a posted airborne radioactivity area and during airborne radioactivity work. When high fixed head airborne radioactivity levels are reported, the radiological technical staff indicated they sent an e-mail to the radiological control supervisors to determine what work went on in the area. If airborne radioactivity work occurred, this is identified in the report. It is unclear how this process ensures personnel who are not monitored for internal exposure and are not wearing respiratory protection, do not exceed 100 mrem internal dose in a year.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F11:

Less than adequate conduct of operations was observed; Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.

Requirements:

10 CFR 830.122 Quality assurance criteria, (e) Criterion 5 Performance/work processes (1) specifies "Perform work consistent with technical standards, administrative controls and other

hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means."

DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities, Chapter XVI Operations Procedures, B. Discussion, specifies "...operations procedures should be sufficiently detailed to perform the required functions without direct supervision.... Operators should not be expected to compensate for shortcomings in such procedures... C. Guidelines ...7. Procedure Use,... Facility operation should be conducted in accordance with applicable procedures... If procedures are deficient, a procedure change should be initiated...."

Discussion:

The surveillance team observed post job reviews and critiques. A contributing factor to events was poor conduct of operations. Contrary to the requirements above, the following are examples of personnel not following appropriate requirements for use of procedures:

- **Less than adequate conduct of operations contributed to personnel receiving low level uptakes during removal of a Plexiglas window between PFP rooms 230C and 235B.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, the work team identified the wall surrounding the Plexiglas windows was made of stainless steel sheets bolted in place. The team decided to unbolt the stainless steel plates in lieu of cutting as identified in the procedure. Because of the perceived safer condition, the FWS and lead RCT decided respiratory protection was not needed. The work team did not make an appropriate change to the work package prior to performing the work. An unanalyzed hazard associated with contamination on the gasket around the Plexiglas window resulted in four low level uptakes.

- **Personnel observed not following controls established in the procedure contributed to generation of airborne radioactivity above the respiratory protection factor of the airline respirator at the chop shop.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, airborne radioactivity levels during work in chop shop repetitively exceeded respiratory protection factors of the airline respirator. The facility modified the chop shop work package to add additional radiological work instructions on March 10, 2011. When the chop shop work team commenced work on March 16, 2011, the corporate radiological control mentor identified workers had not implemented several of the radiological control requirements in the procedure. Airborne radioactivity levels exceeded the RWP limits for airborne radioactivity and work was stopped.

- **Personnel did not stop when Pyrex tank did not fit into 55 gallon drum. Unplanned work resulted in airborne radioactivity and spread of contamination (OA 35484).**

The work instruction (2Z-10-03825), for preparation of glove box 522 for removal, did not identify a need, option, or instruction to size reduce a Pyrex tank in the glove box. The Pyrex tank was sleeved out of the glove box, but did not fit into the 55 gallon drum staged for its disposal. When personnel in the field concluded the tank should be size reduced they did not recognize work instructions and controls should have been specified and approved prior to performing the actions they did to size reduce the tank. While attempting to break the Pyrex tank with a pipe wrench, a release of airborne radioactivity occurred when the sleeving around the tank was breeched.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F12

Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.

Requirements:

10 CFR 830.122(c)(1) Establish and implement processes to detect and prevent quality problems.

Form A-6004-634 specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

Discussion:

The AMW documents the radiological considerations, analysis and controls to be incorporated for high and medium risk radiological work. Contrary to the requirements in Form A-6004-634, documentation on the AMW Part II, Radiological Protective Measures/Considerations was not consistently completed per the form's instructions. The AMW form specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

The surveillance team reviewed 7 released complete work packages supplied by PFP; the AMWs associated with these work packages did not fully follow the previously stated instruction. The surveillance team found sections on each AMW where the radiological work planner checked, "Incorporate into work instruction," without any text being bolded for inclusion. Failure to follow the forms instructions, e.g. lack of bold text, potentially contributed to the less than adequate inclusion of intended controls in work instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O01:

Job Specific RWPs were written broad and generically to cover multiple work packages.

Discussion:

As part of the PFP work planning surveillance, the team noted that RWPs were written to cover multiple work packages and were broad and general in nature. An example of this is RWP Z-005, "Perform Glove box Work Activities (As per Listed Work Procedures), Handling/Movement of Radioactive Material, Low Level Waste Handling & Disposal and Minor Decontamination." This RWP had been revised 72 times, covered 6 PFP procedures and 28 work packages.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-002-O02:

The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.

Discussion:

During the surveillance, there were a lot of concerns expressed by workers on the use of plutonium levels for determining when beryllium monitoring was required. The workers expressed concern over the accuracy of the technical basis for the policy and on lack of follow through by facility management in performing beryllium characterization.

During review of FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954-1997), the surveillance team noted on page 20 of the report that a spread of contamination from a plutonium-beryllium source occurred in 1981 in room 236. This source of beryllium was not evaluated by the facility in the development of their beryllium monitoring program.

The additional technical staff brought into PFP had an additional benefit of supporting resolution of worker concerns in the beryllium monitoring program. When the additional source of beryllium contamination was identified by RL, the additional staff reviewed its potential impact on the PFP beryllium monitoring program.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O03:

Poor practices identified in EDIR review.

Discussion:

The following additional poor practices were observed:

- **Poor resolution to a technical issue.**

EDIR-10-077 indicated a technical issue existed with the type of direct reading dosimeters (DRD) used at WRAP. The EDIR specified the cause of "ACES report indicated that estimated dose recorded was grossly underreported for [DRD]", was "DRD do not detect neutron radiation and electronic dosimeters can under respond to lower energy spectra." The resolution states: "Return to monthly dosimeter issuance." This resolution does not address the technical shortfall of the equipment. Therefore, the response was less than adequate. 10 CFR 835 requires monitoring be performed with equipment appropriate for the type and energy of radiation encountered.

- **Gross inconsistencies in whose neutron dose from the HSD gets corrected in the individuals record.**

There were gross inconsistencies in whose neutron dose from the HSD got corrected in the individuals record and whose did not. Examples include: A neutron dose correction of 1 mrem was made in one EDIR, a dose of 31 was zeroed in another, and a HDS dose of 199 mrem (99.5 mrem with PFP correction factor applied), was not corrected at all.

- **Rounding is inconsistent.**

Some EDIRs truncated the fraction of a mrem, while others used normal rounding practices. Had the 99.5 mrem corrected value from the example above used normal rounding practices, the corrected dose would be 100 mrem and the CHPRC procedure would require dose correction.

- **Technical justification for use of inconsistent neutron correction factors for ISA pad work was not documented in the EDIR.**

All 4 EDIR reports for individuals working at ISA (correction factor 5) pad that the surveillance team reviewed had neutron dose and no gamma dose. Two individuals had some entries into CSB also. The correction factor applied to those individuals was 3. There was no documentation that indicated why the facility chose to use the 3 over the 5. The correction factor of 3 resulted in a conservative higher dose in the record.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O04:

The use of the PRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors are identified

Discussion:

As part of the PFP work planning process surveillance, the team observed PFP investigate upset conditions and events using the ALARA post-job review as a fact finding tool. By design, the ALARA post-job review did not provide sufficient fact finding guidance to discover the event details needed to identify failure points and prevent recurrence. The site form (site form A-6004-821) provided questions geared toward evaluating causes not gathering factual details. The contractor should provide a more appropriate and effective process for gathering and identifying facts related to upset conditions.

RL Lead Assessor Closure Required: **YES[ ] NO [X]**

Contractor Self-Assessment:

The surveillance team reviewed the contractor's self-assessments and corrective action data base for PFP deficiencies for June, 2010 through April, 2011.

Issues with radiological work control planning and implementation have been previously identified by the CHPRC. On July 13, 2010, CHPRC identified within a conditional report (CR) three Stop Works at PFP related to Procedure Compliance, Entry Requirements and RWP Violations. These formal Stop Works were recorded in CR-2010-2201 to document issues with scope creep, procedure compliance, hazards and controls, pre- job briefs, and duct level entry requirements. As a result of the evaluation of the Stop Work issues, this CR was screened as adverse.

Analysis contained within CR-2010-2201 revealed that multiple issues throughout most aspects of work performance had risen to a level that workers felt the need to implement the formal Stop Work process in order to see that they were adequately addressed. Ten corrective actions were established to resolve these issues.

On October 22, 2010, CR-2010-3327, Contamination Spread in Multiple Rooms during Glove Box Separation Activities, was initiated due to contamination spread during glove box separation activities in room 139 of A Labs. Analysis of this event determined that the work controls were not adequate to handle the potential levels of contamination in areas inaccessible for survey and the configuration of the glove box was such that engineered barriers were considered impractical. Two work control corrective actions were identified in response to this event.

However, the number of radiological work planning events and deficiencies identified during this surveillance, indicates the corrective actions associated with the above issues were not sufficiently effective. This assessment of PFP's radiological work planning corrective action effectiveness aligns with RL's overall evaluation of CHPRC's corrective action management performance (See letter CHPRC-1100939, Integrated Corrective Action Plan).

Contractor Self-Assessment Adequate: **YES [ ]** **NO [X]**

Management Debriefed:

David Del Vecchio, CHPRC
Terry Vaughn, CHPRC
Curtis Bean, CHPRC
Tom Bratvold, CHPRC

Department of Energy
Richland Operations Office (RL)
Surveillance Report

Division: Safety and Engineering Division (SED)

Surveillance Team: Brenda Pangborn (lead), Joe DeMers, Wayne Glines, Rick Jansons, Ed MacAlister, Ed Parsons, Kerry Schierman, Sandra Trine

Surveillance Number: S-11-SED-CHPRC-PFP-002

Date Completed: April 29, 2011

Contractor: CH2MHILL Plateau Remediation Company (CHPRC)

Facility: Plutonium Finishing Plant (PFP)

Title: Radiological Work Planning

Guide: 10 CFR 835

Surveillance Scope:

The objective of this surveillance was to evaluate the adequacy of radiological work planning at PFP. This was a process audit (oversight of the work planning process) that included review of the development of radiological work packages, identification, analysis and control of radiological work hazards, review of work planning resources, and review of radiological deficiencies resulting from less than adequate work planning and the associated corrective actions management. This surveillance also included investigation of specific radiological deficiencies anonymously sent to RL.

Surveillance Summary:

The surveillance team reviewed documents that included, among others:

- Contractor work planning documents, (b)(5)
  (b)(5)
- Training course materials for both radiological work planners and the line work planners,
- Radiological control procedures and technical basis documents.

- Radiological performance indicators including contractor self assessments, contractor corrective action reports, and RL operational awareness (OA) reports for activities at PFP,
- Historical documents of the PFP, including the Radiological History of the Plutonium Finishing Plant (1954-1997) that described radiological upsets in the facility (dates, locations and contamination values),
- Work packages and associated radiological screening forms, As-Low-As-Reasonably-Achievable (ALARA) Management Worksheets (AMW), and radiological work permits (RWP).

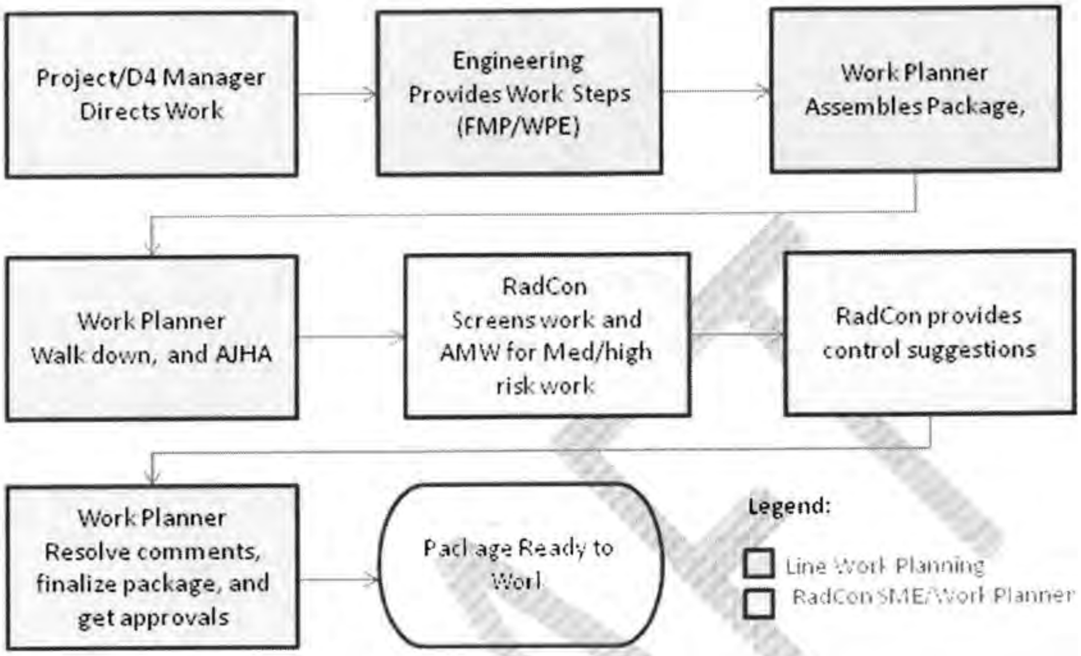
The surveillance team interviewed more than forty (40) personnel involved in the work planning process and execution of work in the field, including:

- Three (3) radiological work planners,
- Eight (8) line work planners,
- Four (4) field work supervisors (FWS),
- Four (4) superintendants,
- Three (3) project managers,
- Two (2) Integration Planners,
- Four (4) radiological control supervisors (RCS),
- Eight (8) lead radiological control technicians (lead RCT),
- One (1) Director of Radiation Protection, Industrial Hygiene, and Occupational Safety (RHS),
- One (1) Director of Environment Safety and Health for CHPRC,
- Two (2) former PFP radiological Control Managers (RCM),
- One (1) Radiological controls mentor, and
- Three (3) engineers or engineering managers, including the Design Authority for High Efficiency Particulate Air (HEPA) filtered ventilation

The surveillance team observed the following work planning processes:

- Walk downs of the work area including, scoping walk downs, workability walk downs, and Automated Job Hazard Analysis (AJHA) walk downs,
- Preliminary planning meetings (prior to AJHA meetings),
- AJHA meetings,
- Work Planner schedule status meeting,
- Plan of the Day (POD) meetings,
- Pre-job meetings,
- Post-job meetings,
- Critiques, and
- Observations of work activities (e.g., Chop shop, 242Z…)

The surveillance team performed a process audit, looking at the PFP process for planning work. From a review of the contractor procedures, and interviews of personnel, the basic simplified flow chart of the work planning process used at PFP is shown below:



The surveillance team found multiple deficiencies in the work planning and other technical work performed by the PFP radiation protection organization. Deficiencies in the work planning process included less than adequate involvement of radiation protection early in the work planning process and for work planning at the activity level. There were inadequate levels of radiological technical staffing, less than adequate training and qualification of radiological work planners, and unclear roles and responsibilities for determining radiation protection controls as implemented in the field. Additionally, the surveillance team identified deficiencies in other technical aspects of radiation protection program at PFP. Several of the deficiencies identified in this surveillance had ties back to deficiencies in the CHPRC radiological control program.

The deficiencies in radiological work planning also demonstrated weaknesses in implementation of Integrated Safety Management Systems at PFP and CHPRC.

As a result of the deficiencies identified by RL, the contractor brought in additional radiological control staff to shore up PFP's radiological control program. The project developed a living radiological control improvement plan that has been adjusted as the RL surveillance team and additional contractor radiological control staff identified more deficiencies for correction.

The surveillance resulted in one (1) concern, twelve (12) findings and four (4) observations.

- **S-11-SED-CHPRC-PFP-002-C01:** The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

- **S-11-SED-CHPRC-PFP-002-F01:** Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and spreads of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).
- **S-11-SED-CHPRC-PFP-002-F02:** Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.
- **S-11-SED-CHPRC-PFP-002-F03:** The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field without adequate hazards analysis, by individuals not qualified to make the decisions. Roles and responsibilities for determining radiological controls were not clearly defined.
- **S-11-SED-CHPRC-PFP-002-F04:** Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.
- **S-11-SED-CHPRC-PFP-002-F05:** Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.
- **S-11-SED-CHPRC-PFP-002-F06:** A CHPRC level or PFP procedure on how to perform airborne radioactivity estimates for airborne radioactivity hazards analysis and work planning did not exist.
- **S-11-SED-CHPRC-PFP-002-F07:** The contractor's radiological staffing resources and long-range staff planning were less than adequate to accommodate personnel loses and planned accelerated decontamination and demolition work.
- **S-11-SED-CHPRC-PFP-002-F08:** The Hanford Combination Neutron Dosimeter (HCND) was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document: CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F09:** Technical errors were identified in five out of nineteen External Dosimetry Investigation Reports (EDIRs) (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F10:** Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.
- **S-11-SED-CHPRC-PFP-002-F11:** Less than adequate conduct of operations was observed; Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.
- **S-11-SED-CHPRC-PFP-002-F12:** Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.
- **S-11-SED-CHPRC-PFP-002-O01:** Job Specific RWPs, were written broad and generically to cover multiple work packages.

