

ATTACHMENT

CHPRC-1904859 R1
CONTRACT NUMBER DE-AC06-08RL14788

ROOT CAUSE EVALUATION REPORT
MANAGEMENT STOP WORK ON RADIOLOGICAL ACTIVITIES AT 324 BUILDING
CR-2019-3146, REVISION 1

Consisting of 153 pages,
including this cover page

ROOT CAUSE EVALUATION REPORT

Management Stop Work on Radiological Activities at 324 Building

Revision 1

CR-2019-3146

Cause Analysis Leader: per attached email Date: 6/8/2020
(b)(6) Performance Assurance
Waste and Fuels Management Project

Resumption Team Lead: per attached email Date: 6/4/2020
(b)(6)
324 Building Safety and Health

Responsible Manager: per attached email Date: 6/4/2020
(b)(6)
River Risk Management Project

324 Project
Resumption Manager: per attached email Date: 6/8/2020
(b)(6)
Project Technical Services

ESRB Chair: per attached email Date: 6/8/2020
(b)(6)
CH2M Hill Plateau Remediation

(b)(6)

Subject: FW: FOR APPROVAL: RCA for CR-2019-3146, Revision 1

I concur with this revision

(b)(6)

(b)(6) [redacted]

(b)(6) [redacted]

(b)(6) [redacted]

From: (b)(6) [redacted] <[redacted]@ri.gov>

Sent: Thursday, June 04, 2020 4:14 PM

To: (b)(6) [redacted] <[redacted]@ri.gov>; (b)(6) [redacted] <[redacted]@ri.gov>; (b)(6) [redacted]

(b)(6) [redacted] <[redacted]@ri.gov>

Cc: (b)(6) [redacted] <[redacted]@ri.gov>; (b)(6) [redacted] <[redacted]@ri.gov>

Subject: FOR APPROVAL: RCA for CR-2019-3146, Revision 1

Please provide your email concurrence with the attached revision. This addition to the revision changes the action statement and closure requirement for CA20. I have highlighted the changes that were made today.

(b)(6)

(b)(6) [redacted] [redacted]

(b)(6) [redacted]

(b)(6) [redacted]

From: (b)(6)
To:
Subject: RE: FOR APPROVAL: RCA for CR-2019-3146, Revision 1
Date: Thursday, June 4, 2020 4:20:22 PM
Attachments: Scott Lavoie Analysis Revision 1 DRAFT 6-4-20.doc

concur with the changes in this revision.

(b)(6)

From: (b)(6)@ri.gov>
Sent: Thursday, June 04, 2020 4:14 PM
To: (b)(6)@ri.gov>; (b)(6)@ri.gov>;
(b)(6)@ri.gov>
Cc: (b)(6)@ri.gov>; (b)(6)@ri.gov>
Subject: FOR APPROVAL: RCA for CR-2019-3146, Revision 1

Please provide your email concurrence with the attached revision. This addition to the revision changes the action statement and closure requirement for CA20. I have highlighted the changes that were made today.

(b)(6)
(b)(6) *WSPMR Performance Assurance*
(b)(6)
SCL for (b)(6)

From: (b)(6)
To:
Cc:
Subject: Re: FOR APPROVAL: RCA for CR-2019-3146, Revision 1
Date: Thursday, June 4, 2020 4:34:56 PM

I Approve.

Get Outlook for iOS

From: (b)(6)@ri.gov>
Sent: Thursday, June 4, 2020 4:13:55 PM
To: (b)(6)@ri.gov>; (b)(6)@ri.gov>;
(b)(6)@ri.gov>
Cc: (b)(6)@ri.gov>; (b)(6)@ri.gov>
Subject: FOR APPROVAL: RCA for CR-2019-3146, Revision 1

Please provide your email concurrence with the attached revision. This addition to the revision changes the action statement and closure requirement for CA20. I have highlighted the changes that were made today.

(b)(6)
(b)(6) WSPMP Performance Assurance
(b)(6)
Cell 503 (b)(6)

From: (b)(6)
To:
Cc:
Subject: RE: FOR APPROVAL: RCA for CR-2019-3146, Revision 1
Date: Monday, June 8, 2020 11:10:12 AM

(b)(6)

have reviewed and approve the revision

(b)(6)

From: (b)(6)@ri.gov>
Sent: Thursday, June 4, 2020 4:14 PM
To: (b)(6)@ri.gov>; (b)(6)@ri.gov>; (b)(6)@ri.gov>
Cc: (b)(6)@ri.gov>; (b)(6)@ri.gov>
Subject: FOR APPROVAL: RCA for CR-2019-3146, Revision 1

Please provide your email concurrence with the attached revision. This addition to the revision changes the action statement and closure requirement for CA20. I have highlighted the changes that were made today.

(b)(6)
(b)(6) WSPMP Performance Assurance
(b)(6)
Call 508 (b)(6)

From: (b)(6)
To:
Cc:
Subject: FW: FOR APPROVAL: Revision 1, CR-2019-3146 Root Cause Analysis
Date: Monday, June 8, 2020 4:09:18 PM

See below

From: (b)(6)@ri.gov>
Sent: Monday, June 8, 2020 4:08 PM
To: (b)(6)@ri.gov>
Cc: (b)(6)@ri.gov>
Subject: RE: FOR APPROVAL: Revision 1, CR-2019-3146 Root Cause Analysis

(b)(6)

Thank:

am good with it.

(b)(6)

From: (b)(6)@ri.gov>
Sent: Monday, June 8, 2020 11:32 AM
To: (b)(6)@ri.gov>
Cc: (b)(6)@ri.gov>
Subject: FW: FOR APPROVAL: Revision 1, CR-2019-3146 Root Cause Analysis
Importance: High

(b)(6) we will try this again. Please see the attached revision to the 504 BCE. I believe the only change is to corrective action 20. Thank - (b)(6)

From: (b)(6)@ri.gov>
Sent: Monday, June 8, 2020 11:29 AM
To: (b)(6)@ri.gov>
Cc: (b)(6)@ri.gov> (b)(6)@ri.gov> (b)(6)@ri.gov> (b)(6)
(b)(6)@ri.gov> (b)(6)@ri.gov> (b)(6)@ri.gov> (b)(6)
(b)(6)@ri.gov> (b)(6)@ri.gov>
Subject: FW: FOR APPROVAL: Revision 1, CR-2019-3146 Root Cause Analysis
Importance: High

(b)(6)

(b)(6)

Please provide this updated Revision 1 to (b)(6) for ESRB approval. The addition to the revision changes

Revision History

Revision 0 March 2020: Initial document release

Revision 1, June 2020: Document revised to change dates on the corrective action plan to compensate for the impacts of the COVID-19 response and to allow for worker involvement in key actions following COVID-19 phased approach to return to work. CA20 was revised to remove the prestart criteria and to modify the closure requirement.

Table of Contents

1.0	EXECUTIVE SUMMARY	1
2.0	PROBLEM STATEMENT	3
3.0	EVENT DESCRIPTION/NARRATIVE	3
3.1	Background.....	3
3.2	Sequence of Events.....	7
3.3	Investigation Strategy	12
3.4	Investigation Results.....	13
3.4.1	Proficiency.....	13
3.4.2	Training.....	14
3.4.3	Change Management.....	16
3.4.4	Hazard Awareness.....	19
3.4.5	Hazard Controls	20
3.4.5.1	Personnel Protective Equipment.....	20
3.4.6	Contamination Control Measures	22
3.4.6.1	Donning/Doffing Practices.....	22
3.4.6.2	Use of Anti-Static Controls	23
3.4.6.3	Airflow	23
3.4.6.4	Configuration of HCA Work Areas	24
3.4.6.5	Contamination Control of Work Areas	25
3.4.7	Radiological Work Planning.....	26
3.4.7.1	Technical Work Documents	26
3.4.7.2	AMWs /Rad Hazard Planning.....	27
3.4.7.3	JHAs/HASP	27
3.4.8	Monitoring Performance.....	28
3.4.8.1	Metrics	28
3.4.8.2	In-Field Oversight	29
3.4.8.3	CHPRC Oversight	30
3.4.9	Performance Assurance.....	30
3.4.9.1	Critiques and Investigations	30
3.4.9.2	Assessment	31
3.4.9.3	Readiness Assessment.....	31

3.4.9.4	Corrective Action	32
3.4.9.5	Lessons Learned	33
3.4.10	ISMS Approach	34
3.4.11	Communications.....	35
4.0	HISTORICAL REVIEW (SIMILAR OCCURRENCES	36
5.0	EVALUATION OF ASSESSMENT PERFORMANCE.....	37
6.0	PROBLEM EVALUATION	38
6.1	Root Causes	38
6.2	Contributing Causes	43
6.3	Extraneous Conditions Adverse to Quality (ECAQ).....	43
7.0	EXTENT OF CONDITION/GENERIC IMPLICATION	46
8.0	CORRECTIVE ACTION PATH FORWARD.....	46
9.0	EFFECTIVENESS REVIEW CRITERIA.....	46
10.0	ATTACHMENTS	48
10.1	Attachment 1: Corrective Action Plan.....	49
10.2	Attachment 2: Barrier Analysis	73
10.3	Attachment 3: WHY Staircase	116
10.4	Attachment 4: Lines of Inquiry	124
10.5	Attachment 5: Summary of Personnel Interview Responses.....	127
10.6	Attachment 6: Documents Reviewed	132
10.7	Attachment 7: Analysis Team Charter.....	143

1.0 EXECUTIVE SUMMARY

Between October 2018 and November 2019, the 324 Building experienced twelve personnel contamination events. The events consisted of six modesty clothing contamination, three personal clothing contaminations, and three skin/hair contaminations. None of the contamination events resulted in an uptake of contamination.

In November 2019, following the last personnel contamination event, 324 Building Management suspended radiological work beyond minimum safe activities, pending further investigation and analysis. The Department of Energy Richland Operations Office (DOE-RL) transmitted a letter reinforcing 324 Management's suspension of radiological work beyond minimum safe activities and requested concurrence with the corrective actions and path forward.

The 324 Building is in the process of establishing controls to enable excavation of highly radioactive soil from beneath the 324 Building Radiochemical Engineering Complex (REC). In order to avoid damaging the REC structure and components, structural modifications are necessary to support the REC foundation prior to performing excavation. The support will consist of 22 micropiles installed around the structure to transfer the loads to the underlying soil. The micropiles will be installed in Room 18, which is adjacent to the REC.

In March 2019, during drilling of a pilot hole to install micropiles in Room 18 of the facility, an unexpected condition was encountered. The drilling activity found loose sandy soil which had not been identified during previous soil samples. This soil was contaminated with Strontium 90 (Sr-90), which had not been expected in this location. Due to the drilling process and the talc-like nature of the soil, Sr-90 was released into Room 18, resulting in changing the working conditions from a Contamination Area to a High Contamination Area.

The 324 Building paused work following this event to develop a point source capture device for the drilling operation. Drilling was resumed in June 2019. As drilling progressed, further engineered barriers and administrative controls were put in place to refine the contamination controls.

In addition to work in Room 18, manned entries into the REC Airlock and C-Cell have been made to remove equipment and waste in preparation for equipment installation and placement of high-activity waste associated with waste site remediation. Several waste boxes containing high dose rate and/or highly contaminated waste and debris have been removed from the airlock. The REC Airlock is a High Radiation/High Contamination/Airborne Radioactivity Area. The primary source of contamination is high energy beta particles, which are easily suspended and transferred to personal protective equipment.

In November 2019, CHPRC Senior Management chartered a resumption team to investigate the contamination events, perform a root cause analysis, and develop

corrective actions. The resumption team performed the investigation through document reviews, personnel interviews, video reviews, and bench-marking with other CH2M Hill Plateau Remediation Company (CHPRC) organizations.

The resumption team found that contamination control practices used by 324 Building personnel demonstrated that personnel (b)(6) (b)(6) While 324 Building had developed an informal practical demonstration for donning and doffing of Personal Protective Equipment (PPE), no objective criteria for performance demonstration had been established.

Each of the individual contamination events was addressed at the facility. Actions were focused on the specific events and were inconsistent in documentation. A systematic approach was not used to evaluate processes. 324 Management (b)(6) (b)(6) (b)(6)

The Functional Radiological Protection organization began working with 324 Building in March 2019 to address personnel contamination events. The Functional Performance Assurance and Functional Training organizations also provided support to the facility. However, attempts to improve compliance with established processes was met with resistance. In July 2019, the Functional Radiological Protection and Functional Performance Assurance commissioned a commonality review of the contamination events. While this analysis identified apparent causes, it did not analyze underlying causes.

PRC-PRO-RP-40439, *Radiological Change Control Process*, is a company-level procedure which provides a systematic process for examining changes in radiological conditions and documenting the rationale behind changes. This tool was not used by 324 Building to address either the discovery of unexpected conditions in Room 18 or the increasing personnel contamination events. Review determined that PRC-PRO-RP-40439 was not referenced in any of the radiological control procedures that might identify changes, nor was there training to the procedure. PRC-PRO-RP-40439 provides a systematic process for evaluating changes, but is limited to radiological control processes. While some change management tools are already built into CHPRC procedures, an integrated approach to evaluating changes which impact facility operational risk and life cycle management is lacking. Expanding the process discussed in PRC-PRO-RP-40439 to address other operational activities would provide better triggers for evaluation of changes and improve the tools for operational risk management.

The analysis identified four underlying causes and one contributing cause:

Root Cause 1: Level of Risk Acceptance for Contamination Events (b)(6)

(b)(6)

Root Cause 2: An Integrated Approach was not Used in Response to Personnel Contamination Events

Root Cause 3: The 324 Building Management's (b)(6)

(b)(6)

(b)(6)

Root Cause 4: Evaluation of Changes to Operational Risk is not well integrated into CHPRC Processes

Contributing Cause 1: Digital Recording Equipment was not used as a Performance Improvement Tool.

The analysis also identified extraneous conditions adverse to quality (ECAQ). While not causal to the contamination events, these issues must be addressed to improve processes and the level of rigor applied to nuclear facility operations

ECAQ 1: Outdated/Conflicting Documents

ECAQ 2: Evaluate the Impact of Radiation Exposure on installed equipment

ECAQ 3: Donning Area has not been evaluated for Human Factor Impacts

ECAQ 4: Wording in the Criteria for When to Conduct an Investigation could be improved

ECAQ 5: 324 Building-specific Donning/Doffing instructions are not under Formal Configuration Control.

2.0 PROBLEM STATEMENT

From October 2018 to November 2019, the 324 Building experienced 12 personnel contamination events (6 modesty clothing, 3 personal clothing, 3 skin/hair). The consequence is a lack of stakeholder confidence in the contamination controls currently in place at the 324 Building. The corollary consequence is that the Department of Energy (DOE) has transmitted a letter reinforcing 324 Management's suspension of radiological work beyond minimum safe activities and has requested concurrence with the corrective actions and path forward.

3.0 EVENT DESCRIPTION/NARRATIVE

3.1 Background

Room 18:

The River Risk Management Project will remediate the highly radioactive soil from the 300-296 waste site, located beneath the 324 Building Radiochemical Engineering Complex (REC). The highly radioactive soil will be remotely excavated from within B-Cell in order to take advantage of the radiological shielding provided by the thick

concrete walls of the REC. Excavation beneath B-Cell will remove soil from the foundations and undermine the footings of the cell. Soil from adjoining areas of the REC could also slump into the excavation area causing additional undermining of the REC foundations. Undermining the REC foundations could lead to settling of the REC, causing cracks in the cell walls, preventing the opening and closing of cell doors, and causing misalignment of the REC cranes. Additionally, slumping of soil from areas adjacent to B-Cell could lead to excavating more soil than necessary to remediate the highly radioactive soil. The REC cells, cell doors, and cranes are vital systems needed to provide radiological shielding and remote equipment/waste handling to enable excavation of the soil from beneath B-Cell.

In order to avoid damaging the REC structure and components and to minimize slumping of soil, structural modifications are necessary to support the REC foundation. The foundation support system designed for the REC is based upon 22 micropiles (Figure 1) installed beneath new continuous concrete pile caps to transfer the loads to the underlying soil. Additionally, permeation grouting will be used to create a soil stabilization gravity block to stabilize the existing soils remaining along the exterior face of B-Cell. This grouting decreases the risk of potential soil raveling during excavation and removal of contaminated soil below B-Cell.

Prior to commencing installation of pilot holes within the 324 Building, the Project conducted testing outside the facility. In part, this testing was performed to develop and demonstrate engineered controls for the drilling operation. Ten test micropiles were installed on the north and south sides of the 324 Building using preliminary defined radiological engineered controls. No radiological issues were identified during this testing; however, the need for better dust control was identified. The drilling subcontractor modified the drilling equipment to implement the improved dust controls. While the modified dust controls were tested prior to deployment, the Resumption Team was unable to locate documentation containing the test results.

Prior to release of the work package to install the test pilot-holes in Room 18, ventilation flow testing was conducted to verify the engineered controls would control the spread of contamination and airborne radioactivity as planned. A containment tent was constructed surrounding the area of potential contamination to eliminate a possible airborne release. A local High Efficiency Particulate Air (HEPA) filter exhaust system was also installed to ventilate the containment tent.

During the process of soil drilling, spoils were extracted through the drilling shaft opening at the floor level. A hose connected from the pilot hole drill to a cyclone separator, which discharged into 55-gallon drums used to collect the soil spoils. The cyclone separator was connected to an air duct that connected to a pre-filter and HEPA filtered portable exhaust. The 55-gallon drums used to collect the spoils were positioned behind prefabricated shielding racks and shielding blankets to reduce personnel radiation exposure. Additionally, temporary shielding was installed on the transfer hose from the drill to the cyclone separator. Radiation monitoring was performed on the drill rig, soil transport hose, and soil collection drum during the drilling operation to alert workers of unexpected radiation levels. Soil samples from the first two pilot holes were also collected from the soil collection drum at predefined intervals to verify soil types present.

On March 13, 2019, the Project began drilling the first pilot hole (location S-16 shown in Figure 1) through the Room 18 floor into the underlying soil. The drilling unit operates using compressed air. The engineered control for the drilling unit included a Teflon inner seal in a collar bolted to the floor to mitigate dust and fugitive air from escaping from below grade. Higher than expected Sr-90 contamination levels and radiation dose rates were encountered while drilling the first pilot hole, resulting in an airborne radioactivity release into Room 18. The soil encountered was dune sand, which had not been expected based on previous soil sampling. The Project stopped drilling the first pilot-hole to evaluate the change in radiological conditions. As a result, the Project installed additional engineered barriers and administrative controls to control contamination spread before resuming pilot hole drilling. The ring collar, which was adhered and bolted to the floor, was modified to connect the point source capture device to a negative air machine.

The Project resumed drilling in Room 18 on June 6, 2019. A trail of contamination on the concrete floor in Room 18 was detected due to air pressure escaping the drilling unit. The Project stopped drilling to evaluate the change in radiological conditions. Adhesive was applied to seal the Teflon inner seal to the concrete surface. The first pilot hole drilling resumed and was completed on June 12, 2019.

Drilling for the second pilot hole (location S-22) was started on June 18, 2019. A contamination release into Room 18 occurred and work was suspended for decontamination and an In Progress As Low As Reasonably Achievable (ALARA) Review (IPAR). Material was observed by (b)(6) from a break-out joint in the drill connection to the casing (i.e. diverter). In response to this contamination event, duct tape was applied to the diverter on the drill unit to seal this joint. A custom built flange was constructed to eliminate the break-out joint from progressing past the gasketed area. Additional modifications to engineered controls were also implemented:

- A needle valve was added to the water injection system to improve control and efficiency of the spray volume and misting quality for contamination control.
- The exhaust from the negative air machine was directed to the 324 Building Zone II exhaust ventilation system.
- Oil impregnated cloths were applied around the work area to aid in trapping future fugitive contamination.

The Project resumed drilling the pilot holes and completed the fourth pilot hole in November 2019. A casing cap was installed over each pilot hole opening so that the pilot hole could later be accessed to install a production micropile.

PRC-SRP-00154, *300-296 Remote Soil Excavation Project As Low As Reasonably Achievable (ALARA) Design Review*, and early revisions of the ALARA Management Worksheet (AMW) indicate the Project did not expect to encounter the high Sr-90 contamination or elevated radiation levels while drilling through the Room 18 floor. For example, the original micropiling activity exposure estimate from PRC-SRP-00154, Appendix B, Section B.2 "REC Foundation Support System" is based on an average radiation dose rate of 0.1 milli-roentgen equivalent man (mrem) per hour. The original AMW (AMW-18-RL-009 Rev. 0) and Radiological Work Permit (RWP) (WL-18-0009 Rev. 0) included high contamination area (HCA), high radiation area (HRA) and airborne

radioactivity area (ARA) action levels and limits as contingencies in the event abnormal conditions were encountered. Geoprobe inserted beneath the B-Cell floor showed extensive and varying radiation dose rates in the soil beneath B-Cell. However, these geoprobes did not extend beyond the south wall of B-Cell where pilot-hole S-16 was installed. Dose rate measurements taken inside of the geoprobes indicated radioactivity in the soil was confined within a relatively tight area under the B-Cell sump and floor expansion joint. The Project recognized that geoprobe measurement methods were not capable of detecting Sr-90.

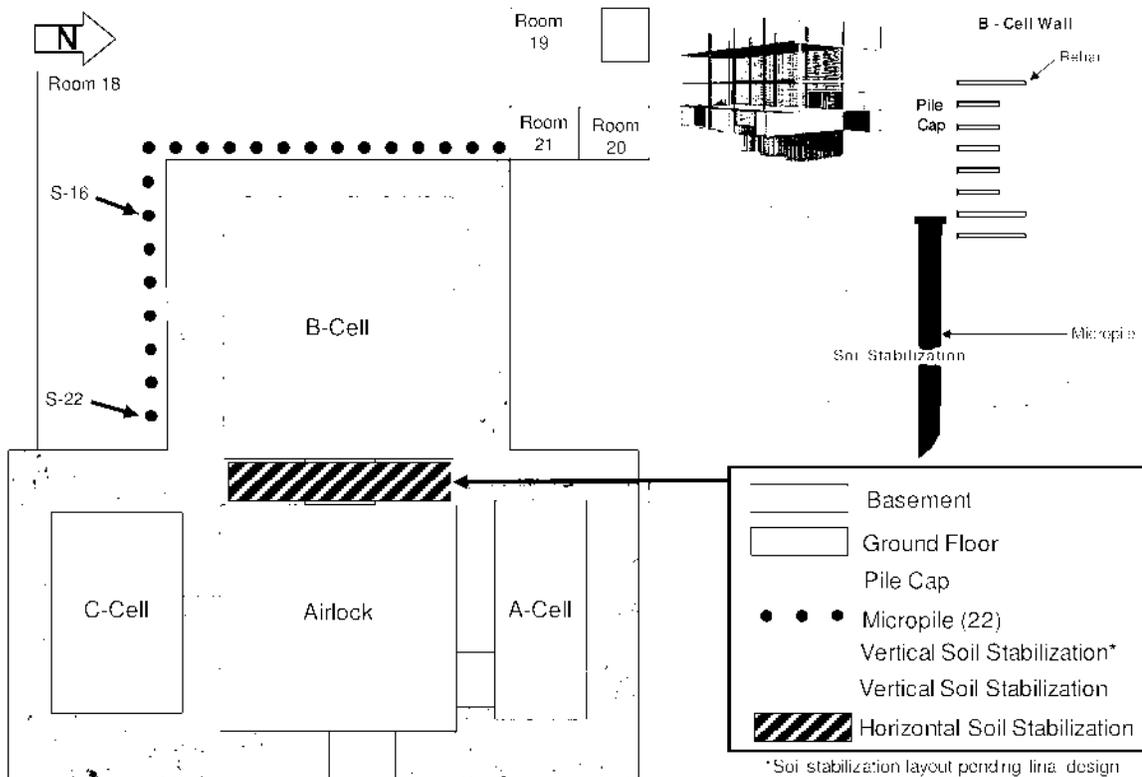


Figure 1. 324 Building Room 18 REC Foundation Support System

REC Airlock:

Manned entries into the REC Airlock and C-Cell have been made to remove equipment and waste in preparation of equipment installation and placement of high-activity waste associated with 300-296 waste site remediation. Several waste boxes containing high dose rate and/or highly contaminated waste and debris have been removed from the airlock.

High Radiation Area and HCA conditions inside of the REC Airlock have existed for several decades and are well understood. Whole body exposure during entries into the airlock is assumed to be up to 200 mrem per entry in radiological work planning

documents, based on historical records. Worker exposure is location-dependent, with average values being lower than 200 mrem.

Removable beta-gamma contamination levels of $5.05E+01 \mu\text{Ci}/100 \text{ cm}^2$ ($1.12E+08 \text{ dpm}/100 \text{ cm}^2$) and total contamination levels of $1.52E+03 \mu\text{Ci}/100 \text{ cm}^2$ ($3.37E+09 \text{ dpm}/100 \text{ cm}^2$) in the airlock are identified in WCH-412, *324 Building Baseline Radiological Characterization*.

3.2 Sequence of Events

The table below provides a sequence of events related to the personnel contaminations at the 324 Building. The event descriptions include a summary of the events, suspected causes, and actions taken to understand or address the events, as documented in the Condition Reporting and Resolution System (CRRS) and IPARS. Due to the low levels of contamination involved, personnel doses would be reported as zero millirem as per current procedure requirements.

Date	Associated Condition Reports (CRs)	Description
10/30/2018	CR-2018-2877	<p>During an exit from the airlock, (b)(6) modesty clothing, badge holder, and personal shirt were contaminated. The suspected cause was the zipper on the outer layer of anti-contamination clothing coming undone while the worker was in the HCA.</p> <p>To address this event, a Stop Work was called. 324 Building changed the donning process to tape the zipper and outer hood.</p>
1/9/2019	CR-2019-0080	<p>During an exit from the airlock, contamination was found on the modesty clothing of an entrant. The suspected cause was cross contamination during doffing.</p> <p>To address this event, the facility instituted surveys of the inner pair of personal protective equipment (PPE) in a lower background count rate area. Donning/doffing assistants repeated the donning/doffing practical. Wipe downs of PPE prior to doffing were increased.</p>
2/21/2019	CR-2019-0353	<p>(b)(6) was in the Cask Handling Area (CHA) when the airlock door was opened. (b)(6) sat in a chair in the CHA contamination area. Contamination was found on the individual's modesty clothing. No suspected cause was identified.</p> <p>To address this event, the facility evaluated wicking of</p>

Date	Associated Condition Reports (CRs)	Description
		moisture through PPE and performed surveys to confirm that laundry (modesty clothing) was not a potential cause.
3/13/2019	CR-2019-0524, CR-2019-1744	<p>During drilling in Room 18, the drill equipment unexpectedly hit highly contaminated sand on the first hole. Sample analysis identified Sr-90, a beta-only emitter, as the radionuclide of concern.</p> <p>Room 18 was placed on Sr-90 contamination survey protocols and bioassay; Evaluated use of soil stabilizers; Performed smoke tests of the drill rig supply and exhaust piping; Collected samples for isotopic analysis; Increased the number of Radiological Control Technicians (RCTs) present during drilling.</p>
3/28/2019	CR-2019-0658	<p>Following surveys of items at the Room 123 step off pad, contamination was found on an individual's modesty clothing. The suspected cause was cross-contamination from particulate on items being surveyed out.</p> <p>To address this event, a Stop Work was called on Radiological work activities at 324 from 4/1/2019 through 4/4/2019; Surveys were conducted and no Sr-90 was found in the Radiological Buffer Area (RBA) outside of Room 18; Sr-90 controls were implemented facility-wide. Engineering changes to the drilling equipment were implemented to minimize migration of contaminated soil outside of the micropile bore hole. Operations systematically released scopes of work and/or work packages, via the daily release sheet, after the incorporation of the Sr-90 controls had been verified in those documents.</p>
6/6/2019	CR-2019-1350	<p>Following Room 18 micropile support, contamination was found on a worker's modesty clothing. The suspected cause was wicking of contamination through PPE.</p> <p>To address this event, engineering changes to the drill rig were continued. Use of cooling apparatus was considered.</p>
6/18/2019	CR-2019-1352, CR-2019-1742	<p>Following drill activities in Room 18, dune sand was encountered on the second micropile bore hole. Contamination migrated to the RBA. Contamination was found on both work boots of [redacted] the suspected cause was the migration of contamination.</p>

(b)(6)

Date	Associated Condition Reports (CRs)	Description
		<p>Actions taken to address this event were:</p> <p>324 Building added wipe down of Powered Air Purifying Respirator (PAPR) hood and blower prior to removal of outer PPE; Required use of wet rags at the drill string to floor interface; Continued engineering changes; Performed airflow evaluation in Room 18 with all equipment running; Discontinued use of the tool port and sealed that area of the drill string; Developed a Recovery plan.</p>
6/19/2019	CR-2019-1357	<p>During routine surveys, a spot of fixed contamination was found in Mobile Office (MO) 245. The suspect cause was unknown.</p> <p>Actions taken to address this event were:</p> <p>Timely order 2019-324-03 was issued to require use of personal contamination monitors (PCMs) when accessible and use of two independent whole body surveys when not accessible. Increased oversight of the step-off pads was assigned for two weeks. Note: There was no basis documented for the period of observation or for step-out criteria from performing observations. Step off pad radiological surveys were increased to twice per shift.</p>
6/24/2019	CR-2019-1510	<p>Upon exit from Room 18, skin contamination was found on a worker's elbow and on the thigh of their modesty clothing. The suspected cause was inadequate PPE, as the contamination was found above the arm sleeves.</p> <p>Actions taken to address this event were:</p> <p>324 requested an independent review of engineering controls; The outer pair of PPE was switched to impermeable; Required demonstration of PPE doffing prior to working in room; Required decontamination techniques briefing; Required sticky paper under the drill set up; ALARA response action changed to 400 mrem/hour at 30 centimeters (cm); Increased use of water for dust control.</p>
7/2019	CR-2019-1349	<p>Based on the collective personnel contamination events, Central Radiological Protection and Central Performance Assurance requested that a commonality review of the events be performed. A Management Concern Occurrence Report (EM-RL—CPRC-2019-0004) was issued to</p>

Date	Associated Condition Reports (CRs)	Description
		<p>document the collective issues and the path forward.</p> <p>The commonality review identified two common factors: 1) Less than adequate radiological work practices, primarily cross contamination during doffing but also including surveying out/clearance of zone and personal behavior. 2) Less than adequate PPE. No further analysis for underlying causes of these issues was conducted.</p> <p>Actions taken to address the commonality review were:</p> <ol style="list-style-type: none"> 1. Evaluate Room 123 step off pad table configuration to lessen chance of particulate cross contamination 2. Evaluate upgrading to use of aprons as additional PPE 3. Provide subcontractor with don/doff instructions 4. Evaluate the use of an air space divider/curtain for use during egress from Room 18 5. Verify laundering of modesty clothing is a closed loop process 6. Reconfigure/replace the Room 123 step off pad table to lessen the chance of personnel contamination
8/27/2019	CR-2019-2370	<p>Following micropile drilling activities in Room 18, a worker was found to have contamination in their hair. The IPAR states there were several potential causes but no conclusive cause was identified.</p> <p>Actions taken to address this event were:</p> <p>Review and compare doffing process between Airlock and Room 18 for effectiveness; Evaluate the use of fixatives used during doffing; Discuss the use of tape on seams of PAPR hoods; Evaluate implementation of continuous coverage requirements at Room 18 to C-Gallery step off pad; Provide refocus discussion to donning/doffing personnel on possible avenues of cross contamination when removing PPE and PAPR Hood; Institute Independent Radiological Control observations of 324 Building doffing process from Room 18 for the next three entries</p>
9/10/2019	CR-2019-2433	<p>Following exit from the airlock, a worker was found to have contamination on their modesty clothing and underwear. Suspected cause of the issue was wicking of contamination due to sweat-through.</p> <p>Actions taken to address the event were:</p>

Date	Associated Condition Reports (CRs)	Description
		<p>Stagger entry/exit times between those supporting Room 18 and supporting the REC Airlock. Alternatively, expand the area to facilitate the quantity of individuals entering/exiting; Put a large magnet with doffing instructions on the airlock door as a sequencing aide for those receiving undress assistance; Locate and return the lead (Pb) blanket curtain back to the Cask Handling Area (CHA) for use when exiting the REC Airlock; Inspect impermeable outer PPE suit for potential defects; Evaluate the ability to remotely decontaminate the REC Airlock.</p>
9/24/2019	CR-2019-2401	<p>At the Room 123 step off pad, (b)(6) who had moved a container into the truck lock was found to have contamination on their modesty clothing. The suspected cause is listed as unknown.</p> <p>Actions taken to address this event were:</p> <p>Issued Interoffice Memo 1904152 "Contamination control mitigation process for PPE donning and doffing" for 324 Building; Issued Interoffice Memo 1904201 "Oversight and Mentoring Requirements During Radiological Egress at Room 123 Step-Off Pad".</p>
9/25/2019	CR-2019-2460	<p>Following work in the airlock, a worker was found to have contamination on their modesty clothing. The suspected cause is listed as unknown. Laboratory analysis of the tape press indicated no gamma emitter present, indicating the source term was likely from Room 18.</p> <p>In response to this event, a Technical Response Team (TRT) of independent personnel was convened to assist the facility (reference Work Site Assessment (WSA) 324-2020-WSA-25035). The TRT recommended the following actions:</p> <p>Use of anti-static products as a pre-treatment to anti-C clothing prior to entry; At the step off pad, apply hair spray to fix potential contamination in place prior to doffing; Survey techniques and fixative/fogging application in overhead areas; Use of "sticky" rollers, as a supplement for classic cloth mops; 100 cm² tape presses as a smear technique to supplement classic technical smear approaches.</p>
~10-1-2019	NA	<p>(b)(6) with a background in Nuclear Facility Operations was assigned to support the 324 Building</p>

Date	Associated Condition Reports (CRs)	Description
		(b)(6)
10-1 through 11/5 2019	Multiple	Jacobs corporate personnel conducted an independent assessment of the 324 Building. The assessment evaluated the areas of Organizational Effectiveness, Safety Culture, Work Planning, Conduct of Work, and Radiological Controls. Ten recommendations were identified (Reference 324-2020-IA-25211).
11/14/2019	CR-2019-2905, CR-2019-3146	<p>Following exit from the airlock, (b)(6) was found to have contamination on their face, neck, and modesty clothing. The suspected cause was inadequate doffing practices.</p> <p>Immediate actions to address this event were:</p> <p>Survey equipment that remained at the step off pad; Evaluate potential use of wireless communications headsets; 324 Project Management declared a Stop Work on all radiological work at the facility beyond that which is necessary to maintain minimum safe operations.</p>
11/18/2019	NA	CHPRC Senior Management assigned a Resumption Team to investigate the collective personnel contamination issues, perform a causal analysis, and develop a resumption plan for the facility.
1/16/2020	Multiple	An independent assessment of 324 Building Radiological Control Planning and Implementation was completed, based on recommendations from the Jacobs corporate assessment (reference SHS&Q-2020-MA-25394)

3.3 Investigation Strategy

The Resumption Team, as well as a panel of workers from other CHPRC Projects with experience in HCA entries, reviewed digital recordings of entries into the airlock. Based on the initial information collected from review of the digital recordings, as well as review of assessment 324-2020-IA-25211, the Resumption Team developed a set of lines of inquiry to guide the investigation (Attachment 4, Lines of Inquiry). To conduct the investigation into potential causes for the cumulative contamination events, the Resumption Team reviewed documentation (See Attachment 5, Documents Reviewed) and conducted interviews with facility personnel (See Attachment 6, Summarized Personnel Interview Results).