- **S-11-SED-CHPRC-002-O02:** Facilities technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.
- **S-11-SED-CHPRC-PFP-002-O03:** Poor practices identified in EDIR review.
- **S-11-SED-CHPRC-PFP-002-O04:** The use of the CHPRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors were identified.

Due to the number and significance of the deficiencies identified, the contractor will be requested to submit a corrective action plan.

Surveillance Results:

Concern: S-11-SED-CHPRC-PFP-002-C01:

The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

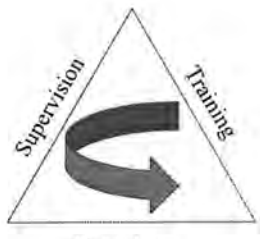
Discussion:

The surveillance team performed a radiological work planning process audit. The surveillance included interviews of personnel involved in the work planning process, observation of work planning process activities, reviews of work planning documents, procedures and work packages, and investigation of radiological events.

To adequately plan work, the hazards associated with the work must be fully understood. The radiological hazards are the sum of the hazards from the system that is being breeched, the work operation being performed, and the hazards associated with the work location.

Radiological hazards associated with the system include radionuclides present, at what concentrations, and in what chemical form. How is the system being breeched constructed? What is the material of construction, how is the interior of the system designed, what are the potentials for holdup of radioactive materials and radioactive liquids and where in the system.

The radiological hazards associated with work operations relate to how the work operation could spread contamination or generate airborne radioactivity, and how the work operation could affect the engineered airborne radioactivity controls. As an example, a circular saw used on highly contaminated surfaces would generate high airborne radioactivity with turbulent air flow patterns. Normal ventilation is designed for laminar flow, such that it would be significantly less effective in capturing airborne radioactivity from a circular saw.



Radiological hazards associated with the work location must include an understanding of the history of upset conditions that resulted in spread of contamination, including the levels of radioactive contamination that could be present on exposing surfaces that were contaminated from fires and spills involving radioactive materials.

Once the hazards are understood, the radiological controls are incorporated. These controls may involve elimination or reduction of the hazard by removal of the source term or limiting the amount of source term that is accessible (e.g., decontamination, application of fixatives). These controls also involve proper selection of the work operations (substituting less turbulent work operations where needed), and implementation of engineered controls to keep the hazard away from the worker (use of glove boxes or glove bags, and appropriately engineered ventilation). After reducing the hazards through elimination or reduction of the source term, and applying engineered controls, administrative controls and personal protective equipment and clothing (PPE) are used to protect the workers.

The radiological controls are then implemented through procedures, training and supervision. The sum of these must be adequate to ensure protection of the workers. The higher the hazard and the more complex the work, more of the controls need to be performed via a procedure, with a well trained work force.

At PFP the surveillance team observed deficiencies in multiple areas of the work planning process. The radiological hazards of the work were not properly analyzed. The radiological controls for some high hazard work were less than adequate, relying on PPE in lieu of implementing engineering controls. Personnel, who were not qualified, were found making inappropriate technical decisions in the field (i.e., decisions through direct supervision) that resulted in unplanned personnel exposures to airborne radioactivity.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F01:

Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and spreads of

contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).

Requirements:

10 CFR 835.501(b) specifies "The degree of control shall be commensurate with existing and potential radiological hazards within the area."

10 CFR 835.501(d) specifies "Written authorizations shall be required to control entry and perform work within radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards."

10 835.1102 (b) specifies "Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, radionuclides present, and the fixed and removable surface contamination levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "…The contractor shall, in the performance of work, ensure that… (5) Before work is performed, the associated hazards are evaluated…"

Discussion:

As discussed in concern S-11-SED-CHPRC-PFP-002-C01 above, radiological work planning needs to understand the hazards associated with the system, work operations and location in order to determine appropriate controls to mitigate the hazards. Multiple examples exist where the hazards were not appropriately analyzed, resulting in airborne radioactivity generation that exceeded the applicable protection factor for the respiratory protection worn and/or spread of contamination:

1. **The hazard associated with using a circular saw to cut a highly internally contaminated glove box was not analyzed, resulting in very high airborne radioactivity that exceeded the respiratory protection factor for airline respirators.**

The work in room 172 of PFP involved cutting up highly internally contaminated glove boxes for disposal. The room is referred to as the chop shop. On December 29, 2010, workers used a circular saw to cut pieces off the back (exposing internals) of Glove box 139-3/4. The airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator worn. The highest level found on the lapel was 7100 Derived Air Concentration (DAC)-hr (0.71 after taking into account the protection factor of the airline respirator). The surveillance team requested a copy of the airborne radioactivity calculations for the work operation that was performed.

On January 25, 2011, workers again used a circular saw to size reduce a glove box. The airborne radioactivity levels "jumped". The highest DAC-hr value on workers lapel air sampler was 17000 DAC-hr, 1.7 DAC-hr after adjusting for the protection factor of the airline respirator (10,000). Assuming the jump in airborne radioactivity occurred over a five minute period (time between monitoring the air sample filter), the airborne radioactivity level generated by the circular saw was more than 200,000 DAC. This was the second time the work team used a circular saw for size reducing the glove boxes and exceeded the airborne radioactivity limits in their RWP (see OA 35012).

The surveillance team again requested the work planning documentation that would indicate the project had evaluated the airborne radioactivity hazard associated with use of the circular saw. The contractor could not provide any. The contractor facility radiological control manager indicated no airborne radioactivity estimate had been made.

- **Investigation revealed PFP radiological work planners routinely did not perform airborne radioactivity estimates to ensure appropriate controls were selected for the work activity.**

Interviews with the radiological work planners at PFP revealed the facility did not evaluate the potential airborne radioactivity levels for use of the circular saw on contaminated glove boxes. In fact, the radiological work planners indicated they had not ever performed airborne radioactivity estimates for work at PFP. The surveillance team reviewed the work planning records for several work packages confirming there were no records of the analysis of the airborne radioactivity hazards for the work reviewed.

After initially requesting the airborne calculations after the December 29, 2010 event, the PFP Director, RHS obtained documentation from another facility on how to perform airborne radioactivity estimates and provided it to the PFP radiological work planners.

A significant contributing factor to this programmatic deficiency was the lack of training and lack of procedures provided by CHPRC that would show the radiological work planner how to analyze the airborne radioactivity hazard to ensure adequate engineered controls and/or respiratory protection are provided (see findings S-11-SED-CHPRC-PFP-002-F05 and S-11-SED-CHPRC-PFP-002-F06). In this case, no respiratory protection had a protection factor high enough for the work. The analysis of the airborne hazard would have demonstrated the need to incorporate engineered controls.

- **The Radiological Hazards Screening Form indicated no airborne radioactivity above 1000 DAC (unmitigated), even though no estimate was performed**

One of the high hazard radiological work screening criteria is "Will predicted airborne radioactivity concentrations exceed 1000 DAC…." This block is marked no, even though no calculation was performed, and there were no limitations in the procedure on work operations (i.e., any power tool was OK to use) or accessible contamination levels within the glove boxes at the locations being cut. There were no bounds on the radiological conditions of the glove boxes provided to the chop shop except, less than 240 grams of plutonium (Pu). Since airborne radioactivity generation depends on the amount of accessible contamination being disturbed and the work activity disturbing the contamination, there is no technical basis for the conclusion that unmitigated DAC values would be below 1000 DAC. Clearly, the reality is we have repetitively generated much higher levels of airborne contamination at the chop shop.

- **Investigation revealed the effectiveness of the point source ventilation used in the chop shop for removing airborne radioactivity during cutting with the circular saw had not been evaluated by PFP engineering.**

The surveillance team interviewed the design authority for HEPA ventilation and requested a copy of the ventilation calculations that would demonstrate the effectiveness of the spot ventilation when using a circular saw. The project could not produce the calculations since they had not been performed.

Interviews indicated that the ventilation engineers were primarily involved in ensuring the PFP HEPA ventilation system and air flow through the plant was not adversely impacted by changes to the system and ensuring HEPA ventilation for tents were adequate to provide appropriate air changes. Some evaluation of point source ventilation had been performed, but not where turbulent air flow patterns were involved. The engineer provided an example of an evaluation of a point source ventilation calculation with typical laminar flow. The work planning process at PFP did not ensure that engineering was adequately utilized in the work planning process. Since DOE identified this deficiency, there has been greater use of engineered ventilation and participation by engineering in its design.

- **Air monitoring in the chop shop with DAC-hr limiting conditions have kept personnel from getting a significant uptake to date, but has not been a cost effective means of performing the work due to multiple shut downs of the work for re-planning.**

To control worker exposures to airborne radioactivity, the project incorporated airborne radioactivity void limits. While this process is more of an emergency response, and has minimized the potential dose consequences to the workers to date, it does not control the generation of airborne radioactivity or prevent airborne that exceeds the respiratory protection factor of equipment worn, and creates a highly inefficient work process.

A review of the contractors work records indicated between December 15, 2010 (the start of cutting operations in the chop shop) and March 16, 2011, work was performed in room 172 during 40 days. Out of those days of work, cutting of glove boxes occurred during 20 days. Airborne radioactivity levels exceeded the radiological work permit DAC-hr limits during 30% (6 out of 20) of the days where glove box cutting occurred. These events resulted in stopping work operations to re-plan work.

- **Continued problems in chop shop revealed glove boxes were not adequately prepared for safe size reduction; fixatives were not adequately applied before the boxes were removed from the E-4 ventilation system and sent to the chop shop.**

After shut down of the chop shop on March 16th, work restarted April 20, 2011, with the first intrusive work performed on April 25, 2011. On that day, airborne radioactivity levels increased and personnel stopped work within a half hour. On the next day, airborne radioactivity levels exceeded the limiting conditions of the RWP. At the post job workers revealed the glove boxes were not being provided to the chop shop in a condition that would permit safe size reduction. The glove box they were working on had bare metal inside, indicating less than adequate application of fixatives, gloves were not properly rolled up and secured (making fixative application less effective), and pie plates were improperly secured (OA 37140). A review of a sample of glove box removal work packages confirmed there were no quality assurance steps in the procedures to verify adequacy of glove box preparation for the chop shop. Additionally, the chop shop work package contained two "size reduction hand-off checklists", one for glove-box 139-5, and one for 139-6. Both check lists showed the "Contamination fixed inside/outside" block left blank, indicating the action was not completed.

2. **The high contamination hazard associated with exposing and cutting a neoprene gasket exposed to historical releases of airborne radioactivity was not recognized or analyzed resulting in four individuals receiving a low level uptake of plutonium.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. Airborne radioactivity was generated when the neoprene gasket was exposed, cut and swipe surveyed (50,000 dpm alpha). Personnel were not wearing respiratory protection.

Historical records indicated several significant spreads of contamination in room 270 and 235 from undetected glove breeches to explosions and resulting fires. Contamination levels between 2000 and 6 x 10^6 dpm alpha are described (FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954 – 1997)). Historical records indicated the contractors partially decontaminated the surfaces and then apply paint to fix the contamination, indicating the likelihood of uncovering contamination when exposing previously inaccessible surfaces. PFP has also experienced a greater hazard of loose surface contamination associated with gaskets (e.g., 10/22/10 open air separation of Glove box 139-1/2, exposing previously inaccessible areas resulted in a spread of contamination when gasket between glove boxes swings free; 3/16/11 airborne radioactivity levels increase above limiting conditions of RWP for the chop shop when cutting an area where a gasket had been removed without application of fixative (OA36431).

- **Less than adequate involvement of PFP engineering in the work planning process resulted in incorrect work instructions.**

Work instruction 2Z-09-06644/M WCN2, step 6.10.2, specified "Cut wallboard/Plexiglas panels surrounding Conveyor HC-4 in room 230C & 235B." The wall was not constructed of wallboard, but had stainless steel plates bolted in place around the Plexiglas windows with neoprene gaskets. The wall had been painted over due to the historical spreads of contamination in the area. The engineer did not provide drawings of the wall construction to the work planner, providing a missed opportunity to plan for the hazard associated with a gasket exposed to contamination being uncovered. The surveillance team requested a copy of the engineering drawing associated with the wall. It clearly identified the existence of the neoprene gasket and steel plates.

- **The AMW did not address the hazards associated with removal of a portion of the wall and Plexiglas windows.**

AMW 5549, rev 0, for work package 2Z-09-6644, dated January 26, 2011, did not address the hazards associated with removing a portion of the wall between rooms 230C and 235B The AMW only addressed breaching radioactive systems.

- **CHPRC review of the work package identified the AMW did not address each task, but did not ensure correction of the deficiency prior to releasing the work.**

After a couple of weeks into the fieldwork portion of the surveillance, RL requested the contractor perform compensatory actions to shore up weaknesses in the radiological control program at PFP. One of the actions taken by CHPRC was to bring a team in to review the high risk work packages. During this review on March 6, 2011, the CHPRC task team identified the deficiency in the AMW not addressing each task, but no action was taken to correct the issue prior to releasing the work.

- **When the work team performed their workability walk down, the team determined unbolting the steel plates was easier, and safer, but did not make a change to the procedure.**

During the workability walk down prior to performing the work, the work team decided unbolting (vice cutting) the wall would be safer, but no change to the procedure was made. The field work supervisor, in consultation with the lead RCT, determined respiratory protection was not needed since they were not cutting. Using wet methods during unbolting was started with no airborne generation. It was not until the gasket around the Plexiglas window was disturbed that high contamination levels were found (50,000 dpm/swipe alpha), exceeding the limits in the RWP. One low level nasal smear was found, but in performing additional voluntary bioassays, a total of four individuals were found to have had low level uptakes of plutonium (54 person-mrem committed effective dose)).

Failure to obtain a procedure change was a missed opportunity to identify and analyze the hazard. The deficiencies in conduct of operation, and clearly defines roles and responsibilities are addressed in S-11-SED-CHPRC-PFP-002-F11 and S-11-SED-CHPRC-PFP-002-F03 respectively.

3. **Airborne radioactivity generation hazards for Glove box WT-4 size reduction and glove box floor removal was not adequately analyzed, resulting in high airborne radioactivity that exceeded the supplied airline respiratory protection factor.**

Glove box WT-4 is in the control room of the Americium Recovery Facility (242-Z). The work package, 2Z-10-02068, was for removal of glove boxes WT-3, WT-4, and WT-5. On April 6, 2011, airborne radioactivity was generated that exceeded the limits of the radiological work permit (OA 36771), and the respiratory protection factor for the supplied airline respirator.

The airborne radioactivity was generated during use of a crow bar to pry up and remove a polyethylene liner on the floor of the glove box (show in drawing H-2-24954). The crow bar was used to pry up flashing ("20 GA S STL") used to hold the liner in place, and then to pry up the polyethylene. During the post job, the workers indicated there were some hot spots (4-5 rem/hr) on the floor of the glove box, indicating very high levels of contamination at that location. The airborne radioactivity hazard associated with the activity of scraping on this highly contaminated surface was not analyzed.

4. **Inadequate analysis of material compatibility results in a spill of an acidic plutonium material; additionally, a precursor event was not appropriately analyzed.**

Work package 2Z-10-0679, involved removing plutonium chemical transfer lines. These lines contained three individual lines inside a protective pipe. The packaging included insertion of a rubber plug to hold the three chemical transfer lines in place within the protective pipe. A red cap was placed over the pipe end to prevent the sharp ends of the pipe cut from damaging the packaging. The cut pipe was "horse tailed" out of the glove bag containment (poly-vinyl-chloride (PVC) sleeve) and sealed using duct tape. A reinforced bag was placed over the horse tail, and sealed with "chem" tape. Then a PVC ridged cap is placed over that and secured with "chem" tape.

The team had successfully made 17 cuts using glove bags (engineered barrier), but had started to find some liquid (described as runny like water (1/4 cup) in a couple of cuts made prior to the events described herein.

On 3/30/2011, while performing post job surveys, an RCT identified 600,000 dpm/100cm^2 alpha contamination on the bottom of a packaged pipe end. Even though the contamination was found on the bottom of the pipe, where the PVC rigid cap (sealed with "chem." tape) meets the pipe, the work team did not recognize this as an indicator of a breach of the sealing system. While recovering from this event, a second cut in the system sat with the same packaging system.

On 4/6/2011, the second pipe end was flipped up to drain the pipe into the glove bag. As workers exited the area, six persons were found to have contamination on their PPE, and contamination above the limiting conditions of the RWP were found on surfaces in the exit path.. The full extent of the spread of contamination was not understood until a recovery team entered. A visible spill of a thick (honey like) brown plutonium substance was found. Contamination in the spill area was as high as 150,000,000 dpm/100cm^2 alpha. The floor in the area contained crevices, complicating clean-up. Disposable surfaces below the work area to protect the floor in case of a spill, were not adequately used during the job. A partial decontamination was performed and the area painted over to fix the contamination.

The work team believes the plutonium acidic material ate through the adhesive in the tape, spilling out of the sleeve onto the floor. RL requested the D&D engineer assigned to the project for the chemical compatibility information for the tape used. The information provided to RL from the manufacturer showed it was not rated for nitric acid (expected chemical form in the pipe). Discussions with the field work supervisor indicated they were not aware of any specific time limitations for satisfactory seal due to the nitric acid that was anticipated.

5. **Inadequate hazards analysis results in workers drilling into the E-3 HEPA ventilation ducting.**

On April 7, 2011, workers, installing anchors in room 235B, inadvertently drilled into the contaminated E-3 HEPA filtered ventilation duct located inside the wall. The E-3 duct is a void in the wall, thus contains no metal. The work planning was less than adequate in that drawings that show the location of the E-3 ventilation were not appropriately used in determining the location of the anchors (OA 36775).

6. **Less than adequate analysis of hazards results in airborne radioactivity release while breaking a bagged Pyrex tank**

On January 27, 2011, a Pyrex tank was removed from glove box 522. The bagged tank was too big to fit into the 55-gallon waste drum. The work team attempted to size reduce the Pyrex tank by padding the tank and hitting it with a pipe wrench. The bag holding the tank was breeched, resulting in high airborne radioactivity and continuous airborne radioactivity monitor (CAM) alarm. (OA 35484)

7. **Deficiencies in analysis of hazards extends beyond radiation protection; Potential fire was narrowly averted when a worker questioned cutting on a pipe containing plutonium contaminated combustible material**

During interviews of personnel, workers reported a near miss that occurred in January of 2011. Work package 2Z-10-07673, Separate Glove box 100C from Glove box 200 in room 235D , specified cutting a hydraulic ram that was filled with plutonium contaminated combustible waste (paper, plastic and miscellaneous step off pad waste). At the pre-job briefing a worker raised a concern regarding the potential for the heat generated by the blade during the cutting reaching temperatures that could ignite the material inside the pipe. When the concern was raised, a mock-up was performed and the mock-up demonstrated the cutting operation started a fire.

The contractor issued a lessons learned praising the workers attentiveness and questioning attitude. However, corrective actions for preventing recurrence of the inadequate hazard analysis were not identified.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F02

Scope of Work was not always adequately defined for hazards analysis at the activity level, resulting in less than adequate radiological controls implementation.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (c), specifies "The contractor shall manage and perform work in accordance with a documented Safety Management System (System)…. Documentation of the System shall describe how the contractor will: (1) Define the scope of work…."

PRC-MP-MS-003, Integrated Safety Management System/Environmental Management System Description (ISMSD), section 3.1 Define Scope of Work, third paragraph, specifies "Work identified in the [work breakdown structure] is further divided into discrete tasks that are individually planned for execution using PRC-PRO-WKM-12115, Work Management, which describes the process for initiating, authorizing, performing, and conducting field work."

PRC-PRO-WKM-12115, Work Management, section 3.2.3, Plan Work, Step 19 states "...State the precise scope of work, including the methods of performing the work.... The scope description must be detailed enough to support the development of effective and accurate hazard controls for the proposed work activity... . Work steps provide the sequence and technical information for the work team to accomplish work that was described in the scope statement. The [field work supervisor] is responsible to direct the work team in a manner that complies with the approved instructions...."

PRC-PRO-WKM-079, section 3.1 Review the work scope, states "1. REVIEW work scope to be sure it is adequately defined.... 2. IF the work scope is not adequately defined, THEN UPDATE work scope in accordance with PRO-WKM-12115 or PRC-PRO-MS-589."

Discussion:

As discussed in the concern above, analysis of hazards includes the hazards associated with the system being breached, the work operations performed, and the location of the work. To appropriately analyze the hazards of the work at the activity level, the work scope must be clearly defined. This means the individuals analyzing the hazards must know the details of how the job will be performed. As specified in PRC-PRO-WKM-12115, the work scope description must be detailed enough to support the development of effective and accurate hazards controls for the proposed work activity.

Less than adequate hazards analysis and implementation of controls is in part a result of less than adequate definition of the work scope. Examples of less than adequate definition of scope from Finding S-11-SED-CHPRC-PFP-002-F01, include:

- **Work scope definition/limitations for size reduction of Glove box 522 Pyrex tanks was not adequate, and therefore adequate controls were not established to prevent an airborne radioactivity release (OA 35484)**

Airborne radioactivity was generated 1/27/11, room 152 when workers attempted to size reduce a Pyrex tank from Glove box 522 by padding it on the outside of its containment bag, and then striking it with a pipe wrench. This work activity was not identified in the work package. The work instruction in (2Z-10-03825) in general, and section 6.4.2.4 (disconnect/removal of Pyrex tanks) in particular, did not identify a need, option, or instructions to size-reduce the Pyrex tank, to fit it into the waste container.

- **Work scope definition for removing Plexiglas windows with radioactively contaminated neoprene gaskets between PFP room 230C and 235B was not adequate.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. The procedure did not adequately define the scope of work.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F03:

The "flexible" D&D work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field without adequate hazards analysis, by individuals not qualified to make the decisions. Roles and responsibilities for determining radiological controls were not clearly defined.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that…(2) Clear and unambiguous lines of authority and responsibility for ensuring (ES&H) are established and maintained at all organizational levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that… (3) Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities."

Discussion:

The surveillance team interviewed more than 40 individuals involved in work planning, including work planners, radiological work planners, lead radiological control technicians, radiological control supervisors, field work supervisors, project managers, the safety and health manager, a radiation protection corporate mentor, and some radiation protection personnel that left PFP to work elsewhere. Additionally, the team interfaced with workers during observation of work planning processes.

Interviews revealed that there was a lot of frustration felt by both workers and managers that were a result of work planning being performed in the field, instead of being planned up front. Disagreements on the appropriate radiological controls to implement for a work activity resulted in everything from work stoppages, to implementation of inadequate controls.

- **Work packages were built with "flexibility", so the procedure would not tie the work team down as to how the work was performed; Radiological controls were "flexible" to accommodate decisions on how to do the work in the field.**

The work team and management expressed the desire for flexibility in how the work was performed, letting this be "skill of the craft". Consequently, the radiological work planners specified "flexible" radiological controls in the work packages. This resulted in management abdication of their responsibility for hazards assessment and controls.

Some examples include generic instructions such as:

Chop shop: 2Z-10-05648, room 172 size reduction operations, 6.2.5 "Perform size reduction activities using power tools (i.e., nibbler, sawzall, circular saw, bandsaw) on hood/glove box/ducting.... Move point source ventilation as needed for contamination control during cutting.... Implement contamination control, as needed, using hand held fogging unit...."

2Z-09-3291, Rm 139 Glove Box Removal, section 4.6 "Use wet methods, sleeving and/or HEPA filtered spot ventilation to control contamination, as necessary."

Work package 2Z-10-2115/M, 4.6.4 included the following, "Wet towels, HEPA vacuum, Glove bags/sleeving and or catch bags shall be used as the main engineering controls during the task as necessary."

When RL debriefed the contractor on preliminary findings of the surveillance team and requested CHPRC to implement compensatory actions to shore up the radiation protection organization at PFP, one of the compensatory actions was to review high risk work packages for adequacy of radiological controls.

- **Roles and Responsibilities for the FWSs, lead RCTs, and other craft work team members are not intended to include radiological hazards analysis; Radiological training programs for these individuals did not include this qualification.**

The absence of specific radiological hazard controls in work instructions/packages resulted in radiological hazard control decisions being done by the field work team. These individuals were not technically qualified to analyze radiological hazards.

While the field work supervisors and lead RCTs have extensive experience in their roles, the surveillance team review of the FWS and RCT training was less than adequate to qualify them for radiological hazards analysis and control. The FWS training and qualification in radiological subject areas was limited to Radiological Worker II training. Radiological Worker II did not provide qualification on radiological hazard analysis and control selection. The surveillance team reviewed the RCT training, which is based on the DOE training standards. While the level of training exceeds radiological worker II training, RCT training objectives were not intended or designed to provide qualification on radiological hazards analysis and selection of engineered controls for work. The surveillance team also found that the training for lead RCTs did not include additional hazard analysis and control topics. The training reviewed for FWS and RCTS did not include appropriate education, training, and skills to discharge these responsibilities, specifically the radiological hazard analysis and selection of engineered controls.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F04

Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination; Engineering staff were not always adequately engaged in the radiological engineering of the work.

Requirements:

10 CFR 835.1001 Design and control, (a) specifies "Measures shall be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative controls. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure."

10 CFR 835.1002 Facility design and modifications, (c) specifies "Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used."

10 CFR 835.1003 Workplace controls specifies "During routine operations, the combination of engineered and administrative controls shall provide that…(b) The ALARA process is utilized for personnel exposures to ionizing radiation."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "…The contractor shall, in the performance of work, ensure that…(6) Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures.

Discussion:

Engineering controls are the first line of defense against airborne radioactivity and spread of contamination. Some work teams have appropriately performed work activities using glove bags and glove boxes, to keep the worker from being exposed to the source of contamination.

Examples of poor use of engineering controls include:

- **Less than adequate use of engineering controls at the chop shop**

Work in the chop shop directly exposes personnel to high contamination levels inside glove boxes that are not designed for human entry. The chop shop and the work performed there was not properly designed up front with adequate engineering controls. As a result, airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator multiple times, and the project continually struggles with back fitting radiological controls. The facility did not use the glove box itself and facility ventilation system (E-4) to adequately reduce the hazards prior to disconnection from the E-4 system and transporting the glove boxes to the chop shop, nor designed the chop shop facility for size reducing the glove boxes inside an engineered barrier (glove box or engineered ventilation hood).

- **Less than adequate use of engineered ventilation in general; less than adequate involvement of engineering in the design of spot ventilation.**

Engineered ventilation was not always used. An example included scraping of the polyethylene liner with high dose rates, indicative of high contamination, at the bottom of glove box WT-4 without engineered spot ventilation (see Finding S-11-SED-CHPRC-PFP-002-F01).

Spot ventilation being used at the facility was not always being adequately designed to meet its intended use. Elephant trunks and HEPA filtered vacuums cleaners had been used, but were not always adequate. Examples include the use of an elephant trunk for engineered ventilation while cutting a glove box with a circular saw (see Finding S-11-SED-CHPRC-PFP-002-F01).

As the RL surveillance progressed, more involvement of the ventilation engineer in spot source ventilation design was observed. A corporate mentor had previously brought up the need for PFP to use a "B-box", a spot ventilation used at Rocky Flats. Facility action was not observed by the surveillance team until compensatory actions to shore up the radiological controls at PFP were implemented by the contractor.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F05:

Training and qualification of radiological work planners was found less than adequate; Training did not adequately cover applied radiological hazards analysis.

Requirements:

10 CFR 835.103 Education, Training and Skills, specifies "Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this part shall have the appropriate education, training, and skills to discharge these responsibilities."

(b)(5)

identify positions that develop and implement measures necessary to comply with 10 CFR 835. At a minimum, this includes those individuals filling the following positions.... Facility/Project Rad Con technical staff...."

Discussion:

Training and qualification of radiological work planners did not ensure that individuals, who were determining and implementing radiological controls, were appropriately trained and qualified to perform applied radiological hazards analysis.

- **The Radiological Control Work Planning training course does not adequately teach applied analyze the hazards.**

Course number 022801, Planning Radiological Work – Initial, section F, Purpose and Overview, specifies "This course does not attempt to teach radiological work planning...." The course does not teach how to plan work, nor does it provide instruction on how to perform applied hazard analysis. Some radiological work planners were RCTs that were promoted to work planners. The RCT qualification program also does not teach personnel applied radiological hazards analysis. There was no documented training that demonstrated knowledge of how to perform applied hazard analysis prior to assignment as a radiological work planner.

The primary emphasis of the course 022801 is to teach the radiological work planners how to fill out the radiological hazards screening and ALARA Management Worksheet forms to support the work management process. The course contains general discussion on factors affecting radiological hazards, but does not adequately cover practical application of hazards analysis and selection of controls.

- **Radiological work planner training did not demonstrate how to perform airborne radioactivity estimates based on contamination levels, work operations, and application of airborne radioactivity controls.**

A review of radiological work planning training documents and interviews found that the training did not provide adequate instruction on how to predict airborne concentrations. The training materials directed the trainee to use the facility Technical Evaluation (TE) to predict airborne concentration. The PFP TE did not contain guidance on how to estimate airborne concentrations. The training material did not demonstrate how to perform these airborne radioactivity calculations.

- **Selection of appropriate respiratory protection requires the ability to calculate airborne estimates.**

The radiological work planning course does not show the work planner how to select respiratory protection based on estimated airborne radioactivity levels.

- **Radiological work planning training did not adequately cover limitations of HEPA filtered ventilation as an engineered control.**

Interviews found that staff did not understand the limitations of ventilation as an engineered control. Personnel did not demonstrate understanding that ventilation is typically designed for laminar flow. Ventilation is significantly less effective when generating turbulent air flow patterns, such as those created with a circular saw. This is important to understand, so that radiological work planners do not specify ineffective controls.

The radiological work planner training course did not cover the technical aspects of engineered ventilation or the need to engage engineering in its design.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F06:

A CHPRC level or PFP procedure on how to perform airborne radioactivity estimates for airborne radioactivity hazards analysis and work planning did not exist.

Requirements:

10 CFR 835.104 Written Procedures specifies, "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

Discussion:

The surveillance team reviewed the CHPRC and PFP list of procedures on line and technical basis documents. Neither CHPRC nor PFP had a procedure providing instructions on how to predict airborne radioactivity levels. Airborne radioactivity estimates were needed to complete the Radiological Work Screening process (PRC-PRO-RP-40108, "Radiological Hazard Screening," and Site form A-6004-654). Some projects and other contractors had procedures for performing airborne radioactivity calculations. After the deficiency in performing airborne radioactivity calculations was identified by RL, PFP obtained another projects methodology for performing airborne radioactivity calculations to develop their own instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F07

The contractor's radiological staffing resources and long-range staff planning were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work

Requirements:

CRD O 5480.19 Chg 2 (Supp Rev 4) Conduct of Operations Requirements for DOE Facilities Chapter I, Operations Organization Administration: C. Guidelines; (2) Resources: specifies "The operations supervisor for DOE facilities should be provided with sufficient… personnel to accomplish assigned tasks without requiring excessive overtime by the operations staff. These resources should include technical personnel needed to support the operations. A long-range staffing plan that anticipates personnel losses should be developed and implemented."

Discussion:

In decontamination and decommissioning of a facility, an increased level of radiological risk and potential for rapidly changing conditions are expected. Multiple systems are being breached, facility engineered controls are being deactivated, etc. Planning for appropriate additional staff is critical to effectively handle the increased work and continual changes in facility conditions.

The contractor did not adequately ensure adequate staffing resources and long-range staff planning at PFP.

- **PFP experienced the loss of the facility RadCon Manager, a key position, in June 2010 and did not permanently replace the manager until March 7, 2011.**

The lack of priority and urgency in filling this key position for a high risk and accelerated project demonstrated less than adequate planning and response to key personnel losses. The high risk and accelerated nature of PFP work should have driven a more expedient permanent replacement for this key role. For approximately 8 months, the project did not have a permanent RadCon Manager.

PFP assigned personnel as temporary radiological control managers. The RHS Director intermittently acted as RadCon manager. However, the RHS Director's other duties combined with the RadCon organization's span of control, made this approach less than adequate. For 5 months (August through December), the facility had a central RadCon staff member acting in a temporary capacity. After the central RadCon staff member went back to the central organization, the radiological control manager position was rotated among the radiological control supervisors. Experience shows personnel in a temporary position are not as effective because staff know they are temporary.

- **There was insufficient radiological technical staff to adequately manage the work planning process.**

The radiological work planner and engineers needs to be an integral part of the work team. They need to be there at the start of the work planning, providing input into how the work is performed from a risk assessment perspective. If the work operations are not clearly defined during the planning, hazards assessments may not be accurate, as was observed during the surveillance for some work activities. This contributed to the adverse outcomes realized during work (e.g. RWP voids, high airborne generation, contamination spreads, and radiological uptakes).

At the start of this surveillance, the project had three radiological work planners. This resource level was not adequate to support work planning based on the level of hazards in the facility and the pace of work at PFP. Based on organizational chart reviews and interviews, the three radiological work planners supported approximately twenty-six line work planners.

- **Insufficient numbers of radiological work planners did not permit adequate engagement of the work planner during performance of work.**

The radiological work planners need to be engaged during performance of the work. Field presence by radiological technical support and work planners helps to validate and ensure that radiological controls are implemented as intended. As the level of flexibility in work operations and changing conditions increase, field observations provide for early recognition and correction of potential inadequacies in engineered controls. The shortage of radiological work planners resulted in their limited field presence. Lack of observation of the implementation of controls in the field represents a program weakness and a missed feedback opportunity.

In response to the RL surveillance, the contractor added a radiological engineering manager and additional radiological work planners at PFP.

- **PFP had insufficient numbers of first line radiological control supervisors (RCS) to effectively support radiological work.**

A review of the PFP organizational chart and interviews with the PFP RCS found that approximately 102 RCTs were supervised by five RCS. Interviews indicated the following: One of these RCS had double duty as PFP's acting radiological control manager. One of the RCS was assigned Duty RCS for making personnel assignments, responding to emergencies, and completing other administrative duties. Additionally, the RCSs review completed radiological surveys. As a result, only two RCS were typically available to oversee the ongoing work. The ratio of RCTs to RCS is very high considering the level of radiological hazard associated with the work at PFP.