3.4 Investigation Results

3.4.1 Proficiency

Based on a Plant Forces Work Review conducted in 2011, the 324 Building moved from use of Hanford Atomic Metal Trades Chemical (HAMTC) to a Building Trades workforce acquired through contracted vendors in 2017. No previous radiological experience is required for this workforce. Workers go through Radiological Worker II training at the HAMMER Training Facility, but may not be experienced in radiological work, particularly in entry into HCAs. This established a workforce that requires a different level of training to become proficient in contamination control practices.

During interviews, personnel throughout the facility organization structure repeatedly stated that if the workforce is not productive, they could be sent back to the Labor Hall to save costs. If they go back to the hall and do not return, it requires extensive training and time to develop proficiency in new personnel. The perception that the workforce must remain productive may have influenced rapid response to issues in order to keep work in process.

Note: 324 Building has stopped work in response to many of the contamination events with no impact to the workforce. The workforce is maintained productive by working low priority tasks and corrective actions.

Room 18 uses the same crew each day and makes entries more frequently. The lower dose rates in Room 18 do not require personnel rotation to keep exposure ALARA. As such, the same workers are involved with each Room 18 entry and maintain a higher level of proficiency.

In contrast, personnel supporting 324 Building REC airlock work are rotated to the mock-up for weeks at a time in order to equalize dose. To maintain individual radiological exposure ALARA, personnel with the lowest accumulated dose for a given craft/skill set are selected for airlock entry when possible. Consequently, they make infrequent airlock entries and maintaining proficiency is more challenging.

In order to manage dose following an airlock entry, the entrant's record dosimeter is collected and read before the individual can make an additional entry. The intent is to verify they have at least 200 mrem margin to reaching their Administrative Control Level (ACL) of 500 mrem. Reading the record dosimeter typically takes 1-2 days. This affects the continuity of the teams that are entering the airlock. During interviews, personnel explained that this monitoring was due to the difficulty in obtaining ACL extensions.

There appears to be good agreement between record dosimetry and supplemental dosimetry used to estimate dose for the airlock, but this correlation has not been formally documented. Dosimetry used in Room 18 does not have close agreement. Workers entering the airlock may receive between 140-180

mrem per entry, which is the basis for the 200 mrem limit. In 2018, the average dose per entry was 60 mrem. Average team dose was 190-200 mrem per entry. Maximum individual entry dose was 140 mrem. A documented study has not been conducted to determine the agreement between types of dosimetry and determine if immediate reading of dosimetry can be ended. The Resumption Team was told the facility was planning to perform this evaluation.

Observation of digital recordings of REC airlock work, as well as review of RL Operations Awareness (OA) reports, Condition Reports in the Condition Reporting and Resolution System, and Management Oversight Program (MOP) reports all identified poor contamination control practices at 324 Building. Examples included: throwing materials into waste containers, pushing down on bagged waste, handling contaminated waste multiple times, not changing outer gloves frequently, touching surfaces with contaminated gloves, adjusting outer PPE to reseat hardhats or radios, etc. These behaviors were (b)(6)

(b)(6)

While issues were identified with how work in contamination areas is performed, it should be noted that poor performance should not be considered the norm for behaviors. The majority of entries into HCAs do not result in contamination events. However, since controls to mitigate human factors are not well integrated into the 324 Building control set, an isolated human error has a higher potential to result in a consequential event. Examples of human factors that had not been addressed are:

- Desire to spread out dose to workers affected the ability to develop proficiency in airlock entries.
- Loose and ill-fitting PPE increased distractions during HCA entries.
- Personnel interviews, coupled with review of digital recordings, demonstrated (b)(6)
- (b)(6)
- Satisfactory demonstration of doffing is evaluated by the 324 Building (b)(6) and is not based on objective criteria.
- There is no objective criteria for refresher on doffing practices.
- Failure to remove obstructions in the HCAs created a condition where a human error could have higher consequence.

Additionally, inadequate proficiency may lead to at-risk behaviors for contamination control. The 324 Management Team (b)(6)

(b)(6)
(b)(6)

3.4.2 Training

CHPRC radiological workers who will enter contamination areas unescorted are required to complete Radiological Worker II training (Course 020001 and at the HAMMER facility. The initial course (020001) is 20 hours long, covering basic

principles of radiation and contamination, donning and doffing of protective clothing, checking dosimetry, and response to upset conditions. A practical demonstration is required to complete the course. The refresher course (020003) is required every two years, addressing similar content and practical demonstration. Radiological Worker II does not address additional work practices or doffing techniques, which may be needed for work in HCAs.

As Hanford work progresses to address decommissioning buildings and managing historic waste sites, each high-risk activity may generate a hazard or risk that requires special training. CHPRC relies heavily on the existing training courses available through HAMMER and at the facilities. Evaluation of operational risk should evaluate gaps between the knowledge/skills that the work requires and what is provided through standard training.

During interviews, personnel repeatedly referenced the 324 Building donning/doffing training for PPE. Review of 324 training documentation found no training materials or course number. The Resumption Team was provided with inconsistent responses regarding how 324 Building PPE donning/doffing proficiency is established and maintained. This ranged from (b)(6)

(b)(6)

(b)(6)

Further research determined that a practical demonstration of PPE donning/doffing techniques has been in place at 324 Building for some time. The AMWs governing REC airlock entry cite the doffing practical under "Special Training." However, this requirement is not flagged for incorporation into work instructions and is not carried over into the RWP or procedure 324-PRO-OP-54055, *Airlock/C-Cell Access*. The doffing practical is not a requirement in the Room 18 AMW or RWP, but is a requirement in the work package. Completion of the doffing practical has been tracked internally for Room 18 personnel since July 2019. The doffing practical for the airlock is not specifically tracked. Since no course number has been assigned, the standard training reports cannot be used to confirm who has completed the practical and when.

While personnel are expected to go through one PPE donning/doffing proficiency demonstration prior to REC airlock entry, expectations to refresh personnel proficiency for personnel who have not recently entered the airlock is not formalized. There is no objective criteria for proficiency. Personnel perform to the satisfaction of the supervisor.

Per interviews, current doffing assistants have a proficiency demonstration to the satisfaction of Operations and Radiological Control Supervisors before they are added to the list of doffers. Doffing assistant proficiency demonstration has not gone through training analysis and has not been assigned a course number. The practice of maintaining "chain of custody" of an individual is not addressed in a training course.

324 Building has an Airlock Entry Training course (course number 324026). This training does not contain a practical demonstration, but reviews the donning and doffing instructions and expectations for their use. However, review of the

doffing checklist currently in use against course content indicated the materials were out of date.

During interviews, (b)(6) were questioned as to why the donning/doffing course had not gone through training analysis. Responses were that formal training would not allow for frequent refreshers and that it took weeks to get something into formal training. When interviewed, (b)(6) were aware that the doffing practical had not been formalized. An analysis had been started, but was cancelled. When asked why this had occurred, (b)(6) responded that, beyond required training, it was up to facility management what went into formal training.

324 Building has a mockup facility, which was used in 2017 for airlock training as the initial PPE set was developed. The airlock at the mockup is the true size of the 324 Airlock with an outline of the airlock door taped to the floor. The mockup is used for contamination control practice/verification of controls for new operations planned at 324 Building. Full dress mockups are performed as part of procedure/work package validation at the mockup (e.g., Remote Excavation Arm (REA) Through Support Installation). Use of the mockup to develop and rehearse good contamination control practices, including removal of waste boxes and personnel airlock entry and exit, was one of its intended uses under Washington Closure Hanford (WCH). This is included in the WCH ALARA Design Review document as well as PRC-SRP-00154. Because all that was needed for doffing was a simulated door exit, the teams decided it was more convenient to perform mockups at the 324 Building (clean side) and practice the doffing there. Since 2017, the mockup facility has not been used to improve performance or proficiency in contamination control practices.

Review of 324 Building training documents identified little information relevant to contamination control practices within a HCA. Work processes in HCA/ARA/HRA conditions do not have formal performance based training (wipe downs, frequent glove changes, waste handling). Review of digital recordings indicated that poor execution of these processes might contribute to transfer or resuspension of contamination.

3.4.3 Change Management

Until April 2017, 324 Building was not making manned airlock entries. The airlock was opened only once or twice per year. This created a condition where processes with the appropriate rigor for personnel entry had to be re-established to work in high contamination/high dose rate areas.

During interviews, personnel repeatedly commented that changes to correct contamination issues have been reactionary. Reaction to events provides the impression that issues are being "band-aided". Change Management systems (such as training, causal analysis, Radiological Change Control Process, etc.) were not consistently engaged in the evaluation and promulgation of changes.

Without use of the existing systems, it is difficult to demonstrate whether actions taken are appropriate and effective.

TE-WL-17-001-05, *324 Building Radiological Control Technical Evaluation*, has been updated as unexpected conditions have been identified (i.e., when Sr-90 was identified, when alpha contamination in C-Cell was detected, etc.). This document forms a baseline for radiological hazard planning.

Documents such as PRC-SRP-00009, *300-296 Soil Remediation Project Radiation Material Evaluation* and PRC-SRP-00154, *300-296 Remote Soil Excavation Project ALARA Design Review* have not been updated since they were published (November 2016 and February 2018, respectively). PRC-SRP-00154 includes a general discussion on the micropile foundation support system, but contains no detail on the equipment that will be used or any specific contamination hazard analysis or control methods. Other related documents have been updated (e.g., PRC-SRP-00184, *324 Building Disposition Project Waste Management Plan* reissued September 2019), but the updates have created inconsistencies between the documents.

PRC-SRP-00154 is intended to:

“...evaluate the As Low As Reasonably Achievable (ALARA) considerations for the current design and associated anticipated operations for the remote remediation of the 300-296 Remote Soil Excavation Project waste site [located under the 324 Building Radiochemical Engineering Complex (REC) B-Cell]. Note that if the remediation design or anticipated operations evolve such that the basis, assumptions, or conclusions of this document are no longer valid, then this document will be revised accordingly. This document also evaluates the Project’s soil remediation design for compliance with the requirements of 10 Code of Federal Regulations (CFR) 835, *Occupational Radiation Protection*.”

PRC-SRP-00009 provides estimates of the total radiation exposure and operating life for the equipment that will be used to remotely excavate the contaminated soil from beneath B-Cell. PRC-SRP-00009, which was based on a July 2016 schedule, concluded that some equipment failures may be experienced before retrieval of the primary soil zone of concern was complete. Components susceptible to failure prior to project completion include cameras, lights, lower REA, and long reach bucket components. Updating this document to reflect changes in the technical approach and schedule (e.g., installing the upper remotely operated excavator arm earlier than assumed) is necessary to update the operating life and estimate replacement frequency of equipment. Personnel radiation exposure and airlock entries are required to replace failed remotely operated equipment, which needs to be reflected in the ALARA Design Review. Additionally, the replacement frequency for remotely operated soil excavation equipment is one of the inputs needed for the project cost and schedule baseline.

When interviewed, most people could not speak to the technical baseline documents for control of radiological processes. Personnel were aware of PRC-SRP-00154 document, but did not mention other documents that record decision making about radiological processes. The 324 Management Team used baseline documents in the initial planning phase of the work, and then relied on the work management change control process for implementing process improvements as work progressed. The facility has not been documenting the rationale behind changes that have been implemented to address the contamination events. Consequently, even value-added actions do not show evidence of how they were derived.

While Radiological Technical Evaluations (TEs) and implementing documents were updated as changes occurred, the facility does not have evidence of examining the issues from a systematic, integrated approach. Review of 300-296 Project remediation process changes (e.g., removing waste boxes from the REC airlock instead of remote placement of waste into A-, C- or D-Cell) did not document the associated increasing potential for contamination control issues. 324 Senior Management determined that it was beneficial to free up more space in A-, C-, and D-Cells to provide contingency for encountering soil that is more contaminated than is identified in the limited analytical data available. 324 Senior Management determined it would be much more problematic to try to remove higher dose rate soil out of the REC than the lower dose rate waste currently being encountered. There is no evidence that the potential for personnel contamination and changes to PPE was formally evaluated from an integrated risk perspective. While changes to PPE and contamination controls were flowed down into implementing documents, the basis/rationale for those changes is not documented.

PRC-PRO-RP-40439, *Radiological Control Change Management*, identifies specific criteria for process changes that must be evaluated in accordance with the procedure. This process, as guided by form A-6006-153, *RadCon Change Management Checklist*, requires use of benchmarking, review of lessons learned, use of causal analysis or other analytical processes, and identification of methods to control and monitor change. In the case of 324 Building, the discovery of greater than expected levels of Sr-90 contamination and the identification of a trend of contamination control events would both reach the thresholds for documented change control evaluation. The Resumption Team found no evidence that 324 Building used the process called out in PRC-PRO-RP-40439 to evaluate or develop controls for changed conditions. Review of CHPRC's CRRS database found evidence that PRC-PRO-RP-40439 was used in 2012 through 2016 at some CHPRC projects, but no change actions had been recorded since 2016. Discussion with radiological control personnel external to 324 Building found that PRC-PRO-RP-40439 is not well known by Radiological Control personnel and is not referenced in other radiological control procedures. Review of PRC-PRO-RP-40439 found both predictive and reactive criteria for using the change control process and an effective method to document tools used to analyze the change.

PRC-PRO-RP-40439 provides a systematic process for evaluating changes, but is limited to radiological control processes. Some change management tools are

built into CHPRC procedures, but an integrated approach to evaluating changes which impact facility risk and life cycle management is lacking. As Hanford work progresses to address decommissioning buildings and managing historic waste sites, the potential for encountering unexpected conditions increases. Limited documentation on historic practices and events exacerbates this condition. Expanding the process discussed in PRC-PRO-RP-40439 to address other disciplines would provide better triggers for evaluation of changes and improve the tools for operational risk management.

3.4.4 Hazard Awareness

Based on the weak radiological control practices observed during work and doffing activities, as well as the informality of the 324 donning/doffing practical demonstration, the Resumption Team investigated whether personnel understand how easily contamination can be spread. Understanding of the nature of the contamination forms the basis for the effectiveness of many of the controls intended to prevent personnel contaminations.

Interviews found that the Room 18 crew currently has a high level of understanding of the hazards. Their understanding evolved as they had to react to unexpected conditions such as the discovery of greater than expected levels of Sr-90 (a high-energy beta emitter) in the soil beneath the Room 18 floor. Personnel assigned to the airlock understood that the contamination is flighty. However, personnel (b)(6) (b)(6)

During interviews, personnel at various levels throughout the organization made statements that (b)(6) (b)(6) While personnel understood the (b)(6) (b)(6) Personnel stated in interviews that they assume they have contamination on their outer PPE, but actions in digital recordings of airlock operations (b)(6)

The contamination in the Airlock and Room 18 primarily consists of Sr-90 and Cesium 137 (Cs-137), with some limited alpha contamination present as well. CHPRC has few work locations with these levels of contamination. Similarly, a limited number of personnel in the company have knowledge and experience related to performance of hands-on work in HCAs containing high levels of high-energy beta (e.g., Sr-90) contamination. (b)(6)

While many 324 Building personnel have experience on the Hanford site, (b)(6) (b)(6) increased training, communication, and proficiency. (b)(6) the 324 Management Team (b)(6) (b)(6) CHPRC proactively provide (b)(6) the 324 Management Team (b)(6)

(b)(6)

(b)(6)

3.4.5 Hazard Controls

3.4.5.1 Personnel Protective Equipment

The 324 Building developed the initial set of PPE for use in Airlock entries by working with experienced personnel from multiple facilities. The initial set of PPE started with the suite utilized for entries into HCAs at the Plutonium Finishing Plant (PFP). Facility personnel spent several months performing mock-ups and evaluations to tailor this set of PPE for the initial Airlock entries.

In response to the contamination events and IPARs, the PPE suite was changed several times since 2017. The current suite of PPE for airlock entry requires:

- One set of disposable cotton coveralls as an inner pair and one set of disposal impermeable coveralls as an outer pair.
- Five sets of gloves: surgeons, bismuth, Cannerns, surgeons, work glove.
- Five sets of lower extremity PPE: Cloth or nylon, two sets of rubber booties or overshoes, cloth or nylon shoe covers, rubber overshoes.
- Double-bib hood.
- PAPR (single or double-bib) is required for entry into the airlock. Double-bib hood is required when wearing a corded radio communication headset.
- Lapel Air Sampler for internal exposure monitoring from particulate airborne radioactivity
- Lapel Air Sampler for airborne metal constituents
- Heat stress monitoring gear.
- Corded radios with headsets.
- Hard hats (when working with elevated equipment).

Use of PPE becomes problematic in some situations, as the PPE is not designed for all sizes. Shorter personnel or personnel who are heavy-set may wear PPE that is too long in the arms or legs. This may cause PPE to drag on contaminated surfaces, increasing the potential for transfer of contamination during doffing. Impermeable coveralls are used as an outer pair to reduce the potential for wicking of contamination due to moisture (e.g., sweat-through). However, the fabric of the impermeable PPE is a porous surface. This can cause contamination to be embedded in the fabric during wipe downs. The impermeable layer of PPE increases body temperature, which may exacerbate the potential for heat stress and sweat through. Furthermore, the impermeable PPE material will pass water vapor above ~70% relative humidity according to tests conducted at Los Alamos National Laboratory (LA-13438-PR 1998

Technology Development, Evaluation and Application (TDEA) FY 1997 Progress Report).

Due to the seal of the double-bibbed hoods and the tape at arms and legs, the airflow from the respirators inflates the impermeable PPE. Communication units and hard hats are not well secured and the airflow may contribute to equipment dislodging during work activities. Additionally, if not properly secured, radios and security badges may become dislodged. Working in a HCA/ARA/HRA where contamination is flighty requires focus and diligence in movements to prevent transfer of contamination. Issues with PPE provide distractors, which can impact focus.

During review of the digital recording showing personnel exiting the airlock, independent personnel noted that yellow vinyl tape was being used to form a seal around gloves. This type of tape was encouraged by the 324 Building as it adheres strongly and seals well. The independent team of workers reviewing the digital recording expressed concern that that tape was fastened tightly and appeared difficult to remove. As personnel were stripped out of their outer PPE, some personnel shook out of their sleeves and outer gloves. This action could re-suspend or transfer contamination during doffing.

As contamination events have occurred, the PPE requirements have been modified to address individual issues. The current set of PPE creates set-up factors for human error due to the amount of equipment and the opportunities for distraction during work. No evidence was found to show that an integrated evaluation of PPE, considering industrial, radiological, and human factors considerations, had been performed. Consequently, the facility has not examined whether controls can be reduced or tailored in order to mitigate human factors.

324 Building utilized lessons learned from PFP in determining their initial suite of PPE. However, as changes were implemented to the initial suite, no documented evidence is available to show that the 324 Building did further benchmarking. Benchmarking could have been done within CHPRC or across the DOE Complex, to evaluate the changes to PPE and contamination controls. Central Radiological Protection supported 324 Building by conducting limited requests for information to PFP and other facilities with HCAs on doffing practices and PPE. The 324 Building did not investigate with the vendor whether PPE could be modified to provide better fit. They did not solicit information from other CHPRC facilities or other contractors to improve the selection of controls or to adopt tools that had previously been successful.

3.4.6 Contamination Control Measures

3.4.6.1 Donning/Doffing Practices

Starting with the event on January 9, 2019, additional focus was placed on donning/doffing practices at the 324 Building. Assistants were assigned to personnel donning PPE to review the 324 Building donning checklist and ensure equipment was in place. Assistants were expected to maintain personnel "chain of custody" of each of the entrants. Entrants were monitored and supported on a 1:1 ratio until they were ready to enter. While there is a facility-specific checklist for donning PPE, it is not under configuration control. Expectations for "chain of custody" are not documented or incorporated in training. The donning area is congested and contains both the donners and assistants during the process. The crowded area impacts the workers' ability to hear and can lead to distractions.

Prior to doffing PPE, the practice is to wipe down the outer set of coveralls. This control addresses both beryllium and radiological contamination. It was unclear to the Resumption Team whether this wipe down is effective. Personnel did not receive training on the wipe down process and were skeptical about the effectiveness. Moreover, when the Resumption Team reviewed the digital recordings of personnel

performing the wipe down process, (b)(6) personnel wiped in a spiral motion instead of a downward motion. They did not use multiple wipes or the wipe-and-fold method.

The 324 Building utilizes a facility-specific doffing instruction posted at the airlock door. (b)(6)

(b)(6)

(b)(6) There are numerous activities occurring during doffing and there are times when the entrant is left unobserved. While personnel "chain of custody" is expected during doffing, it is not consistently implemented at the airlock. Interviews indicated that personnel "chain of custody" is more rigorously implemented for Room 18.

Doffing is performed by peeling down the outer layer of PPE. Review by independent personnel experienced with HCA work noted that the 324 Building is not cutting personnel out of the outer layer or using drawstring PPE which can be easily dropped (which was recognized as a proven and effective method of contamination control at PFP). Once the contaminated outer pair is removed, it is returned to the airlock and placed in a waste container by entrants waiting to doff. Per current process, the entrants have removed their outer gloves prior to handling the waste. Observation of the digital recording show entrants pushing down on the waste in the container while personnel are standing in the area, which may re-suspend contamination. The outer PPE of the last

person who doffs is placed back into the airlock to be picked up and placed in a waste container by the next entrants. These practices require that contaminated waste be handled multiple times and moved from the immediate doffing area to the airlock without being placed in a bag or container to limit the potential spread of contamination.

The 324 Building uses two doffing assistants at the HCA. No doffing assistance is provided at the CA unless an entrant is contaminated. Benchmarking within CHPRC by the Resumption Team indicates that typically two assistants are assigned at the HCA and one at the CA step off pads.

If contamination is found during surveys at the airlock HCA or CA step off pad, application of a fixative is optional at the 324 Building. The option was allowed due to concerns about the odor of the fixative. If a fixative is not used, the worker receives a whole body survey. At the airlock, tape patches are used. A tape patch may press contamination into PPE rather than contain it. The Resumption Team noted that at Room 18, fixative was consistently applied if contamination was identified before the individual was doffed.

3.4.6.2 Use of Anti-Static Controls

There is a technical correlation between low humidity days and migration of Sr-90 particles. Prior lessons learned at the Hanford site support this correlation (e.g., Lesson Learned # 1998-RL-HNF-0022, *Reducing Contamination Events during Facility Deactivation* dated July 28, 1998). Following a contamination event in September 2019, the 324 Building convened a TRT to provide recommendations to address the contamination events. Use of fabric softener dryer sheets, rubbed on the inner set of PPE, was recommended based on use at PFP. The Resumption Team found no documented evidence of the benefit of using dryer sheets, which requires heat and physical contact to transfer the softening and anti-static ingredients to the fabric. However, evidence that static reduction can be beneficial certainly exists. Industry practice is to use an anti-static spray product. The Resumption Team also identified that the inner cotton set of PPE contains a carbon weave that provides static control.

3.4.6.3 Airflow

When the Airlock door is being opened, there is initially a high air velocity due to the small area of the opening. As the Airlock is opened further, the air velocity is reduced as the area of the opening is enlarged. The initial high air velocity may have an unintended consequence of re-suspending contamination as the door is opened. While a smoke test was performed

to verify inward flow, there was no documentation found of a smoke test to verify air flow does not result in eddies in the immediate area around the airlock threshold, particularly when materials or personnel are in the airlock entry. A waste box or personnel in the airlock doorway may create eddies in the general flow of the room which could contribute to contamination events. Without performance of a comprehensive smoke test at the airlock threshold, insufficient information is available to determine if appropriate controls are in place. An air flow study of the REC was performed in May 2017, but was not released as a controlled document. While there is an approval date and signatures, there is not a document number for this airflow study and a record copy could not be located. The airflow study focused on general air movement in the facility. Airflow effects on potential contamination spread near the open airlock door were not discussed.

3.4.6.4 Configuration of HCA Work Areas

The Cask Handling Area (CHA) is a high background radiation area, particularly when the airlock shield door is open. To allow survey of cloth wipes, a shielded survey "cave" was installed. After donning their outer set of PPE, individuals move behind the shield door and are surveyed. However, these surveys can only detect gross contamination due to the high background count rate levels. If HCA levels of contamination are indicated on the inner pair of PPE, a tape patch is applied to fix the contamination in place. There is no defined criteria for this survey and its purpose is not defined or well understood. Go/no-go is a subjective process. A consequence of this location is that the RCTs must move throughout the CHA to complete tasks. An RCT does not provide focused monitoring of the doffing process.

Surveying in a lower background count rate area would allow detection of lower levels of contamination, which could be mitigated prior to doffing of the inner set. Most of the personnel contamination events have been under 10,000 disintegrations per minute (dpm). This change would also allow better evaluation of doffing performance and of the effectiveness of PPE.

In the airlock, rails are located at the entryway to the HCA step off pad at the airlock. The rails pose a tripping hazard during work in this area. These rails are only used during waste box removal or installation of equipment. They have not been removed because the A/D airlock crane is out of service. There are tools and cables on the airlock floor. The airlock has restricted areas for movement. In Room 18, cable trays and other interferences remain on the walls. There is high radiation source term in some areas.

Working around obstacles increases the potential for distraction. These conditions may also cause personnel to brush up against contaminated

materials, increasing the potential for transfer during doffing. The 324 Building Management made a determination to (b)(6) (b)(6) Based on interviews, 324 Building personnel have the perception that addressing these issues (b)(6) and that the ability to retain the present workforce would be negatively impacted.

The Resumption Team found no documented evidence that the impact of these constrained areas was evaluated to determine how the conditions influenced the personnel contamination events.

3.4.6.5 Contamination Control of Work Areas

The AMW and RWP for airlock work establish action levels for discontinuing work in the affected area until contamination reduction has been performed. Action levels are based on the highest contamination values identified to date and have not been exceeded. Though contamination levels in the work area are high, decontamination of the airlock is not routinely performed. One reason provided is that the cranes and waste containers move between A-Cell and B-Cell into the airlock airspaces, which redistributes contamination. Consequently, decontamination is a temporary measure and results in an increase in worker whole body exposure. Since the dose consequences of a clothing/skin/hair contamination are low compared to whole body exposure, clothing/skin/hair contamination events are viewed by the 324 Management Team (b)(6) (b)(6)

The airlock contains a drainage trench, which is a higher dose rate area than the rest of the airlock. The drainage trench is partially plugged, causing it to drain slowly to the pipe trench beneath. The drainage trench contributes to higher dose rates in its vicinity. The condition of this trench also limits the amount of water that can be used in decontamination activities. There has been no evaluation conducted of whether to remove the obstruction plugging the drain.

Several personnel who were interviewed indicated that carbon dioxide (CO²) decontamination of airlock surfaces had been suggested, and did not know why these suggestions had not been implemented. During the investigation, the Resumption Team discovered that plans to acquire a CO² decontamination system were in progress. The Room 18 RWP contains specific limits at which decontamination is performed.

During drilling on March 13, 2019, the facility found fine sand (dune sand) containing unexpectedly high levels of Sr-90 contamination at the first inside pilot hole location. When the drill rig contacted the sand, which was contaminated with Sr-90, contamination was spread into Room 18. Soil samples obtained outside of the 324 building did not provide

indication of fine sand under the foundation. Review of the construction specification for the building also did not indicate the presence of fine sand. Upon discovery of this unexpected condition, work was stopped and additional engineered controls were developed for the drill rig to minimize the potential for spread of contamination. However, no documented evaluation could be found for whether the change in soil and type of contamination necessitated any additional changes to the drilling operation.

Fixatives are not currently used on building surfaces in either the airlock or Room 18 to reduce the potential for contamination spread. Some 324 Building personnel expressed in interviews that use of fixatives locks material down and may increase dose rates. No documentation was evident to show that an alternatives evaluation for use of fixatives had been performed.

3.4.7 Radiological Work Planning

3.4.7.1 Technical Work Documents

Drilling work performed in Room 18 is completed via work package 30-17-06238, *324 BDP: Pilot/Micropile Holes*. Per interviews, the initial controls in the work package were based on the belief that high levels of contamination would not be encountered. In the nine months since the package has been released, there have been six changes. The work packages were planned for HCA levels as a contingency, but not for the levels actually encountered. Review of work packages indicated that AMW bolded controls had been flowed down as required.

Work in the airlock is conducted to 324-PRO-OP-54055, *Airlock/C-Cell Access*. The procedure is generic for hazard controls – some controls are not embedded in the procedure but the procedure vectors to the RWP.

324-PRO-OP-54055 reference the Airlock/C-cell access PPE Plan, dated 12/3/18, which is listed as a baseline document in the procedure history file. The document contains several PPE requirements that are not incorporated in the procedure or other control documents (e.g., safety glasses, bismuth gloves). Although there is an approval date and signatures for the PPE plan, there is no document number. There have been several changes to process and PPE since this document was last revised. The PPE plan was intended to bring all control sets together for review, but it has not been maintained. The PPE plan is not a formally released/controlled document.

High and medium risk work instructions, including changes to the documents, were reviewed through the 324 Building Hazard Review

Board (HRB). The 324 Building HRB has rejected only one package – the others have been approved with comments. Per the 324 Building HRB designation list, all members of the board are 324 Building personnel. Independent personnel are designated as alternates. Typically, 1-2 alternate independent personnel were selected to participate in 324 Building HRBs. One of the lessons learned from PFP was to increase the independence of the HRB and decrease thresholds for what requires HRB review. Increased independence in 324 Building HRB personnel would help to detect issues involving less than adequate work planning.

Soil contamination was expected to be low in Room 18 based on soil sampling and other available information. Drilling was started in the highest potential contamination area, rather than selecting the lowest potential contaminated area.

3.4.7.2 AMWs /Rad Hazard Planning

Research determined that a practical demonstration of doffing techniques has been in place at 324 Building for some time, with varied implementation rigor. The AMW for the airlock cites the doffing practical under “Special Training.” However, there is no direction for the practical to be added to the RWP and the text is not bolded indicating it is to be included in the work instructions. Completion of the doffing practical has been tracked internally for Room 18 personnel since July 2019. Unlike the AMW for supporting airlock entries, the AMW and the work control documents for Room 18 work do not address doffing as special training. The Job Control System (JCS) work package 3O-17-06238, however, stipulates as a pre-requisite that the 324 Building Manager (or designee) has completed a Work Record Entry accepting work proficiency training/briefing for donning and doffing impermeable PPE used for entry and exit to Room 18. Daily inspections cited also ensure personnel have completed 324 Building specific donning and doffing training per rosters. The doffing practical for the airlock is not specifically tracked. Since no course number has been assigned, the standard training reports cannot be used to confirm who has completed the practical and when.

3.4.7.3 JHAs/HASP

The Job Hazard Analysis(es) (JHAs) vector to other documents and plans rather than specifically listing controls. Interview and observation indicated that use of hard hats under the PAPR hoods create distractions, as the hard hat frequently comes loose and blocks vision during an HCA entry. Issues related to the hard hats coming loose have been brought up multiple times. The applicable JHA requires hardhats in the airlock anytime the man lift is in use. This is currently implemented as all

personnel in the airlock wearing a hard hat even when the lift is not being elevated (e.g., when the lift is moved from one location to another without elevating the platform). This expectation contrasts with the control for falling objects, which states hard hats are required during aerial lift operations. This control is also reflected in PRC-SRP-00113-01, *324 Building Disposition Project Site Health & Safety Plan (HASP)*, but the basis for the requirement is not provided in the document. 324 Building has not evaluated whether distractions can be mitigated by reducing the requirements for hard hats to operations where the lift platform is raised, or by providing an exclusion area that would not require hardhats while the lift is operated.

Wipe downs and personnel air samples for beryllium/heavy metals are required. The 324 Building Industrial Health Manager is collecting beryllium sample data, but no trending has been conducted to determine if reduction to these activities is appropriate. The beryllium controls provide questionable value and create set-up factors for human error.

3.4.8 Monitoring Performance

3.4.8.1 Metrics

Following the eighth personnel contamination event in July 2019, a commonality review was performed. 324 Building Radiological Control has continued to add to this document as each event occurs. However, there is no evidence that this data is used to improve performance. The facility Radiological Control group maintains a metric on personnel contamination that reflects as a ratio of how many contaminations have occurred per number of personnel who signed into the RWP in the Radiological Access Control system. The actual number of personnel entering a HCA may be significantly fewer than the personnel who have signed the RWP. This ratio provides a false indicator of performance. The metric gives the appearance that the facility considered these issues as a low and acceptable risk.

The facility does not maintain a performance metric or leading indicator for skin and clothing contamination events, contrary to PRC-PRO-RP-40389, *As Low As Reasonably Achievable (ALARA) Program Structure and Goals*. The facility is not tracking contamination of inner PPE as an indicator of whether doffing of outer PPE is being effectively implemented. An acceptable rate of performance has not been established and no thresholds are established that drive action.

Field observations from MOP reports and DOE-RL OA reports have identified many issues related to contamination control. For MOPs, issues corrected in the field are not required to be entered into CRRS.

The facility does not conduct a manual review of OAs or MOPs for leading indicators, although this review is performed at the Radiological Protection Program level. Data sources are not reviewed collectively to detect performance issues and remediate them.

Metrics are maintained at the company-level for personnel contamination events. These metrics identified 324 Building as needing improvement in this area. Actions were assigned to provide recommendations to 324 Building on PPE and to provide support and oversight for contamination control issues at 324 Building. In addition to the company-level metrics, Radiological Protection maintains additional sub-metrics for monitoring performance. The Resumption Team noted that the company-level metrics require 2-3 personnel contamination events per month to trigger a yellow "needs improvement" rating. The basis for this threshold is not documented. To support a target zero philosophy for personnel contamination, the threshold for "needs improvement" should be re-evaluated.

3.4.8.2 In-Field Oversight

Feedback to personnel (b)(6)
 (b)(6) Due to high radiation dose rates in the airlock, observation of personnel is conducted from the CHA outside of the airlock. While Operations Field Work Supervisors (FWS), Maintenance FWS, and Labor Foremen may observe work via camera or from the CA collocated in the CHA, (b)(6)
 (b)(6)

In interviews, personnel indicated that upper management (b)(6)
 (b)(6) (b)(6)
 (b)(6) Review of 324 Building MOP reports indicated that managers had conducted 32 oversight activities in 2019, with first line management conducting an additional 28 oversight activities. Ten of these oversight activities were Senior Supervisory Watch (SSW). The 324 Building also maintains a log for SSW observations. Contrary to procedure, this log is not routinely reviewed and the issues from the log are not recorded in CRRS. After eight personnel contamination events had occurred, independent Radiological Control personnel were assigned to perform three observations of work activities and doffing practices. The observations and associated documentation had been completed, but 324 Building had not consolidated and published the observations in a Work Site Assessment (WSA), in accordance with the CRRS commitment, while this investigation was in process. Other independent resources have not been requested to support observation of day-to-day work activities.

Review of the 324 Building SSW Designation Letter and selection process showed that no specific qualification process is used for SSWs.

A limited number of personnel independent from the 324 Building are assigned to perform SSW.

Observation of doffing practices is difficult due to the congestion of the area and the number of personnel assisting entrants. Although a camera system has been installed in 324 Building, current placement of the cameras in the CHA does not allow monitoring of the doffing process. The digital recordings have not been used as a tool to review work practices and identify potential drifts in performance.

3.4.8.3 CHPRC Oversight

While Functional organizations provided some support to the 324 Building, the (b)(6)

(b)(6) While there was awareness that 324 Building was (b)(6) (b)(6) CHPRC processes, the (b)(6) (b)(6) at the company level. Functional personnel interviewed stated that they (b)(6) (b)(6) CHPRC processes. The Functional groups (b)(6) (b)(6)

While the Functional Radiological Protection organization was aware of the repetitive nature of the contamination events by April 2019, the commonality review was not performed until eight events had occurred. It was not until Events 10s and 11 in October 2019 that CHPRC management chartered a corporate team to assess the 324 Building. The corporate assessment identified the first indications of underlying issues during their evaluation.

3.4.9 Performance Assurance

3.4.9.1 Critiques and Investigations

324 Building critiques are conducted immediately following an event, at times while recovery actions are still underway. Consequently, not all personnel or technical information necessary to understand the issue may be available for the critique meeting. Follow-up interviews may be conducted with these individuals. Critiques may be conducted by Director-level personnel or by a qualified Performance Assurance (PA) critique leader. The Project Vice President determines who will lead the critique. While allowed by PRC-PRO-EM-058, *Event Initial Investigation and Critique Meeting Process*, use of senior management to conduct critiques may inhibit open discussion. Review of 324 Building critique reports for 2019 showed that timelines were developed, but the critique

reports seldom contained context for personnel actions. 324 Building does not currently collect information to understand the context and human factors associated with the event in order to provide greater insight into the effectiveness of actions and whether course corrections are appropriate.

3.4.9.2 Assessment

324 Building personnel conducted eight WSAs of radiological areas during FY 2019. The majority of WSAs reviewed were not in depth reviews. 324 Building did not conduct any management assessments of radiological activities in FY 2019.

Assessments were performed by a CHPRC Safety, Health, Security and Quality (SHS&Q) manager to compare radiological practices in Room 18 and the airlock. No issues were identified. A program level assessor conducted some assessments in radiological control at the 324 Building, including the areas of contamination control and design control. Assessments conducted by personnel independent from the facility were not scoped to examine how processes had been developed. The assessments did not identify underlying issues. A Jacobs corporate assessment was completed November 5, 2019. It identified several underlying issues, which were affecting the personnel contamination events.

3.4.9.3 Readiness Assessment

In FY 2019, 324 Building readiness activities for soil removal graded as a contractor readiness review, with the scope focused on a limited number of project areas. The scope was based on the assumption of existing mature programs. The management assessment performed in preparation for the readiness focused on these limited areas. The management assessment was conducted by 324 Building resources and reviewed by independent personnel in a Readiness Review Board (RRB). The readiness review was not scoped to detect the undocumented practices and performance issues that contribute to the contamination events. The scope of the management assessment for readiness exempted most radiological work activities. As the contamination events emerged, CHPRC senior management postponed the readiness assessment until the issues could be resolved.

3.4.9.4 Corrective Action

Most of the personnel contamination events resulted in actions to address the immediate issue. 324 Building Management addressed each of the individual events, (b)(6)

(b)(6)

A review of the causal analyses for previous contamination events showed that actions were frequently documented as complete before the causal analysis was performed. This sequence suggests that actions had been determined and implemented without benefit of formally analyzing the issues. Actions were remedial in nature, which is acceptable for Apparent Cause Analysis. None of the individual contamination issues at 324 Building has reached a level that requires a root cause analysis or verification of corrective actions. Three of the twelve individual events reached an occurrence reporting threshold as Reporting Level Low events, which require an Apparent Cause Analysis but not a Root Cause Analysis.

In July 2019, an independent cause analyst assisted the facility in performing a commonality review of eight contamination events. The commonality review was also documented as an information only occurrence report. The review identified less than adequate radiological work practices and less than adequate PPE. No further analysis of these common factors was performed to identify underlying causes. While actions were assigned to address the commonality review, these actions were not scoped to address underlying causal factors.

Until the Stop Work was declared on November 14, 2019, no root cause analysis was performed to identify those factors that were impeding the effectiveness of contamination control corrective actions. Actions to verify effectiveness of actions through assessment or follow-up were infrequently assigned. Due to the pace of work, little wait time to verify whether the actions had been implemented effectively was available.

Review of action statements in 324 Building lower threshold issues found that actions rely heavily on wording like "brief" and "evaluate". 324 Building actions, in general, did not result in institutionalized controls. Some issues were entered into CRRS five days to one month from the identification date. Actions were often listed as complete at the time of entry. For 324 Building items in CRRS, development and completion of actions often lags behind due dates (e.g., issues identified in October 2019 did not have action plans in December 2019). Failure to identify and correct issues in a timely manner leaves set-up factors in place for additional issues.

Review of 324 Building processes identified several items that are not routinely documented in CRRS:

- For several personnel contamination events, the action was to conduct an IPAR. Numerous actions have been taken under the IPARs that have not been recorded in CRRS.
- The Safety Issues and Ideas logbook is used to track stop work issues. These Stop Works have not been consistently entered into CRRS.
- The facility established a SSW logbook. Contrary to procedure, the logbook was not periodically reviewed for issues that should be entered into CRRS.
- Some MOP issues corrected in the field were not entered into CRRS. While this is allowed by the company procedure, 324 Building did not periodically review the MOP issues for leading indicators of drifts in performance.

Not all of the actions taken to address 324 Building personnel contamination events are transparent. It is difficult to credit or monitor undocumented actions. Failure to document issues in a single system can influence the ability to detect emerging issues and adverse trends. While some 324 Building actions may be appropriate to address the contamination issues, there has been no evaluation to determine what is or is not working effectively.

When interviewed on use of CRRS, 324 Management views CRRS as not "real time". (b)(6)

(b)(6) Rather than using the institutionalized system, some information is tracked internally and is not transparent.

The 324 Building PA group has sought help from the functional Performance and Quality Assurance organization. Assistance has been provided when requested, but is not routine. There is no structured process to provide mentoring in the area of Performance Assurance. There is limited oversight/assessment from the PA functional group. There are a limited number of experienced PA personnel in CHPRC, so mentoring is limited based on available resources.

3.4.9.5 Lessons Learned

324 Building performed a review of the lessons learned from the W-130 Project events and documented a series of actions in the 300-296 Project Action Tracker database. While these actions show as closed in the Project Action tracker database, some do not include the results of the action. For example, an action to review the trending process for the 324 Building project does not provide the results of the review or if further actions were taken. Other actions show closures that are not responsive to the action. An action to assess whether performance objectives and lines of inquiry identified in the W-130 Lessons Learned report were appropriately incorporated into 324 Building Disposition project was

closed with the statement that “the leadership team conducted several meeting to review W-130 lessons learned and corrective actions. The results of the reviews are incorporated in the Project Action Tracking list.” Subsequent to conducting this review, the management team at 324 Building changed. As the actions from the review were not institutionalized, some processes were changed as work progressed.

While 324 Building did not document a review of the lessons learned from the PFP contamination event in December 2017, a company wide in-depth extent of condition review was performed. The extent of condition review examined the potential for PFP causal factors to affect other projects. 324 Building participated in this review. The improvement actions, as implemented at 324 Building, did not effectively imbed the contamination control, radiological trending, and change control/communications.

A review of the Hanford Operating Experience database identified several lessons learned which would be applicable to 324 Building activities. No evidence was available to demonstrate that these lessons learned documents had been reviewed or that recommended practices had been incorporated in 324 Building activities. Example lessons learned include:

- WPRS-IB-18-006, Differing Levels of Worker Experience and Handling Highly Contaminated Materials
- RCCC-2016-0001 Low Risk Doesn't Equal No Risk
- 2016-RL-HNF-0010 Step Back and See the Forest
- 1998-RL-HNF-0022 Reducing Contamination Events during Facility Deactivation

3.4.10 ISMS Approach

As previously noted, 324 Building changes to correct personnel contamination events have addressed individual issues as they arose. The Resumption Team could find limited documentation to explain the rationale for changes or to demonstrate that a systematic approach had been taken to analyze the hazards and develop controls. The 324 Building approach to managing the change process is to obtain worker feedback or event investigation (IPAR, critique), analyze and document the change in the AMW or TEs (if required for rad controls), obtain reviews by Subject Matter Experts, and implement via the work control change process.

Some support documents, such as PRC-SRP-00154, and the Airlock/C-cell access PPE Plan, have not been updated to reflect current facility conditions and controls. Several documents were found to be informally issued and not under configuration control (i.e., 324 Building Air Flow Study; Donning and Doffing checklists, Donning and Doffing training material).

The 324 Building Management Team (b)(6)
 (b)(6) Company-level systems and tools, such
 as causal analysis, the Systematic Approach to Training, etc., (b)(6)
 (b)(6)
 (b)(6) The 324 Senior Management (b)(6)
 (b)(6)
 (b)(6) Consequently, the 324
 Building Management Team (b)(6)
 (b)(6)

(b)(6)

(b)(6)

Although CHPRC has checks and balances in place to detect drift in performance, (b)(6) to correct the conditions at the 324 Building. Previous practice for determining level rigor to be applied to review of changes has been focused on the facility hazard categorization (tied to the nuclear operating criteria of the facility. As Hanford work progresses to address decommissioning buildings and managing historic waste sites, the potential for encountering unexpected conditions increases. (b)(6)
 (b)(6)

3.4.11 Communications

During interviews, personnel were asked if they were involved in the development of hazard controls or corrective actions. Apollo contract workers, comprising the majority of the workforce, felt they had good involvement in development of hazard controls. However, other labor, craft, and exempt personnel indicated that they were not involved, nor had they heard about all of the events. Some personnel who were interviewed indicated they were surprised the facility had received a letter from DOE-RL on the contamination events. Others stated that they were not immediately aware of the stop work called on November 14, 2019.

Monday meetings are the primary method for 324 Building management to communicate to the Project personnel. Other communications may come out via project-wide emails or through the morning plan of the day/resource assignment meeting, with the expectations that management flow down the information. 324 Building personnel indicated that the Monday briefings do not consistently discuss events or status. Contamination events were discussed at the two Monday meetings following the November 14, 2019 stop work, but information on the other contaminations was not discussed.

Some 324 Building personnel brought up suggestions (e.g., CO² decontamination) but did not receive feedback on why their suggestions were not implemented. Consequently, some employees expressed frustration that they were not listened to, recommendations were not acted on, and management either took a different path or no action. Some of the (b)(6) and (b)(6) interviewed felt first line management was very responsive to issues. (b)(6)
 (b)(6)

(b)(6) Some personnel interviewed indicated they (b)(6)
 (b)(6) management (b)(6)
 Based on (b)(6)
 (b)(6)

Pre-job meetings are another tool to promote good communications. Personnel interviewed commented that communication in pre-jobs consists of going through the pre-job checklist, but does not focus on the work to be performed. One interviewee stated that, when questioned, some workers did not know the tasks after the pre-job was completed. A 324 Building safety issue was identified on the length of the pre-jobs impacting the ability of personnel to focus on key information about the work (reference Safety Issue 2019-300-020, initiated in August 2019).

4.0 HISTORICAL REVIEW (SIMILAR OCCURRENCES)

Review of CRRS, as well as the Occurrence Reporting and Processing System, identified EM-RL--CPRC-324FAC-2019-0004 *Management Concern Regarding Personnel Contamination Events*, as the most relevant related occurrence. This information-only occurrence report documented the emerging trend of contamination events at the 324 Building. The commonality review of the first eight personnel contamination events was performed to analyze this trend. This is discussed in more detail under section 3.4.9.4 above.

In addition to the 324 Building event, EM-RL--CPRC-PFP-2017-0018, *Discovery Of Contamination Spread*, EM-RL--CPRC-WESF-2016-0005, *Contamination Found Outside Controlled Area*, and S-17-OOD-WESF-001, *C01: W-130 Project work activities were not planned adequately commensurate with the risk to the worker and project* (CR-2017-1240), are considered similar events. All events discuss encountering unexpected conditions and contamination spreads which occurred due to inadequate controls. The analysis for EM-RL--CPRC-PFP-2017-0018 cited inadequate monitoring and management of change processes as underlying causes. EM-RL--CPRC-WESF-2016-0005 and S-17-OOD-WESF-001 identified issues with radiological planning as underlying causes.

For EM-RL--CPRC-PFP-2017-0018, a company-wide extent of condition review was performed. This review examined the potential for individual causal factors to impact other CHPRC facilities. 324 Building was included in this review. The extent of condition review identified 10 opportunities for improvement. The improvement actions, as implemented at 324 Building, did not effectively imbed the contamination control, radiological trending, and change control/communications.

For EM-RL--CPRC-WESF-2016-0005 and S-17-OOD-WESF-001, a review of lessons learned was performed. As stated above in Section 3.4.9.5, it was difficult to determine from the available information whether all of the lessons learned elements had been fully addressed. In those cases where objective evidence had been generated, it was entered into the 300-296 Project files and was not readily retrievable.

5.0 EVALUATION OF ASSESSMENT PERFORMANCE

Assessment records were reviewed for the period between 10/1/2018 and 11/14/2019 to determine what assessments had been performed at 324 Building in the area of radiological control.

- SHS&Q-2019-SURV-21499, *CHPRC 10 CFR 835 Occupational Radiation Protection, Subpart K, Design and Control*, evaluated 324 Building as part of routine cross-company assessment. No issues were identified at 324 Building.
- SHS&Q-2019-WSA-23431, *Radiological Work Planning*, evaluated compliance of documentation with company requirements. One issue was identified with a 324 Building ALARA Management Worksheet, which was corrected.
- SHS&Q-2019-WSA-24259, *Implementation of the ALARA Program*, identified that several projects, including River Risk Management Project, were not routinely meeting and documenting quarterly ALARA reports.
- 324-2019-WSA-24159, *Comparison of Entry Requirements Room 18 vs. the Airlock*, was conducted in July 2019 by a manager independent from the 324 Building. This assessment noted that the AMW for airlock entry required mock-up of PPE removal, while the AMW for Room 18 did not contain this requirement. The assessor believed this was appropriate based on the differing levels of contamination between the two locations. No issues were identified.
- An effectiveness review for actions under CR-2017-1240, *W-130 Project work activities were not planned commensurate with the risk to the worker and the project*, was conducted in September 2019 and reviewed 324 Building radiological work planning to validate that company-level actions had been sustained. The effectiveness review identified two issues at 324 Building: 1) Expectations for subcontractor personnel facility orientation were not clearly flowed down, although all subcontractor personnel had completed the training; and 2) One AMW bolded requirement and one hazardous energy control requirement were not landed in facility implementing documents.
- PTS-2020-WSA-25365, *Independent Review of Subcontractor Oversight at 324 Project as Requested by RRMP Vice President*, was completed while this investigation was in process. The assessment identified that not all (b)(6) (b)(6) were knowledgeable of the facility and subcontractor work scope. Oversight of subcontractor work was not being performed as required. Interviews identified that the knowledge of (b)(6) (b)(6) in several areas related to control of hazards (both industrial and radiological).
- 324 Building has conducted a limited number of WSAs in the radiological area. The majority of WSAs reviewed were not in depth reviews. Review of MOPs indicated that managers had conducted 32 oversight activities in 2019, with first line management conducting an additional 28 oversight activities. Ten of these oversight activities were Senior Supervisory Watch (SSW). Review of the MOP/SSW documentation identified (b)(6) were periodically identified and corrected in the field. As allowed by procedure, issues corrected in the field were not entered into CRRS; consequently, they are not readily visible for tracking and trending

- Jacobs Corporate personnel conducted an independent assessment of the 324 Building. The assessment evaluated the areas of organizational effectiveness, Safety Culture, Work Planning, Conduct of Work, and Radiological Controls. Ten recommendations were identified (Reference 324-2020-IA-25211).

The majority of the 324 Building assessments of radiological control examined documentation processes. They addressed specific requirements and were not scoped to look holistically at how the documentation influenced in-field processes. Those assessments that utilized in-field observation and interviews identified issues that were related to contamination and hazard control practices. While performance issues were identified by in-field observation of radiological work, the (b)(6) (b)(6) was not recognized.

An operational assessment of 324 Building was performed using independent personnel from Jacobs Corporate. This assessment was conducted in October 2019, after ten events had occurred. This independent assessment was scoped to allow identification of several organizational issues; however, these issues were only rated as opportunities for improvement. While CHPRC has a procedure for conducting Independent Assessments, criteria for when an independent assessment should be performed is lacking.

6.0 PROBLEM EVALUATION

The analysis was performed using Barrier Analysis and Why Staircase techniques.

6.1 Root Causes

RC01: Level of Risk Acceptance for Contamination Events (b)(6) (b)(6)

The Jacobs corporate assessment (324-2020-IA-25211), the investigation by the analysis team, and the independent assessment of radiological controls (SHS&Q-2020-MA-25394) each identified weaknesses at 324 Building (b)(6) (b)(6)

324 Management (b)(6) (b)(6) (b)(6)

324 Management works to limit direct dose to the workers entering the HCAs. The emphasis on equalizing dose among workers drove personnel rotations, (b)(6) (b)(6)

(b)(6) (b)(6) 324 Management (b)(6) as the events did not result in dose consequence, a limited number of events resulted in occurrence reports, and the individual events did not reach a threshold to trigger (b)(6) 324

Management (b)(6)

(b)(6)

Similarly, 324 Senior Management (b)(6)

(b)(6) The 324 Building Management Team
 (b)(6) Investigation into
 use of fixatives or decontamination of the work areas has been delayed and has not
 taken advantage of knowledge gained by HCA entries in other CHPRC facilities. The

(b)(6)

Interviews identified that communications between management and the work force needs to improve. Facility personnel indicated that the 324 Building briefings do not consistently discuss events or status. Several personnel were not aware of all of the personnel contamination events and were surprised to hear that DOE-RL had issued a letter related to the events. During interviews, personnel provided examples of recommendations raised to the management team (e.g., CO² decontamination). The individuals had not seen action taken nor had received feedback on why action had not been taken. While personnel, particularly (b)(6) and (b)(6) felt that their immediate management was responsive to addressing issues, (b)(6)

(b)(6) Consequently, some personnel indicated that they no longer brought up issues, as the issues would not be addressed.

(b)(6)

The Resumption Team observed that 324 Management (b)(6)

(b)(6) with some managers performing tasks that should be performed by individual contributors. Decisions on processes are made at the upper management level, rather than allowing lower level management to take responsibility. Examples include:

- The Nuclear Facility Manager writes test questions for qualification packages rather than a trainer.
- The decision on where to start the pilot holes in Room 18 was made by the Director of Programs, rather than Operations and Radiological Control.
- The River Risk Management Project Vice President assigns who will perform critiques, frequently to a Director in the organization. In other projects, this assignment is made by the Performance Assurance Manager to a member of the Performance Assurance group.
- Operations management decided there would be no real time air monitoring in Room 18 during grout injection. This determination should have been made by Radiological Control to ensure compliance with DOE regulations and CHPRC procedures.
- Direction on soil sampling in Room 18 was provided by the River Risk Management Project Vice President. This determination should have considered input from Environmental, Radiological Control, and Waste Services to ensure that newly identified hazards were characterized adequately as well as to ensure compliance with DOE regulations and CHPRC procedures pertaining to their respective disciplines.

The lack of clarity in roles and responsibilities detracts from (b)(6) focus on (b)(6). Additionally, time spent performing activities that would normally be assigned to delegates, decreases the ability of (b)(6) to provide oversight and hold personnel accountable to high standards of performance.

Cause Code:

A4B5C04: Risk/Consequences Associated with Change not Adequately Reviewed/Assessed

RC02: An Integrated Approach was not Used in Response to Personnel Contamination Events.

The 324 Building organization has developed a culture of solving problems in a timely manner (b)(6). Consequently, actions to address personnel contamination events have not used a systematic approach to develop and implement controls. No evidence was found of a systematic approach to analyze the potential causes of the contamination events and to address them in an integrated fashion. Change Management systems (such as training, Corrective Action Management, etc.) were not utilized in the evaluation and promulgation of changes. The technical bases for changes in processes have not been documented and baseline documents have not been routinely updated. While Radiological Technical Evaluations and implementing documents were updated, this was conducted following the change decisions. Without use of these institutionalized change systems, it is difficult to demonstrate whether actions were appropriate and effective.

This condition is exacerbated (b)(6). Examples include:

- The donning/doffing practical was developed outside of the training process and has been tracked internally. No objective criteria for proficiency has been identified, nor has a frequency for refresher been established. Internal tracking of completion started in July 2019. This activity is referenced in controlled documents such as AMWs, but is not under configuration control.
- As noted in 324-2020-IA-25211, 324 Building (b)(6) Performance Assurance processes. The facility does not have a set of performance measures that are routinely reviewed, and no thresholds have been identified for action. All actions taken to address contamination events were not consistently entered into CRRS. Apparent cause analysis was performed for occurrence reportable contamination events, but the repetitive nature of the events did not drive analysis of underlying issues.
- The 324 Building does not have (b)(6).
- (b)(6) on one contamination event without the individual who was contaminated in attendance. That individual was going through decontamination processes (b)(6). The individual was later interviewed.

- (b)(6) maintains a spreadsheet of post-job feedback rather than enter the information in the Automated Job Hazard Analysis database as required by procedure.

(b)(6) impacts the effectiveness of actions. These institutionalized processes are constructed to implement Integrated Safety Management System (ISMS) principles, which foster a strong safety culture. Failure to use established systems also prevented the appropriate Subject Matter Experts (SME) from reviewing changes, which in turn removed opportunities to detect lack of rigor and to mitigate the potential for contamination events.

Cause Codes:

A4B5C04: Risk/Consequences Associated with Change not Adequately Reviewed/Assessed

RC03: (b)(6)

(b)(6)

(b)(6)

(b)(6) in the facility. (b)(6) the 324

(b)(6)

(b)(6) When personnel contaminations increased and when Sr-90 contamination was found in an unexpected location, CHPRC management (b)(6)

(b)(6)

CHPRC (b)(6) (b)(6) 324 Building Operations in a timely manner. While the Functional Radiological Protection organization began providing support to 324 Building after the first four events had occurred, the focus was on personnel contamination control. The commonality review performed in July 2019 was requested by the Functional Radiological Control and Functional Performance Assurance organization, but the common factors were not analyzed to determine underlying causes. Although the Functional Training organization was aware of the informal donning/doffing practical, the group did not use appropriate channels to cause 324 Building to build an effective process. While the Functional Performance Assurance group provided support to 324 Building for causal analysis, long-term help was not assigned. CHPRC has a limited number of highly experienced PA personnel, so mentoring was impacted by the available resources.

In July 2019, both the CHPRC President's Office and 324 Senior Management met with DOE-RL senior management on recovery from the first pilot hole contamination event. However, not until the events in October 2019, did CHPRC (b)(6) have a Jacobs corporate team assess the 324 Building and underlying issues were documented.

CHPRC has a procedure for independent assessment of projects and activities. Beyond requirements-based assessments, there is no criteria established for when an independent assessment should be performed. Determination of when to perform an

independent assessment is subjectively driven by management knowledge and experience. Objective criteria would allow for earlier evaluation of potential performance weaknesses, emerging trends, and cultural issues.

The CHPRC-level metric for Skin and Clothing Contamination requires 3-6 events per month across CHPRC to trigger a yellow score (needs improvement). The basis for this number is not documented. The grading does not account for a cumulative number of events or events over time. To promote a target zero philosophy for personnel contamination, the threshold for "needs improvement" should be re-evaluated.