Since RL identified the overall weaknesses in radiological staffing at PFP, the contractor has increased the number of RCS.

- **Fifty percent of the RCTs at PFP are junior**

Interviews with personnel indicated fifty percent of the RCTs at PFP were junior, meaning they were not qualified to work alone on high risk work activities and required more oversight by the lead RCTs on the work team.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F08:

The HCND was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document: CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).

Requirements:

10 CFR 835, Subpart E-Monitoring of Individuals and Areas, Article 835.401(b) Instruments and equipment used for monitoring shall be... (2) Appropriate for the type(s), levels, and energies of the radiation9s) encountered..."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section F External Dosimetry, paragraph 3, specifies "The contractor shall participate in the development and maintenance of a Hanford site-wide external dosimetry basis document. The contractor's external dosimetry program shall be performed in accordance with this technical basis document."

PNNL-15750 Rev. 1, PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, section 6.3, Selection of Dosimeter Types to Use, specifies "Individuals who are likely to receive Hp(10)n greater than 100 mrem per year should be issued a HCND, which provides a more accurate measurement of neutron dose. In addition, individuals who routinely have Hp(10)n greater than 100 mrem per year reported on an [Hanford Standard Dosimeter (HSD)] should be issued a HCND."

Discussion:

The surveillance team reviewed the CHPRC deficiency reports for PFP. Multiple deficiency reports identified issues with neutron dose over-response from personnel wearing the Hanford Standard Dosimeter at PFP that required modifications to personnel dose of record. RL investigated the issue and found it to be programmatic at CHPRC.

CHPRC reduced the numbers of personnel monitored with HCND to reduce costs. In the process, individuals who should have been wearing the combination dosimeter were not appropriately monitored in accordance with the Hanford External Dosimetry Technical Basis. In 2010, CHPRC processed 117 External Dosimetry Investigation Reports to correct the neutron reading from a Hanford Standard Dosimeter.

The HSD can measure neutron, and is Department of Energy Laboratory Accreditation Program (DOE LAP) accredited for its response to a Californium neutron source (Fast neutron). The HSD over-responds significantly to a thermal neutron flux. Depending on the neutron energy where the individual was exposed, correction factors between 2 and 5 are used. The HCND has a neutron dosimeter which has multiple thermoluminescent dosimeters (TLDs) inside that respond to different neutron energy levels and thus more accurately measure neutron, but costs more. However, this cost is less than the contractor's estimated man-hours costs taken to investigate and correct the neutron dose.

The HCND was not assigned to multiple individuals meeting the monitoring criteria as specified in the Hanford technical basis document. CHPRC processed 117 External Dosimetry Investigation Reports (EDIRs) to change the record doses to personnel. Many more individual dose records were reviewed for high neutron doses, where doses indicated personnel should have been assigned a HCND, but were not, and the project decided not to make a change in the individual's dose of record.

A review of the CHPRC External Dosimetry Program, PRC-PRO-RP-379, revealed the document is inconsistent with the Hanford External Dosimetry Technical Basis Document. While PNL-MA-842 specifies personnel who routinely have neutron dose, as reported on an HSD, should be issued a HCND, CHPRC has not implemented this in their External Dosimetry Program. PRC-PRO-RP-379, section 3.15, , step 5, only specifies to change the dosimeter to a HCND if the corrected neutron dose is greater than 100 mrem.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F09

Technical errors were identified in five out of nineteen EDIRs.

Requirements:

PRC-PRO-RP-379, External Dosimetry Program, section 3.15, Neutron Correction to HSD Measurements, step 2 specifies "If calendar year-to-date (CTD) uncorrected neutron exposure is [greater than or equal to] 100 mrem, then correct readings using the following correction factors: PFP = 2, ISA = 5, Others = 3." "Note: Justification is required in the project's technical equivalent document if there is a deviation from the given correction factors per project."

10 CFR 830.122 Quality Assurance Criteria (c) specifies "Criterion 3 Management/Quality Improvement (1) Establish and implement processes to detect and prevent quality problems. (2) Identify, control, and correct items, services, and processes that do not meet established requirements. (3) Identify causes of problems and work to prevent recurrence as a part of correcting the problem. (4) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section J, Radiological Records, paragraph 2, specifies "The contractor shall ensure that permanent radiological records are accurate and legible…."

Discussion:

The surveillant reviewed 19 out of 120 External Dosimetry Investigation Reports (EDIR) that involved adjusting neutron doses from the Hanford Standard Dosimeter readings. Technical errors (math errors, wrong radiation type, zeroing dose without adequate technical justification) were identified in five out of 19 (26 percent) of the EDIRs. There were other potential issues in 4 other EDIRs. The following technical errors were identified:

- **Several EDIRs contained math errors.**

EDIR-10-223 divided 20 mrem neutron by a correction factor of 3, and specified the corrected dose as three mrem neutron (20 divided by 3 is 6.67, or rounded to the nearest mrem is 7 mrem, not 3 mrem). EDIR-10-077 took 60 mrem neutron divided by a correction factor of three and said the resulting dose was 17 mrem neutron. EDIR-10-179 erroneously added the gamma dose to the neutron dose when correcting the neutron dose (520 neutron +53 gamma = 573; 573 divided by 2 = 287). The corrected neutron dose should have been 520 divided by 2 = 260 mrem neutron.

- **One workers dose was corrected twice, but the dose was assigned as neutron vice gamma.**

The EDIR did not specify the type of radiation, no radiation survey record was attached. The worker had been taking photographs in PFP A-labs, for a total of 2 hours, and lost his HSD. The EDIR specified general radiation levels in A labs as 0.5 mrem/hr, but did not specify that was gamma radiation vice neutron. PFP general area radiation levels are both gamma and neutron in most places, and 0.5 mrem/hr is the typical minimum detectable activity (MDA) of the gamma dose reading instrument. The 0.5 mrem/hr dose rate was likely a gamma reading based on the location, A-Labs. The EDIR should have contained both gamma and neutron dose rates for preparation of the dose estimate. The first time the dose was corrected, a math error was made, 2 hrs times 0.5 mrem per hr, was recorded as 2 mrem neutron. The contractor caught the math error and changed the dose to 1 mrem neutron, but did not catch the error in no radiation type being specified by the facility providing the dose rate data.

- **A neutron dose record indicating 31 mrem neutron was changed to zero (see EDIR-10-176).**

The 31 mrem recorded neutron was corrected by dividing by 3 (10 mrem neutron), but then recorded as zero, without appropriate technical justification.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F10:

Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

Requirements:

10 CFR 835.403 Air monitoring, specifies "(a) Monitoring of airborne radioactivity shall be performed (1) Where an individual is likely to receive an exposure of 40 or more [Derived-Air Concentration (DAC)]-hours in a year…."

10 CFR 835.402 (c) specifies "For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs (including routine bioassay programs) shall be conducted for: (1) radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year…."

Discussion:

The surveillance team reviewed four (4) quarterly PFP workplace Air Monitoring Tracking and Trending Reports (Calendar year 2010). This review was performed in response to an earlier discovery of the tracking and trending not being performed (OA 33986) and an employee concern at PFP over the sporadic elevations of airborne radioactivity in the plant.

- **PFP Closure Project Workplace Air Monitoring Tracking and Trending reports identify locations with unexplained elevated airborne radioactivity above one DAC-hr;**

The surveillance team verified that Workplace Air Monitoring Tracking and Trending Reports have identified areas with sporadic unexplained elevated airborne radioactivity. As an example, the Third quarter 2010 PFP Closure Project Workplace Air Monitoring Tracking and Trending Report identified six (6) areas with greater than 1 DAC-hr airborne radioactivity. The third quarter 2010 report did not provide any actions taken to ensure unmonitored personnel receive less than 40 DAC-hr (100 mrem internal dose) in a year, or actions taken monitor exposed individuals through bioassay or a DAC-hr tracking program.

- **The third and fourth quarter reports did not contain any trending data for locations with elevated airborne radioactivity.**

Review of the Third and Fourth Air Monitoring Tracking and Trending Reports confirmed they did not include any trending data for the locations with elevated airborne radioactivity. Interviews with radiological control technical staff indicated the staffing shortages were a major contributor to the task not being completed.

- **The PFP administrative trigger level for investigating elevated airborne radioactivity was 1 DAC-hr (in a week), which was inconsistent with 40 DAC-hr in a year [0.77 DAC-hr per week].**

A fixed head air monitor draws airborne radioactivity into it and collects the contamination on a filter. When the filter is counted, the contamination is a direct measure of DAC-hr. The airborne radioactivity could have occurred in a short period of time as a result of a work activity, or be the collection of ambient low level airborne radioactivity. Assuming the airborne radioactivity actually occurs when people are in the area as a result of their activities, 40 DAC-hr per year would be 0.77 DAC-hr per week. It is unclear why the facility has used a higher trigger for investigation than that which ensures compliance with 10 CFR 835.

- **Airborne radioactivity area (ARA) posting at PFP goes up and down regularly, it is not clear how the air monitoring program verifies personnel not in respiratory protection receive less than 100 mrem internal dose (40 DAC-hr) in a year when these areas are not posted ARA.**

Interviews with the radiological control technical staff and reviews of the quarterly workplace air monitoring tracking and trending reports revealed the fixed head air monitors run both during the period when the area is not a posted airborne radioactivity area and during airborne radioactivity work. When high fixed head airborne radioactivity levels are reported, the radiological technical staff indicated they sent an e-mail to the radiological control supervisors to determine what work went on in the area. If airborne radioactivity work occurred, this is identified in the report. It is unclear how this process ensures personnel who are not monitored for internal exposure and are not wearing respiratory protection, do not exceed 100 mrem internal dose in a year.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F11:

Less than adequate conduct of operations was observed; Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.

Requirements:

10 CFR 830.122 Quality assurance criteria, (e) Criterion 5 Performance/work processes (1) specifies "Perform work consistent with technical standards, administrative controls and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means."

DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities, Chapter XVI Operations Procedures, B. Discussion, specifies "...operations procedures should be sufficiently detailed to perform the required functions without direct supervision.... Operators should not be expected to compensate for shortcomings in such procedures... C. Guidelines ...7. Procedure Use,... Facility operation should be conducted in accordance with applicable procedures... If procedures are deficient, a procedure change should be initiated...."

Discussion:

The surveillance team observed post job reviews and critiques. A contributing factor to events was poor conduct of operations. The following are examples of personnel not following appropriate requirements for use of procedures:

- **Less than adequate conduct of operations contributed to personnel receiving low level uptakes during removal of a Plexiglas window between PFP rooms 230C and 235B**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, the work team identified the wall surrounding the Plexiglas windows was made of stainless steel sheets bolted in place. The team decided to unbolt the stainless steel plates in lieu of cutting as identified in the procedure. Because of the perceived safer condition, the FWS and lead RCT decided respiratory protection was not needed. The work team did not make an appropriate change to the work package prior to performing the work. An unanalyzed hazard associated with contamination on the gasket around the Plexiglas window resulted in four low level uptakes.

- **Personnel observed not following controls established in the procedure contributed to generation of airborne radioactivity above the respiratory protection factor of the airline respirator at the chop shop.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, airborne radioactivity levels during work in chop shop repetitively exceeded respiratory protection factors of the airline respirator. The facility modified the chop shop work package to add additional radiological work instructions on March 10, 2011. When the chop shop work team commenced work on March 16, 2011, the corporate radiological control mentor identified workers had not implemented several of the radiological control requirements in the procedure. Airborne radioactivity levels exceeded the RWP limits for airborne radioactivity and work was stopped.

- **Personnel did not stop when Pyrex tank did not fit into 55 gallon drum. Unplanned work resulted in airborne radioactivity and spread of contamination (OA 35484)**

The work instruction (2Z-10-03825), for preparation of glove box 522 for removal, did not identify a need, option, or instruction to size reduce a Pyrex tank in the glove box. The Pyrex tank was sleeved out of the glove box, but did not fit into the 55 gallon drum staged for its disposal. When personnel in the field concluded the tank should be size reduced they did not recognize work instructions and controls should have been specified and approved prior to performing the actions they did to size reduce the tank. While attempting to break the Pyrex tank with a pipe wrench, a release of airborne radioactivity occurred when the sleeving around the tank was breeched.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F12

Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.

Requirements:

10 CFR 835.104 Written Procedures specifies, "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

10 CFR 830.122(c)(1) Establish and implement processes to detect and prevent quality problems.

Form A-6004-634 specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

Discussion:

The AMW documents the radiological considerations, analysis and controls to be incorporated for high and medium risk radiological work. Documentation on the AMW Part II, Radiological Protective Measures/Considerations was not consistently completed per the form's instructions. The AMW form specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

The surveillance team reviewed 7 released complete work packages supplied by PFP; the AMWs associated with these work packages did not fully follow the previously stated instruction. The surveillance team found sections on each AMW where the radiological work planner checked, "Incorporate into work instruction," without any text being bolded for inclusion. Failure to follow the forms instructions, e.g. lack of bold text, potentially contributed to the less than adequate inclusion of intended controls in work instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O01:

Job Specific RWPs were written broad and generically to cover multiple work packages.

Discussion:

As part of the PFP work planning surveillance, the team noted that RWPs were written to cover multiple work packages and were broad and general in nature. An example of this is RWP Z-005, "Perform Glove box Work Activities (As per Listed Work Procedures), Handling/Movement of Radioactive Material, Low Level Waste Handling & Disposal and Minor Decontamination." This RWP had been revised 72 times, covered 6 PFP procedures and 28 work packages. PFP should review the RWP process to ensure that RWPs are adequate, sufficiently specific and conform to best practices. The use of generic RWPs can lead to error likely conditions and worker errors.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-002-O02:

Facilities technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.

Discussion:

During the surveillance, there were a lot of concerns expressed by workers on the use of plutonium levels for determining when beryllium monitoring was required. The workers expressed concern over the accuracy of the technical basis for the policy and on lack of follow through by facility management in performing beryllium characterization.

During review of FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954-1997), the surveillance team noted on page 20 of the report, that a spread of contamination from a plutonium-beryllium source occurred in 1981 in room 236. This source of beryllium was not evaluated by the facility in the development of their beryllium monitoring program.

The additional technical staff brought into PFP had an additional benefit of supporting resolution of worker concerns in the beryllium monitoring program. When the additional source of beryllium contamination was identified by RL, the additional staff reviewed its potential impact on the PFP beryllium monitoring program.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O03:

Poor practices identified in EDIR review.

Discussion:

The following additional poor practices were observed:

- **Poor resolution to a technical issue.**

EDIR-10-077 indicated a technical issue existed with the type of direct reading dosimeters (DRD) used at WRAP. The EDIR specified the cause of "ACES report indicated that estimated dose recorded was grossly underreported for [DRD]", was "DRD do not detect neutron radiation and electronic dosimeters can under respond to lower energy spectra." The resolution states: "Return to monthly dosimeter issuance." If we are not getting what we need out of our DRD, based on the type and energy of radiation encountered, this technical issue should be addressed. By regulation, we should be monitoring with equipment appropriate for the type and energy of radiation encountered.

- **Gross inconsistencies in who's neutron dose from the HSD gets corrected in the individuals record**

There were gross inconsistencies in who's neutron dose from the HSD got corrected in the individuals record and who's did not. Examples include: A neutron dose correction of 1 mrem was made in one EDIR, a dose of 31 was zeroed in another, and a HDS dose of 199 mrem (99.5 mrem with PFP correction factor applied), was not corrected at all.

- **Rounding is inconsistent.**

Some EDIRs truncated the fraction of a mrem, while others used normal rounding practices. Had the 99.5 mrem corrected value from the example above used normal rounding practices, the corrected dose would be 100 mrem and the CHPRC procedure would require dose correction.

- **Technical justification for use of inconsistent neutron correction factors for ISA pad work was not documented in the EDIR.**

All 4 EDIR reports for individuals working at ISA (correction factor 5) pad that the surveillance team reviewed had neutron, no gamma dose. Two individuals had some entries into CSB also. The correction factor applied to those individuals was 3. There was no documentation that indicated why the facility chose to use the 3 over the 5. The correction factor of 3 resulted in a conservative higher dose in the record.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O04:

The use of the PRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors are identified

Discussion:

As part of the PFP work planning process surveillance, the team observed PFP investigate upset conditions and events using the ALARA post-job review as a fact finding tool. By design, the ALARA post-job review did not provide sufficient fact finding guidance to discover the event details needed to identify failure points and prevent recurrence. The site form (site form A-6004-821) provided questions geared toward evaluating causes not gathering factual details. The contractor should provide a more appropriate and effective process for gathering and identifying facts related to upset conditions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Contractor Self-Assessment:

The surveillance team reviewed the contractor's self-assessments and corrective action data base for PFP deficiencies for June, 2010 through

Issues with radiological work control planning and implementation have been previously identified by the CHPRC. On July 13, 2010, CHPRC identified within a conditional report (CR) three Stop Works at PFP related to Procedure Compliance, Entry Requirements and RWP Violations. These formal Stop Works were recorded in CR-2010-2201 to document issues with scope creep, procedure compliance, hazards and controls, pre- job briefs, and duct level entry requirements. As a result of the evaluation of the Stop Work issues, this CR was screened as adverse.

Analysis contained within CR-2010-2201 revealed that multiple issues throughout most aspects of work performance had risen to a level that workers felt the need to implement the formal Stop Work process in order to see that they were adequately addressed. Ten corrective actions were established to resolve these issues.

On October 22, 2010, CR-2010-3327, Contamination Spread in Multiple Rooms during Glove Box Separation Activities, was initiated due to contamination spread during glove box separation activities in room 139 of A Labs. Analysis of this event determined that the work controls were not adequate to handle the potential levels of contamination in areas inaccessible for survey and the configuration of the glove box was such that engineered barriers were considered impractical. Two work control corrective actions were identified in response to this event.

However, the number of radiological work planning events and deficiencies identified during this surveillance, indicates the corrective actions associated with the above issues were not sufficiently effective. This assessment of PFP's radiological work planning corrective action effectiveness aligns with RL's overall evaluation of CHPRC's corrective action management performance (See letter CHPRC-1100939, Integrated Corrective Action Plan).

Contractor Self-Assessment Adequate: **YES [ ]** **NO [X]**

Management Debriefed:

David Del Vecchio, CHPRC
Terry Vaughn, CHPRC
Curtis Bean. CHPRC
Tom Bratvold, CHPRC

Department of Energy
Richland Operations Office (RL)
Surveillance Report

Division: Safety and Engineering Division (SED)

Surveillance Team: Brenda Pangborn (lead), Joe DeMers, Wayne Glines, Rick Jansons, Ed MacAlister, Ed Parsons, Kerry Schierman, Sandra Trine

Surveillance Number: S-11-SED-CHPRC-PFP-002

Date Completed: April 29, 2011

Contractor: CH2M HILL Plateau Remediation Company (CHPRC)

Facility: Plutonium Finishing Plant (PFP)

Title: Planning and Execution of Radiological Work

Guide: 10 CFR 835

Surveillance Scope:

The objective of this surveillance was to evaluate the adequacy of planning and execution of radiological work at PFP. This was a surveillance of the work planning process that included a review of the identification, analysis and control of radiological work hazards. The surveillance reviewed work planning resources and the development of radiological work packages. This surveillance also included investigation of specific radiological deficiencies anonymously sent to the Richland Operations Office (RL).

Surveillance Summary:

The surveillance team reviewed documents, including:

- Contractor work planning documents.
- Training course materials for both radiological work planners and the line work planners.
- Radiological control procedures and technical basis documents.
- Radiological performance indicators including contractor self assessments, contractor corrective action reports, and RL operational awareness (OA) reports for activities at PFP.
- Historical documents of the PFP, including the Radiological History of the Plutonium Finishing Plant (1954-1997) that described radiological upsets in the facility (dates, locations and contamination values).
- Work packages and associated radiological screening forms, As-Low-As-Reasonably-Achievable (ALARA) Management Worksheets (AMW), and radiological work permits (RWP).

The surveillance team interviewed more than 40 personnel involved in the work planning process and execution of work in the field, including:

- Three radiological work planners;
- Eight line work planners;
- Four field work supervisors (FWS);
- Four superintendants;
- Three project managers;
- Two integration planners;
- Four radiological control supervisors (RCS);
- Eight lead radiological control technicians (lead RCT);
- One Director of Radiation Protection, Industrial Hygiene, and Occupational Safety (RHS);
- One Director of Environment Safety and Health for CHPRC;
- Two former PFP radiological control managers (RCM);
- One radiological controls mentor; and
- Three engineers or engineering managers, including the Design Authority for High Efficiency Particulate Air (HEPA) filtered ventilation system.

The surveillance team observed the following work planning processes:

- Walk downs of the work area including, scoping walk downs, workability walk downs, and Automated Job Hazard Analysis (AJHA) walk downs;
- Preliminary planning meetings (prior to AJHA meetings);
- AJHA meetings;
- Work planner schedule status meeting;
- Plan of the Day (POD) meetings;
- Pre-job meetings;
- Post-job meetings;
- Critiques; and
- Observations of work activities (e.g., Chop shop, 242Z).

The surveillance team performed a surveillance of the work planning process, looking at the PFP process for planning radiological work. From a review of the contractor procedures, and interviews of personnel, the basic simplified flow chart of the work planning process used at PFP is shown below.

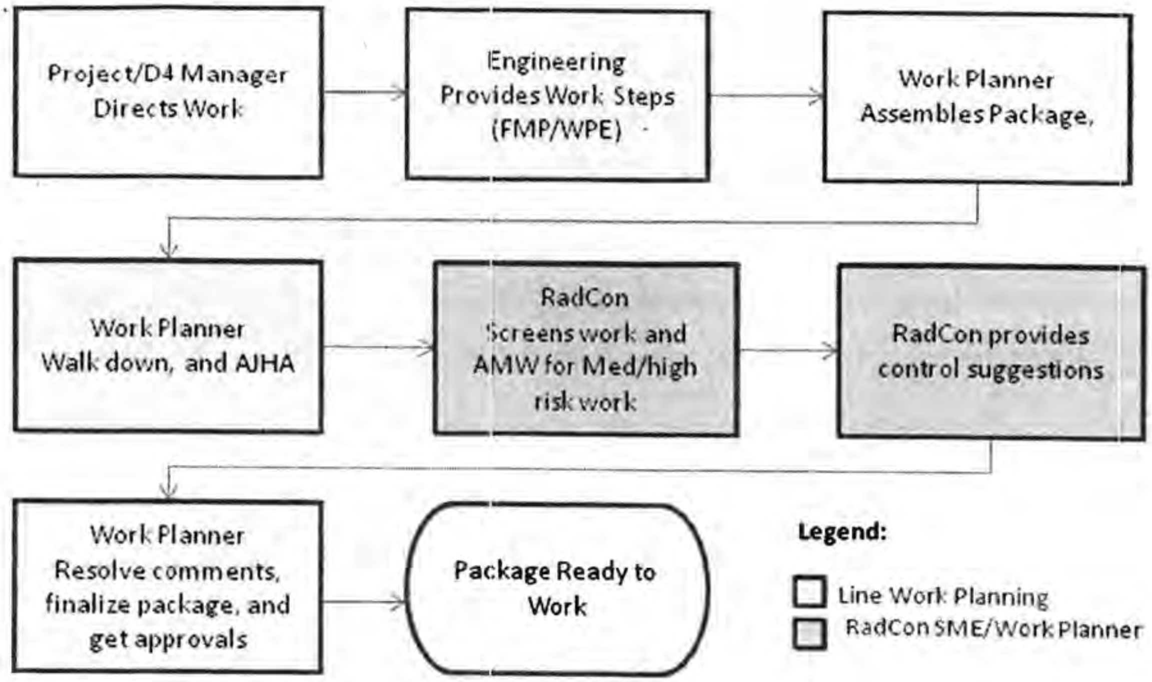


Figure 1 Simplified Work Planning Process Flow Chart

The surveillance team found multiple deficiencies in planning and execution of radiological work, and some deficiencies in other technical work performed by the PFP radiation protection organization. Deficiencies in the work planning process included less than adequate involvement of radiation protection early in the work planning process, and less than adequate involvement of radiation protection and some engineering work planning at the activity level. There were inadequate levels of radiological technical staffing, less than adequate training and qualification of radiological work planners, and unclear roles and responsibilities for determining radiation protection controls as implemented in the field. Additionally, the surveillance team identified some deficiencies in other technical aspects of the radiation protection program at PFP. Several of the deficiencies identified in this surveillance had ties back to deficiencies in the CHPRC radiological control program.

The deficiencies in radiological work planning also demonstrated weaknesses in implementation of Integrated Safety Management Systems at PFP and CHPRC.

As a result of the deficiencies identified by RL, the contractor brought in additional radiological control staff to shore up PFP's radiological control program. The project developed a living radiological control improvement plan that was adjusted as the RL surveillance team and additional contractor radiological control staff identified more deficiencies for correction.

The surveillance resulted in one concern, twelve findings and four observations.

- **S-11-SED-CHPRC-PFP-002-C01:** The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium, and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.
- **S-11-SED-CHPRC-PFP-002-F01:** Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory

protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).

- **S-11-SED-CHPRC-PFP-002-F02:** Scope of Work was not always adequately defined at the activity level for hazards analysis, resulting in less than adequate radiological controls identification and implementation.
- **S-11-SED-CHPRC-PFP-002-F03:** The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.
- **S-11-SED-CHPRC-PFP-002-F04:** Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination. Engineering staff were not always adequately engaged in the radiological engineering of the work.
- **S-11-SED-CHPRC-PFP-002-F05:** Training and qualification of radiological work planners was found less than adequate. Training did not adequately cover applied radiological hazards analysis.
- **S-11-SED-CHPRC-PFP-002-F06**: PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning. The CHPRC technical basis document for workplace air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.
- **S-11-SED-CHPRC-PFP-002-F07:** The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work.
- **S-11-SED-CHPRC-PFP-002-F08:** The Hanford Combination Neutron Dosimeter (HCND) was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document. The CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F09:** Technical errors were identified in five out of nineteen External Dosimetry Investigation Reports (EDIRs) (OA 36921).
- **S-11-SED-CHPRC-PFP-002-F10:** Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclide intakes in a year were appropriately monitored through the internal dosimetry program.
- **S-11-SED-CHPRC-PFP-002-F11:** Less than adequate conduct of operations was observed. Failures to follow procedures contributed to generation of airborne radioactivity and low level uptakes.
- **S-11-SED-CHPRC-PFP-002-F12:** Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.
- **S-11-SED-CHPRC-PFP-002-O01:** Job Specific RWPs, were written broadly and generically to cover multiple work packages.
- **S-11-SED-CHPRC-PFP-002-O02:** The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.
- **S-11-SED-CHPRC-PFP-002-O03:** Poor practices were identified in multiple EDIRs reviewed.
- **S-11-SED-CHPRC-PFP-002-O04:** The use of the CHPRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors were identified.

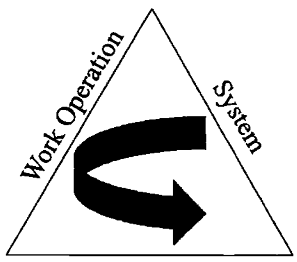
Due to the number and significance of the deficiencies identified, the contractor will be requested to submit a corrective action plan.

Surveillance Results:

Concern: S-11-SED-CHPRC-PFP-002-C01

The radiological work planning process at PFP was less than adequate resulting in inadequate analysis of radiological hazards, inadequate use of engineering controls for some work activities, airborne radioactivity levels that exceeded the maximum protection factor of the type of respiratory protection used, multiple low level uptakes of plutonium, and spreads of contamination. CHPRC programmatic deficiencies in the work planning process contributed to less than adequate planning at PFP.

Discussion:



RL performed a surveillance of planning and execution of radiological work. The surveillance included interviews of personnel involved in the work planning process, observation of work planning process activities, reviews of work planning documents, procedures and work packages, and investigation of radiological events.

To adequately plan work, the hazards associated with the work must be fully understood. The radiological hazards are the sum of the hazards from the system that is being breeched, the work operation being performed, and the hazards associated with the work location.

Radiological hazards associated with the system include radionuclides present, at what concentrations, and in what chemical form. How is the system being breeched? How is it constructed? What is the material of construction, how is the interior of the system designed, what are the potentials for holdup of radioactive materials and radioactive liquids, and where is it located in the system?

The radiological hazards associated with work operations relate to how the work operation could spread contamination or generate airborne radioactivity, and how the work operation could affect the engineered airborne radioactivity controls. As an example, a circular saw used on highly contaminated surfaces would generate high airborne radioactivity with turbulent air flow patterns. Normal ventilation is designed for laminar flow, such that it would be significantly less effective in capturing airborne radioactivity from a circular saw.

Radiological hazards associated with the work location must be adequately characterized. This should include an understanding of the history of upset conditions that resulted in spread of contamination, including the levels of radioactive contamination that could be present upon exposing surfaces that were contaminated from fires and spills involving radioactive materials.

Once the hazards are understood, the radiological controls are incorporated. These controls may involve elimination or reduction of the hazard by removal of the source term or limiting the amount of source term that is accessible (e.g., decontamination, application of fixatives). These controls also involve proper selection of the work operations (substituting less turbulent work operations where needed), and implementation of engineered controls to keep the hazard away from the worker (use of glove boxes or glove bags, and appropriately engineered ventilation). After reducing the hazards through elimination or reduction of the source term and applying engineered controls, administrative controls and personal protective equipment and clothing (PPE) are used to protect the workers.

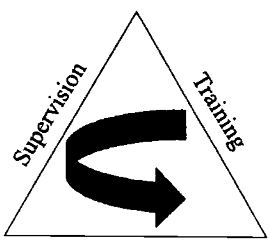
The radiological controls are then implemented using procedures, training and supervision. The sum of the procedures, training and supervision must be adequate to ensure protection of the workers. The higher the hazard and the more complex the work, the more formal the controls that are needed.

At PFP the surveillance team observed deficiencies in multiple areas of the work planning process. The radiological hazards of the work were not properly analyzed. The radiological controls for some high hazard work were less than adequate, relying on PPE in lieu of implementing engineering controls. Personnel, who were not qualified, were found making inappropriate technical decisions in the field (i.e., decisions by first line supervision) that resulted in unplanned personnel exposures to airborne radioactivity.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F01

Less than adequate analysis of hazards has occurred at PFP resulting in airborne radioactivity above the protection factor of the respiratory protection worn and multiple events involving spread of contamination. Investigation revealed a programmatic deficiency in hazards analysis existed (OA 35469).



Requirements:

10 CFR 835.501(b) specifies "The degree of control shall be commensurate with existing and potential radiological hazards within the area."

10 CFR 835.501(d) specifies "Written authorizations shall be required to control entry and perform work within radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards."

10 CFR 835.1102 (b) specifies "Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, radionuclides present, and the fixed

and removable surface contamination levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "...The contractor shall, in the performance of work, ensure that... (5) Before work is performed, the associated hazards are evaluated..."

Discussion:

As discussed in concern S-11-SED-CHPRC-PFP-002-C01 above, radiological work planning needs to understand the hazards associated with the system, work operations and location in order to determine appropriate controls to mitigate the hazards. Multiple examples exist where the hazards were not appropriately analyzed, resulting in airborne radioactivity generation that exceeded the applicable protection factor for the respiratory protection worn and/or spread of contamination. Contrary to the requirements of Dear 970.5223-1, analysis of hazards was less than adequate as discussed below. Contrary to the requirements of 10 CFR 835, radiological controls were not commensurate with potential hazards generated by the work activities as described below:

1. **The hazard associated with using a circular saw to cut a highly internally contaminated glove box was not analyzed, resulting in very high airborne radioactivity that exceeded the respiratory protection factor for airline respirators.**

The work in room 172 of PFP involved cutting up highly internally contaminated glove boxes for disposal. The room is referred to as the chop shop. On December 29, 2010, workers used a circular saw to cut pieces off the back (exposing internals) of Glove box 139-3/4. The airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator worn. The highest level found on the lapel was 7100 Derived Air Concentration (DAC)-hr (0.71 after taking into account the protection factor of the airline respirator). The surveillance team requested a copy of the airborne radioactivity calculations for the work operation that was performed. None was provided.

On January 25, 2011, workers again used a circular saw to size reduce a glove box. The airborne radioactivity levels jumped. The highest DAC-hr value on workers lapel air sampler was 17000 DAC-hr, 1.7 DAC-hr after adjusting for the protection factor of the airline respirator (10,000). Assuming the jump in airborne radioactivity occurred over a five minute period (time between monitoring the air sample filter), the airborne radioactivity level generated by the circular saw was more than 200,000 DAC. This was the second time the work team used a circular saw for size reducing the glove boxes and exceeded the airborne radioactivity limits of the RWP (see OA 35012).

The surveillance team again requested the work planning documentation that would indicate the project had evaluated the airborne radioactivity hazard associated with use of the circular saw. The contractor could not provide any. The contractor facility radiological control manager acknowledged no airborne radioactivity estimate had been made.

- **Investigation revealed PFP radiological work planners routinely did not perform airborne radioactivity estimates to ensure appropriate controls were selected for the work activity.**

Interviews with the radiological work planners at PFP revealed the facility did not evaluate the potential airborne radioactivity levels for use of the circular saw on contaminated glove boxes. In fact, the radiological work planners acknowledged they had never performed airborne radioactivity estimates for work at PFP. The surveillance team reviewed the work planning records for several work packages confirming there were no records of the analysis of the airborne radioactivity hazards for the work reviewed.

After initially requesting the airborne calculations after the December 29, 2010 event, the PFP Director, RHS obtained documentation from another facility on how to perform airborne radioactivity estimates and provided it to the PFP radiological work planners.