Cause Code:

A4B1C04: Management Follow-up or monitoring of activities did not identify problems (Best Fit Code)

RC04: Evaluation of Changes to Operational Risk is not well integrated into CHPRC Processes

PRC-PRO-RP-40439 identifies specific criteria for radiological process changes that must be evaluated in accordance with the procedure. This process, as guided by form A-6006-153, *RadCon Change Management Checklist*, requires use of benchmarking, review of lessons learned, use of causal analysis or other analytical processes, and identification of methods to control and monitor change. The Resumption Team (b)(6) (b)(6) PRC-PRO-RP-40439 to evaluate or develop controls for changed conditions. Discussion with Radiological Control personnel external to 324 Building found that PRC-PRO-RP-40439 is not well known by Radiological Control personnel and it is not referenced in other radiological control procedures. Review of the procedure indicated that it contains both predictive and reactive criteria for using the change control process, as well as an effective method to document tools used to analyze the change. In the case of 324 Building, the discovery of greater than expected levels of Sr-90 contamination and the identification of a trend of contamination control events both would reach the thresholds for documented change control evaluation. This procedure provides a valid process for managing changes. As it is not integrated into other Radiological procedures or training, there is no process in place to make personnel aware of the procedure and when to use it.

PRC-PRO-RP-40439 provides a systematic process for evaluating changes, but is limited to radiological control processes. Previous practice for determining level rigor to be applied to review of changes has been focused on the facility hazard categorization (tied to the nuclear operating criteria of the facility). As Hanford work progresses to address decommissioning buildings and managing historic waste sites, the potential for encountering unexpected conditions increases. Level of risk and level of rigor are now more applicable to the hazard level of the activity rather than the hazard categorization of the facility. For example, each high-risk activity may generate a hazard or risk that requires special training. CHPRC relies heavily on the existing training courses available through HAMMER and at the facilities. Evaluation of operational risk should evaluate gaps between the knowledge/skills that the work requires and what is provided through standard training. While some change management tools are already built into CHPRC procedures, an integrated approach to evaluating changes which impact facility

operational risk and life cycle management is lacking. Processes which may detect a change do not reference triggers for the level of rigor that should be applied in evaluating the change. Expanding the process discussed in PRC-PRO-RP-40439 to address other operational activities would provide better triggers for evaluation of changes and improve the tools for operational risk management.

Cause Code:

A5B3C02: Written Communication Not Used, Not Available or Inconvenient for Use (Best Fit Code)

A5B3C01: Lack of Written Communication

6.2 Contributing Causes

CC01: Digital Recording Equipment was not used as a Performance Improvement Tool

324 Building has cameras installed throughout the facility to allow observation of activities without entry into high hazard radiological areas. These cameras provide digital recordings that can be reviewed at a later time. Until the November 14, 2019, contamination event, the facility had not utilized the recordings to review worker performance. (b)(6)

(b)(6) Some areas, such as the airlock doffing area and sections of Room 18, are difficult to observe from the floor level. Additional cameras in these locations would allow for better observation, which in turn could be used to provide worker feedback and improve performance.

Cause Code:

A4B4C02: Progress/status of task not adequately tracked

6.3 Extraneous Conditions Adverse to Quality (ECAQ)

The issues below were determined not to be causal to the personnel contamination events, but should be addressed to improve processes and the level of rigor applied to nuclear facility operations. The ECAQs will be issued as stand-alone Condition Reports to track the recommended actions to closure.

ECAQ 1: Outdated/Conflicting Documents

During documentation reviews, the Resumption Team noted that a number of documents had not been updated to reflect current facility conditions. In some cases, one document had been updated, but others that had not been updated were now in conflict. The list of documents that need to be updated includes, but may not be limited to, the documents listed below:

- ALARA Design Review (has not been updated to reflect discovery of greater than expected levels of Sr-90 contamination and changes to the Waste Management Plan)
- Responsible Manager Designation Letter (two personnel listed have left the facility)
- Airlock Entry Course (does not reflect the current version of the doffing checklist)
- Operations Plan

Tracked under CR-2020-0479.

To address this issue, the Resumption Team recommends:

- Revise the PRC-SRP-00154, ALARA Design Review to reflect current radiological conditions, durations of activities and updated exposure estimates, and specific contamination control practices.
- Revise PRC-SRP-00030, Operations Plan, to reflect changes to the planned equipment for remotely excavating the 300-296 waste site and disposition of in-cell waste and soil excavated beneath B-Cell.
- Update the Maintenance Responsible Manager Designation memo to reflect current personnel
- Review other 324 Building designation and supporting documentation for needed updates.

ECAQ 2: Evaluate the Impact of Radiation Exposure on installed equipment

The upper REA has been installed in B-Cell and is now exposed to radiation levels that will degrade the equipment (e.g., seals and hoses) over time. The REA hydraulic hoses in B-cell are exposed to high gamma and beta radiation fields and contamination levels and are not periodically decontaminated to limit degradation. With changes to schedule, this exposure will occur for a longer duration than initially assumed and failure rates may increase. There has been no analysis on the impact of the beta radiation exposure to REA components susceptible to failure. PRC-SRP-00009 needs to be updated in order to determine impacts these have on equipment failure rates and current plans to compensate for degradation to the equipment. Tracked under CR-2020-0480.

To address this issue, the Resumption Team recommends:

- Revise PRC-SRP-00009 to document evaluation of the potential for the degradation of equipment currently installed to support 324 Building activities based on current schedule.
 - Ensure evaluation addresses beta exposure rates as well as gamma.
 - Apply lessons learned from remote equipment operated in similar high beta/gamma radiation and contamination environment such as the Hanford tank farms (e.g., RPP-RPT-55036 *Summary Evaluation of ERSS Hydraulic Hose Failures* and RPP-RPT-58658 *Tank 241-C-111 Mid Hose Failure Mechanism Report*).

ECAQ 3: Donning Area has not been evaluated for Human Factor Impacts

The donning area in 324 Building is constrained. When a team of entrants and their assigned custodians are in the donning area, the space is crowded and noisy. Both of these set-up factors could result in human errors during donning. While there are plans in place to expand the donning area, this change should be coordinated with changes in the corrective actions for this event to minimize impact to workers. Tracked under CR-2020-0481.

To address this issue, the Resumption Team recommends:

- Establish a new expanded donning area within 324.

ECAQ 4: Wording in the Criteria for When to Conduct an Investigation could be improved

PRC-PRO-EM-058, *Event Initial Investigation and Critique Process*, currently contains language that significant skin or clothing contamination events will receive investigation. The term "significant" may be subject to interpretation and should be deleted. Additionally, the procedure states that repeat issues must receive investigation. Commonality reviews/common cause analysis is typically the response to repetitive issues. This wording should be clarified to "repeat events". Tracked under CR-2020-0482.

To address this issue, the Resumption Team recommends:

- Revise PRC-PRO-EM-058, *Event Initial Investigation and Critique Process*, to clarify wording under items that should have an investigation:
 - Remove the word "significant" before skin and clothing contamination
 - Revise repeat issues to repeat events

ECAQ 5: 324 Building-specific Donning/Doffing instructions are not under Formal Configuration Control

The current copies of the 324 Building-specific Donning/Doffing instructions contain revision numbers, but the documents are not published in any formal system. As 324 Building is improving their rigor of operations and their methods for donning/doffing, these instructions should be placed under configuration control to ensure that the latest revisions are used and that changes are triggered in documents that reference these instructions. Tracked under CR-2020-0483.

To address this issue, the Resumption Team recommends:

- Place the 324 Building donning and doffing instructions under configuration control.

7.0 EXTENT OF CONDITION/GENERIC IMPLICATION

Several facilities within CHPRC contain HCAs. While the nature of the contaminants are dependent on the previous or current mission of the facilities, all HCAs pose challenges for conducting work and for exiting without transfer of contamination. CHPRC has primarily relied on Radiological Worker II training to ensure that radiological workers gain practical experience in donning PPE, working in radiological areas, and doffing PPE. However, Radiological Worker II does not fully address the level of proficiency needed to support routine entries into HCAs. Some facilities, like PFP, have created formal facility-specific training to address improved proficiency. To address the extent of condition, CHPRC Training will perform a needs analysis for development of company-wide training on HCA work practices and doffing practices (Action 39).

PRC-PRO-RP-40439 was generated in 2011 in response to an issue identified with radiological work planning (reference CR-2011-2196). The procedure provides an effective and systematic approach to analyzing changes, determining impacts, and documenting decisions. However, the procedure is not integrated into other radiological control procedures, which creates a set-up factor for other facilities implementing changes to radiological processes. Actions 36-38 of this analysis will better integrate the procedure to allow other facilities to better utilize this tool.

In order to evaluate the causal factors, lessons to be learned, and potential actions at other CHPRC facilities, each project will perform a Work Site Assessment to document their review and enter condition reports to track any necessary actions (Action 42-47).

8.0 CORRECTIVE ACTION PATH FORWARD

The corrective action plan was developed using a phased approach to resumption of activities. Initial pre-start activities will be completed prior to resuming beyond minimum safe activities in Contamination Areas. The second phase of pre-start activities will be completed prior to resuming work in Room 18. The third phase of pre-start activities will be completed prior to resuming work in the REC airlock.

All actions on the corrective action plan will be independently verified as complete by the 324 Building Resumption Manager. Additionally, all actions for the ECAQs will also be independently verified as complete by the 324 Building Resumption Manager.

9.0 EFFECTIVENESS REVIEW CRITERIA

PO01: The facility has reduced the rate of contamination events

LOI - Do the 324 Building metrics demonstrated improved performance with regarding to contamination events (e.g., inner PPE and skin/clothing)?

LOI – Based on review of CRRS and the Occurrence Reporting and Processing System, 324 Building has performed analysis and identified corrective actions for any additional contamination events.

PO02: The facility has managed changes and unexpected conditions through systematic analysis and development of controls

LOI – Does the facility have documentation of using the Radiological Change Control process to evaluate changes and unexpected conditions?

LOI - Review the revised work documents to ensure the results of the integrated hazard analysis (considering radiological, industrial and human factors) have been incorporated and effectively implemented.

LOI - Interview a selection of personnel from the workforce, exempt, and management to determine the processes used for managing changes.

LOI – Review Technical Evaluations, ALARA Design Review, ALARA Management Plan, AMWs, and RWPs to determine if changes have been sustained and reflect current practices.

LOI – Review changes to PPE, equipment, and processes to determine if the changes have received a systematic evaluation and the basis for the change is documented.

PO03: The facility has demonstrated appropriate response in the event of negative indicators

LOI – Have negative trends identified in the CHPRC-level metrics and 324 Building metrics been documented in CRRS for evaluation?

LOI – Has investigation and/or common cause analysis been used to address the negative trend and develop actions?

PO04: CHPRC has proactively used independent assessments to evaluate Project/Program areas of performance that show as needing improvement.

LOI – Have independent assessments been conducted to evaluate Project/Program areas of performance that show as needing improvement?

PO05: The 324 Building is using established company processes to manage performance in the following areas:

- Use of Performance Assurance Processes
- Conducting investigations and causal analysis
- Maintaining documentation under configuration control
- Development and tracking of training
- Systematic evaluation of changes to processes

LOI – Review recent causal analyses to determine if causal factors are addressed and actions have been closed appropriately.

LOI – Review facility trending documentation to determine if trending is being maintained, performance goals/action levels have been established, and actions have been taken to address negative performance.

LOI – Review the event files and associated CRs to confirm the facility is using established processes for conducting investigations and causal analysis.

LOI - Review the MOP reports and Senior Supervisory Watch logs to confirm conditions reports have been submitted for any noncompliant or inadequate at/risk work practice identified during the performance of MOP or SSW.

LOI - Interview the functional personnel on their responsibilities to ensure that facility compliance has been maintained (i.e. Performance Assurance, Radiological Control, and Training).

LOI – Has the facility utilized mock ups as a means to identify areas of improvement resulting from further contamination events?

LOI – Review recent 324 Building Safety Conscious Work Environmental survey results against baseline results to evaluate improvements.

PO06: Facility personnel demonstrate good understanding of facility hazards and the nature of the contamination in the facility.

LOI – Observe work in HCAs and exits to verify work practices reflect the appropriate level of rigor.

LOI – Interview a selection of personnel to determine level of understanding of facility hazards and the nature of the contamination in the facility.

LOI – Review SSW and MOP documentation to confirm that oversight is being provided to field operations.

10.0 ATTACHMENTS

- Attachment 1: Corrective Action Plan
- Attachment 2: Barrier Analysis
- Attachment 3: Why Tree Analysis
- Attachment 4: Lines of Inquiry
- Attachment 5: Documents Reviewed
- Attachment 6: Summary of Personnel Interview Responses
- Attachment 7: Analysis Team Charter

10.1 Attachment 1: Corrective Action Plan

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
1	Document lessons learned, benchmarking from projects that have performed high contamination operations, recommendations from peer review by independent HCA workers, and feedback from the vendor on PPE modification.	Document alternatives for contamination control.	(b)(6) 6/30/20	Copy of issued supporting document (e.g., good practices guide).	RC01, RC02	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations
2	Assign a resumption manager to provide oversight of corrective action completion and organizational improvement in key areas.	Facilitates cultural change, provides mentoring and oversight to reinforce compliance.	(b)(6) Complete	Charter for resumption manager.	RC01, RC02, RC03	

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
3	Assign resources to the 324 Building to infuse additional experience with high hazard nuclear operations to strengthen performance in decision making, implementation of best practices, and integration within the management team.	Facilitates cultural change and provides oversight/guidance to implement company processes.	(b)(6) Complete	Revised organization chart.	RC01, RC02, RC03	
4 NTS	<p>Develop/revise the 324 Building project execution plan to depict the organization and update the roles and responsibilities to address:</p> <ul style="list-style-type: none"> ○ Mixed responsibilities for work planning and execution ○ Defining who sets weekly and daily priorities. ○ Clarifying support organization R2A2 and the role of Performance Assurance ○ Assign responsibility to status and update the project schedule. 	Strengthen organizational weaknesses and improve safety culture.	(b)(6) 6/30/20	Copy of approved project execution plan.	RC01	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
5	<p>Develop a Communications Plan addressing:</p> <ul style="list-style-type: none"> ○ A schedule for providing information and routine status on the Resumption Plan actions to 324 Building personnel. ○ Designation of those communication channels that are primary and alternate to sharing project priorities, changes to planned work execution, safety issues and ideas, EZAC. ○ Re-establishing routine meetings and roundtable discussions to provide a mechanism for feedback from the workers on activities and concerns. 	Strengthen organizational weaknesses and improve safety culture.	<div style="border: 1px solid black; padding: 2px;">(b)(6)</div> Complete	Copy of approved communications plan.	RC01	
6 NTS	<p>Revise the 324 Building SSW designation letter to specify:</p> <ul style="list-style-type: none"> • The qualification process that will be used for assigned 324 Building SSW personnel. • Use of personnel independent from the facility to perform SSW • Reporting process for issues identified during SSW 	Restores compliance.	<div style="border: 1px solid black; padding: 2px;">(b)(6)</div> Complete	SSW designation letter and expectations.	RC02	

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
7 NTS	<p>Based on CA 1 and the facility personnel interviews conducted by the Resumption Team, issue an ALARA Plan to:</p> <ul style="list-style-type: none"> • Address phased approach to resuming radiological activities in 324 Building <ul style="list-style-type: none"> ○ Document selected controls for doffing, PPE, and contamination control. ○ Address establishing a 1 to 1 ratio for Donning personnel Chain of Custody, 2 to 1 Doffing personnel Chain of Custody at the HCA boundary and 1 to 1 personnel Chain of Custody at the CA step-off pad. ○ Establish a low background area for airlock exits, (for example, inside room 147), to perform personnel surveys capable of detecting less than CA levels of removable contamination prior to personnel doffing inner set of PPE and PAPR. 	<p>Establish a control set to reduce the potential for personnel contamination</p> <p>Provides a documented baseline of the control set.</p>	<div style="border: 1px solid black; display: inline-block; padding: 2px;">(b)(6)</div> 7/30/20	Copy of released ALARA Management Plan that addressed phased approach to resuming activities.	RC01, RC02	<p>Corrected terminology to align with CHPRC procedures</p> <p>Extended to allow worker involvement following COVID -19 resumption of work</p>

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
7 (cont)	<ul style="list-style-type: none"> Institute a team approach to airlock entries. The teams should consist of entrants, a lead for the donning/doffing process, doffers, and donners with RCTs assigned to each team, that can rotate across these areas for dose management over time. Each of the teams should be assembled of more experienced and less experienced workers so that support proficiency is maintained. include review of video monitoring during post work review or IPARs 					
8 NTS	Document, in accordance with the CHPRC work control/planning processes, an integrated hazard analysis that considers radiological, industrial, and human factors in development of the HCA control set.	Reduce equipment to a minimal level in order to reduce distractions and set-up factors for human error.	(b)(6) 8/15/20	JHA or equivalent.	RC02	Extended to allow worker involvement following COVID -19 resumption of work

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
9 NTS	Perform an impact analysis for the revised control set to identify impacts to documents, tools, and training.	Identifies impacted documents, checklists, and training that may be impacted by the revised tool set.	(b)(6) 8/30/20	Copy of impact analysis listing affected documents. Add actions to this CR to revise the impacted documents.	RC02	Extended as completion of this action is contingent on completion of Actions 7 and 8

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
10	<p>Perform training needs analyses by training professionals and Radiological Control Subject Matter Experts on:</p> <ul style="list-style-type: none"> • Worker knowledge on the nature of the contamination in 324 Building and ease of transfer. • Donning/Doffing practice for HCA/ARA/HRA, including donning/doffing assistants and personnel "chain of custody." • Contamination Control Work Practices. • Decontamination work practices. • Waste handling in a HCA/ARA/HRA. • Lessons Learned from the Energy Facility Contractors Group (EFCOG) (e.g., body position in HCAs). <p>The needs analyses shall address personnel requiring training, determination of proficiency criteria, testing/performance demonstration, retrain frequency, DIF analysis of tasks, and critical tasks.</p>	Formalizes training process. Establishes proficiency requirements and refresher frequency. Promulgates controls. Mitigates performance issues.	(b)(6) 08/30/20	Copy of signed needs analysis, to include STAR, task analysis, and DIF.	RC02	Extended as completion of this action is contingent on completion of Actions 7, 8, and 9

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
11 NTS	Develop formal training course(s) based on the results of the needs analysis.	Promulgates controls. Mitigates performance issues.	(b)(6) 10/28/20	Copies of approved training materials.	RC02	Extended to allow for social distancing impacts to training and to support phased approach to resuming 324 work scope.
12 NTS	Provide training to 324 Building personnel on new training courses.	Promulgates controls. Mitigates performance issues.	(b)(6) 11/30/20	ITEM report demonstrating 90% completion.	RC02	Extended to allow for social distancing impacts to training and to support phased approach to resuming 324 work scope.

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
13	Set up the Mockup facility to provide a more realistic training facility for establishing and maintaining contamination control proficiency.	Provides an uncontaminated location for proficiency development.	(b)(6) 7/30/20	Completed work package or equivalent.	RC02	Extended to allow worker involvement following COVID -19 resumption of work
14 NTS	Provide a refresher on course 600082, Responsible Manager Issues Management, to 324 Building Management team.	Reinforces expectations and compliance to PA processes.	(b)(6) Complete	Course outline and completion rosters.	RC02	

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
15 NTS	<p>Create a set of performance metrics that clearly demonstrate the project performance related to contamination control and document in the Project Execution Plan. The initial set of metrics will benchmark against past practices to determine action thresholds for contamination control performance. The metrics will include, but are not limited to:</p> <ul style="list-style-type: none"> • Contamination events per individual airlock entry (NOT the number of who signed in via Radiological Access Control) • Contamination events per Room 18 entry evolution • Contamination events per entry evolution in other areas of 324 • Average whole body and extremity Radiation field/dose rate in the airlock and Room 18 over time • Number of planned HCA entries vice number of entries actually made • Percentage of eligible workers who have passed PPE donning/doffing training • Incidents of inner PPE contaminations per entry evolutions (total and broken out by location) 	Creates tools to evaluate performance and triggers for actions if performance trends in an unfavorable direction.	(b)(6) 6/30/20	Copy of revised Project Execution Plan.	RC01, RC02	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
16 NTS	Provide gap training to reaffirm the expectations, as defined in PRC-MP-MS-19361, <i>CHPRC Project Execution Plan</i> , Section 4.0, to both the Projects and the Functional Organization for the interface of functional organizations (e.g., Performance Assurance, Rad Con, Training) with the Projects to ensure compliance, independence and authority is maintained.	Interim action to reinforce expectations to functional organizations and projects for interfaces.	(b)(6) 7/15/20	Training materials and ITEM report showing completion by 90% of CHPRC exempt personnel.	RC03	Extended to compensate for limitations to personnel remote access during COVID 19 response and completion of priority training following resumption of work
17	Revise the 324 Building HRB designation letter to specify: <ul style="list-style-type: none"> the number of independent personnel who will support the HRB, the criteria for when an independent chair will be assigned, that any changes to high-risk work packages will be reviewed by the HRB chair. 	Provide additional independence in review process.	(b)(6) Complete	Revised 324 Building HRB designation letter.	RC03	

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
18	Document review of the 324 Building HRB Designation letter by HRB members and 324 Building Field Work Supervisors.	Disseminate expectations.	(b)(6) 07/15/20	Course roster or equivalent documentation.	RC03	Extended to compensate for limitations to personnel remote access during COVID 19 response
19	Issue a charter to appoint a team to conduct an alternatives analysis to determine the viability of the current design and plan as well as alternatives to the current plan that would reduce the life cycle risk to the project and DOE.	Disseminate expectations.	(b)(6) Complete	Copy of memorandum/charter.	RC01	
20	Document an options analysis to evaluate changes to the process for excavating and removing contamination beneath the 324 Building.	Determine if a process change would improve risk and efficiency.	(b)(6) 6/30/20	Approved document	RC01	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
21 NTS	Prior to resuming high-risk work in Room 18, document a staffing analysis to align the 324 Building future work plan with available resources, including as a minimum: <ul style="list-style-type: none"> • Performance Assurance • Radiological Control • Operations Supervisors 	Ensures that sufficient resources are available to oversee planned work.	(b)(6) 6/30/20	Results of the staffing analysis based on the resumption plan. Add action(s) to CR as determined necessary by the analysis.	RC01	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations
22 NTS	Upon resumption of work in Room 18, assign SSW, to include independent personnel and 324 Building Senior Management (Director and above), to observe activities in Room 18. Observations will be conducted for all HCA entries performing intrusive work.	Provides oversight and coaching to improve performance in HCAs.	(b)(6) 9/30/20	SSW designation letter and expectations. SSW may be discontinued in this area after the facility has no further personnel skin or modesty contaminations for at least 20 entries into Room 18.	RC01, RC02	Extended to allow for completion of training following COVID-19 phased approach to labor force returning to work
23 NTS	Prior to resuming high-risk work in the airlock, update the PPS basis documents for 324-PRO-OP-54055, <i>Airlock/C-Cell Access</i> 324-PRO-OP-53674, <i>Airlock Shielding Door Controls</i> , to delete the uncontrolled PPE Plans.	Removes document no longer needed.	(b)(6) 8/30/20	Screen prints showing updated basis documents.	RC02	Extended to align with revised dated for actions 8 and 9

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
24 NTS	Upon resumption of work in the airlock, assign SSW, to include independent personnel and 324 Building Senior Management (Director and above), to observe activities in the airlock. Observations will be conducted for all HCA entries performing intrusive work.	Provides oversight and coaching to improve performance in HCAs.	(b)(6) 10/29/20	SSW designation letter and expectations. SSW may be discontinued in this area after the facility has no further personnel skin or modesty contaminations for at least 20 entries into the airlock.	RC01, RC02	Extended to allow for completion of training following COVID-19 phased approach to labor force returning to work
25	Remove excess equipment, tools, and interferences from Room 18 to reduce tripping and puncture hazards.	Reduces potential for consequence from human error.	(b)(6) 11/18/20	Completed work package or equivalent.	RC01, RC02	Extended to allow for completion of training following COVID-19 phased approach to labor force returning to work

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
26	Remove excess equipment, tools, and interferences from the airlock to reduce tripping and puncture hazards.	Reduces potential for consequence from human error.	(b)(6) 12/31/20	Completed work package or equivalent.	RC01, RC02	Extended to allow for completion of training following COVID-19 phased approach to labor force returning to work
27 NTS	Conduct smoke testing to determine airflow patterns from CHA into airlock for following work conditions: <ul style="list-style-type: none"> • Opening of airlock door. • Waste box on rail system in CHA while personnel exiting airlock and doffing assistants present. • Personnel exiting airlock with doffing assistants present. 	Verifies airflow to allow compensation for resuspension of contamination.	(b)(6) 12/01/20	Completed work package.	RC02	Extended to allow for completion of training following COVID-19 phased approach to labor force returning to work

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
28 NTS	<p>Perform a documented Airlock decontamination options analysis, to include:</p> <ul style="list-style-type: none"> • How movement of cranes and items into/out of the REC hot cells into the Airlock affects decontamination and contamination control decisions. • Cost/benefit analysis for decontamination of airlock drain. • Impact of additional contamination events. • Cost/benefit analysis for decontamination of the crane(s). • Analysis of fixatives for contamination control in the airlock. • Analysis of how to fix contamination at the source – prior to removal from the cells. 	Selected option will provide the greatest ALARA benefit.	(b)(6) 8/30/20	Copy of options analysis. Add actions in this CR to implement selected option.	RC01, RC02	Extended to allow for worker involved following COVID-19 phased return to work
29	Install additional cameras to allow better observation of Room 18 and the airlock doffing area.	Allows for better oversight of radiological practices.	(b)(6) 11/30/20	Completed FMP/work package.	CC01	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
30 NTS	Revise Conduct of Work training to reaffirm the expectations, as defined in PRC-MP-MS-19361, <i>CHPRC Project Execution Plan</i> , Section 4.0, to both the Projects and the Functional Organization for the interface of functional organizations (e.g., Performance Assurance, Rad Con, Training) with the Projects to ensure compliance, independence and authority is maintained.	Reinforces expectations to functional organizations and projects for interfaces.	(b)(6) 9/15/20	Revised training materials.	RC03	Extended to align with anticipated training resource priorities following COVID-19 phased resumption of work
31	Revise the CAS/CAM metric for skin/clothing contaminations to reduce the action threshold to 2 events per months as needing improvement and 3 or greater as requiring action, based on evaluation of past performance.	Provide a better leading indicator of drift in performance.	(b)(6) Complete	Copy of revised metric.	RC01, RC03	
32 NTS	Document a meeting with CPRM personnel to apply lessons learned and experience from RTL scabbling in the work planning documents for scabbling activities within the 324 Building.	Applies lessons learned to promote a conservative planning approach.	(b)(6) 12/31/20	Meeting Minutes. Issue new CR to track actions required to implement recommendations.	RC01, RC02	Extended to align with anticipated work priorities following COVID-19 phased resumption of work

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
33	Revise PRC-PRO-RP-40109, <i>Radiological Work Planning</i> to: <ul style="list-style-type: none"> • Include review of video monitoring (when available). • Clarify that actions from the IPAR must be entered into CRRS for tracking. 	Allows for better oversight of radiological practices.	(b)(6) 7/30/20	Revised procedure	CC01	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations
34 NTS	Using PRC-PRO-RP-40439, <i>Radiological Control Change Management</i> , document the analysis and contamination mitigation strategies for micropile casing removal and soil stabilization beneath room 131 floor (first floor adjacent B-Cell), beneath room 18 floor, and beneath the east wall of B Cell.	Provides a systematic review to mitigate contamination control issues.	(b)(6) 09/30/20	Completed form A-6006-153	RC02	Extended to allow for worker involved following COVID-19 phased return to work
35 NTS	Revise PRC-MP-QA-40092, <i>CHPRC Assessment Program Plan</i> , to provide thresholds/conditions when an independent assessment, comprised of a multi-disciplinary team, should be chartered to evaluate project performance.	Provide criteria to trigger more in-depth evaluation of problem areas.	(b)(6) 9/30/20	Copy of revised procedure	RC03	

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
36 NTS	<p>Develop a CHPRC Change Management procedure to provide:</p> <ul style="list-style-type: none"> • Clear triggers for evaluating changed conditions • Defined actions to be taken to address changed conditions, including criteria for review against base assumptions • Interface between the change management and risk management processes 	Increases visibility and usability of a change management tool.	(b)(6) 9/30/20	Copy of released procedure.	RC04, EOC	Extended to compensate for resource and priority impacts during COVID-19 essential personnel operations
37 NTS	Conduct a training needs analysis for the new CHPRC Change Management procedure.	Increases visibility and usability of a change management tool.	(b)(6) 10/30/20	Copy of approved needs analysis. Add actions to develop and provide training as determined by needs analysis.	RC04, EOC	Extended to align with due date for CA36
38	Perform an impact analysis to determine which CHPRC procedures need to reference the newly developed Change Management procedure (Action 36).	Identifies impacted documents, checklists, and training that may be impacted by the revised tool set.	(b)(6) 10/30/20	Copy of impact analysis listing affected documents. Add actions to this CR to revise the impacted documents.	RC04, EOC	Extended to align with due date for CA36

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
39 NTS	Conduct a training needs analysis for facility-specific Advanced Radiological Practices at the other PRC facilities/projects.	Addresses gap in training to work in HCAs for other PRC facilities.	(b)(6) 8/31/20	Copy of approved needs analysis. Add actions to develop and provide training as determined by needs analysis.	RC03, EOC	Extended to allow for anticipated training priorities following COVID-19 phased resumption
40 NTS	Update the Level of Readiness Score Sheet and associated readiness plan for Remote Soil Excavation Operations to incorporate recent identified weaknesses/lessons learned.	Ensure that readiness is evaluated in appropriate areas.	(b)(6) 6/30/20	Copy of revised documents.	RC03	
41	Using the safety conscious work environment employee survey data, establish a baseline for 324 Building to be utilized in measuring organizational improvement.	Establish a baseline for evaluating cultural change.	(b)(6) Complete	Copy of baseline survey responses.	NA	

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
42	Document the review of the 324 Building causal analysis and corrective actions, assessment of project vulnerabilities, and actions that will be entered into CRRS to incorporate lessons learned at CPRM.	Promulgation of lessons to be learned.	(b)(6) 9/30/20	Work Site Assessment or equivalent documentation citing actions to be taken.	EOC/LL	Extended to compensate for limited personnel during COVID-19 response and worker input following phased resumption
43	Document the review of the 324 Building causal analysis and corrective actions, assessment of project vulnerabilities, and actions that will be entered into CRRS to incorporate lessons learned at PFP.	Promulgation of lessons to be learned.	(b)(6) 9/30/20	Work Site Assessment or equivalent documentation citing actions to be taken.	EOC/LL	Extended to compensate for limited personnel during COVID-19 response and worker input following phased resumption

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
44	Document the review of the 324 Building causal analysis and corrective actions, assessment of project vulnerabilities, and actions that will be entered into CRRS to incorporate lessons learned at 100 K.	Promulgation of lessons to be learned.	(b)(6) 9/30/20	Work Site Assessment or equivalent documentation citing actions to be taken.	EOC/LL	Extended to compensate for limited personnel during COVID-19 response and worker input following phased resumption
45	Document the review of the 324 Building causal analysis and corrective actions, assessment of project vulnerabilities, and actions that will be entered into CRRS to incorporate lessons learned at SGRP.	Promulgation of lessons to be learned.	(b)(6) 9/30/20	Work Site Assessment or equivalent documentation citing actions to be taken.	EOC/LL	Extended to compensate for limited personnel during COVID-19 response and worker input following phased resumption

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
46	Document the review of the 324 Building causal analysis and corrective actions, assessment of project vulnerabilities, and actions that will be entered into CRRS to incorporate lessons learned at W&FMP.	Promulgation of lessons to be learned.	(b)(6) 9/30/20	Work Site Assessment or equivalent documentation citing actions to be taken.	EOC/LL	Extended to compensate for limited personnel during COVID-19 response and worker input following phased resumption
47	Document the review of the 324 Building causal analysis and corrective actions, assessment of project vulnerabilities, and actions that will be entered into CRRS to incorporate lessons learned at ERDF/IDF.	Promulgation of lessons to be learned.	(b)(6) 9/30/20	Work Site Assessment or equivalent documentation citing actions to be taken.	EOC/LL	Extended to compensate for limited personnel during COVID-19 response and worker input following phased resumption
48 NTS	Conduct interim verification of effectiveness review.	Measures progress to change culture and develop proficiency.	(b)(6) 9/30/20	Approved WSA. Add actions to this CR as needed.	NA	Extended to align with other extended actions

Action #	Action	Success Criteria/Expected Result	Actionee/Due Date	Closure Requirements	Causal Factor Addressed	Justification for change
49 NTS	Conduct interim verification of effectiveness review.	Measures progress to change culture and develop proficiency.	(b)(6) 12/31/20	Approved WSA. Add actions to this CR as needed.	NA	Extended to align with other extended actions
50 NTS	Conduct a final verification of effectiveness review (to be conducted by independent personnel).	Measures progress to change culture and develop proficiency.	(b)(6) 3/21/21	Approved verification of effectiveness.	NA	Extended to align with other extended actions

10.2 Attachment 2: Barrier Analysis

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Management Barriers			
Risk Assumptions	<p>Less than Adequate (LTA): (b)(6) (b)(6) understood the increased risk for contamination events posed by increased entries into the airlock.</p> <p>As events to date have not resulted in added dose, (b)(6) (b)(6)</p> <p>LTA: (b)(6) that the air lock sump drain line was plugged. (b)(6) (b)(6) the plugged line in order to reduce source term.</p> <p>LTA: 324 Building does not have a plan in place for decontamination of the air lock beyond floor surfaces, nor is there a plan to utilize fixatives on contaminated surface areas.</p>	<p>Missing Barrier: (b)(6) (b)(6)</p> <p>Set-Up Factor: Rotating airlock entry personnel based on dose increased opportunities for personnel contamination.</p> <p>Missing Barrier: (b)(6) (b)(6)</p> <p>Missed Opportunity: Acceptance of facility conditions resulted in the decision not to perform decontamination. Decontamination, while dose intensive, would have decreased potential for contamination events.</p> <p>Failed Barrier: The Jacobs corporate assessment (324-2020-IA-25211), the investigation by the analysis team, and the independent assessment of radiological controls (SHS&Q-2020-MA-25394) each identified weaknesses at 324 Building (b)(6)</p>	CA1, 2, 3, 4, 7, 19, 20, 21, 22, 24, 28, 32, 34

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
ISMS Approach/ Systematic Review of Issues	<p>LTA: (b)(6)</p> <p>(b)(6)</p> <p>(b)(6)</p> <p>(b)(6) Examples include less than adequate development of training, tracking of events, corrective action processes, and review of SSW logs.</p> <p>LTA: The technical basis for changes in processes have not been documented and baseline documents have not been routinely updated.</p> <p>LTA: The 324 Building organization has developed an approach of solving problems in a timely manner (b)(6)</p> <p>(b)(6)</p>	<p>Missing Barrier: Failure to implement institutionalized processes impacts the rigor and effectiveness of actions. This failure may also prevent the appropriate SMEs from reviewing changes. Lack of SME involvement removes an opportunity to detect lack of rigor.</p> <p>Failed Barrier: (b)(6)</p> <p>(b)(6)</p> <p>Missed Opportunity: CHPRC inherited some decisions that had been made by a previous contractor (e.g., design for the remote excavation for B-Cell) and had not re-evaluated those decisions</p>	CA1-3, 6-15 22 – 28, 31, 32, 34
Evaluation of Level of Rigor	<p>LTA: Previous practice for determining level rigor to be applied to review of changes has been focused on the facility hazard categorization (tied to the nuclear operating criteria of the facility. As Hanford work progresses to address decommissioning buildings and managing historic waste sites, the potential for encountering unexpected conditions increases. (b)(6)</p> <p>(b)(6)</p>	<p>Missed Opportunity: Processes which may detect a change do not reference triggers for the level of rigor that should be applied in evaluating the change.</p>	CA36-38

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
<p>CHPRC Oversight/Support</p>	<p>Set-Up Factor: The 324 Management Team (b)(6) contaminants at current levels in the airlock and Room 18. The 324 Team (b)(6) (b)(6) (b)(6)</p> <p>LTA: While Functional organizations provided some support to 324 Building, the extent of issues and underlying causes were not addressed in a timely manner (i.e., a commonality review performed after eight events had occurred; after Events 10 and 11 in October 2019, a corporate team assessed the 324 Building and the underlying issues began to be revealed).</p> <p>LTA: CHPRC (b)(6) (b)(6) (b)(6) (b)(6) had awareness of the issues, but when interviewed these personnel stated that they (b)(6) (b)(6) when the (b)(6) attempted more rigorous implementation of CHPRC processes.</p>	<p>Missing Barrier: Providing focused support or evaluation is frequently dependent on the knowledge and experience of the management team. The CHPRC Independent Assessment procedure does not contain criteria for when an independent evaluation of facility processes should be performed. Consequently, support may not be assigned early enough to mitigate a more serious event.</p> <p>Missing Barrier: When personnel contaminations increased and when Sr-90 contamination was found in an unexpected location, CHPRC (b)(6) (b)(6)</p>	<p>CA2, 3, 6, 35</p>

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Roles and Responsibilities	<p>(b)(6) with some managers performing tasks that should be performed by individual contributors. Examples include:</p> <ul style="list-style-type: none"> The Nuclear Facility Manager writes test questions for qualification packages rather than a trainer. The decision on where to start the pilot holes in Room 18 was made by the Director of Programs, rather than Operations and Radiological Control. The RRMP Vice President assigns who will perform critiques, frequently to a Director in the organization. In other projects, this assignment is made by the Performance Assurance Manager. 	<p>Failed Barrier: The lack of clarity in roles and responsibilities detracts from (b)(6) focus on (b)(6). Additionally, time spent performing activities that would normally be assigned to delegates, decreases the ability of (b)(6) to provide oversight and hold personnel accountable to high standards of performance.</p>	CA4
Management Oversight	<p>LTA: 324 Project Management (b)(6)</p> <p>(b)(6)</p> <p>Managers/supervisors leading activities (b)(6)</p> <p>(b)(6)</p>	<p>Missing Barrier: The 324 Management Team, from Senior Management to first line management, (b)(6) (b)(6) (b)(6) (b)(6)</p>	CA6, 22, 24

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Ownership of Issues/Roles and Responsibilities	<p>LTA: During interviews, 324 personnel expressed that they do not know who is really in charge in their organization. 324 personnel are not staying within their organizational responsibilities.</p> <p>Based on interview responses, it is unclear who owns the contamination control issues for resolution. The perception is that this is a Rad Con issue only.</p>	Set-Up Factor: The lack of adherence to defined roles, responsibilities, accountabilities and authorities creates confusion within the project.	CA4
Program Barriers			
ALARA Design Review	LTA: The Project level ALARA Design Review has not been updated since 2018. The existing ALARA Design Review does not discuss the contamination in Room 18 or removing the waste from the airlock. Both changes increased the potential for personnel contamination.	ECAQ: ALARA Design Review should be revised to reflect current conditions and processes.	ECAQ1
Training to entry/exit of HCAs	LTA: A gap between Rad Worker II training and knowledge/skills needed for working in and exiting high-risk HCAs, such as those in the 324 Building, has not been addressed.	Missing Barrier: The existing site-wide Radiological Worker II training does not ensure the level of proficiency required for work in HCAs.	CA10, 11, 12 39

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Training to support High-Risk Activities	LTA: As Hanford work progresses to address decommissioning buildings and managing historic waste sites, each high-risk activity may generate a hazard or risk that requires special training. CHPRC relies heavily on the existing training courses available through HAMMER and at the facilities. Evaluation of operational risk should evaluate gaps between the knowledge/skills that the work requires and what is provided through standard training.	Missing Barrier: While there is a CHPRC radiological change control process, this process has not been expanded to other areas. Consequently, there is not a strong trigger for evaluation of specialized training to support high-risk activities.	CA36-38
Oversight from Program Groups	LTA: Based on interviews, Training Functional personnel were aware that the doffing practical had not been formalized. The response was that, beyond training required by law or DOE order, facility management determined what went into formal training.	Missing Barrier: The training program personnel were unsuccessful in working with the 324 Building to resolve the noncompliance. Training did not raise the issue up the management chain for resolution.	CA2, 16, 30, 35
	LTA: The 324 Performance Assurance group has sought help from the Functional organization. Assistance has been provided when requested, but assistance is not routine. With recent high levels of turnover in personnel, mentoring in the area of PA has not been adequate.	Missing Barrier: The Functional Performance Assurance program provides limited oversight/assessment. A limited number of experienced PA personnel exist in CHPRC, so mentoring is limited based on available resources.	

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>Adequate: The project reached out to the functional Radiological Protection group on a routine basis. Functional group personnel attended IPARs/critiques. However, the project did not determine causes for some of the contamination events. The functional organizations (Radiological Protection and PA) recommended the commonality review.</p> <p>Note: Functional Radiological Protection was involved with the change to impermeable outer PPE. The Functional group participated in the Technical Response Team and the facility meeting following the November 14 contamination event.</p>		

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Readiness Process	<p>LTA: 324 Building readiness activities for use of the remote excavation arm graded as a contractor readiness review, with the scope focused on a limited number of 324 Project areas. The management self-assessment performed in preparation for the readiness focused on these limited areas. The scope was based on the assumption of existing mature programs.</p> <p>The management self-assessment was conducted by 324 Building resources and was reviewed by independent personnel in a Readiness Review Board (RRB). This segment of readiness review was not scoped to detect the undocumented practices and performance issues that contributed to the contamination events.</p>	<p>Missed Opportunity: The scope of the management assessment for readiness exempted review of most radiological activities. 324 Building Management participating in scoping the readiness review failed to see the cumulative skin/clothing events as a potential weakness in program implementation.</p> <p>Mitigating Factor: As the contamination events emerged, CHPRC Senior Management postponed the readiness assessment until the issues could be resolved.</p>	CA40
Assessment	<p>LTA: A Functional level assessor conducted some assessments in radiological control at the 324 Building, including the areas of contamination control and design control. No issues related to the contamination events were identified.</p> <p>LTA: An ESH&Q manager conducted an assessment to compare practices in Room 18 and the airlock. No issues were identified.</p>	<p>Missed Opportunity, Failed Barrier: Assessments conducted by personnel independent from the facility were not scoped to examine how processes had been developed. The assessments did not identify underlying issues.</p> <p>Mitigating Factor: A Jacobs corporate assessment was completed November 5, 2019. The corporate assessment identified several underlying issues that were potential contributing factors to the contamination events.</p>	CA3, 16, 30, 35

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Causal Analysis/Commonality Review	<p>LTA: An independent cause analyst assisted the facility in performing a commonality review of eight contamination events. The commonality review identified less than adequate radiological work practices and less than adequate PPE. No further analysis of these common factors to identify underlying causes was conducted.</p> <p>Until the Stop Work was declared, no root cause analysis was used to identify factors impeding the effectiveness of the corrective actions.</p>	Missed Opportunity, Failed Barrier: While actions were assigned to address the commonality review, these actions were not scoped to address underlying causal factors.	CA2, 3, 14
Company-level metrics and performance monitoring	<p>LTA: The CHPRC company-level performance metrics identified personnel contamination issues as needing improvement (yellow rating). This metric requires 3-5 events per month to trigger a yellow rating (needs improvement). The basis for this threshold is not documented.</p> <p>The program metrics have action levels established as monthly goals are exceeded, but do not have action levels established for issues occurring over a period of months.</p> <p>Response actions were for the Central Group to provide support and oversight for contamination control issues at the 324 Building and to provide the 324 Building recommendations to improve PPE doffing practices.</p>	<p>Missing Barrier: Based on a target zero philosophy for skin/clothing contamination, the threshold for "needs improvement" should be re-evaluated.</p> <p>Missed Opportunity, Missing Barrier: The current method of trending does not reflect small changes over time and may not allow detection of leading indicators. The focus has been on monthly performance, but not on accumulation over time.</p>	CA31

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
<p>PRC-PRO-RP-40439 <i>Radiological Control Change Management</i></p>	<p>Note: Review of the procedure identified both predictive and reactive criteria for using the change control process and an effective method to document tools used to analyze the change.</p> <p>LTA: 324 Building did not use PRC-PRO-RP-40439 to evaluate significant changes to their operations.</p> <p>LTA: Discussion with radiological control personnel external to 324 found that PRC-PRO-RP-40439 is not well known by Rad Con personnel and is not referenced in other radiological control procedures.</p>	<p>Missing Barrier: This procedure provides a process for managing changes. Without integration into other Radiological Procedures or training, no link is in place to make personnel aware of the procedure and to drive implementation.</p>	<p>CA36 – 38</p>
<p>Change Management</p>	<p>LTA: PRC-PRO-RP-40439 provides a systematic process for evaluating changes, but is limited to radiological control processes. As Hanford work progresses to address decommissioning buildings and managing historic waste sites, the potential for encountering unexpected conditions increases. Limited documentation on historic practices and events exacerbates this condition.</p>	<p>Missing Barrier: Some change management tools are built into CHPRC procedures, but an integrated approach to evaluating changes which impact facility risk and life cycle management is lacking. Expanding the process discussed in PRC-PRO-RP-40439 to address other disciplines would provide better triggers for evaluation of changes and improve the tools for operational risk management.</p>	<p>CA36 – 38</p>

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Process Barriers			
Use of change management tools	<p>LTA: To develop the initial set of PPE, 324 Building worked with PFP personnel, specifically those with experience entering the McClusky room. The initial set of PPE was incorporated into AMWs and RWPs. However, the development process was not documented.</p> <p>After the initial set of PPE was developed for 324, limited requests were made for information from PFP or other facilities with HCAs on exiting/doffing practices or PPE.</p> <p>LTA: The Resumption Team found no evidence that 324 used the process called out in PRC-PRO-RP-40439, <i>Radiological Control Change Management</i>, to evaluate or develop controls for changed conditions</p>	<p>Missing Barrier: PRC-PRO-RP-40439 identifies specific criteria for process changes that must be evaluated in accordance with the procedure. In the case of 324 Building, the discovery of Sr-90 contamination and the identification of a trend of contamination control events would reach the thresholds for documented change control evaluation.</p> <p>Missed Opportunity: As the need for change was identified, 324 Building did not solicit information from other CHPRC facilities or other contractors to improve the selection of controls.</p> <p>Mitigating Factor: Central brought in experienced personnel from other facilities when recommending controls and conducted some benchmarking with PFP.</p>	CA1, 7, CA36-38
Hazard Analysis/Planning	LTA: Radiological hazards and OS/IH hazards were evaluated in isolation. Developing controls in isolation has resulted in a variety of equipment worn by entrants that increases the potential for distractions.	Missing Barrier: Hazard Planning has not been performed in an integrated manner. No evidence was found that human performance impacts and the potential for distraction had been factored into selection of controls.	CA8-9

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Baseline Documents	<p>LTA: While technical baseline documents exist, several documents have not been updated since spring of 2018. Many lessons learned and changing conditions have not been incorporated. A recent update to the 324 Building Waste Management Plan has created inconsistencies with other baseline documents.</p> <p>LTA: When interviewed, most people could not speak to the technical baseline documents (beyond the safety basis).</p>	<p>Missing Barrier: The set of documents that form a baseline have not been clearly defined and 324 Building Management is not clear what comprises this baseline.</p> <p>Failed Barrier: No evidence was found to show that the facility was using their technical baseline documents to review changes and determine the impact to the baseline. If evaluations were performed, documentation was not generated.</p> <p>Missing Barrier: Because the rationale behind changes has not been documented, even value-added actions do not show evidence of how they were derived.</p> <p>Set-Up Factor: There are inconsistencies between baseline documents.</p>	CA36 – 38 ECAQ1
Corrective Action/Causal Analysis	<p>LTA: A review of the causal analysis for previous contamination events shows evidence that actions were determined and implemented before the causal analysis was performed. A bias to focus on those actions already taken, rather than identifying true underlying causes, may have existed.</p> <p>324 Building corrective actions rely heavily on actions like “brief” and “evaluate”. Objective evidence is not consistently provided for closures.</p>	<p>Failed Barrier: Actions were remedial in nature, which is acceptable for Apparent Cause Analysis. However, actions did not result in institutionalized controls.</p> <p>Missing Barrier, Failed Barrier: The cumulative nature of the events did not cause (b)(6)</p> <p>(b)(6)</p> <p>Missed opportunity: While none of the events reached a threshold that would require verification of effectiveness, (b)(6)</p>	CA2, 3, 14, 35

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: Numerous actions were taken under the 324 Building IPARs that were not been recorded in CRRS.</p> <p>LTA: The 324 Building SII log is used to track stop works, but stop works are not consistently entered in CRRS.</p> <p>LTA: 324 Senior Management views CRRS as not "real time." They recognize the expectation to use the process, but do not see it as value-added.</p> <p>LTA: Limited attempts have been made to verify the effectiveness of corrective actions. For the contamination events, little wait time was allowed to verify whether the actions had truly been completed and were effective.</p> <p>LTA: Issues are entered into CRRS five days to one month from the identification date. Actions are often listed as complete at the time of entry. Developing actions and completing them often lags behind due dates (e.g., some issues identified in October do not have action plans yet).</p>	<p>Missing Barrier: Actions taken are not transparent. Undocumented actions are difficult to credit or monitor.</p> <p>Set-Up Factor, Missed Opportunity: Data sources like IPARs, Safety Idea/Issues (SII), and corrected issues on MOPs are not captured in a single system. This lack of consolidation inhibits the ability to detect issues and adverse trends.</p> <p>Failed Barrier: Lack of acceptance of the institutionalized system results in internal tracking and information that is not transparent.</p> <p>Missing Barrier: While some actions may be appropriate to address the contamination issues, no evaluation has been made to determine what was or was not working.</p> <p>Failed Barrier: Failure to identify, document and correct issues in a timely manner leaves set-up factors in place for additional issues.</p>	CA2, 3, 14, 35

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Assessments	<p>LTA: 324 Building has conducted a limited number of Work Site assessments in the radiological area. The majority of WSAs reviewed were not in depth reviews.</p> <p>324 Building has performed few management assessments in 2019.</p> <p>Assessments performed by functional organizations were scoped narrowly and would not have detected underlying issues that contributed to the contamination events.</p>	<p>Missed Opportunity, Missing Barrier: Internal assessments were narrowly scoped and did not identify underlying issues. 324 has performed limited in-depth management assessments.</p>	CA35
Critiques	<p>LTA: Some critiques are conducted immediately following an event; at times while recovery actions are still underway. While timeliness is a concern, per PRC-PRO-EM-058, <i>Critique and Initial Investigation Process</i>, management is tasked with verifying all required personnel are in attendance.</p> <p>LTA: Director-level personnel conducted some 324 Building critiques and a qualified PA critique leader conducted others. The VP makes the determination of the critique leader.</p> <p>LTA: Review of 324 Building critique reports content shows that timelines are developed, but the critique reports seldom contain context for personnel actions.</p>	<p>Failed Barrier: Not all personnel necessary to understand the issue may be available for a critique meeting immediately following an event.</p> <p>Exacerbating condition: Use of senior management to conduct critiques may inhibit open discussion.</p> <p>Missed Opportunity: Understanding the context and human factors associated with the event would provide greater insight into the effectiveness of actions and whether corrections are needed.</p>	<p>CA2, 3</p> <p>CA2, 3</p>

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	LTA: PRC-PRO-EM-058, Critique Process, currently contains language that significant skin or clothing contamination events will receive investigation. The term "significant" may be subject to interpretation. Additionally, the procedure states that repeat issues must receive investigation. Most critiques and investigations are event driven rather than issue driven.	ECAQ: The wording in the procedure should be clarified to reduce the potential for misinterpretation.	ECAQ4
Design Control	LTA: Lack of drawings and documentation have added complexity to making determinations of path forward. Technical solutions (e.g., cell dams and structural modifications), expected to take months, have taken much more time to implement.	Set-Up Factor: Creates schedule pressure and contributes to reactionary approach.	CA19, 20
	LTA: Upper REA has been installed and is now exposed to radiation that will degrade the equipment over time. No practice has been developed to decontaminate beta particles from hoses. Beta radiation can contribute to hose degradation.	ECAQ: No analysis on the impact of project delays to the REA or hoses has been performed. No documented mitigation plan is in place for the degradation to the equipment.	ECAQ2

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Performance Monitoring	<p>LTA: The 324 Building spreadsheet on contamination events contains a ratio of how many contaminations have occurred per number of personnel who signed in under the RWP. This ratio provides a false indicator as fewer people enter the HCA than sign in under the RWP.</p> <p>A 324 Building spreadsheet on contamination event is maintained, but is not being used for any purpose other than to record information.</p> <div data-bbox="411 651 997 803" style="border: 1px solid black; padding: 5px;">(b)(6)</div>	<p>Failed Barrier: The 324 Building spreadsheet does not provide a realistic measure of operational performance. 324 Building spreadsheet gave the appearance that the facility considered these issues as an acceptable risk.</p> <p>Missing Barrier: At 324 Building, multiple sources of data are available, but limited reviews of the data are performed to determine issues. Data sources are not reviewed collectively to detect performance issues and remediate them. No use of leading indicators to detect drift in performance.</p>	CA15

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Resource Management	<p>LTA: As highlighted in the examples below, the project has not maintained a balance between workload (schedule pressure) and available resources.</p> <ul style="list-style-type: none"> • The need for additional RCTs is frequently discussed/raised as a factor. However, no staffing analysis has been developed to formally estimate the increased need. • Every event implemented more actions that required RCT resources. RCTs are currently resource-scheduled at 100%. • Facility has been instructed to wait for additional resources until other CHPRC priority work is completed. However, the pace of work was not adjusted based on the limitations to existing resources. <p>NOTE: 324 Building has experienced fairly high turnover in some areas.</p>	<p>Missing Barrier: 324 Building has faced resource constraints over the last year. (b)(6)</p> <p>(b)(6)</p> <p>Personnel appreciate and can perform well at certain levels of overtime. However, prior to the stop work, 324 Building had intense periods of overtime, which may have influenced some individual and team performance.</p> <p>Set-Up Factor: The project has not been not able to form dedicated teams to develop proficiency for the airlock work.</p>	CA3, 21

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Use of Lessons Learned	<p>LTA: 324 performed a review of the lessons learned from the W-130 Project events and documented a series of actions in the 300-296 Project Action Tracker database. Closures were not institutionalized and may have changed over time.</p> <p>An in-depth extent of condition review was performed across CHPRC related to the PFP contamination event in December 2017. The corrective actions implemented at 324 Building did not effectively imbed the contamination control, radiological trending, and change control/communications lessons learned.</p> <p>No evidence was available to demonstrate that relevant lessons learned documents from OPEX had been reviewed or that recommended practices had been incorporated in 324 Building activities.</p>	Missing Barrier: Failure to integrate lessons learned removes an opportunity to learn from other facilities and mitigate the potential for similar events.	CA1, 7, 32
Schedule	LTA: Perceived need to keep the subcontracted workforce productive – if work is not available, could mean 324 Building experienced (b)(6) do not return to the project.	Set-up Factor: The perceived need to keep the (b)(6) productive may influence reactive responses to issues.	CA5

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Assumed Risk	LTA: Continue to work activities that assumed that the A/D crane would be operational.	<p>Set-Up Factor: The crane failure resulted in making more cell entries to investigate the failure, which increased the potential for a contamination event.</p> <p>This condition also limits the ability to move waste box tracks from the airlock, which causes workers to have to step over and around them.</p> <p>Missed Opportunity: (b)(6)</p> <p>(b)(6)</p>	CA19-20
	LTA: Cell dams and structural design is still not 100%. If the dams were available, some waste would have been placed in A-Cell. Since the dams are not available, more entries are required to move waste to other locations.	<p>Set-Up Factor: Making more cell entries increases the potential for a contamination event.</p> <p>Missed Opportunity: (b)(6)</p> <p>(b)(6)</p>	CA19-20
Change Management	LTA: During interviews, personnel repeatedly commented that actions to correct issues have been reactionary.	Missing Barrier, Exacerbating condition: The facility does not have evidence of examining the issues from a systematic, integrated approach. Reaction to events provides the impression that issues are being "band-aided."	CA1, 7-13

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: Little evidence could be identified to demonstrate that changes had been systematically reviewed against radiological control baselines to validate the actions. While Technical Evaluations and implementing documents were updated, this was conducted following the change decisions.</p>	<p>Missing Barriers: Change Management systems were not engaged in the evaluation and promulgation of changes. Without use of the existing systems, it is difficult to demonstrate whether actions were appropriate and effective.</p>	CA36-38
	<p>LTA: Reviews of potential changes did not consider whether the change would increase the need for entries, thereby increasing the potential for contamination issues.</p>	<p>Missing Barrier: No threshold to detect changes in performance in order to determine when more comprehensive review of issues is appropriate (see trending).</p>	CA36-38
Work packages	<p>Adequate: Requirements of the AMW are flowed down to the work packages adequately.</p> <p>LTA: PPE requirements from the RWP are in the work instruction, but they do not address bismuth gloves.</p>	<p>Missed Opportunity: One AMW requirements was not flowed down into the implementing document.</p>	CA1, 7
Procedures	<p>LTA: 3I-SOP-REC-A-05, Airlock/C Cell Access, is generic for some hazard controls – does not contain some controls and, references out to the RWP. See discussion on PPE plan.</p> <p>3I-SOP-REC-A-05 contains the AMW requirements, and in some cases, provides greater detail on the radiological controls.</p>	<p>Missing Barrier: Not all PPE requirements are flowed into the 3I-SOP-REC-A-05 procedure. The exception is AMW controls, which are consistently flowed down.</p>	CA1, 7

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Airlock/C-cell access PPE Plan, dated 12/3/18	<p>LTA: This document is referenced in 3I-SOP-REC-A-05 and is a baseline document for the procedure in PPS. The document contains several PPE requirements that are not incorporated in the procedure or other control documents (e.g., safety glasses, bismuth gloves).</p> <p>Although there is an approval date and signatures for the PPE plan, there is no document number. The document was last updated in December 2018. Several changes to process and PPE have occurred, since this document was last revised.</p>	<p>ECAQ: This document was intended to bring all control sets together for review, but has not been maintained.</p> <p>Failed Barrier: This document was not formally released, but was referenced in a released procedure.</p>	CA23
HRB	<p>NOTE: The HRB allows approval with comments. 324 has only rejected one package – the others have been approved with comments. The team was not able to determine how extensive comments may be and still allowed to pass.</p> <p>LTA: Per the facility designation letter, all members of the board are 324 personnel, with independent personnel designated as alternates. 324 typically designated 1-2 independent person per HRB.</p>	<p>Missed Opportunity: Lessons learned from PFP was to increase the independence of the HRB and increase thresholds for what requires HRB review. 324 Building should implement increased independence in their HRB while resumption activities are in process.</p>	CA17-18

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Flow down of Rad Hazard Planning into Implementing Documents	<p>LTA: The RWPs for the airlock cite the doffing practical under "Special Training." Completion of the doffing practical has been tracked internally for Room 18 personnel since July 2019. Unlike the RWP supporting airlock entries, the AMW and RWP supporting the Room 18 work does not address doffing as special training.</p> <p>Adequate: Review of AMWs, RWPs, and work documents indicated other than this control, other controls were adequately flowed down.</p>	Missing Barrier: The requirement for donning/doffing practical is inconsistently flowed down	CA7, 8
	NOTE: The procedure requires lapels for 20% of the entry population. In the airlock, since only 3-4 people enter, the practice is to put a lapel on everyone	<p>Set-Up factor: The lapels add additional equipment to individuals entering the airlock and can cause distractions.</p> <p>Missing Barrier (b)(6) [redacted] (b)(6) [redacted] but no trending has been performed to determine if changes are appropriate.</p> <p>Set-Up Factor: The Be controls provide questionable value and create set-up factors for human error.</p>	CA7, 8

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
JHAs	<p>LTA: The 324 JHA requires hardhats in the airlock anytime the man lift is in use. This requirement is more conservative than the JHA control for falling objects, which states that hard hats are required during aerial lift operations, e.g., when the lift is being raised.</p> <p>The requirement to wear hardhats is flowed down from the HASP, which does not contain the basis for the requirement. The 324 Building interpretation may cause some personnel to wear hard hats when they are not required.</p>	Set-Up Factor, Missed Opportunity: Hard hats provide another source of distraction.	CA7, 8
Technical Evaluation	<p>Adequate: The Radiological Control Technical Evaluation has been updated (e.g., when Sr-90 was identified, alpha contamination in C cell).</p> <p>This document forms a baseline for radiological hazard planning</p>	N/A	NA
ALARA Design Review	LTA: Does not reflect changes to the facility (Sr-90, loading out waste).	ECAQ: Document was written generally, because at the time of creation many unknowns existed. No update has been made based on new information.	ECAQ1

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
324 Building Donning/Doffing Practical - Content and Methodology	<p>LTA: 324 Building Doffing briefing/practical is not formalized (no course number). It is managed by expectation. 324 Building doffing assistance does not have formal training. 324 Building Chain of Custody for donning and doffing does not have formal training.</p> <p>Interviews provided inconsistent responses related to requalification. If a person has not made an entry for a while, one statement was that there was an expectation to have them refresh. Another statement was that personnel might re-perform the practical if they choose. Still another statement is that they would work support to the HCA prior to making an entry.</p>	<p>Missing Barrier: Doffing, doffing assistance, and personnel "Chain of Custody" during donning and doffing have not been through a formal training analysis. Consequently, there is no formal criteria for proficiency or retraining. 324 Building management commented that it takes weeks to get a course formalized.</p> <p>Missing barrier: Completion of the practical for Room 18 is tracked internally via a spreadsheet. No formal tracking of the practical for the airlock exists.</p>	CA10 - 13
	LTA: Work processes in HCA/ARA/HRA conditions do not have performance based qualification training (wipe downs, frequent glove changes, waste handling).	Missing Barrier: Review of videos indicated that poor execution of these processes might contribute to transfer or resuspension of contamination.	CA10 - 13
	LTA: The Airlock Entry Training course has a course number. However, review of the doffing checklist against course content indicates the materials are out of date.	ECAQ: Configuration control between field practices and training have not been consistently maintained.	CA10 - 13

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Monitoring (Oversight)	<p>LTA: Digital recording reviews indicated (b)(6)</p> <p>(b)(6)</p> <p>SSW has been assigned to some activities, but not on a continuous basis. The project also uses an SSW logbook, but it is not routinely reviewed for potential noncompliance and trends. There was no evidence of a qualification process for 324 Building SSW.</p> <p>LTA: Oversight of doffing process practices is limited based on MOPS and SSW documentation.</p> <p>Note: Due to the location of the doffing areas and the number of people in a constrained space, it is difficult to observe the doffing practice.</p>	<p>Missed Opportunity: 324 Building level of rigor for SSW qualification is (b)(6) SSWs were assigned on a limited basis and a limited number of independent personnel were utilized.</p> <p>Failed Barrier: 324 Building SSW log is not routinely reviewed for trends or items requiring entry into CRRS. Sharing of information between personnel performing the SSW is not performed.</p>	CA6, 22, 24
	<p>LTA: Monitoring was available via the camera system, but (b)(6)</p> <p>(b)(6)</p>	<p>Missed Opportunity: The facility is not using digital recordings as a training tool, nor as a method to evaluate drift in performance.</p>	CA29, 33