A significant contributing factor to this programmatic deficiency was the lack of training and lack of procedures provided by CHPRC that would show the radiological work planner how to analyze the airborne radioactivity hazard to ensure adequate engineered controls and/or respiratory protection are provided (see findings S-11-SED-CHPRC-PFP-002-F05 and S-11-SED-CHPRC-PFP-002-F06). In this case, no respiratory protection had a protection factor high enough for the work. The analysis of the airborne hazard would have demonstrated the need to incorporate engineered controls.

- **The Radiological Hazards Screening Form indicated no airborne radioactivity above 1000 DAC (unmitigated), even though no estimate was performed.**

One of the high hazard radiological work screening criteria is "Will predicted airborne radioactivity concentrations exceed 1000 DAC…." This block is marked no, even though no calculation was performed, and there were no limitations in the procedure on work operations (i.e., any power tool was OK to use) or accessible contamination levels within the glove boxes at the locations being cut. There were no bounds on the radiological conditions of the glove boxes provided to the chop shop except, less than 240 grams of plutonium (Pu). Since airborne radioactivity generation depends on the amount of accessible contamination being disturbed and the work activity disturbing the contamination, there is no technical basis for the conclusion that unmitigated DAC values would be below 1000 DAC. This lack of analysis resulted in repetitive generation of much higher levels of airborne radioactivity at the chop shop.

- **Investigation revealed the effectiveness of the point source ventilation used in the chop shop for removing airborne radioactivity during cutting with the circular saw had not been evaluated by PFP engineering.**

The surveillance team interviewed the design authority for HEPA ventilation and requested a copy of the ventilation calculations that would demonstrate the effectiveness of the spot ventilation when using a circular saw. The project could not produce the calculations and acknowledged that they had not been performed.

Interviews indicated that the ventilation engineers were primarily involved in ensuring the PFP HEPA ventilation system and air flow through the plant was not adversely impacted by changes to the system, and ensuring HEPA ventilation systems for tents were adequate to provide appropriate air changes. Some evaluation of point source ventilation had been performed, but not where turbulent air flow patterns were involved. The engineer provided an example of an evaluation of a point source ventilation calculation with typical laminar flow. The work planning process at PFP did not ensure that engineering was adequately utilized in the work planning process. Since DOE identified this deficiency, there has been greater use of engineered ventilation and participation by engineering in its design.

- **Air monitoring in the chop shop with DAC-hr limiting conditions have kept personnel from getting a significant uptake to date, but has not been a cost effective**

means of performing the work due to multiple shut downs of the work for re-planning.

To control worker exposures to airborne radioactivity, the project incorporated airborne radioactivity void limits. While this process is more of an emergency response, and has minimized the potential dose consequences to the workers to date, it does not control the generation of airborne radioactivity or prevent airborne that exceeds the respiratory protection factor of equipment worn, and creates a highly inefficient work process.

A review of the contractors work records between December 15, 2010 (the start of cutting operations in the chop shop) and March 16, 2011, indicated that work was performed in room 172 for 40 days. Out of those days of work, cutting of glove boxes occurred during 20 days. Airborne radioactivity levels exceeded the radiological work permit DAC-hr limits during 30% (6 out of 20) of the days where glove box cutting occurred. These events resulted in stopping work operations to re-plan work.

- **Continued problems in the chop shop revealed glove boxes were not adequately prepared for safe size reduction; fixatives were not adequately applied before the boxes were removed from the E-4 ventilation system and sent to the chop shop.**

After shut down of the chop shop on March 16, work restarted April 20, 2011, with the first intrusive work performed on April 25, 2011. On that day, airborne radioactivity levels increased and personnel stopped work within a half hour. On the next day, airborne radioactivity levels exceeded the limiting conditions of the RWP. At the post job, workers revealed the glove boxes were not being provided to the chop shop in a condition that would permit safe size reduction. The glove box they were working on had bare metal inside, indicating less than adequate application of fixatives, gloves were not properly rolled up and secured (making fixative application less effective), and pie plates were improperly secured (OA 37140). A review of a sample of glove box removal work packages confirmed there were no quality assurance steps in the procedures to verify adequacy of glove box preparation for the chop shop. Additionally, the chop shop work package contained two "size reduction hand-off checklists", one for glove-box 139-5, and one for 139-6. Both check lists showed the "Contamination fixed inside/outside" block left blank, indicating the action was not completed.

2. **The high contamination hazard associated with exposing and cutting a neoprene gasket exposed to historical releases of airborne radioactivity was not recognized or analyzed resulting in four individuals receiving a low level uptake of plutonium.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with neoprene gasket between rooms 230C/235B. Airborne radioactivity was generated when the neoprene gasket was exposed, cut and swipe surveyed (50,000 dpm alpha). Personnel were not wearing respiratory protection.

Historical records indicated several significant spreads of contamination in room 230 and 235 from undetected glove breeches to explosions and resulting fires. Contamination levels between 2000 and 6×10^6 dpm alpha are described (FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954 – 1997)). Historical records indicated the contractors partially decontaminated the surfaces and then applied paint to fix the contamination, indicating the likelihood of uncovering contamination when exposing previously inaccessible surfaces. PFP has also experienced a greater hazard of loose surface contamination associated with gaskets. For example, on 10/22/10 open air separation of Glove box 139-1/2, exposed previously inaccessible areas and resulted in a spread of contamination when the gasket between glove boxes swung free. On 3/16/11 airborne radioactivity levels increased above the limiting conditions of the RWP for the chop shop when workers cut an area where a gasket had been removed without application of fixative (OA36431).

- **Less than adequate involvement of PFP engineering in the work planning process resulted in incorrect work instructions.**

Work instruction 2Z-09-06644/M WCN2, step 6.10.2, specified "Cut wallboard/Plexiglas panels surrounding Conveyor HC-4 in room 230C & 235B." The wall was not constructed of wallboard, but had stainless steel plates bolted in place around the Plexiglas windows with neoprene gaskets. The wall had been painted over due to the historical spreads of contamination in the area. The engineer did not provide drawings of the wall construction to the work planner, providing a missed opportunity to plan for the hazard associated with a gasket exposed to contamination being uncovered. The surveillance team requested a copy of the engineering drawing associated with the wall. The drawing identified the existence of the neoprene gasket and steel plates.

- **The AMW did not address the hazards associated with removal of a portion of the wall and Plexiglas windows.**

AMW 5549, rev 0, for work package 2Z-09-6644, dated January 26, 2011, did not address the hazards associated with removing a portion of the wall between rooms 230C and 235B The AMW only addressed breaching radioactive systems.

- **CHPRC review of the work package identified the AMW did not address each task, but did not ensure correction of the deficiency prior to releasing the work.**

During the third week of fieldwork, RL requested the contractor perform compensatory actions to shore up weaknesses in the radiological control program at PFP. One of the actions taken by CHPRC was to bring a team in to review the high risk work packages. During this review on March 6, 2011, the CHPRC task team identified the deficiency in the AMW not addressing each task, but no action was taken to correct the issue prior to releasing the work.

- **When the work team performed their workability walk down, the team determined unbolting the steel plates was easier, and safer, but did not make a change to the procedure.**

During the workability walk down prior to performing the work, the work team decided unbolting (vice cutting) the wall would be safer, but no change to the procedure was made. The field work supervisor, in consultation with the lead RCT, determined respiratory protection was not needed since they were not cutting. Unbolting the steel plates, using the wet method, was started with no airborne generation. It was not until the gasket around the Plexiglas window was disturbed that high contamination levels were found (50,000 dpm/swipe alpha), exceeding the limits in the RWP. One low level nasal smear was found, but in performing additional voluntary bioassays, a total of four individuals were found to have had low level uptakes of plutonium (56 person-mrem committed effective dose)).

Failure to obtain a procedure change was a missed opportunity to identify and analyze the hazard. The deficiencies in conduct of operation, and clearly defined roles and responsibilities are addressed in S-11-SED-CHPRC-PFP-002-F11 and S-11-SED-CHPRC-PFP-002-F03 respectively.

3. **Airborne radioactivity generation hazards for Glove box WT-4 size reduction and glove box floor removal was not adequately analyzed, resulting in high airborne radioactivity that exceeded the supplied airline respiratory protection factor.**

Glove box WT-4 is in the control room of the Americium Recovery Facility (242-Z). The work package, 2Z-10-02068, was for removal of glove boxes WT-3, WT-4, and WT-5. On April 6, 2011, airborne radioactivity was generated that exceeded the limits of the radiological work permit (OA 36771), and the respiratory protection factor for the supplied airline respirator.

The airborne radioactivity was generated during use of a crow bar to pry up and remove a polyethylene liner on the floor of the glove box (shown in drawing H-2-24954). The crow bar was used to pry up flashing ("20 GA S STL") used to hold the liner in place, and then to pry up the polyethylene. During the post job, the workers indicated there were some hot spots (4-5 rem/hr) on the floor of the glove box, indicating very high levels of contamination. The airborne radioactivity hazard associated with the activity of scraping on this highly contaminated surface was not analyzed.

4. **Inadequate analysis of material compatibility results in a spill of an acidic plutonium material; additionally, a precursor event was not appropriately analyzed.**

Work package 2Z-10-0679, involved removing plutonium chemical transfer lines. These lines contained three individual lines inside a protective pipe. The packaging included insertion of a rubber plug to hold the three chemical transfer lines in place within the protective pipe. A red cap was placed over the pipe end to prevent the sharp ends of the pipe cut from damaging the packaging. The cut pipe was "horse tailed" out of the glove bag containment (poly-vinyl-chloride (PVC) sleeve) and sealed using duct tape. A reinforced bag was placed over the horse tail, and sealed with "chem" tape. Then a PVC rigid cap is placed over that and secured with "chem" tape.

The team had successfully made 17 cuts using glove bags (engineered barrier), but found some liquid (described as runny like water) in two cuts made prior to the events described herein.

On 3/30/2011, while performing post job surveys, an RCT identified 600,000 dpm/100cm^2 alpha contamination on the bottom of a packaged pipe end. Even though the contamination was found on the bottom of the pipe, where the PVC rigid cap (sealed with "chem." tape) meets the pipe, the work team did not recognize this as an indicator of a breach of the sealing system. While recovering from this event, a second cut in the system, with the same packaging system, sat an additional six days.

On 4/6/2011, the second pipe end was flipped up to drain the pipe into the glove bag. As workers exited the area, six persons were found to have contamination on their PPE. Contamination above the limiting condition of the RWP was found on surfaces in the exit path. The full extent of the spread of contamination was not understood until a recovery team entered. A visible spill of a thick (honey like) brown plutonium substance was found. Contamination in the spill area was as high as 150,000,000 dpm/100cm^2 alpha. The floor in the area contained crevices, complicating clean-up. Disposable surfaces below the work area to protect the floor in case of a spill, were not adequately used during the job. A partial decontamination was performed and the area painted over to fix the contamination.

The work team believes the plutonium acidic material broke through the adhesive in the tape, spilling out of the sleeve onto the floor. RL requested the Project's D&D engineer to provide the chemical compatibility information for the tape used. The information provided to RL from the manufacturer showed it was not rated for nitric acid (expected chemical form in the pipe). Discussions with the field work supervisor indicated they were not aware of any specific time limitations to maintain a satisfactory seal due to the nitric acid that was anticipated.

5. **Inadequate hazards analysis results in workers drilling into the E-3 HEPA ventilation ducting.**

On April 7, 2011, workers, installing anchors in room 235B, inadvertently drilled into the contaminated E-3 HEPA filtered ventilation duct located inside the wall. The E-3 duct is a void in the wall, thus it contains no metal. The work planning was less than adequate in that drawings that show the location of the E-3 ventilation were not appropriately used in determining the location of the anchors (OA 36775).

6. **Less than adequate analysis of hazards results in airborne radioactivity release while breaking a bagged Pyrex tank.**

On January 27, 2011, a Pyrex tank was removed from glove box 522. The bagged tank was too big to fit into the 55-gallon waste drum. The workers attempted to size reduce the Pyrex tank by padding the tank and hitting it with a pipe wrench. The bag holding the tank was breeched, resulting in high airborne radioactivity and continuous airborne radioactivity monitor (CAM) alarm. (OA 35484)

7. **Deficiencies in analysis of hazards extend beyond radiation protection. A potential fire was narrowly averted when a worker questioned cutting on a pipe containing plutonium contaminated combustible material.**

During interviews of personnel, workers reported a near miss that occurred in January of 2011. Work package 2Z-10-07673, Separate Glove box 100C from Glove box 200 in room 235D, specified cutting a hydraulic ram that was filled with plutonium contaminated combustible waste (paper, plastic and miscellaneous step off pad waste). At the pre-job briefing a worker raised a concern regarding the potential for the heat generated by the blade during the cutting reaching temperatures that could ignite the material inside the pipe. When the concern was raised, a mock-up was performed and the mock-up demonstrated the cutting operation started a fire.

The contractor issued a lessons learned praising the workers attentiveness and questioning attitude. However, corrective actions for preventing recurrence of the inadequate hazard analysis were not identified.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F02

Scope of Work was not always adequately defined at the activity level for hazards analysis, resulting in less than adequate radiological controls identification and implementation.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (c), specifies "The contractor shall manage and perform work in accordance with a documented Safety Management System (System)…. Documentation of the System shall describe how the contractor will: (1) Define the scope of work…."

PRC-MP-MS-003, Integrated Safety Management System/Environmental Management System Description (ISMSD), section 3.1 Define Scope of Work, third paragraph, specifies "Work identified in the [work breakdown structure] is further divided into discrete tasks that are individually planned for execution using PRC-PRO-WKM-12115, Work Management, which describes the process for initiating, authorizing, performing, and conducting field work."

PRC-PRO-WKM-12115, Work Management, section 3.2.3, Plan Work, Step 19 states "...State the precise scope of work, including the methods of performing the work.... The scope description must be detailed enough to support the development of effective and accurate hazard controls for the proposed work activity.... Work steps provide the sequence and technical information for the work team to accomplish work that was described in the scope statement. The [field work supervisor] is responsible to direct the work team in a manner that complies with the approved instructions...."

PRC-PRO-WKM-079, section 3.1 Review the work scope, states "1. REVIEW work scope to be sure it is adequately defined.... 2. IF the work scope is not adequately defined, THEN UPDATE work scope in accordance with PRO-WKM-12115 or PRC-PRO-MS-589."

Discussion:

As discussed in the concern above, analysis of hazards includes the hazards associated with the system being breached, the work operations performed, and the location of the work. To appropriately analyze the hazards of the work at the activity level, the work scope must be clearly defined. This means the individuals analyzing the hazards must know the details of how the job will be performed. As specified in PRC-PRO-WKM-12115, the work scope description must be detailed enough to support the development of effective and accurate hazards controls for the proposed work activity.

Less than adequate hazards analysis and implementation of controls is in part a result of less than adequate definition of the work scope. Contrary to the requirements above, scope of work was not always clearly defined. Examples of less than adequate definition of work scope from Finding S-11-SED-CHPRC-PFP-002-F01, include:

- **Work scope definition/limitations for size reduction of Glove box 522 Pyrex tanks was not adequate, and therefore adequate controls were not established to prevent an airborne radioactivity release (OA 35484).**

Airborne radioactivity was generated 1/27/11, room 152 when workers attempted to size reduce a Pyrex tank from Glove box 522 by padding it on the outside of its containment bag, and then striking it with a pipe wrench. This work activity was not identified in the work package. The work instruction in (2Z-10-03825) in general, and section 6.4.2.4 (disconnect/removal of Pyrex tanks) in particular, did not identify a need, option, or instructions to size-reduce the Pyrex tank, to fit it into the waste container.

- **Work scope definition for removing Plexiglas windows with radioactively contaminated neoprene gaskets between PFP room 230C and 235B was not adequate.**

On March 28, 2011, four individuals received small uptakes of plutonium while disassembling a Plexiglas window with a neoprene gasket between rooms 230C/235B. The procedure did not adequately define the scope of work.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F03

The "flexible" Decontamination and Demolition (D&D) work packages resulted in "flexible" radiological controls in the work packages, which resulted in the actual controls being determined in the field by individuals not qualified in radiological hazards analysis resulting in inadequate hazards controls. Roles and responsibilities for determining radiological controls were not clearly defined.

Requirements:

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that...(2) Clear and unambiguous lines of authority and responsibility for ensuring (ES&H) are established and maintained at all organizational levels."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "The contractor shall, in the performance of work, ensure that... (3) Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities."

Discussion:

Contrary to the requirements above, for clearly defined roles and responsibilities, these roles and responsibilities were not clearly defined in the area of who determined the radiological controls implemented for work.

The surveillance team interviewed more than 40 individuals involved in work planning, including work planners, radiological work planners, lead RCTs, RCSs, FWSs, project managers, safety and health managers, a radiation protection corporate mentor, and some radiation protection personnel that left PFP to work elsewhere. Additionally, the team interfaced with workers during observation of work planning processes.

Interviews revealed that there was a lot of frustration felt by both workers and managers that was a result of work planning being performed in the field, instead of being planned up front. Disagreements on the appropriate radiological controls to implement for a work activity resulted in everything from work stoppages, to implementation of inadequate controls.

- **Work packages were built with "flexibility", so the procedure would not tie the work team down as to how the work was performed; Radiological controls were "flexible" to accommodate decisions on how to do the work in the field.**

The work team and management expressed the desire for flexibility in how the work was performed, letting this be skilled based. Consequently, the radiological work planners specified "flexible" radiological controls in the work packages. This resulted in management abdication of their responsibility for hazards assessment and controls.

Some examples include generic instructions such as:

'Chop shop: 2Z-10-05648, room 172 size reduction operations, 6.2.5 "Perform size reduction activities using power tools (i.e., nibbler, sawzall, circular saw, bandsaw) on hood/glove box/ducting.... Move point source ventilation as needed for contamination control during cutting.... Implement contamination control, as needed, using hand held fogging unit...."

2Z-09-3291, Rm 139 Glove Box Removal, section 4.6 "Use wet methods, sleeving and/or HEPA filtered spot ventilation to control contamination, as necessary."

Work package 2Z-10-2115/M, 4.6.4 included the following, "Wet towels, HEPA vacuum, glove bags/sleeving and or catch bags shall be used as the main engineering controls during the task as necessary."

When RL debriefed the contractor on preliminary findings, RL requested CHPRC to implement compensatory actions to shore up the radiation protection organization at PFP. One of the compensatory actions was to review high risk work packages for adequacy of radiological controls.

- **Roles and Responsibilities for the FWSs, lead RCTs, and other craft work team members are not intended to include radiological hazards analysis. Radiological training programs for these individuals did not include this qualification.**

The absence of specific radiological hazard controls in work instructions/packages resulted in radiological hazard control decisions being done by the field work team. These individuals were not technically qualified to analyze radiological hazards.

While the FWSs and lead RCTs have extensive experience in their roles, the surveillance team review of the FWS and RCT training revealed it was less than adequate to qualify them for radiological hazards analysis and control. The FWS training and qualification in radiological subject areas was limited to Radiological Worker II training. Radiological Worker II did not provide qualification on radiological hazard analysis and control selection. The surveillance team reviewed the RCT training, which is based on the DOE training standards. While the level of training exceeds radiological worker II training, RCT training objectives were not intended or designed to provide qualification on radiological hazards analysis and selection of engineered controls for work. The surveillance team also found that the training for lead RCTs did not include additional hazard analysis and control topics. The training reviewed for FWSs and RCTs did not include appropriate education, training, and skills to discharge these responsibilities, specifically the radiological hazard analysis and selection of engineered controls.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F04

Engineering controls were not adequately incorporated to control airborne radioactivity and spread of contamination for some work activities, resulting in high airborne radioactivity and spreads of contamination. Engineering staff were not always adequately engaged in the radiological engineering of the work.

Requirements:

10 CFR 835.1001 Design and control, (a) specifies "Measures shall be taken to maintain

radiation exposure in controlled areas ALARA through engineered and administrative controls. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure."

10 CFR 835.1002 Facility design and modifications, (c) specifies "Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used."

10 CFR 835.1003 Workplace controls specifies "During routine operations, the combination of engineered and administrative controls shall provide that...(b) The ALARA process is utilized for personnel exposures to ionizing radiation."

DEAR 970.5223-1, Integration of environment, safety, and health into work planning and execution, paragraph (b) specifies "...The contractor shall, in the performance of work, ensure that...(6) Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures."

Discussion:

Engineering controls are required to be the first line of defense against airborne radioactivity and spread of contamination. Some work teams have appropriately performed work activities using glove bags and glove boxes, to keep the worker from being exposed to the source of contamination.

Contrary to the requirements of 10 CFR 835, engineering controls were not adequately incorporated for some work projects. Examples of poor use of engineering controls include:

- **Less than adequate use of engineering controls at the chop shop**

Work in the chop shop directly exposes personnel to high contamination levels inside glove boxes that are not designed for human entry. The chop shop and the work performed there was not properly designed up front with adequate engineering controls. As a result, airborne radioactivity levels exceeded the respiratory protection factor for the airline respirator multiple times, and the project continually struggled with back fitting radiological controls. The facility did not use the glove box itself, and the facility ventilation system (E-4), to adequately reduce the hazards prior to disconnection from the E-4 system and transporting the glove boxes to the chop shop, nor designed the chop shop facility for size reducing the glove boxes inside an engineered barrier (glove box or engineered ventilation hood).

- **Less than adequate use of engineered ventilation in general, and less than adequate involvement of engineering in the design of spot ventilation.**

Engineered ventilation was not always used. An example included scraping of the polyethylene liner with high dose rates, indicative of high contamination, at the bottom of glove box WT-4, without engineered spot ventilation (see Finding S-11-SED-CHPRC-PFP-002-F01).

Spot ventilation being used at the facility was not always adequately designed to meet its intended use. Elephant trunks and HEPA filtered vacuum cleaners had been used, but were not always adequate. Examples include the use of an elephant trunk for engineered ventilation while cutting a glove box with a circular saw (see Finding S-11-SED-CHPRC-PFP-002-F01).

As the RL surveillance progressed, more involvement of the ventilation engineer in spot source ventilation design was observed. A corporate mentor had previously brought up the need for PFP to use a B-box, a spot ventilation used at Rocky Flats. Facility action was not observed by the surveillance team until compensatory actions to shore up the radiological controls at PFP were implemented by the contractor.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**
Finding: S-11-SED-CHPRC-PFP-002-F05

Training and qualification of radiological work planners was found less than adequate. Training did not adequately cover applied radiological hazards analysis.

Requirements:

10 CFR 835.103 Education, Training and Skills, specifies "Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this part shall have the appropriate education, training, and skills to discharge these responsibilities."

CHPRC-00072, Appendix A, Policy and Commitment Basis for 835.103 specifies "CHPRC shall [835.103] identify positions that develop and implement measures necessary to comply with 10 CFR 835. At a minimum, this includes those individuals filling the following positions.... Facility/Project Rad Con technical staff...."

Discussion:

Training and qualification of radiological work planners did not ensure that individuals, who were determining and implementing radiological controls, were appropriately trained and qualified to perform applied radiological hazards analysis. Although these individuals met the educational requirements of CRD 5480.20A and DOE-STD-1107-97, contrary to 10 CFR 835.103, the CHPRC training did not ensure the individuals had all the skills necessary to discharge their assigned responsibilities in the area of applied hazards analysis.

- **The Radiological Control Work Planning training course did not adequately address applied hazards analysis.**

Course number 022801, Planning Radiological Work – Initial, section F, Purpose and Overview, specifies "This course does not attempt to teach radiological work planning...." The course does not teach how to plan work, nor does it provide instruction on how to perform applied hazard analysis.

Some radiological work planners were RCTs that were promoted to work planners. The RCT qualification program does not teach personnel applied radiological hazards analysis. There was no documented training or demonstration of knowledge on how to perform applied hazard analysis prior to assignment as a radiological work planner.

The primary emphasis of course 022801 is to teach the radiological work planners how to fill out the radiological hazards screening and ALARA Management Worksheet forms to support the work management process. The course contains general discussion on factors affecting radiological hazards, but does not adequately cover practical application of hazards analysis and selection of controls.

- **Radiological work planner training did not demonstrate how to perform airborne radioactivity estimates based on contamination levels, work operations, and application of airborne radioactivity controls.**

A review of radiological work planning training documents and interviews found that the training did not provide adequate instruction on how to predict airborne concentrations. The training materials directed the trainee to use the facility Technical Evaluation (TE) to predict airborne concentration. The PFP TE did not contain guidance on how to estimate airborne concentrations. The training material did not demonstrate how to perform these airborne radioactivity calculations.

- **Selection of appropriate respiratory protection requires the ability to calculate airborne estimates.**

The radiological work planning course does not show the work planner how to select respiratory protection based on estimated airborne radioactivity levels.

- **Radiological work planning training did not adequately cover limitations of HEPA filtered ventilation as an engineered control.**

Interviews found that staff did not understand the limitations of ventilation as an engineered control. Personnel did not demonstrate an understanding that ventilation is typically designed for laminar flow. Ventilation is significantly less effective when generating turbulent air flow patterns, such as those created with a circular saw. This is important to understand, so that radiological work planners do not specify ineffective controls.

The radiological work planner training course did not cover the technical aspects of engineered ventilation or the need to engage engineering in its design.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F06

PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning. The CHPRC technical basis document for workplace air monitoring did not address estimating airborne radioactivity levels for hazard analysis and work planning.

Requirements:

10 CFR 835.104 Written Procedures, specifies "Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards."

Discussion:

The surveillance team reviewed the CHPRC and PFP list of procedures on line and technical basis documents. PFP did not have a procedure on how to perform airborne radioactivity estimates for hazards analysis and work planning. The CHPRC had a technical basis document for workplace air monitoring. This technical basis document included formulas to determine if air sampling is required. The technical basis document did not specifically address estimating airborne radioactivity levels for hazards analysis and work planning. Contrary to the requirements of 10CFR835.104, CHPRC did not have adequate procedures for airborne radioactivity estimates for hazards analysis and work planning, consistent with the education, training and skills of the individuals performing the hazards analysis.

Airborne radioactivity estimates were needed to complete the Radiological Work Screening process (PRC-PRO-RP-40108, "Radiological Hazard Screening," and Site form A-6004-654). Some CHPRC projects and other Hanford Site contractors had procedures for performing airborne radioactivity calculations for hazards analysis and work planning. After the deficiency in performing airborne radioactivity calculations was identified by RL, PFP obtained another CHPRC project's methodology for performing airborne radioactivity calculations to develop their own instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F07

The contractor's radiological staffing resources were less than adequate to accommodate personnel losses and planned accelerated decontamination and demolition work

Requirements:

CRD O 5480.19 Chg 2 (Supp Rev 4) Conduct of Operations Requirements for DOE Facilities Chapter I, Operations Organization Administration: C. Guidelines; (2) Resources: specifies "The operations supervisor for DOE facilities should be provided with sufficient... personnel to accomplish assigned tasks without requiring excessive overtime by the operations staff. These resources should include technical personnel needed to support the operations. A long-range staffing plan that anticipates personnel losses should be developed and implemented."

Discussion:

In decontamination and decommissioning of a facility, an increased level of radiological risk and potential for rapidly changing conditions are expected. Multiple systems are being breached, facility engineered controls are being deactivated, etc. Planning for appropriate additional staff is critical to effectively handle the increased work and continual changes in facility conditions.

Contrary to the requirements above, the contractor did not ensure adequate radiological staffing resources at PFP.

- **PFP experienced the loss of the facility RadCon Manager, a key position, in June 2010 and did not permanently replace the manager until March 7, 2011.**

The lack of priority and urgency in filling this key position for a high risk and accelerated project demonstrated less than adequate planning and response to key personnel losses. The high risk and accelerated nature of PFP work should have driven a more expedient permanent replacement for this key role. For approximately eight months, the project did not have a permanent RadCon

Manager.

PFP assigned personnel as temporary radiological control managers. The RHS Director intermittently acted as RadCon manager. However, the RHS Director's other duties combined with the RadCon organization's span of control, made this approach less than adequate. For five months (August through December), the facility had a central RadCon staff member acting in a temporary capacity. After the central RadCon staff member went back to the central organization, the radiological control manager position was rotated among the radiological control supervisors. Experience shows personnel in a temporary position are not as effective because staff know they are temporary.

- **There was insufficient radiological technical staff to adequately manage the work planning process.**

The radiological work planner and engineers need to be an integral part of the work planning team. They need to be there at the start of the work planning, providing input into how the work is performed from a risk assessment perspective. If the work operations are not clearly defined during the planning, hazards assessments may not be accurate, as was observed for some work activities during this surveillance. This contributed to the adverse outcomes realized during work (e.g., RWP voids, high airborne generation, contamination spreads, and radiological uptakes).

At the start of this surveillance, the project had three radiological work planners. This resource level was not adequate to support work planning based on the level of hazards in the facility and the pace of work at PFP. Based on organizational chart reviews and interviews, the three radiological work planners supported approximately twenty-six line work planners.

- **Insufficient numbers of radiological work planners did not permit adequate engagement of the work planner during performance of work.**

The radiological work planners need to be engaged during performance of the work. Field presence by radiological technical support and work planners helps to validate and ensure that radiological controls are implemented as intended. As the level of flexibility in work operations and changing conditions increase, field observations provide for early recognition and correction of potential inadequacies in engineered controls. The shortage of radiological work planners resulted in their limited field presence. Lack of observation of the implementation of controls in the field represents a program weakness and a missed feedback opportunity.

In response to the RL surveillance, the contractor added a radiological engineering manager and additional radiological work planners at PFP.

- **PFP had insufficient numbers of first line radiological control supervisors (RCS) to effectively support radiological work.**

A review of the PFP organizational chart and interviews with the PFP RCS found that approximately 102 RCTs were supervised by five RCS. Interviews indicated the following. One of these RCS had double duty as PFP's acting radiological control manager. One of the RCS was assigned Duty RCS for making personnel assignments, responding to emergencies, and completing other administrative duties. Additionally, RCSs review completed radiological surveys. As a result, only two RCS were typically available to oversee the ongoing work. The ratio of RCTs to RCS was very high considering the level of radiological hazard associated with the work at PFP.

Since RL identified the overall weaknesses in radiological staffing at PFP, the contractor has increased the number of RCS.

- **Fifty percent of the RCTs at PFP were junior.**

Interviews with personnel indicated fifty percent of the RCTs at PFP were junior, meaning they were not qualified to work alone on high risk work activities and required more oversight by the lead RCTs on the work team.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F08

The HCND was not assigned to multiple individuals that met the criteria for monitoring as specified in the Hanford technical basis document. The CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual (OA 36921).

Requirements:

10 CFR 835, Subpart E-Monitoring of Individuals and Areas, Article 835.401(b) "Instruments and equipment used for monitoring shall be... (2) Appropriate for the type(s), levels, and energies of the radiation(s) encountered..."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section F External Dosimetry, paragraph 3, specifies "The contractor shall participate in the development and maintenance of a Hanford site-wide external dosimetry basis document. The contractor's external dosimetry program shall be performed in accordance with this technical basis document."

PNNL-15750 Rev. 1, PNL-MA-842, Hanford External Dosimetry Technical Basis Manual, section 6.3, Selection of Dosimeter Types to Use, specifies "Individuals who are likely to receive Hp(10)n greater than 100 mrem per year should be issued a HCND, which provides a more accurate measurement of neutron dose. In addition, individuals who routinely have Hp(10)n greater than 100 mrem per year reported on an [Hanford Standard Dosimeter (HSD)] should be issued a HCND."

Discussion:

The surveillance team reviewed the CHPRC deficiency reports for PFP. Multiple deficiency reports identified "HSD over-response to neutrons" from personnel wearing the HSD at PFP. RL investigated the issue and found it to be programmatic at CHPRC.

Contrary to 10 CFR 835.401(b), some individuals that met the regulatory criteria for monitoring, a dose of 100 mrem in a year, were assigned a HSD in lieu of the HCND. The HSD is not appropriate for monitoring neutrons with the range of energy levels of neutrons at PFP.

The HSD can measure neutron, and is U.S. Department of Energy (DOE) Laboratory Accreditation Program (DOELAP) accredited based on its response to a bare californium neutron source (fast neutron). The HSD over-responds to a moderated neutron flux. Depending on the neutron energy where the individual was exposed, correction factors between 2 and 5 were used. At PFP, the energy levels of the neutrons vary depending on location. The HCND is a neutron dosimeter which has multiple thermoluminescent dosimeters (TLDs) inside that respond to different neutron energy levels and thus more accurately measure neutron dose, but costs more.

CHPRC reduced the numbers of personnel monitored with HCND to reduce costs. The HSD costs $45.00 to process, while the HCND costs $68.00 to process (data from DOE Dosimetry point of contact). This cost is less than the contractor's estimated man-hours costs taken to investigate and correct the neutron dose.

In the process of reducing the number of personnel assigned a HCND, individuals who should have been wearing the combination neutron dosimeter were not appropriately monitored in accordance with 10 CFR 835.401(b) and the Hanford External Dosimetry Technical Basis.

In 2010, CHPRC processed 119 EDIRs to correct the neutron reading from a HSD. Many more individual dose records were reviewed for high neutron doses, where doses indicated personnel should have been assigned a HCND, but were not, and the project decided not to make a change in the individual's dose of record.

Contrary to the requirements of DOE/RL-2002-12, the CHPRC procedure did not fully incorporate monitoring criteria from the Hanford External Dosimetry Technical Basis Manual. A review of the CHPRC External Dosimetry Program, PRC-PRO-RP-379, revealed the document is inconsistent with the Hanford External Dosimetry Technical Basis Document. While PNL-MA-842 specifies personnel who routinely have neutron dose, as reported on an HSD, should be issued a HCND, CHPRC has not implemented this in their External Dosimetry Program. PRC-PRO-RP-379, section 3.15, step 5, only specifies to change the dosimeter from a HSD to a HCND if the corrected neutron dose (vice reported dose) is greater than 100 mrem.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F09

Technical errors were identified in five out of nineteen EDIRs.