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Monitoring (Metrics)	<p>LTA: No 324 Building performance metric or leading indicator exists for contamination control. An acceptable rate of performance has not been established. A spreadsheet, which was put in place after the commonality review, is used to track the contamination events.</p> <p>The facility is not tracking contamination of inner PPE or other potential leading indicators.</p>	Missing Barriers: No method to predict/measure improvement or drift. No thresholds identified for action.	CA15

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
<p>Work Practices</p> <p>Rotation of Workers to equalize dose</p>	<p>LTA: 324 Building manages entries to HCAs to equalize the potential for receiving radiological dose. This practice reduces individual dose, but does not reduce the dose to the team making entry into an HCA. The activities to equalize dose may increase the overall person rem, due to proficiency issues.</p> <p>One 324 Building practice to manage dose is to take the record dosimetry from an individual and read it before they make another radiological entry. Reading of record dosimeters takes approximately two days. The intent was to verify the worker has 200 mrem below the limit prior to another HCA entry. There appears to be good agreement between record dosimetry and supplemental dosimetry to estimate dose for the airlock. Room 18 does not have close agreement.</p> <p>NOTE: An individual can get between 140-180 mrem per entry, which is the basis for the 200 mrem limit. In 2018, the average dose per entry was 60 mrem per entry. Average team dose was 190-200 per entry. Maximum entry dose was 140 mrem. Dose equalization has been effective.</p>	<p>Set-Up Factor: Reading of dosimeters affects continuity of assignments. Requires more personnel to allow rotation in and out while dosimetry is being read. See discussion on proficiency.</p> <p>Missing Barrier: A study has not been performed to determine the agreement between types of dosimetry and determine if immediate reading of record dosimetry can be ended (per interviews, this study is planned to be performed based on 2018 data).</p>	CA7, 8

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Use of Mockup	LTA: Interviews indicated the 324 mockup was not beneficial for airlock practical training because, as currently configured, it was not representative of this area. The mockup had been used for drills in full dress and for testing and operating new equipment. Pallets have also been put down to simulate tracks.	Missed Opportunity: The facility could use the mock-up more for training and contamination control simulation.	CA13
Management Communications and Feedback	<p>LTA: Some personnel interviewed felt strongly that decontamination should be performed, but did not understand why it is not being performed.</p> <p>Personnel have brought up suggestions (e.g., CO2 decontamination) but have not received feedback on why they were not being implemented.</p> <p>Note: Resumption Team investigation of these comments found that Engineering and Operations personnel were currently evaluating potential decontamination methods for the airlock.</p>	<p>Missing Barrier: Feedback on employee recommendations is lacking. Consequently, employees expressed frustration that they were not listened to, recommendations were not acted on, and management took either a different path or no action.</p> <p>Better feedback to workers on their suggestions for decontamination could relieve some of the frustration expressed.</p>	CA5

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: Some of (b)(6) interviewed felt upper management was not responsive to issues that were raised. Others bring items to their first line manager, but do not believe the issues will be resolved.</p> <p>The willingness to bring up changes varies – some personnel interviewed stated they did not bring up issues because they did not anticipate any action would be taken. Some personnel did not feel comfortable calling a stop work.</p>		CA5
	<p>LTA: 324 Building Employee Zero Accident Committee (EZAC) is not being used as a tool to bring up issues to management. There is low employee attendance by the labor force. Workers have expressed that they do not feel they are getting much from the meetings.</p> <p>LTA: 324 Building SII log is used but timeliness of resolution and feedback has been brought up by the employees. An ALARA committee exists, but difficult to get labor force participation. The 324 ALARA program is focused primarily on dose, not on contamination controls.</p>	<p>Missing Barrier: If personnel do not see response to concerns, there is limited value in EZAC or ALARA committee.</p> <p>Missing Barrier: No evidence that the ALARA committee was used to discuss options for addressing contamination events.</p>	CA5

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Communications	<p>LTA: Some personnel interviewed were not engaged in development of hazard controls or corrective actions.</p> <p>Adequate: (b)(6) workers felt they had good involvement in development of hazard controls.</p>	<p>Missed Opportunity: Lack of communications and involvement negatively affects buy-in from the workers to the controls.</p>	CA5
	<p>LTA: Communication in pre-job meetings goes through the checklist, but does not focus on work to be performed. Some workers did not know tasks after pre-job (per interview).</p> <p>NOTE: A safety issue was identified on the length of the pre-jobs affecting the ability of personnel to focus on key information about the work.</p>	<p>Missed Opportunity: Discussion in the pre-job is intended to focus personnel on the hazards and associated controls.</p>	CA5
	<p>LTA: Personnel interviewed stated that management is not in the field often.</p>	<p>Missed Opportunity: (b)(6)</p> <p>(b)(6)</p>	CA6

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: Some personnel were surprised that the facility received a letter from RL on the contamination events. Some personnel were not immediately aware of the stop work.</p> <p>Monday meetings are the primary method to communicate out to the 324 project. Communications may come out via project-wide emails or through the morning planning meeting, with the expectations that management flow it down. Facility personnel indicated that the Monday briefings do not consistently discuss events or status. Contamination events were discussed at the last two Monday meetings, but did not have information on the other contaminations.</p>	<p>Missing Barrier: Monday meetings and other communication tools are not used consistently.</p>	CA5
Checklists/Tools	<p>LTA: (b)(6) (b)(6) There were no videos of work in Room 18. Do not have a camera set up to observe doffing area</p> <p>LTA: Doffing instructions and the donning checklist are not formally controlled. However, these checklists are referenced in the procedures.</p> <p>Adequate: Apollo personnel had a high level of confidence in the donning checklists and the doffing practices.</p> <p>Donning checklist looks comprehensive.</p>	<p>Missed Opportunity: The videos are not being used to review performance (b)(6)</p> <p>ECAQ: Configuration control of 324 donning/doffing instructions may be appropriate while the facility is going through resumption activities.</p>	CA7, 33, ECAQ5

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Personnel Chain of Custody Practice	<p>NOTE: Implemented while people are donning PPE. The donning checklist is used by donning assistant. Intended to be a 1:1 ratio.</p> <p>LTA: Doffing also has chain of custody, but there are times when the person exiting is unobserved. Doffing Chain of Custody (COC) is not rigorously implemented at the airlock. It is more rigorously performed for Room 18.</p>	<p>Missing barrier: No formal communication or training associated with the COC practice.</p> <p>Missing barrier: The level of rigor for the airlock is not proportional to the risk for contamination.</p>	CA7, 10-13
Contamination Control	<p>LTA: Personnel were skeptical whether the use of dryer sheets as an antistatic control actually works. There is a carbon weave in the inner cotton set of PPE that provides static control.</p> <p>NOTE: The use of dryer sheets was implemented following the TRT in October and was based on the past use of dryer sheets at PFP. There is a technical correlation between low humidity days and migration of Sr-90 particles.</p>	<p>Missed Opportunity: Workers experienced with airlock entries were not engaged with development of contamination controls (within 324 and benchmarking with other facilities with HCA entries).</p> <p>Failed Barrier: The resumption team found no documented evidence of the benefit of using dryer sheets for antistatic on PPE, as they require heat to activate. However, there is evidence that static reduction can be beneficial. Industry practice is to use an antistatic spray product.</p>	CA1, 7
	<p>LTA: The process of drilling agitates the sand, which creates static. Sr-90 and salts are attracted to static. There is a potential for the drilling action to concentrate and then disperse Sr-90 contamination. 324 Building has not performed analysis to evaluate this impact.</p>	<p>Missing barrier: The impact of the drilling operation on the physical characteristics of the sand and associated contamination has not been evaluated</p>	CA34

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Contamination Controls: Equipment Design	NOTE: The design of the drilling equipment created the potential for dust. Controls were established to provide dust suppression. However, when the fine sand contaminated with Sr-90 was identified in the first pilot hole, additional engineered controls had to be developed.	N/A	NA
Contamination controls: Air Flow	<p>LTA: Do not have a documented smoke test for the airlock. Have done a smoke test (required by RWP) while they were setting up air monitoring.</p> <p>LTA: Interviewees expressed concern that B-Cell is not pinned shut, which may allow release of contamination in airflow. Employees wanted a smoke test to verify air was flowing into the cells (currently monitored by differential pressure).</p> <p>Adequate: Reviewed airflow in Room 18 and adjusted negative air monitor so it does not exhaust into the room.</p> <p>LTA: Having a waste box in the airlock creates eddies in the general airflow in the room. If personnel are doffing when a box is in the CHA, they may be doffing in an air current.</p>	<p>Exacerbating Condition: High velocity airflow may re-suspend contamination and cause it to deposit on surfaces in the airlock entryway during opening of the door.</p> <p>Missed Opportunity: A smoke test would provide additional opportunities to understand how the airflow may affect the potential for resuspension of contamination.</p> <p>Missing barrier: Currently do not have any controls in place to compensate for airflow eddies during the movement of a waste box.</p>	<p>CA27</p> <p>CA27</p> <p>CA27</p>

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
<p>Contamination Controls: Selection of PPE</p>	<p>LTA: PPE currently in use may contribute to the potential for personnel contamination – other types of outer PPE, respiratory protections, etc. are in use on site that may mitigate contamination events.</p> <p>Facility understanding is that PPE too long in arms or legs cannot be modified. The Resumption Team contacted the vendor and vendor provided written clarification that PPE may be modified to improve fit (trimming arms and legs).</p>	<p>Missed Opportunity: The facility had not discussed options for modifying PPE with the vendor.</p> <p>Missed Opportunity: Benchmarking with other facilities was not performed as the need for changes to PPE was identified.</p> <p>Missing Barrier: Selection of PPE has not been tailored to the tasks being performed.</p>	CA1, 7
<p>Contamination Controls Practices: Waste handling</p>	<p>LTA: Airlock: Personnel are handling waste at the entryway where personnel are standing prior to exit. Doffed PPE is placed in a waste bag after wipe down of outer PPE and removing outer gloves. The last entrant's discarded PPE is placed in the airlock for the next crew to bag up.</p> <p>Adequate: RM 18 – waste is triple bagged and removed before the next person comes out to doff.</p>	<p>Set-Up Factor, Missing Barrier: Handling contaminated material multiple times creates opportunities for contamination spread.</p>	CA10-13

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: When a box is moved out through the entry, personnel could be temporarily trapped inside the airlock until the outer layer of wrapping on the box is removed. There is tight access until box is completely out of the airlock.</p> <p>NOTE: 324 Building is moving more waste out in boxes than was originally intended. The A-Cell dams are not ready, so there is no location to store the waste.</p>	<p>NOTE: 324 Building is developing a new process for removing box from the airlock that keeps personnel out of the way.</p> <p>Set-Up Factor: Movement of waste requires more entries, which creates more opportunity for contamination events.</p> <p>Missing Barrier: No evidence of evaluation of process and controls based on increase of waste boxes being moved out of the airlock.</p>	CA27
	<p>LTA: The 324 Building is using bags to transport waste from the airlock rather than hardened containers. Room 18 uses a tote.</p>	<p>Missed Opportunity: No benchmarking with other CHPRC projects to integrate lessons learned into 324 practices.</p>	CA1, 7

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Contamination Control Practices: Decontamination of areas	<p>NOTE: Management periodically decontaminates the floor in the airlock area as triggered by AMW controls.</p> <p>LTA: The airlock drainage trench is partially plugged and drains slowly to the pipe trench below. The drainage trench has a high dose rate.</p> <p>Cranes and waste containers are moved between airspaces so 324 Building Management views decontamination as a temporary solution.</p> <p>Adequate: Room 18 developed an engineered control to reduce contamination during drilling. The Room 18 RWP has specific limits for when decontamination is performed.</p>	<p>Set-Up Factor: The partially plugged trench creates a limit on the amount of water that can be used for decontamination.</p> <p>Missing Barrier: The facility has not done an alternatives analysis to determine if the benefit of decontamination is worth the dose that would be taken. NOTE: This analysis is now in process.</p> <p>Alternate methods for decontamination (e.g., CO2) are currently being explored. While the facility is currently exploring alternatives, this analysis was not performed proactively nor was it factored into radiological hazard planning.</p>	CA28, 34
Contamination Control Practices: Use of fixatives to mitigate contamination in the area	<p>LTA: Fixatives are not currently used on surfaces in either the airlock or Room 18</p> <p>Room 18 is using tacky mats to reduce the potential for contamination spread.</p> <p>The facility personnel expressed in interviews that use of fixatives locks material down and may increase dose.</p>	Missing barrier: No documentation was evident to show that an alternatives evaluation for use of fixatives had been performed.	CA1, 7

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Contamination Control Practices: Location of HCA step off pad in CHA	LTA: The location makes it difficult to survey or get any accurate readings (can only be gross contamination readings). The location also requires RCTs to move throughout the area to complete tasks.	Set-Up Factor: RCTs moving to different areas to complete tasks affects the ability to focus on doffing. Set-up Factor: Background levels affect the effectiveness of readings. Cannot detect the levels on inner PPE that have been found in the personnel contamination events.	CA7, 8
Contamination Control Practices: Surveys at the HCA doffing area	LTA: Surveys in this area can only read gross contamination due to background levels. The purpose of the survey is not defined or well understood. There is not defined criteria for go/no go; this depends on the RCT who conducts the survey.	Missing Barrier: There is no defined criteria for this survey. It provides an indication of HCA level contamination on clothing for tape patches, but background levels are too high for an accurate reading. Go/no go is a subjective process.	CA7, 8
Proficiency process	LTA: There is not a process to verify or refresh proficiency on doffing when personnel return from the mock-up facility or when there is an extended period since the person last entered. There is not a formalized test or performance demonstration for proficiency as an initial "qualification" activity.	Missing Barrier: While personnel are expected to perform a doffing practical demonstration, there is no formal training developed. Expectations to refresh personnel proficiency upon return from the mockup are not formalized.	CA10-13
	LTA: Current doffing assistants have to demonstrate proficiency to the satisfaction of Ops and Rad Con before they are added to the list of doffers.	Missing barrier: Doffing assistant proficiency demonstration is not a formalized process. It is subjectively evaluated.	CA10-13

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Configuration of HCA work areas	<p>LTA: Airlock: Rails are located at the entryway to the HCA step off pad at the airlock. The rails have not been removed because the crane is out of service. There are tools and cables on the airlock floor. The airlock has restricted areas for movement.</p> <p>Room 18: Cable trays and interferences on the walls. High radiological source term in some areas.</p> <p>Industrial hazards also exist in both areas.</p>	Set-up factor, Missed Opportunity, Human Factor: Working around obstacles increases the potential for distraction. May cause personnel to brush up against contaminated materials, increasing the potential for transfer during doffing.	CA25, 26
Individual Barriers			
Maintaining Proficiency	<p>LTA: Digital recordings, OAs, and MOPs all identify poor contamination control practices.</p> <p>Room 18 uses the same people each day and they make entries that are more frequent. The frequency provides a higher ability to develop proficiency.</p> <p>Personnel for the airlock are rotated to the mock-up for weeks at a time to distribute dose. They may make airlock entries on a weekly basis. The personnel with the lowest accumulated dose are selected for entry.</p>	<p>Set-Up Factor, Missing Barrier: Less opportunity for personnel to develop proficiency in the airlock.</p> <p>Set-Up Factor, Exacerbating Condition: Collective dose management process is at odds with developing team proficiency.</p>	CA10-13

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Doffing Practices	<p>LTA: (b)(6)</p> <p>(b)(6)</p> <p>Multiple tasks are assigned to the doffing assistants.</p> <p>Personnel continue doffing while RCTs are performing other tasks.</p> <p>LTA: Number of doffing assistants. Benchmarking within CHPRC indicates 2 assistants at HCA and 1 assistant at CA step off pads. Current 324 expectation is 2 assistants at HCA and none at CA unless someone is contaminated.</p> <p>LTA: Unclear whether wipe down of PPE is effective. When conducted, it is inconsistent. Personnel did not receive training on the wipe down process and were skeptical about effectiveness.</p>	<p>Failed Barrier: The doffing instructions require that personnel eliminate extraneous activities to allow focus on doffing. (b)(6) in this manner.</p> <p>Missing barrier: The level of rigor for doffing activities at the airlock is not proportional to the risk for contamination.</p>	CA1, 7
	<p>LTA: Doffing is currently performed by peeling off the outer PPE. After doffing, contaminated PPE is returned to the airlock and placed in a waste container. This occurs after personnel have wiped down for contamination and doffed outer gloves. The last entrant places the last set of doffed PPE back into airlock.</p>	<p>Missed Opportunity, Exacerbating Condition: Some current 324 Building practices require handling contaminated materials multiple times. Lessons learned and practices for other facilities with HCA entries have not been factored in to 324 practices (benchmarking).</p>	CA1,7

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: Fixatives on PPE are optional at the airlock and are not routinely used. At the airlock, tape patches are used.</p> <p>At Room 18, fixative is applied before the individual is doffed if contamination is identified.</p>	<p>Missing Barrier, Exacerbating Condition: Use of use fixatives on the outer PPE is subjectively driven at the airlock. Use of the tape patch technique may press contamination into PPE rather than contain it.</p>	CA1, 7
	<p>LTA: There is a 50,000 dpm void limit set in the RWP. If this limit is exceeded on the hood, this drives a wipe down of the hood. This limit can be read in Room 18. At the airlock, the smear is read in a shield "cave."</p> <p>Current practice at the airlock is to perform a survey of the inner PPE behind the shield door to determine gross contamination levels. Due to background levels, these surveys can only detect HCA levels of contamination. If HCA levels are found on inner PPE, a wipe down or tape patch is applied.</p>	<p>Missed Opportunity: Surveying in a lower background area would allow detection of lower levels of contamination, which could be mitigated prior to doffing of the inner set. Most of the contamination events have been under 10,000 dpm.</p> <p>This change would also allow better evaluation of doffing performance and of the effectiveness of PPE.</p>	CA7
Contamination Control Practices	<p>Partially effective – the majority of entries do not result in contamination events.</p> <p>LTA - Personnel actions in the HCAs do not consistently minimize the potential for contamination: poor wipe downs, throwing items in HCA, pushing down on waste bags, picking up materials after they have dropped them.</p>	<p>Set-Up Factor: The weaknesses in work practices create opportunities for flighty contamination to settle on the outer pair of PPE.</p> <p>Missing Barrier: While personnel perform a doffing practical exercise, there is not facility-specific training or guidance on contamination control practices in a HCA.</p>	CA10-13

Barrier Analysis for CR-2019-3146

Barrier	Effectiveness in this case	Significance	Corrective Actions
Personnel Understanding of Hazards	<p>LTA: Airlock personnel understood that the contamination is flighty; however, personnel were surprised with the flightiness of the material.</p> <p>Adequate: Room 18 workers indicated the first contamination in the room was unexpected. The Room 18 crew currently has a high level of understanding of the hazards. This evolved as they had to react to unexpected conditions.</p> <p>RCTs have a good understanding of the hazards.</p>	<p>Missing Barrier: Discussion/training on the properties of the contamination did not address the flightiness of the contamination.</p>	CA10-13
	<p>LTA - During interviews, some personnel made statements that (b)(6)</p> <p>(b)(6)</p>	<p>Set-Up Factor, Exacerbating Condition: Acceptance of personnel contaminations does not promote a target zero approach.</p> <p>Personnel understand the hazard, but do not understand the consequence of poor performance relative to that hazard. Personnel stated in interviews that they assume they have contamination on their outer PPE, but actions in digital recordings of airlock operations did not demonstrate an appropriate level of concern/diligence.</p>	CA10-13
Labor Workforce	<p>LTA: (b)(6) have limited experienced with HCA work.</p>	<p>Set-Up Factor: An inexperienced workforce needs a different level of training to contamination control practices.</p>	CA10-13

Barrier Analysis for CR-2019-3146

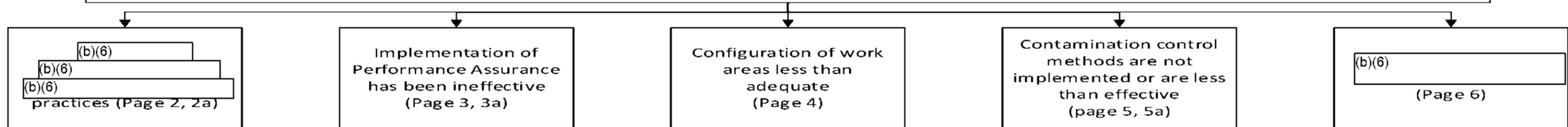
Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: Facility personnel have the perception that if laborers are not productive, they may be sent back to the hall. If they go back to the hall, the same personnel may not return. New labor personnel would mean extensive training to redevelop proficiency.</p> <p>NOTE: The facility has stopped work to address the contamination issues multiple times, which has not resulted in any labor personnel being sent back to the hall.</p>	Set-Up Factor: The perceived need to prevent loss of the labor force may influence taking actions without in-depth evaluation.	CA5
PPE/Equipment	<p>LTA: PPE is not designed for all sizes. Personnel may wear PPE that is too long in the arms or legs, which may cause dragging on contaminated surfaces.</p> <p>LTA: Wiping down the impermeable outer set of PPE can cause contamination to be embedded in the porous surface of the fabric.</p> <p>LTA: Double bib hood inflates the impermeable outer PPE and the PAPR hood tape seal exacerbates this condition.</p> <p>LTA: Yellow vinyl tape adheres strongly around gloves.</p>	<p>Exacerbating condition, Set-Up Factor: Fit of PPE and type may collect contamination that could be transferred.</p> <p>Set-Up Factor: Airflow in PPE contributes to loosening hardhats and communications equipment.</p> <p>Set-Up Factor: When wiped down, the porous material of the outer set of PPE may allow contamination to embed, creating the potential for transfer during doffing.</p> <p>Set-Up Factor: Tightness of tape may require shaking out to doff PPE.</p>	CA1, 7, 8 CA1, 7, 8 CA1, 7, 8

Barrier Analysis for CR-2019-3146

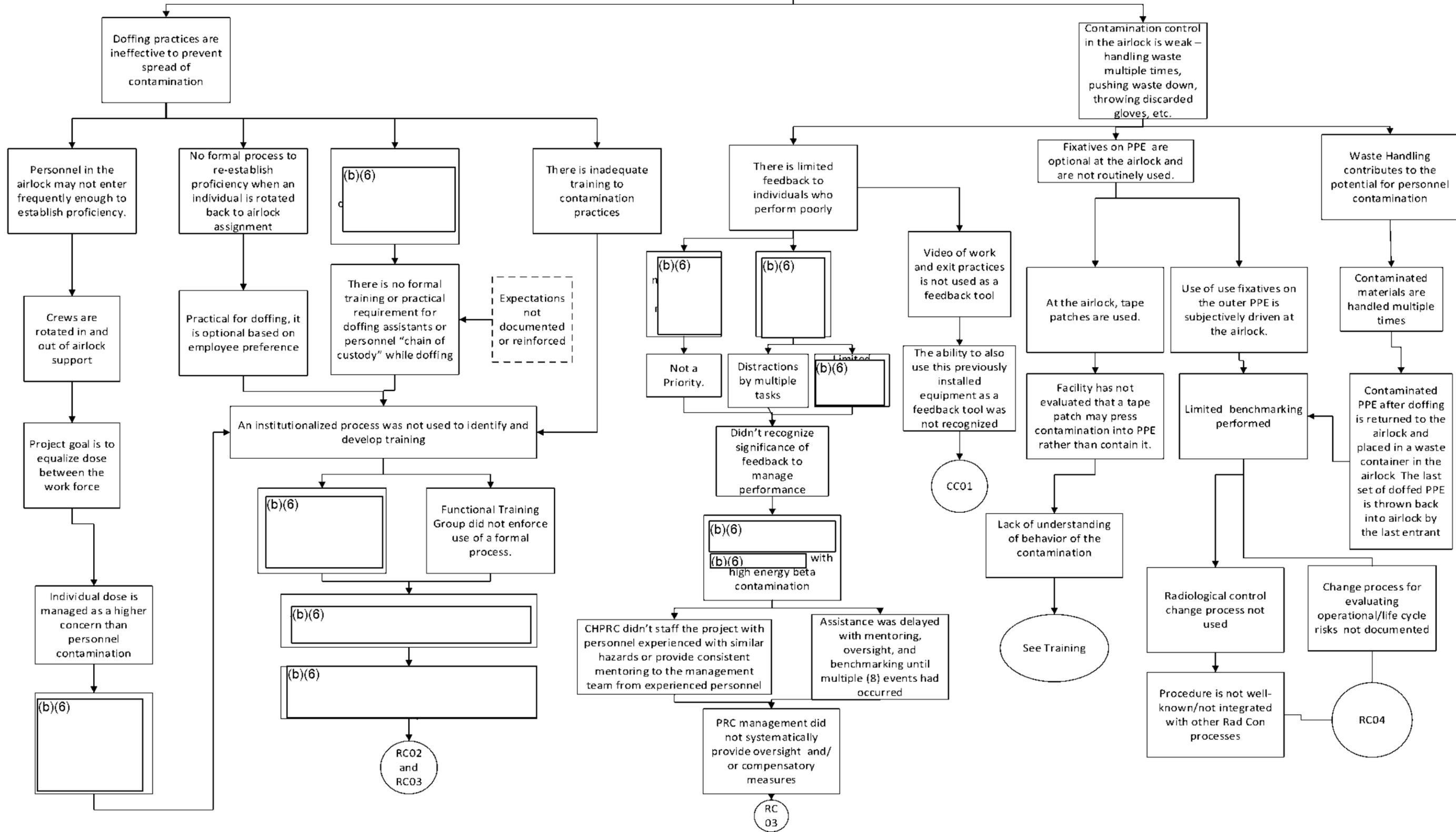
Barrier	Effectiveness in this case	Significance	Corrective Actions
	<p>LTA: Equipment is not well secured under PPE. Communication cords become problematic to wear and cause distractions. Radios/badges may come loose and fall within PPE.</p> <p>Velcro on hardhats does not stay attached, allowing hardhats to shift while working.</p>	<p>Exacerbating condition, human factor: Loose equipment can cause distractions while working in a HCA and while doffing.</p>	<p>CA1, 7, 8</p>

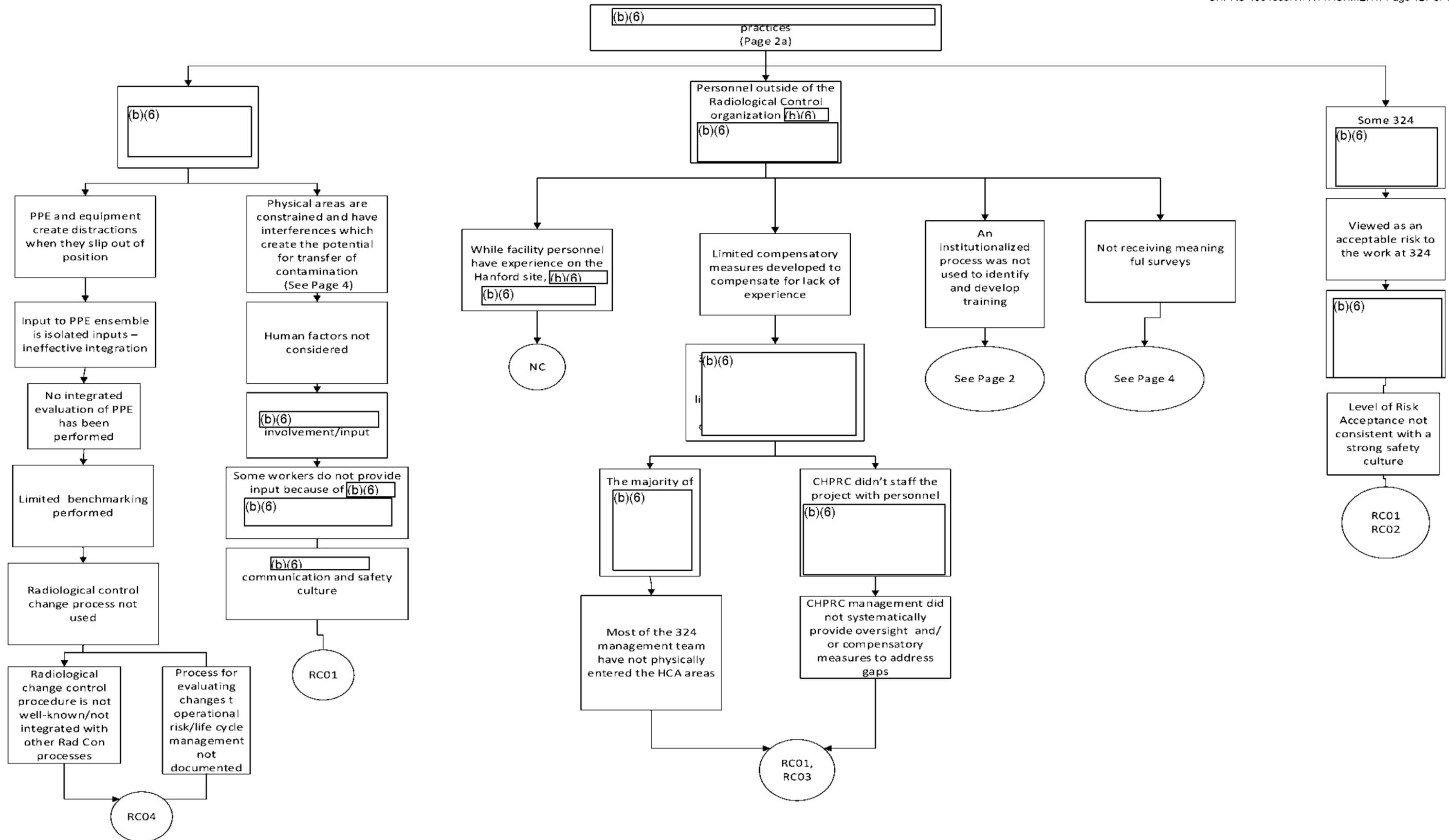
10.3 Attachment 3: WHY Staircase

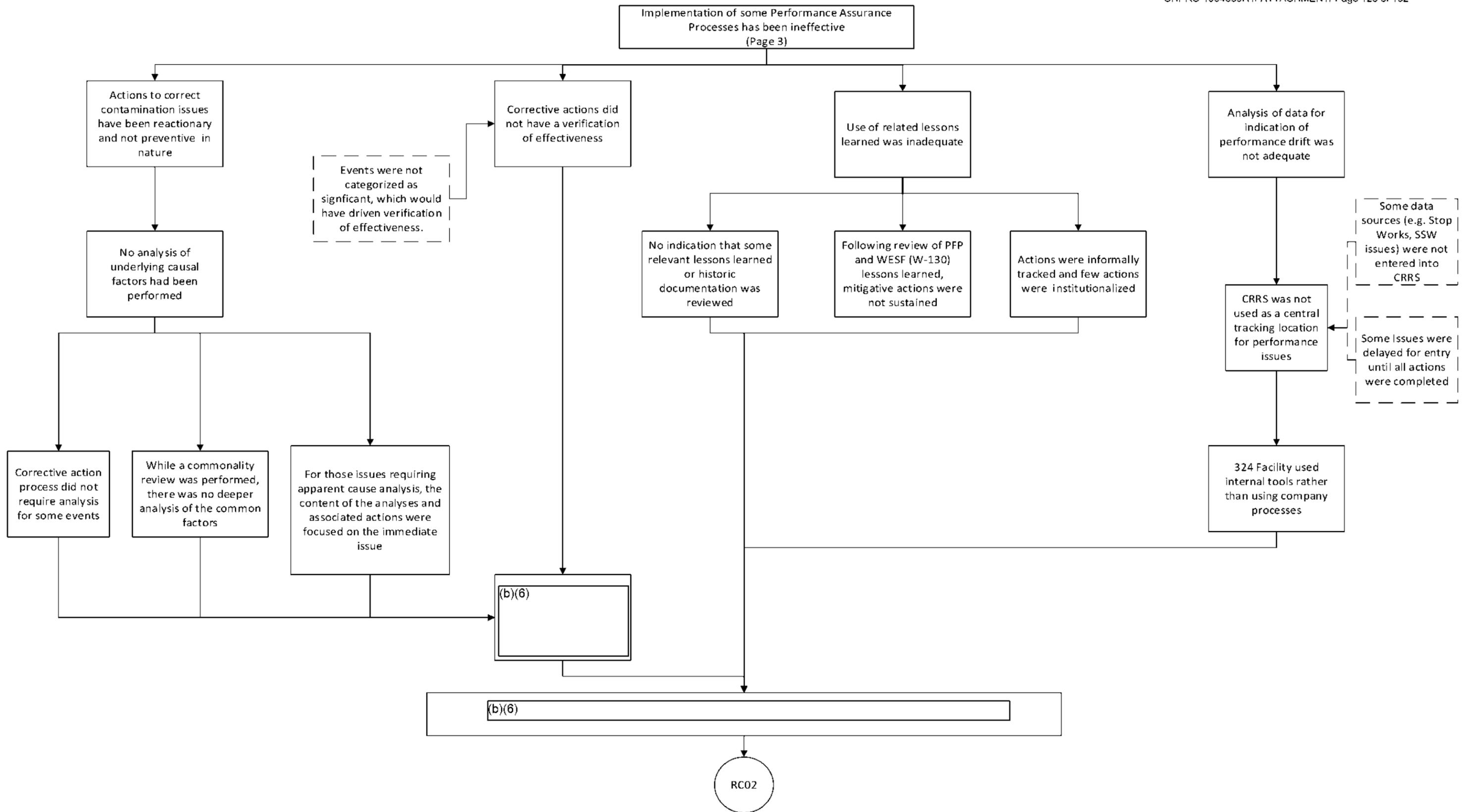
From October 2018 to November 2019, the 324 Facility experienced 13 personnel contamination events (6 modesty clothing, 4 personal clothing, 3 skin/hair). The consequence is a lack of stakeholder confidence in the contamination controls currently in place at the 324 Facility, resulting in the potential for worker exposure. The corollary consequence is that DOE has transmitted a letter reinforcing 324 Management's suspension of radiological work beyond minimum safe activities and requesting concurrence with the corrective actions and path forward.

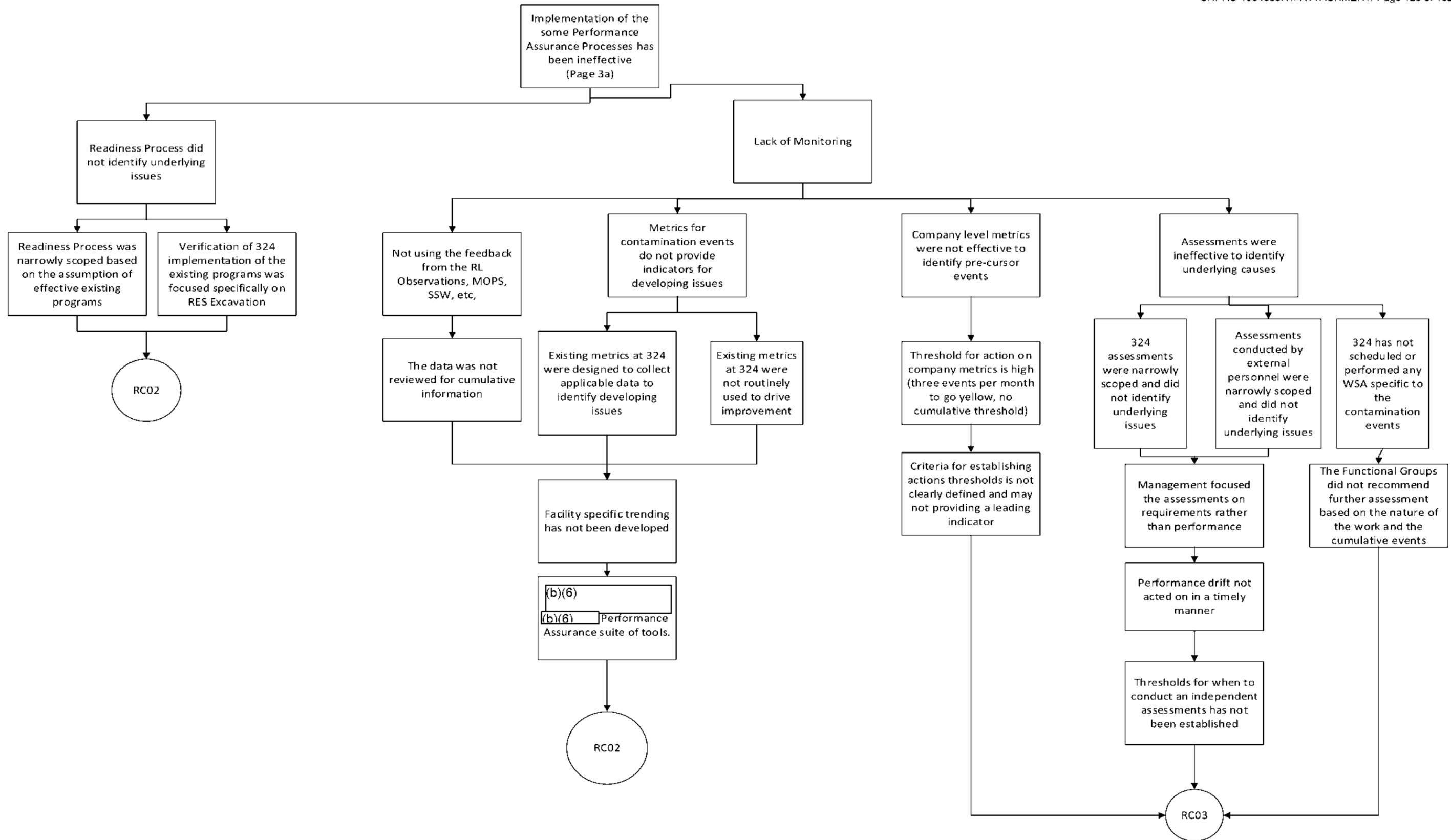


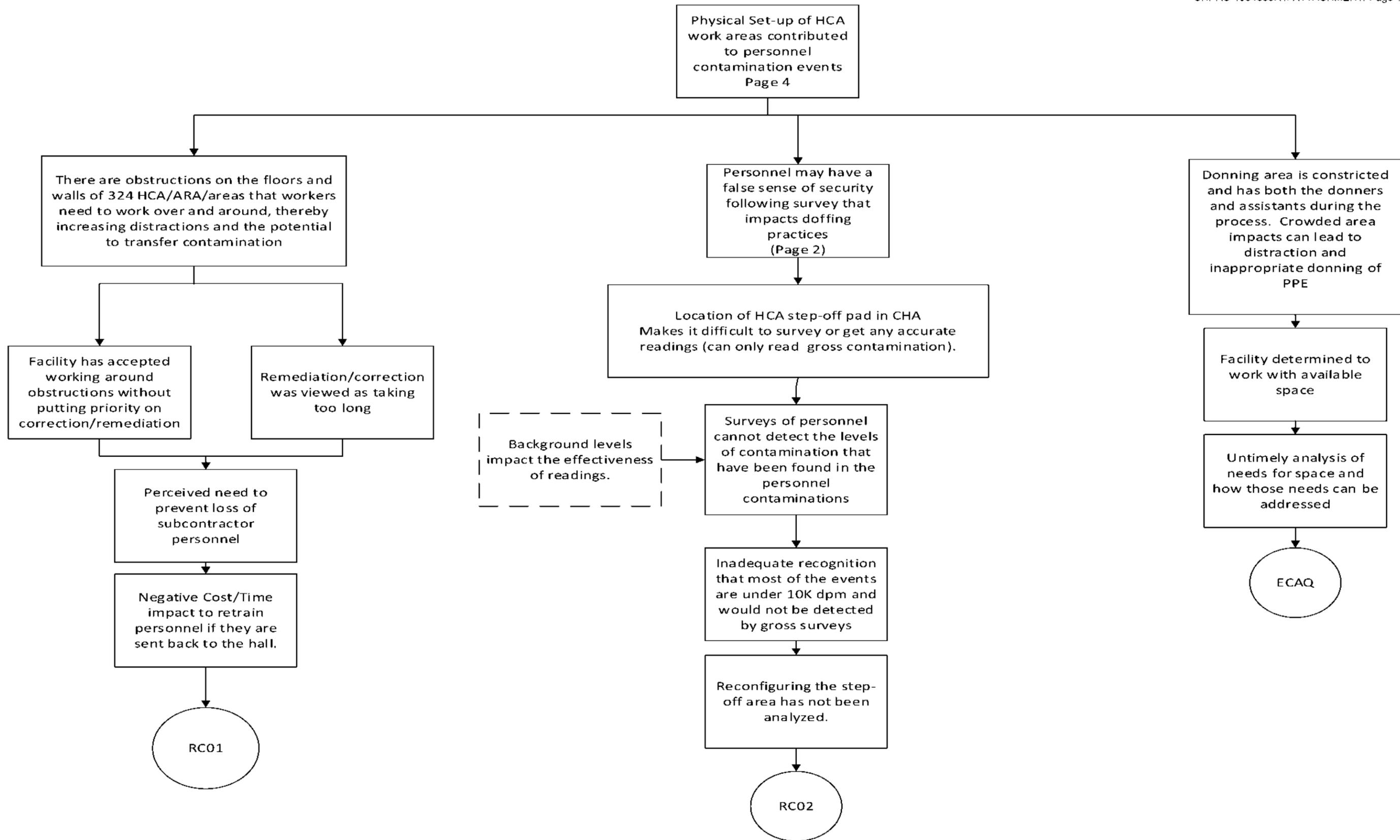
(b)(6) practices (Page 2)

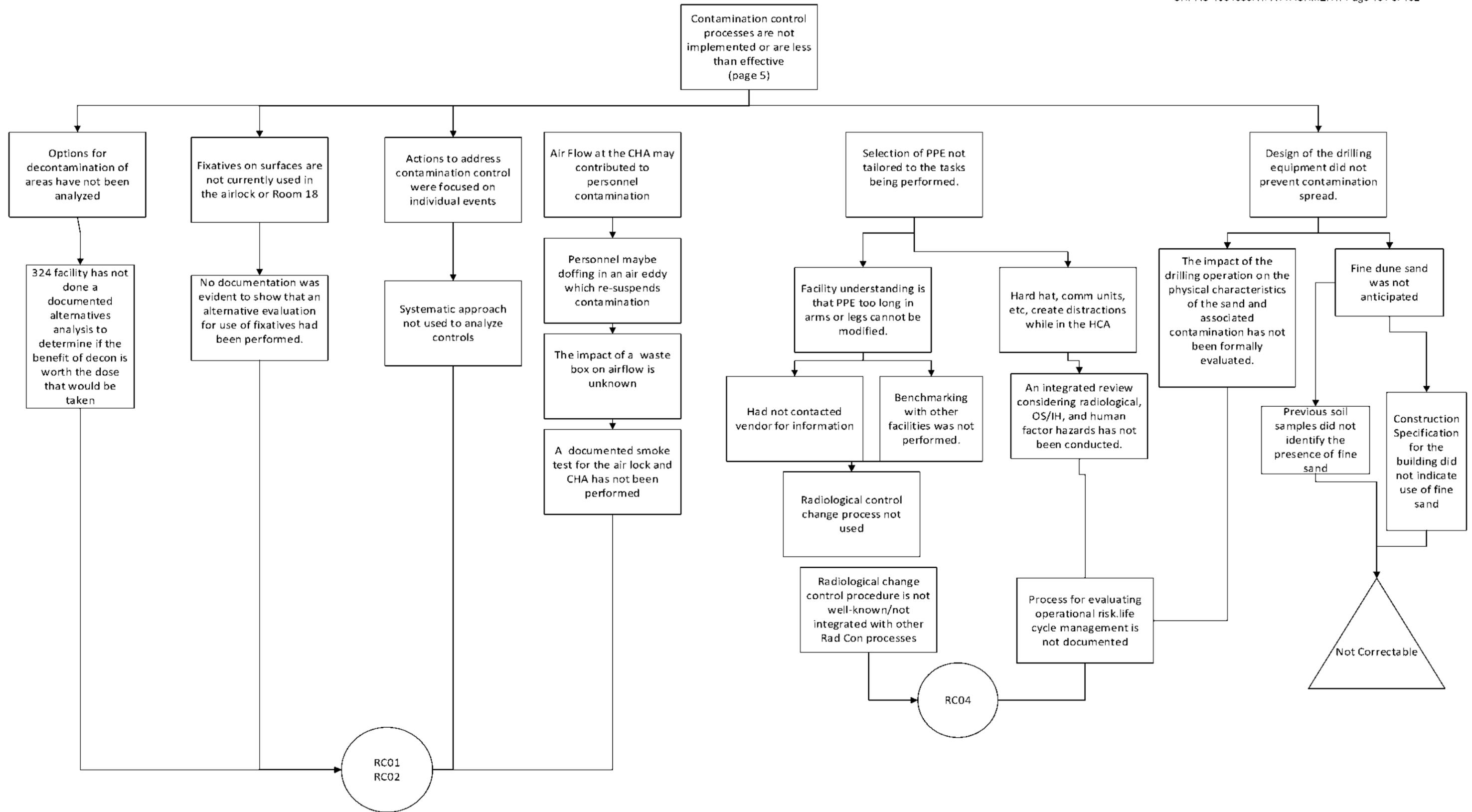


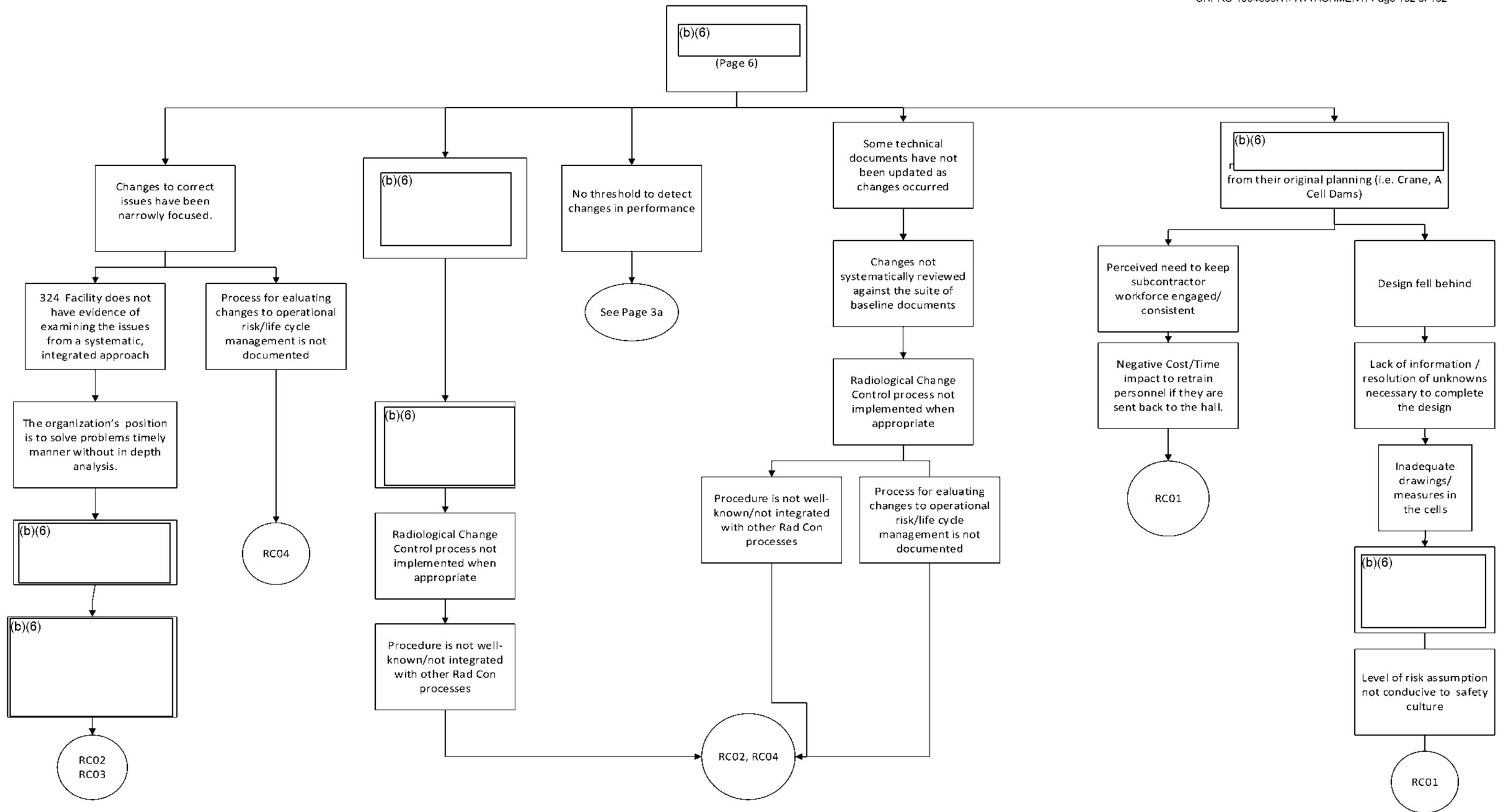












10.4 Attachment 4: Lines of Inquiry

1. Training/Proficiency (PPE, Hazards, Contamination Control)

- How are personnel rotated between the mock-up and working in contamination areas? Is there any action to refresh proficiency following rotation?
- Was there gap training provided when the Sr-90 contamination was identified? Was it hands on or briefing?
- Have qualification materials been updated to discuss current hazards, contamination events, and lessons learned?
- What level of training was provided on the personnel “Chain of Custody” process?
- When the control sets are changed, how is that communicated? Is it provided via training? Briefings? Is training updated?
- Are proficiency demonstrations part of a qualification? How are they administered and tracked?
- Have corrective actions been developed that address training changes and have they been implemented?

2. Management Decision Making/Change Management

- How are changes in conditions being evaluated and decisions documented?
- Does the management team fully understand the impacts and risks when changes in conditions occur?
- Are changes reviewed against baseline hazard documentation (PFP Lessons Learned (LL))?
- Are baselines updated and flowed into implementing documents?
- Are changes to hazards evaluated systematically or piecemeal (reactionary to isolated events)?
- How are key assumptions in baseline documents protected?
- How are changes communicated to the workforce?
- How are personnel trained to work to the process changes?
- Has benchmarking been performed by the project? If yes, what was the outcome?
- Have the potential hazards related to the delay in start-up been identified and evaluated (e.g., equipment degradation)?
- How does management determine who is proficient? Is there any criteria for removing an individual from high contamination work?
- Is time pressure a factor in change management processes?

3. Hazards controls

- Are controls designed in the appropriated hierarchy (elimination, engineered, administrative, PPE, personnel)?
- How have human factors been considered in the control set?
- Have constraints been identified and systematically factored into hazard controls (e.g., space limitations, equipment)?
- Has risk-based hazard analysis been performed to optimize the control set (e.g., increasing dose and potential for contamination by some controls in place).
- Is management accepting artificial limitations to resources and infrastructure? What options have they looked at? What is influencing the decision-making process?
- What was the rationale behind the selection of PPE? Have they explored alternatives?
- What alternatives for reduction of contamination have been explored? What was the result and how was it documented?
- Was benchmarking performed on hazard controls? What was the result?
- Is there a difference in priorities for dose reduction and contamination control?

4. Hazard Awareness

- Are employees aware of the hazards
- Are hazards treated with the appropriate concern (or down played)?
- How well does the project understand the properties of the contamination?
- Have they made accommodations to controls/PPE to address those properties?
- Do the employee understand the level of proficiency necessary to be successful in working/exiting a high contamination area?

5. Monitoring Performance

- What metrics or leading indicators are monitored to detect potential changes? (PFP LL) (e.g., contamination on inner set)
- Following the commonality review, contamination events were flagged as a monitored trend. How was this monitored? Were action thresholds identified?
- Have MOPs or SSW been conducted? Are they focused on more error-likely entries?
- Are supervisors in the field monitoring work evolutions? Where are they when they are monitoring? Do they provide feedback?
- Do the supervisors understand the performance expectations?
- Do the RCTs who are monitoring dose also monitor contamination control performance? Do they provide feedback?
- Are there adequate personnel to perform the work?

6. Corrective Actions

- What is the quality of corrective actions and corrective action closures for previous events?
- Have the underlying causes of the events been explored and acted upon to attempt to prevent recurrence?
- Does management have time to address all of the actions currently in the system related to contamination controls?
- Is the impact of one action set evaluated against actions already in the system?
- What lessons learned have been utilized by the Project and how have they impacted the control set?
- What was the level of worker involvement in identifying and implementing controls?

7. Roles and Responsibilities

- Who is in charge of correcting the problems? Are Radiological Control issues "owned" by Operations or Radiological Control?
- How do supervisors make the decision whether someone is "fit" to perform a high-risk activity that day?
- Who makes the job assignments for personnel?
- What risk level are contamination events perceived as by those assigned to develop corrective actions?

10.5 Attachment 5: Summary of Personnel Interview Responses

Approximately 50 workers at the 324 Building were randomly selected to be interviewed by the 324 Building Resumption team. Workers in the following categories were selected for interview to provide a broad spectrum of worker input:

- (b)(6)
-
-
-
-
-
-
-
-
-
-
-
-
-
-

Interviews were also conducted with the DOE Facility Representatives and members of the 324 Building management team. However, the responses from those interviews are not included below so as to not bias the responses obtained from workers at the 324 Building. Interviews were conducted in private by one to two members of the 324 Building Resumption team to obtain feedback from workers on the contamination events which occurred from October 2018 through November 2019 and on potential improvements for contamination controls. The following ten questions were asked of the interviewees. The individual responses to these questions are confidential and an aggregate of the responses received is summarized below each of the questions.

1. *Tell me a little about your background and your experience. How long have you been at 324 Building? How long have you performed radiological work?*

Figure 2 and Figure 3 identify the years interviewees have worked at the 324 Building or at other Hanford site / related nuclear facilities (e.g., U.S. Navy or commercial nuclear facility). Some workers are new hires, whereas other workers have been at the 324 Building for more than 30 years. Workers' experience at the Hanford site is also variable, ranging from new employee to having spent nearly 40 years working at the Hanford site. Some workers did not provide a response to this question or had experience at only the 324 Building or only at other Hanford site facilities.

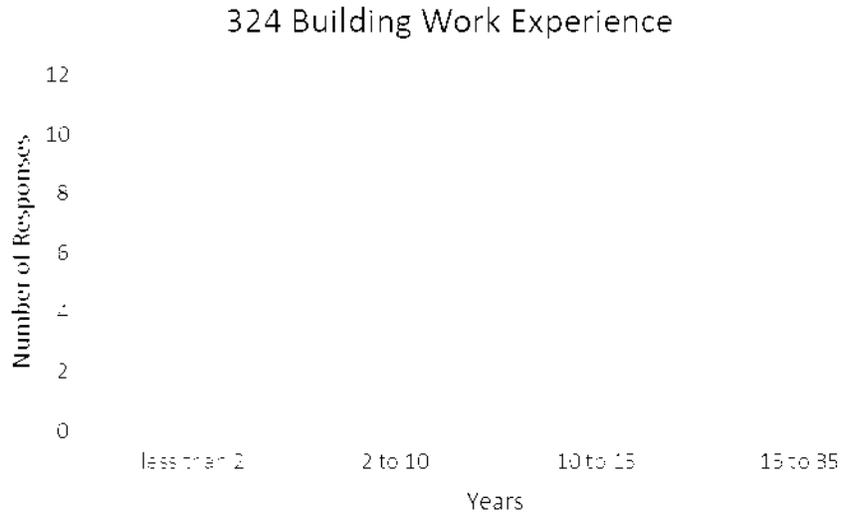


Figure 2. Work Experience at 324 Building

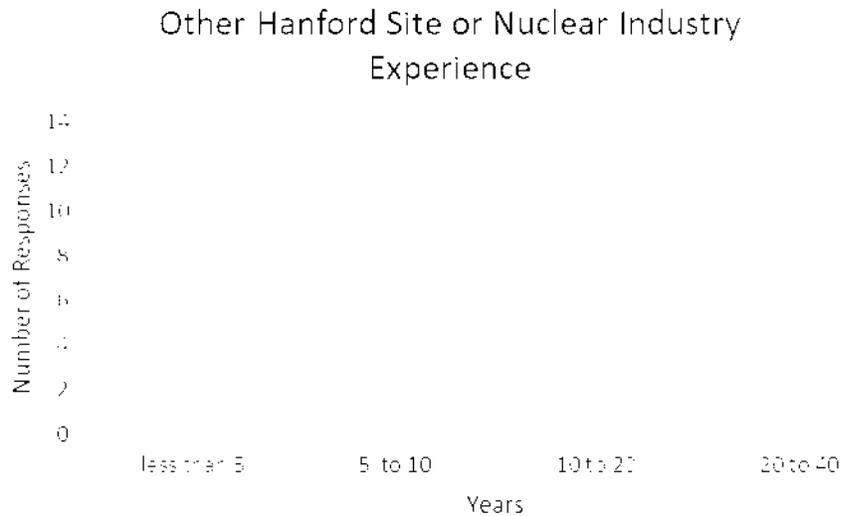


Figure 3. Other Hanford Site and Nuclear Experience

2. What can you tell me about the personnel contamination events at 324?

Worker’s knowledge of the contamination events in Room 18 and the Airlock varied from having not been informed of these events to being very knowledgeable.

A few workers stated the contamination encountered during drilling through the room 18 floor was unexpected.

3. *How do you feel about the level of training/information that the workers have received on radiological work practices in 324 Building and the types of contamination that will be encountered?*

Personnel working in Room 18 to install pilot holes through the floor into the underlying soil stated training was adequate and worker proficiency was being developed with experience.

However, training for workers entering and exiting the Airlock was generally viewed as inadequate.

Additionally, rotating staff that enter the Airlock to level radiation exposure was viewed as hampering development of worker proficiency.

Workers in Room 18 are not routinely rotated to avoid loss of familiarity and proficiency in work.

4. *Tell me about the hazards in Room 18 and/or in performing airlock work?*

Workers were aware of the hazards present in Room 18 and the Airlock.

5. *Whom do you take concerns or suggestions to for resolution? Have you presented any issues before? What was the response?*

In general, workers stated their concerns are discussed with their immediate supervisor. A few workers expressed concern that worker suggestions for improving contamination controls (b)(6)

6. *What can you tell me about the controls that have been put in place to prevent contamination events?*

Workers participated in developing the engineered controls that were installed after the contamination events in Room 18. Workers viewed these engineered controls as being highly successful in preventing additional events.

Several workers responded that hairspray was not routinely being used on personnel exiting the Airlock, which may contribute to the contamination events. Additionally, some workers commented that the dryer antistatic sheet being used to wipe down the PPE is not effective for preventing contamination spread.

7. *Describe how you personally have been involved in developing or implementing contamination controls.*

Workers participated in developing the engineered controls that were installed after the contamination events in Room 18.

Workers involved in Airlock entries or support roles at the 324 Building indicated they have not been involved in developing contamination controls or their suggestions have

(b)(6)

8. *What do you think could be done to improve contamination controls?*

Workers suggestions for improved contamination controls are:

- Involve the workforce in developing improved contamination controls
- Conduct good peer checks
- Conduct smoke testing within the Airlock to verify / adjust airflow is into the adjoining cells
- Provide additional space for donning and doffing PPE
- Unplug the floor drain in the Airlock
- Decontaminate within the Airlock
- Remove contaminated duct from Room 18
- Establish an expert resource for decontamination
- Establish an expert resource for waste management
- Modify PPE
 - Modify existing PPE to fit better
 - Use bubble suits and supplied air for Airlock entry
 - Wear additional layers of PPE
- Provide a decontamination shower
- Provide a shielded vestibule to allow for survey of personnel PPE in a lower background environment
- Workers exiting the Airlock remain in a moderate radiation field while waiting for other workers to clear the doffing process. This contributes to worker radiation dose. Need to improve Airlock egress process.
- Improve training for working in high contamination areas
 - Conduct review of digital recording from HCA work activities
 - Formalize training for donning and doffing PPE

9. *Is there anything else you would like to share with me? Is there a question that I should be asking, but did not?*

The following concerns were expressed by workers:

- Some workers are not attentive during pre-job meetings (e.g., cell phone use).
- Pre-job planning meetings not focusing on work tasks that will be performed
- The rail cart tracks in the Airlock present a tripping hazard and could damage PPE
- Personnel are concerned about retaliation from raising issues
- Fear that management will use the digital recordings of work in the HCAs to discipline workers
- Lack of faith (b)(6)
- (b)(6)
- Not allowed to sample soil removed from beneath Room 18 floor during drilling, leading to uncertainty in the level of contamination
- Loss of knowledgeable and experienced personnel

- Work is driven by schedule
- (b)(6)
- Roles and Responsibilities not adequately defined, communicated and implemented
- CRRS not being used
- Informality of some changes in requirements (e.g., use of interoffice memorandum to communicate changes)
- Airlock and cell cranes haven't been maintained and may fail, impacting mission
- Airflow through A-frame filters may become restricted and impact mission

10. Is there anyone else you would recommend we talk to?

Suggestions received for additional interviews were dispositioned by the 324 Building Resumption team.