Requirements:

PRC-PRO-RP-379, External Dosimetry Program, section 3.15, Neutron Correction to HSD Measurements, step 2 specifies "IF calendar year-to-date (CTD) uncorrected neutron exposure is [greater than or equal to] 100 mrem, THEN correct readings using the following correction factors: PFP = 2, ISA = 5, Others = 3." "Note: Justification is required in the project's technical equivalent document if there is a deviation from the given correction factors per project." Step 3 specifies "IF corrected exposure is ≥ 100 mrem or if record correction is desired, THEN NOTIFY [Dosimetry Operations] AND REQUEST an EDIR number, AND COMPLETE AND SUBMIT [EDIR] to correct the recorded dose."

10 CFR 830.122 Quality Assurance Criteria (c) specifies "Criterion 3 Management/Quality Improvement (1) Establish and implement processes to detect and prevent quality problems. (2) Identify, control, and correct items, services, and processes that do not meet established requirements. (3) Identify causes of problems and work to prevent recurrence as a part of correcting the problem. (4) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement."

DOE/RL-2002-12, Hanford Radiological Health and Safety Document, section J, Radiological Records, paragraph 2, specifies "The contractor shall ensure that permanent radiological records are accurate…."

Discussion:

The surveillance team reviewed 19 out of 119 EDIR that involved adjusting neutron doses from the HSD readings. Contrary to the requirements of DOE/RL-2002-12, technical errors (math errors, wrong radiation type, zeroing dose without adequate technical justification) were identified in five out of 19 (26 percent) of the EDIRs. There were other potential issues in 4 other EDIRs reviewed. The following technical errors were identified:

- **Several EDIRs contained math errors.**

EDIR-10-223 divided 20 mrem neutron by a correction factor of 3, and specified the corrected dose as 3 mrem neutron (20 divided by 3 is 6.67, or rounded to the nearest mrem is 7 mrem, not 3 mrem). EDIR-10-077 took 60 mrem neutron divided by a correction factor of 3 and said the resulting dose was 17 mrem neutron. EDIR-10-179 erroneously added the gamma dose to the neutron dose when correcting the neutron dose (520 neutron +53 gamma = 573; 573 divided by 2 = 287). The corrected neutron dose should have been 520 divided by 2 = 260 mrem neutron.

- **One workers dose was corrected twice, but the dose was assigned as neutron vice gamma.**

EDIR-10-060 information from the facility did not specify the type of radiation, nor was a radiation survey record attached. The worker had been taking photographs in PFP A-labs, for a total of two hours, and lost his HSD. The EDIR specified general radiation levels in A labs as 0.5 mrem/hr, but did not specify whether that was gamma radiation vice neutron. PFP general area radiation levels are both gamma and neutron in most places, and 0.5 mrem/hr is the typical minimum detectable activity (MDA) of the gamma dose reading instrument. The 0.5 mrem/hr dose rate was likely a gamma reading based on the location, A-Labs. The EDIR should have contained both gamma and neutron dose rates for preparation of the dose estimate. The first time the dose was corrected, a math error was made, 2 hrs times 0.5 mrem per hr, was recorded as 2 mrem neutron. The contractor caught the math error and changed the dose to 1 mrem neutron, but did not catch the error of no radiation type being specified by the facility providing the dose rate data.

- **A neutron dose record indicating 31 mrem neutron was changed to zero (see EDIR-10-176).**

The 31 mrem recorded neutron was corrected by dividing by 3 (10 mrem neutron), but then recorded as zero, without appropriate technical justification. Discussions with PNNL dosimetry program technical personnel indicated recording this corrected neutron dose as zero was not consistent with the Hanford external dosimetry technical basis manual.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F10

Airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure

individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclide intakes in a year were appropriately monitored through the internal dosimetry program.

Requirements:

10 CFR 835.403 Air monitoring, specifies "(a) Monitoring of airborne radioactivity shall be performed (1) Where an individual is likely to receive an exposure of 40 or more [Derived-Air Concentration (DAC)]-hours in a year…." Monitoring per the definition in 10 CFR 835, includes analysis of the data.

10 CFR 835.402 (c) specifies "For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs (including routine bioassay programs) shall be conducted for: (1) radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year…."

Discussion:

Contrary to the requirements above, airborne radioactivity monitoring results at PFP were not adequately reviewed to ensure individuals likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclides intakes in a year were appropriately monitored through the internal dosimetry program.

The surveillance team reviewed four quarterly PFP workplace Air Monitoring Tracking and Trending Reports (Calendar year 2010). This review was performed in response to an earlier discovery of the tracking and trending not being performed (OA 33986) and an employee concern at PFP over the sporadic elevations of airborne radioactivity in the plant.

- **PFP Closure Project Workplace Air Monitoring Tracking and Trending reports identify locations with unexplained elevated airborne radioactivity above one DAC-hr.**

The surveillance team verified that Workplace Air Monitoring Tracking and Trending Reports have identified areas with sporadic unexplained elevated airborne radioactivity. As an example, the Third Quarter 2010 PFP Closure Project Workplace Air Monitoring Tracking and Trending Report identified six areas with greater than 1 DAC-hr airborne radioactivity. The third quarter 2010 report did not provide any actions taken to ensure unmonitored personnel receive less than 40 DAC-hr (100 mrem internal dose) in a year, or actions taken to monitor exposed individuals through bioassay or a DAC-hr tracking program.

- **The third and fourth quarter reports did not contain any trending data for locations with elevated airborne radioactivity.**

Review of the third and fourth Air Monitoring Tracking and Trending Reports confirmed they did not include any trending data for the locations with elevated airborne radioactivity. Interviews with radiological control technical staff indicated the staffing shortages were a major contributor to the task not being completed.

After RL expressed concern over the shortage of radiological technical staff at PFP, CHPRC added staffing to shore up the radiological control program. An individual with expertise in airborne radioactivity monitoring programs performed a trending analysis for data from March 2010 through March 2011 to complete the missing analyses.

- **The PFP administrative trigger level for investigating elevated airborne radioactivity was 1 DAC-hr in a week (50 DAC-hr per year for a 50 week work year), which was inconsistent with 40 DAC-hr in a year regulatory requirement.**

A fixed head air monitor draws airborne radioactivity into it and collects the contamination on a filter. When the filter is counted, the contamination is a direct measure of DAC-hr. The airborne radioactivity could have occurred in a short period of time as a result of a work activity, or be the collection of ambient low level airborne radioactivity. Assuming the airborne radioactivity actually occurs when people are in the area as a result of their activities, 40 DAC-hr per year would be 0.8 DAC-hr per week (for 50 work weeks in a year). It is unclear why the facility has used a higher trigger for investigation than that which ensures compliance with 10 CFR 835.

- **Airborne radioactivity area (ARA) posting at PFP goes up and down daily, it is not clear how the air monitoring program verifies personnel not in respiratory protection receive less than 100 mrem internal dose (40 DAC-hr) in a year when these areas are not posted ARA.**

Interviews with the radiological control technical staff and reviews of the quarterly workplace air monitoring tracking and trending reports revealed the fixed head air monitors run both during the period when the area is not a posted airborne radioactivity area and during airborne radioactivity work. When high fixed head airborne radioactivity levels are reported, the radiological technical staff indicated they send an e-mail to the radiological control supervisors to determine what work went on in the area. If airborne radioactivity work occurred, this is identified in the report. It is unclear how this process ensures personnel who are not monitored for internal exposure and are not wearing respiratory protection, do not exceed 100 mrem internal dose in a year.

RL Lead Assessor Closure Required: YES[X] NO [ ]

Finding: S-11-SED-CHPRC-PFP-002-F11

Less than adequate conduct of operations was observed. Failures to follow procedure contributed to generation of airborne radioactivity and low level uptakes.

Requirements:

10 CFR 830.122 Quality assurance criteria, (e) Criterion 5 Performance/work processes (1) specifies "Perform work consistent with technical standards, administrative controls and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means."

DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities, Chapter XVI Operations Procedures, B. Discussion, specifies "...operations procedures should be sufficiently detailed to perform the required functions without direct supervision.... Operators should not be expected to compensate for shortcomings in such procedures... C. Guidelines ...7. Procedure Use,... Facility operation should be conducted in accordance with applicable procedures... If procedures are deficient, a procedure change should be initiated...."

Discussion:

The surveillance team observed post job reviews and critiques. A contributing factor to events was poor conduct of operations. Contrary to the requirements above, the following are examples of personnel not following appropriate requirements for use of procedures:

- **Less than adequate conduct of operations contributed to personnel receiving low level uptakes during removal of a Plexiglas window between PFP rooms 230C and 235B.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, the work team identified the wall surrounding the Plexiglas windows was made of stainless steel sheets bolted in place. The team decided to unbolt the stainless steel plates in lieu of cutting as identified in the procedure. Because of the perceived safer condition, the FWS and lead RCT decided respiratory protection was not needed. The work team did not make an appropriate change to the work package prior to performing the work. An unanalyzed hazard associated with contamination on the gasket around the Plexiglas window resulted in four low level uptakes.

- **Personnel observed not following controls established in the procedure contributed to generation of airborne radioactivity above the respiratory protection factor of the airline respirator at the chop shop.**

As discussed in Finding S-11-SED-CHPRC-PFP-002-F01, airborne radioactivity levels during work in chop shop repetitively exceeded respiratory protection factors of the airline respirator. The facility modified the chop shop work package to add additional radiological work instructions on March 10, 2011. When the chop shop work team commenced work on March 16, 2011, the corporate radiological control mentor identified workers had not implemented several of the radiological control requirements in the procedure. Airborne radioactivity levels exceeded the RWP limits for airborne radioactivity and work was stopped.

- **Personnel did not stop when Pyrex tank did not fit into 55 gallon drum. Unplanned work resulted in airborne radioactivity and spread of contamination (OA 35484).**

The work instruction (2Z-10-03825) for preparation of glove box 522 for removal did not identify a need, option, or instructions to size reduce a Pyrex tank in the glove box. The Pyrex tank was sleeved out of the glove box, but did not fit into the 55 gallon drum staged for its disposal. When personnel in the field concluded the tank should be size reduced, they did not recognize work instructions and controls should have been specified and approved prior to performing the actions they took to size reduce the tank. While attempting to break the Pyrex tank with a pipe wrench, a release of airborne radioactivity occurred when the sleeving around the tank was breeched.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Finding: S-11-SED-CHPRC-PFP-002-F12

Required radiological hazard controls for work were not consistently documented on the AMW as specified by the form's instructions.

Requirements:

10 CFR 830.122(c)(1) Establish and implement processes to detect and prevent quality problems.

Form A-6004-634 specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

Discussion:

The AMW documents the radiological considerations, analysis, and controls to be incorporated for high and medium risk radiological work. Contrary to the requirements in Form A-6004-634, documentation on the AMW Part II, Radiological Protective Measures/Considerations was not consistently completed per the form's instructions. The AMW form specifies, "If there are radiological controls to be incorporated into the work instructions then check the box on the left and identify all radiological controls that are to be incorporated into the work instructions with BOLD lettering. These instructions/controls will be in the work document, procedure, or instructions, not in supporting documentation or permits."

The surveillance team reviewed seven released complete work packages supplied by PFP; the AMWs associated with these work packages did not fully follow the previously stated instruction. The surveillance team found sections on each AMW where the radiological work planner checked, "Incorporate into work instruction," without any text being bolded for inclusion. Failure to follow the forms instructions, e.g., lack of bold text, potentially contributed to the less than adequate inclusion of intended controls in work instructions.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O01

Job Specific RWPs were written broadly and generically to cover multiple work packages.

Discussion:

As part of the PFP work planning surveillance, the team noted that RWPs were written to cover multiple work packages and were broad and general in nature. An example of this is RWP Z-005, "Perform Glove box Work Activities (As per Listed Work Procedures), Handling/Movement of Radioactive Material, Low Level Waste Handling & Disposal and Minor Decontamination." This RWP had been revised 72 times, covered six PFP procedures and 28 work packages.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O02

The facility's technical basis for use of plutonium values as an indicator of when to perform beryllium monitoring did not identify and evaluate plutonium-beryllium sources, as a potential source of beryllium in the facility.

Discussion:

During the surveillance, there were a lot of concerns expressed by workers on the use of plutonium levels for determining when beryllium monitoring was required. The workers expressed concern over the accuracy of the technical basis for the policy and on lack of follow through by facility management in performing beryllium characterization.

During review of FSP-PFP-IP-003, Radiological History of the Plutonium Finishing Plant (1954-1997), the surveillance team noted on page 20 of the report that a spread of contamination from a plutonium-beryllium source occurred in 1981 in room 236. This source of beryllium was not evaluated by the facility in the development of their beryllium monitoring program.

The additional technical staff brought into PFP had an additional benefit of supporting resolution of worker concerns in the beryllium monitoring program. When the additional source of beryllium contamination was identified by RL, the additional staff reviewed its potential impact on the PFP beryllium monitoring program.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O03

Poor practices were identified in multiple EDIRs reviewed.

Discussion:

The following additional poor practices were observed:

- **Poor resolution to a technical issue.**

EDIR-10-077 indicated a technical issue existed with the type of direct reading dosimeters (DRD) used at WRAP. The EDIR specified the cause of "ACES report indicated that estimated dose recorded was grossly underreported for [DRD]," was "DRD do not detect neutron radiation and electronic dosimeters can under respond to lower energy spectra." The resolution states: "Return to monthly dosimeter issuance." This resolution does not address the technical shortfall of the equipment. Therefore, the response was less than adequate. 10 CFR 835 requires monitoring be performed with equipment appropriate for the type and energy of radiation encountered.

- **Gross inconsistencies in whose neutron dose from the HSD gets corrected in the individuals record.**

There were gross inconsistencies in whose neutron dose from the HSD got corrected in the individuals record and whose did not. Examples include: A neutron dose correction of 1 mrem was made in one EDIR, a dose of 31 was zeroed in another, and a HDS dose of 199 mrem (99.5 mrem with PFP correction factor applied), was not corrected at all.

- **Rounding is inconsistent.**

Some EDIRs truncated the fraction of a mrem, while others used normal rounding practices. Had the 99.5 mrem corrected value from the example above used normal rounding practices, the corrected dose would be 100 mrem and the CHPRC procedure would require dose correction.

- **Technical justification for use of inconsistent neutron correction factors for ISA pad work was not documented in the EDIR.**

All four EDIR reports for individuals working at ISA pad (correction factor five) that the surveillance team reviewed had neutron dose and no gamma dose. Two individuals also had some entries into CSB. The correction factor applied to those individuals was three. There was no documentation that indicated why the facility chose to use the three over the five. The correction factor of three resulted in a conservative higher dose in the record.

RL Lead Assessor Closure Required: **YES[X] NO [ ]**

Observation: S-11-SED-CHPRC-PFP-002-O04

The use of the PRC Post-ALARA / Post-Job Review (site form A-6004-821) for event investigation rather than conducting fact-finding or critique meetings did not ensure that causal factors are identified.

Discussion:

As part of the PFP work planning process surveillance, the team observed PFP investigate upset conditions and events using the ALARA post-job review, which is not a fact finding tool. By design, the ALARA post-job review did not provide sufficient fact finding guidance to discover the event details needed to identify failure points and prevent recurrence. The site form (site form A-6004-821) provided questions not geared toward gathering factual details. The contractor should provide a more appropriate and effective process for gathering and identifying facts related to upset conditions.

RL Lead Assessor Closure Required: **YES[ ] NO [X]**

Contractor Self-Assessment:

The surveillance team reviewed the contractor's self-assessments and corrective action data base for PFP deficiencies for June 2010 through April 2011.

Issues with radiological work control planning and implementation have been previously identified by the CHPRC. On July 13, 2010, CHPRC identified within a conditional report (CR) three Stop Works at PFP related to Procedure Compliance, Entry Requirements and RWP Violations. These formal Stop Works were recorded in CR-2010-2201 to document issues with scope creep, procedure compliance, hazards and controls, pre- job briefs, and duct level entry requirements. As a result of the evaluation of the Stop Work issues, this CR was screened as adverse.

Analysis contained within CR-2010-2201 revealed that multiple issues throughout most aspects of work performance had risen to a level that workers felt the need to implement the formal Stop Work process in order to see that they were adequately addressed. Ten corrective actions were established to resolve these issues.

On October 22, 2010, CR-2010-3327, Contamination Spread in Multiple Rooms during Glove

Box Separation Activities, was initiated due to contamination spread during glove box separation activities in room 139 of A Labs. Analysis of this event determined that the work controls were not adequate to handle the potential levels of contamination in areas inaccessible for survey and the configuration of the glove box was such that engineered barriers were considered impractical. Two work control corrective actions were identified in response to this event.

However, the number of radiological work planning events and deficiencies identified during this surveillance, indicates the corrective actions associated with the above issues were not sufficiently effective. This assessment of PFP's radiological work planning corrective action effectiveness aligns with RL's overall evaluation of CHPRC's corrective action management performance (See letter CHPRC-1100939, Integrated Corrective Action Plan).

Contractor Self-Assessment Adequate: **YES [ ] NO [X]**

Management Debriefed:

David Del Vecchio, CHPRC
Terry Vaughn, CHPRC
Curtis Bean, CHPRC
Tom Bratvold, CHPRC