10.6 Attachment 6: Documents Reviewed

Interoffice Memorandums

CHPRC-1704174.3 – 324 Building Disposition Project – Work Management Authorization for PRC-PRO-WKM-12115

CHPRC-1705797 - Plan for 324 Building Breathing Air System Compressors

CHPRC-1801044.5 – Updated Hazard Review Board Membership and Approved Delegates for River Risk Management Project

CHPRC-1904152 – Contamination Control Mitigation Process for PPE Donning and Doffing

CHPRC-1904152.1 – Contamination Control Mitigation Process for PPE Donning and Doffing

Work Packages

3O-17-06238, 324 BDP: Pilot/Micropile Holes

3O-17-07089, 324 BDP: Core Drill Activities

3O-19-05760, 324 BDP: Room 18 RLWS Line Removal

3O-19-06168, A/D Crane Hoist Troubleshoot and Inspection

324 Building Hazard Review Board 2019 Summary

Procedures

324-PRO-OP-53674 / 3I-SOP-REC-A-04, Airlock Shielding Door Controls

324-PRO-OP-54055 / 3I-SOP-REC-A-05, Airlock/C-Cell Access

324-PRO-OP-54209 / 3I-SOP-REC-A-06, Operation of Airlock Tracks and Cart System

324-PRO-OP-53675 / 3I-SOP-REC-A-12, Hot Cell Shielding Door Controls

324-PRO-OP-53676 / 3I-SOP-REC-F-02, Fire Suppression Guidelines for B-Cell and Deluge System

324-PRO-OP-53669 / 3I-SOP-G-22, Hot Cell Combustible Material Inventory

324-PRO-OP-53672 / 3I-SOP-G-26, 324 - Facility Crane Operations

324-PRO-OP-54223 / 3I-SOP-REC-K-03, General Decontamination Guidelines

324-PRO-OP-53680 / 3I-SOP-REC-K-05, REC Cranes

324-PRO-OP-53682 / 3I-SOP-REC-K-30, Operation of Split Plugs and Transfer Ports

324-PRO-OP-53962 / 3I-SOP-REC-K-64, Hot Cell Operations

324-PRO-OP-54358 / 3I-SOP-W-02, 324 Radioactive Material Storage Yard

324-PRO-OP-54163 / 3I-SOP-W-03, Low-Level Waste Container Packaging

324-PRO-OP-53104 / 3IM-SOP-W-07, 324 Building Radioactive Waste Packaging

300A-PRO-OP-54222, 300 Area Waste Container Operations

Radiological Survey Reports

Airlock 2017 - RWP-WL-17-001-06 - 08

Airlock 2018 - RWP-WL-17-001-09 – 18

Airlock 2019 - RWP-WL-17-001_R00 – R08

Room 18 2018 - RWP-WL-18-0009 00 Rev 12

Room 18 2019

Grout Micropiles - RWP-WL-19-0006_R00

Interference and Diverter Removal - RWP-WL-19-0005_R01 – R06

Lead Sampling - RWP-WL-19-0013-00

Pilot Hole - RWP-WL-19-0009_R00 – R12, RWP-WL-1901577, RWP-WL-1901665, RWP- WL-1901611 and RWP-WL-1901766
 RLWS Line Removal - RWP-RL-19-0020_R00 – R02
 RLWS Sampling - RWP-RL-19-0018_00
 Scabbling - RWP-RL-19-0012_R00 – R01
 Subgrade - RWP-RL-19-0004_R00 – R01

Radiological Trending Reports

CHPRC-190332 - FIRST QUARTER CALENDAR YEAR 2019 RADIOLOGICAL MONITORING TRENDING REPORT FOR THE 324 BUILDING
 CHPRC-1903483 - SECOND QUARTER CALENDAR YEAR 2019 RADIOLOGICAL MONITORING TRENDING REPORT FOR THE 324 BUILDING
 CHPRC-1903483.1 - SECOND QUARTER CALENDAR YEAR 2019 RADIOLOGICAL MONITORING TRENDING REPORT FOR THE 324 BUILDING
 CHPRC-1903483.2 - 324 Building Radiological Monitoring Trending Report 3rd Quarter CY2019
 324 Building Air Sample Trending Charts

Radiological Dose Information

324 Building REC Airlock Entry Individual Dose Trending
 324 Sanitized Dose Information - YTD

Beryllium (Be) Sampling and Monitoring

Be area air haz access 1-1-17 to 9-30-17
 Be area air haz access 3-1-19 to 11-30-19
 Be area air haz access 9-1-18 to 2-28-19
 Be area air haz access 10-1-17 to 8-31-18
 Be Bulk results 3-1-19 to 11-30-19
 Be Bulk results 9-1-18 to 2-28-19
 Be Bulk results 10-1-17 to 8-31-18
 Be personal air haz assess 1-1-17 to 9-30-17
 Be personal air haz assess 3-1-19 to 11-30-19
 Be personal air haz assess 9-1-18 to 2-28-19
 Be personal air haz assess 10-1-17 to 8-31-18
 Be Wipe Haz Assess 1-1-17 to 9-30-17
 Be Wipe Haz Assess 3-1-19 to 11-30-19
 Be Wipe Haz Assess 9-1-18 to 2-28-19
 Be Wipe Haz Assess 10-1-17 to 8-31-18
 Summary of Be sampling data for BHAs

Contracts

Apollo NO: 64186
 Ojeda NO: 65723
 Watts NO: 60312

Corrective Actions

324 Actions (excel spreadsheet) Operations Recovery Plan
 CR-2019-0181 Worker wore respirator issued to another worker

CR-2019-0773 Posted Doffing Instructions Not Followed
 CR-2019-1510 Personnel Skin Contamination
 CR-2019-1860 (O-01) Opportunity to utilize HRB process was not seized for higher risk decontamination efforts in Room 18.
 CR-2019-1879 OFIs Identified During Management Observation
 CR-2019-2460 Modesty garment contamination found on a worker exiting the 324 Building Contamination Area
 CR-2019-2808 Worker removed PAPP hood while inside an area posted for silica
 CR-2019-2886 Project has self-imposed pressure Corrective Action Development
 CR-2019-2889 Improve Building 324 hazards appreciation and recognition communications
 CR-2019-2836 What-If analysis on the casing removal and grouting activity
 CR-2019-2887 R2A2s should be updated and refined
 CR-2019-2983 Infuse additional, experienced resources from CHPRC with high-hazard nuclear operations experience
 CR-2019-2894 Roles and responsibilities of management mentor/coach
 CR-2019-2890 Re-invigorate the Building 324 EZAC
 CR-2019-2834 324 specific performance assurance SMART metrics
 CR-2019-2833 Independent Review of 324 Project Radiological Protection Program
 CR-2019-2835 Effectiveness of the project's work planning and approval process
 CR-2019-2891 Evaluate effectiveness of the micropile process and associated controls

Stop Work Corrective Actions

CR-2019-0173 Stop work on the use of REC auxiliary hooks
 CR-2019-0658 Suspect Sr-90 Contamination detected during whole body survey at 324 Facility, Stop Work issued
 CR-2019-1288 Stop Work Called on Zepher Monitoring during 324 Airlock entries due to poor communication
 CR-2019-1822 Evaluation of Naming Conventions on 324 RWP
 CR-2019-1836 A small tear was discovered in a 3M TR600 Versaflo PAPP unit hose.
 CR-2019-2144 Incorrect storage of 3M Versaflo hose at ERDF
 CR-2019-2153 ERDF management issued a stop work on washouts of ZP-1 cans pending a review of the work process.
 CR-2019-2905 324 - Airlock: Facial Contamination and Modesty Clothing Contamination

Training

PRC-SRP-00113 Rev.01 - 324 Building Disposition Project Site Health and Safety Plan (HASP)
 324016 324 BLDG FACILITY SPECIFIC RADIOLOGICAL CONTROL OJT PROGRAM
 DESCRIPTION
 324026 Airlock Entry Training Course Description Report
 324026 Airlock Training Activity Sheet
 Course 324026 Airlock Entry Rev 03 - PowerPoint
 Hot Cell Operations Training Manual - FINAL 8.21.19
 Training Plan Sample (Nicole Markle)
 300 Area Templates – 324 Ops
 300 Area Templates

Qualification Cards

CHPRC Training 300 Area Hot Cell Operations Course 324072, Revision 4
 CHPRC Training 300 Area Hot Cell Doors and Waste Operations Course 324073, Revision 3
 CHPRC Training 300 Area Waste Operations Course 324074, Revision 2

CHPRC Training 324 Building Operations Supervisor Course 324091, Revision 3
 CHPRC Training 324 Soil Remediation Operations Supervisor Course 324092, Revision 3
 CHPRC Training 324 Hot Cell Operations Supervisor Course 324093, Revision 2

324 Doffing – Donning

Airlock

Airlock Doffing Guide Rev.09
 Airlock Donning Checklist Rev.11

Room 18

Room 18 Doffing Guide Rev.05
 Room 18 Donning Checklist Rev.06
 Decontamination Training Rev.01
 DON/DOFF Training Rev.01

Critique Reports

CRT-324-2020-0002 Skin and modesty clothing contamination

Independent Assessment Report

324-2020-IA-25211 - *Building 324 Operations Review Independent Assessment Report*

MOPS

324-2019-MOP-22357 Pre-Job Briefing
 324-2019-MOP-22362 Pipe Cutting Tool Operation
 324-2019-MOP-22359 Go/No-Go Gauge Installation
 324-2019-MOP-22361 REA T/S Penetration Inspection
 324-2019-MOP-22363 Core Drilling A-Cell Shield Wall Pre-Job
 324-2019-MOP-22364 REA Thru Support Grouting Pre-job
 324-2019-MOP-22377 SSW for SLO Room Shield Door Removal
 324-2019-MOP-22518 SSW Coverage of 324 SLO Shield Door Removal
 324-2019-MOP-22637 SOP Operations
 324-2019-MOP-22950 324-PRO-OP-54055 (3I-SOP-REC-A-05) Airlock Entry
 324-2019-MOP-22804 324-PRO-OP-54055 (3I-SOP-REC-A-05) & 324 PRO-OP-54209 (3I-SOP-REC-A-06)
 324-2019-MOP-22848 Airlock Entry and Posting/Boundary Control
 324-2019-MOP-22891 REA Install
 324-2019-MOP-22838 Nicholson Dressing Practice
 324-2019-MOP-22948 Dump Ramp Operations
 324-2019-MOP-23043 324-PRO-OP-54055 (3I-SOP-REC-A-05) Airlock Entry
 324-2019-MOP-23138 324-PRO-OP-54055 (3I-SOP-REC-A-05) Airlock Entry
 324-2019-MOP-23099 324 Air Lock Don/Doff Training
 324-2019-MOP-23219 Pre-job Briefing
 324-2019-MOP-23220 A-Cell Crane door repair
 324-2019-MOP-23256 Core Drilling Pre-Job
 324-2019-MOP-23384 SSW coverage of Rm 18 Pilot Holes
 324-2019-MOP-23310 Dress/Undress PPE
 324-2019-MOP-23395 Posting and Labeling
 324-2019-MOP-23333 Pre-job Briefing
 324-2019-MOP-23392 SSW Coverage of Pilot Hole Drilling
 324-2019-MOP-23399 324 BDP Pilot Holes
 324-2019-MOP-23439 Room 18 Egress

324-2019-MOP-23702 Survey Activities and Temporary Posting
 324-2019-MOP-23724 Micropile Drill Setup
 324-2019-MOP-23752 Performance of pre-job and post-job meetings
 324-2019-MOP-23762 Geo Probe Removal
 324-2019-MOP-23763 Airlock/C-Cell entry
 324-2019-MOP-23764 SOP activities
 324-2019-MOP-23806 Pilot Hole Drilling
 324-2019-MOP-23841 Micropile Drilling Operations
 324-2019-MOP-23844 Partial entry/Contamination Control
 324-2019-MOP-23839 Concrete Wall Scarification
 324-2019-MOP-23840 Pre Job Brief for Pilot Holes
 324-2019-MOP-23843 Pilot Hole Drilling
 324-2019-MOP-23880 Worker Don/Doff at Rm 19 Step Off Pad
 324-2019-MOP-23876 SOP Clearance Surveys
 324-2019-MOP-23896 Airlock Entry and C-Cell Internal Sealing
 324-2019-MOP-23915 3O-19-01270 Concrete Wall Scarification
 324-2019-MOP-23972 Personnel Exit through SOP
 324-2019-MOP-23842 SOP egress
 324-2019-MOP-24013 PPE Doffing
 324-2019-MOP-24014 Scabbling Activities
 324-2019-MOP-23807 PPE Change Room
 324-2019-MOP-23834 Pilot Hole Drilling
 324-2019-MOP-24010 PCM Alarm Response
 324-2019-MOP-24015 Operations Drill
 324-2019-MOP-24016 Operations Drill
 324-2019-MOP-24108 Advanced PPE Donn/Doff for Room-18 work activities
 324-2019-MOP-24189 Egress from room 18 HCA/ARA
 324-2019-MOP-24230 Don/Doff PPE, Step Off Pad Checklist.
 324-2019-MOP-24237 NE TSA Go/No Go Measurement
 324-2019-MOP-24538 Room 18 Donn/Doff
 324-2019-MOP-24539 Room 18 Work
 324-2019-MOP-24763 Clearance of PAPR Units
 324-2019-MOP-24758 324 Airlock & Room 18 Entry, Radiological Boundary Control
 324-2019-MOP-24759 324 Room 18 Entry
 324-2019-MOP-25018 Doffing Practices Exiting from Building 324
 324-2019-MOP-25131 Room 18 Work
 324-2019-MOP-25155 Remove waste box from Airlock and associated activities

Senior Supervisory Watch (SSW)

CHPRC-1800670.6 – River Risk Management Project Senior Supervisory Watch
 SSW Field Logbook

Work Site Assessments

324-2019-WSA-23315 Radiological Posting Compliance
 324-2019-WSA-22174 Zone I & II Exhaust Ventilation System
 324-2019-WSA-23601 RCT Training
 324-2019-WSA-23748 Radiological Posting and Boundaries
 324-2019-WSA-24159 Comparison of Entry Requirements Room 18 vs. the Airlock
 324-2019-WSA-22237 324 Hot Cell Radiation and Contamination Surveys

324-2020-WSA-25035 Technical Response Team (TRT) review
 324-2020-IA-25211 Building 324 Operations Review Independent Assessment (Jacobs corporate assessment number NU-MASS-0115)
 SHS&Q-2019-WSA-22707 324 RBA entry/exit areas
 SHS&Q-2019-WSA-23288 Radiological Survey Report (RSR) Review
 SHS&Q-2019-WSA-23033 Sealed Radioactive Mylar Sources Integrity Test Frequency Evaluation
 SHS&Q-2019-WSA-23431 Radiological Work Planning
 SHS&Q-2019-WSA-22969 10 CFR 835 Subpart E, Monitoring of Individuals and Areas
 SHS&Q--2019-WSA-22970 10 CFR 835 Subpart L, Radioactive Contamination Control
 SHS&Q-2019-WSA-23930 CHPRC Radiological Posting
 SHS&Q-2019-WSA-22971 10 CFR 835 Subpart M, Sealed Radioactive Source Control
 SHS&Q-2019-WSA-24187 Implementation of Controls for "Low Hazard with Specific Controls" Radiological Work
 SHS&Q-2019-WSA-24259 Implementation of the ALARA Program
 SHS&Q-2019-WSA-22972 10 CFR 835 Subpart H, Records
 SHS&Q-2019-WSA-19188 (CHPRC) 10 CFR 835 Occupational Radiation Protection, Subpart G, Posting and Labeling
 SHS&Q-2019-WSA-21499 (CHPRC) 10 CFR 835 Occupational Radiation Protection, Subpart K, Design and Control
 SHS&Q-2019-WSA-21498 (CHPRC) 10 CFR 835 Occupational Radiation Protection, Subparts I & N, Reports to Individuals and Emergency Exposure Situations
 SHS&Q-2019-WSA-21497 (CHPRC) 10 CFR 835 Occupational Radiation Protection, Subpart C, Standards for Internal and External Exposure
 SHS&Q-2019-WSA-21636 Potential exposure of personnel to ionizing radiation is monitored and measured as required by 10 CFR 835.

DOE-RL Operational Awareness Reports

Summary of U. S. Department of Energy Richland Operations Office Operational Awarenesses Performed at 324 Building
 OA 80538 Evaluation of activity three in surveillance guide for operating efficiencies affecting safety
 OA 80577 Review of MA on Physical Changes to safety SSCs
 OA 80702 Pre-job brief for A-Cell Crane Door Hoist Wire Rope Replacement, Task 4: A-cell Crane Door Hoist Wire Rope Installation
 OA 80883 Quarterly operations meeting
 OA 81135 Oversight of airlock entry
 RL-ASMT-2019-0548 Radiological Work Practices
 RL-ASMT-2019-0569 324 Bldg Vital Safety System Review
 RL-ASMT-2019-0696 Oversight of contactor self-assessment at building 324
 RL-ASMT-2019-0701 CONOPS – Timely Instructions / Orders, OOD-CL-54
 RL-ASMT-2019-0709 Building 324 Facility Maintenance
 RL-ASMT-2019-0718 CONOPS – Building 324 component labeling, OOD-CL-51
 RL-ASMT-2019-0719 CONOPS – Building 324 operator aids, OOD-CL-57
 RL-ASMT-2019-0724 Building 324 structural stabilization activities
 RL-ASMT-2019-0725 Building 324 modification / equipment Installation
 RL-ASMT-2019-0726 Building 324 mock-up activities
 RL-ASMT-2019-0834 90% Structural Design Review 300-296
 RL-ASMT-2019-1100 Event at building 324 – closed loop roll-on/roll-off (RO/RO) containers in the 300 area container transfer area (CTA)

RL-ASMT-2019-1214 Walk through of room 147
 RL-ASMT-2019-1312 Pilot Hole Drill Rig Dust Collector Ring demonstration
 RL-ASMT-2019-1375 Hazard Review Board for changes to 3O-17-06238, 324 BDP: Pilot Holes
 RL-ASMT-2019-1437 ORPS Reportable Event - Group 2 Subgroup A (7) L –Exposure to Acrylamide > Occupational Exposure Limit (OEL)
 RL-ASMT-2019-1470 Pre-job brief for Pilot Hole Drilling in accordance with 3O-17-06238, 324 BDP: Pilot Holes
 RL-ASMT-2019-1579 324 Readiness Review Board - Nuclear Safety
 RL-ASMT-2019-1635 Pre-Job Brief and Performance of 3I-19-02140, Annual Stack Flow
 RL-ASMT-2019-1680 Readiness Review Board, Affidavit 6.2 (FY19 IEP #11164)
 RL-ASMT-2019-1812 Pre-job brief for performance of work in accordance with 3O-17-06238, 324 BDP: Pilot Holes
 RL-ASMT-2019-1825 Pre-job brief for drilling accomplished IAW 3O-17-06238, 324 BDP: Pilot Holes
 RL-ASMT-2019-2281 WP&C - Perform: 3O-18-05152, 324 BDP: Camera and Lighting Support System Installation
 RL-ASMT-2019-2283 324 Unprotected Overexposure
 RL-ASMT-2019-2300 324 In Progress ALARA Review Low Level Modesty Clothing Contamination
 RL-ASMT-2019-2408 Event and follow-up / oversight at building 324 - Used prefilter unintentionally contacted during work in Radiochemical Engineering Complex (REC) airlock and C-cell
 RL-ASMT-2019-2464 Work Boot Contamination at 324, In Progress ALARA Review
 RL-ASMT-2019-2632 Decontamination activities in Room 18 related to pilot hole drilling performed under work instructions for interference removal
 RL-ASMT-2019-2705 324 Personal Contamination Critique and Information Gathering
 RL-ASMT-2019-2797 Affidavit 14.1 Operations (FY19 IEP #11164)
 RL-ASMT-2019-2829 324 Personal Contamination Common Cause Evaluation
 RL-ASMT-2019-3035 HRB for 3O-17-06238, 324 BDP; Pilot Holes
 RL-ASMT-2019-3078 324 training for donning/doffing and decontamination techniques
 RL-ASMT-2019-3089 Oversight of CHPRC self-assessment of 10 CFR 835, Subpart M at 324
 RL-ASMT-2019-3102 Building 324, room 18 doffing and decontamination demonstrations
 RL-ASMT-2019-3130 324 Mockup Facility and 324 Building Tour
 RL-ASMT-2019-3131 324 Remote Soil Excavation Operations Readiness Review Board Meeting (FY19 IEP #11164)
 RL-ASMT-2019-3716 Special packaging authorization (SPA) shipment from building 324 to the Environmental Restoration Disposal Facility (ERDF) on August 16 – electronic dosimeter (ED) alarm occurred during transportation preparation activities.
 RL-ASMT-2019-3740 Floor Saw and WDS Installation Performance Demo
 RL-ASMT-2019-3775 324 In Progress ALARA Review, CAM Alarm
 RL-ASMT-2019-3894 324 Personal Contamination In-Progress ALARA Review
 RL-ASMT-2019-3902 IPAR for personnel contamination during egress following drilling activities in room-18
 RL-ASMT-2019-4113 Airlock Entry for A/D Crane Radiological Surveys 09.10.2019
 RL-ASMT-2019-4182 324 room 18 Don/Doff training demonstration
 RL-ASMT-2019-4224 Pre-Job Brief and perform 3I-19-05310, Annual 30/5 Ton Crane Inspection
 RL-ASMT-2019-4379 Emergency Light and Exit sign Inspection 09.24.2019
 RL-ASMT-2019-4387 Walk-down of 324 emergency exit routes 09.23.2019

RL-ASMT-2019-4389 WP&C - Feedback and improvement: Review of Acrylamide use in work package 3O-18-04649, 324 BDP -PIT 6 Soil Stabilization Demonstration and Verification Testing

RL-ASMT-2019-4465 Modesty Clothing Contamination Events at 324 Building

RL-ASMT-2019-4485 Pre-Job Brief and perform 3O-19-00514, 324 BDP: North Shoring Installation (09.27.2019)

RL-ASMT-2019-4535 RCT briefing on new contamination controls for "hot beta" particles at Bldg. 324

DOE-ASMT-2020-0813 Contamination controls at 324

DOE-ASMT-2020-0853 Contamination controls at Bldg. 324

DOE-ASMT-2020-0891 Sub-contractor open house for 324 grouting of micropiles

DOE-ASMT-2020-0892 Contamination Controls Building 324

DOE-ASMT-2020-0916 Review of Hanford Fire Marshal Permits

DOE-ASMT-2020-0929 324 Contamination control work practices

DOE-ASMT-2020-0941 Beta Radiation Exposure Controls at 324 Building

DOE-ASMT-2020-0945 Perform 3O-19-00514, 324 BDP: North Shoring Installation (10.02.2019)

DOE-ASMT-2020-0995 Building 324 radiological controls

DOE-ASMT-2020-1014 324 RLWS Pipe Removal High Risk Review Board

DOE-ASMT-2020-1038 Pre-job brief for and drilling per 3O-17-06238, 324 BDP: Pilot Holes 10.09.2019

DOE-ASMT-2020-1039 Pre-job brief for drilling per 3O-17-06238, 324 BDP: Pilot Holes 10.15.2019

DOE-ASMT-2020-1060 Pre-job brief for and drilling per 3O-17-06238, 324 BDP: Pilot Holes (10.16.2019)

DOE-ASMT-2020-1134 Radiological control routine survey WL-W003 performed on backshift

DOE-ASMT-2020-1167 324 Apparent Cause Evaluation for Modesty Clothing Contamination Sept 25, 2019

DOE-ASMT-2020-1265 In-Progress ALARA Review for higher than expected dose to a worker

DOE-ASMT-2020-1316 In-Progress ALARA Review (IPAR) Dosimetry Results/Alarm

DOE-ASMT-2020-1471 Contamination controls at building 324

DOE-ASMT-2020-1575 Oversight of path forward discussions following personnel contamination on November 14

Lessons Learned

Summary of Table 1. Examples of Hanford Site Lessons Learned Applicable to 324 Building
1998-RL-HNF-0022 July 1998 Reducing Contamination Events during Facility Deactivation B Plant Canyon HCA

2016-RL-HNF-0010 PFP June 2016 Rad Planning - Defense in Depth Needed

RCCC-2016-0001 - Low Risk Does Not Mean No Risk - Fixative Application in 324 Building June 2105

WRPS-IB-18-006_2 June 2018 Differing Levels of Worker Experience and Handling Highly Contaminated Materials - 219- S B Cell

Energy Northwest - Doffing-Donning Training Information

On the Job Training (OJT) guide - Donning and removing bubble hoods

On the Job Training - Don and Remove Powered Air Purifying Respirator (PAPR)

On the Job Training – Under Vessel Job Coverage for Control Rod Drive (CRD) Change Out Procedure HPI-8.7 Bubble Hood Donning and Removal

Procedure GEN-RPP-10 – Use of Respiratory Protection Equipment

Procedure HPI-8.8 Supplied-Air Suit Donning and Removal
Dynamic Learning Activity (DLA's) Template

Los Alamos National Laboratory

LA-13438-PR Progress Report – Technology Development, Evaluation, and Application (TDEA)
FY 1997 Progress Report – Environment, Safety, and Health (ESH) Division

PFP Documents

CR-2018-0022 – Spread of Contamination Outside of the Posted Area Results in Stop Work
and Safety Pause (Plutonium Finishing Plant Root Cause Evaluation and Corrective Action
Status)

CHPRC-03688 - Extent of Condition Review for CR-2018-0022

PNL Documents

PNL-D-356 – Fixation of Residual Contamination in Room 18 of the 324 Building

PNL-D-430 – Approval to Paint Over Radioactive Contamination in Room 18, 324 Building

PNL--8361 – Pacific Northwest Laboratory ALARA Report for CY 1991 – 324 Bld skin
contamination

PNL-8849 - Pacific Northwest Laboratory ALARA Report for CY 1992 – 324 Bld skin
contamination

PNL-9445 - Pacific Northwest Laboratory ALARA Report for CY 1993 – 324 Bld skin
contamination

PNL-10715 - Pacific Northwest Laboratory ALARA Report for CY 1994 – 324 Bld skin
contamination

Tank Farms Documents

RPP-RPT-58658, Rev. 0 – Tank 241-C-111 Mid-Hose Failure Mechanism Report

West Valley

West Valley Demonstration Project (WVDP) Responses on Open Air Demolition Vulnerability

Washington Closure Hanford Documents

14-AMRP-0286 Tri-Party Agreement Milestone M-089-06-TO1 – 30% Design Submission

WCH-481 Rev. 0 TRIZ Innovation Process Report for Hanford 324 Building B-Cell Soil
Contamination Project

WCH-503 Rev. 0 Remediation Alternatives Evaluation for Contaminated Soil beneath the 324
Building

WCH Memo from D.A. Elkins to Dan Thompson dated April 25, 2013 Memo No. CCN 170560

PPE

Summary of PPE Changes since 2017 in Rm 18 and Airlock

324 Presentations / Videos

191121_AL_Rm18_Recover_IN – PowerPoint

Room 18 Pilot Hole Installation – PowerPoint

324 Airlock Exit Video 11/14/19

Safety Issues and Ideas Log Book

SII 2019-300-001 – SII 2019-300-025

Technical Baseline Documents

CHPRC-03066-01, *PROJECT EXECUTION PLAN for 300-296 REMOTE SOIL EXCAVATION PROJECT*

PRC-SRP-00002-00, *300-296 Soil Remediation Project Operations Assessment for Soil Retrieval*

PRC-SRP-00003-00, *Design Review Report for Transition of 300-296 Waste Site Remediation Project*

PRC-SRP-00009-00, *300-296 Soil Remediation Project Radiation Material Evaluation*

PRC-SRP-00030-03, *OPERATIONS PLAN (300-296 Remote Soil Excavation Project)*

PRC-SRP-00113-01, *324 Building Disposition Project Site Health & Safety Plan (HASP)*

PRC-SRP-00130-00, *End State Criteria for Meeting TPA Milestone M-016-85A and Gaining Backfill Concurrence Authorization*

PRC-SRP-00135-00, *300-296 Remote Soil Excavation Project Mockup Operations Plan*

PRC-SRP-00141-00, *300-296 Remote Soil Excavation Project - Impacts of Extending Remote Soil Excavation to 15-ft. beneath 324 Building B-Cell Foundations*

PRC-SRP-00147-00, *Estimate of the Number of B-Cell Filter Replacements during Soil Excavation - 300-296 Remote Soil Excavation Project*

PRC-SRP-00154, *ALARA Design Review*

PRC-SRP-00165, *Functional Design Criteria for the 324 Building Disposition Project*

PRC-SRP-00169-00, *2018 Alternative Analysis for Packaging Radiologically Contaminated Soil Excavated from Beneath the 324 Building B-Cell*

PRC-SRP-00180-01, *324 BUILDING DISPOSITION PROJECT - REMOTE OPERATIONS TRAINING AND PROFICIENCY PLAN*

PRC-SRP-00184-00, *324 Building Disposition Project Waste Management Plan*

PRC-SRP-00184-01, *324 Building Disposition Project Waste Management Plan*

PRC-SRP-00185-01, *324 Building Disposition Project Engineering Plan*

PRC-SRP-CN-C-00032-01, *300-296 REMOTE SOIL EXCAVATION PROJECT 324 BUILDING REC A, C, D, CELL FLOOR LOADING CALCULATION*

PRC-SRP-CN-O-00108-00, *300-296 SOIL REMOVAL PROJECT, TOTAL ALPHA-EMITTING RADIONUCLIDE CONCENTRATION VS. ELEVATION*

PRC-SRP-CN-O-00112-00, *300-296 Soil Removal Project End State Criteria Recommendations*

PRC-SRP-00214 Rev.0 EDG#: EGR-19-001778, *What-If Analysis of Building 324 Micropile Grouting*

CALC_0300X-CA-N0140_002_DE *Characterization of Soil under B Cell*

H-3-317735 S1 R2 *MACHINE WASTE BIN WELDMENT AND DETAILS*

H-3-317735 S2 R1 *MACHINE WASTE BIN WELDMENT AND DETAILS*

Technical Evaluations

2018-324-02 Rev 00 *Airlock.C-Cell Entry Alpha Survey Requirements*

2018-324-02 Rev 01 *324 Project Alpha Survey Requirements*

2019-324-02, *324 Project Strontium - 90 Survey Requirements*

2019-324-02, R1, *324 Project Strontium - 90 Survey Requirements*

TE-WL-17-001-00, *324 Building Radiological Control Technical Evaluation (initial), Revision 0 through 5.*

TE-WL-18-001-01

Other 324 Documents

324 Building Air Flow Study Report May 2017

324 Operations Recovery Plan Schedule

324 Contamination Record
RRMP Project Org Chart 10-30-2019
324 Interview Results / Summary
324 Building Remote Soil Excavation Hazard Analysis dated April 2018, Doc. No. PRC-SRP-00077
300-296 FY20 Risk Register
Commonality Report – Personnel Skin and Clothing Events @ 324 Facility
324 Facility Management Evaluation Focus Areas 11-15-19
Company ALARA Meeting Q1/Q2 CY2019
Airlock/C-Cell Access Plan Rev. 07
NCO Log Book 9-19-19 to 12-13-19

DOE/RL-96-73 Rev. 4 - 324 Building Dangerous Waste Management Units Closure Plan
DOE-RL-2014-13-ADD1 Rev. 1 – Remedial Design Report/Remedial Action Work Plan for 300-FF-2 Soils

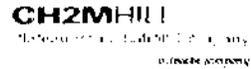
Fluor Daniel Memo from W.D. Adair, FDH to J.E. Rasmussen, RL dated May 27, 1997
Correspondence No. FDH-9751880.1

Numerical Modeling of Sr-90 and Cs-137 Transport from a Spill in the B-Cell of the 324 Building, Hanford Site 300 Area dated March 2012, Doc. No. PNNL-21214

Radiological Dose Consequence Comparison of 324 Building Waste Spill Accidents for B-Cell and for Soil below B-Cell dated December 2016, Doc. No. PRC-SRP-CN-N-00041

Three-Dimensional Groundwater Models of the 300 Area at the Hanford Site, Washington State dated September 2008, Doc. No. PNNL-17708

10.7 Attachment 7: Analysis Team Charter



INTEROFFICE MEMORANDUM

CHPRC-324-19-001

Date: December 10, 2019

To: (b)(6)
W&FM³ Performance Assurance

From: (b)(6) *2/10/19*
324 Resumption Team

Subject: TEAM CHARTER FOR CAUSAL ANALYSIS FOR 324 PERSONNEL CONTAMINATION EVENTS RESUMPTION PLAN

You are hereby assigned to lead a root cause analysis associated with the collective personnel contamination events occurring at the 324 Facility between October 2018 and November 2019. The collective events resulted in a management declared Stop Work of radiological activities beyond those necessary for minimum safe operations. Your analysis should take into consideration factors influencing the events and underlying causes that have prevented completed actions from effectively resolving the issues.

The following individuals have been assigned, or will provide resources, to assist you in the performance of this investigation and causal analysis:

Resumption Team Members

(b)(6)

324 Facility Support

(b)(6)