UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
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ATLANTA, GEORGIA 30303-1257

September 7, 2017

EN52840

Mr. B. Joel Burch
Vice President and General Manager
BWX Technologies
Nuclear Operations Group, Inc.
P.O. Box 785
Lynchburg, VA 24505-0785

SUBJECT: BWXT NUCLEAR OPERATIONS GROUP - NUCLEAR REGULATORY COMMISSION SPECIAL INSPECTION REPORT NUMBER 70-27/2017-007

Dear Mr. Burch:

This report documents the results of the Nuclear Regulatory Commission (NRC) special inspection (SI) conducted from July 6 - 14, 2017, at your facility in Lynchburg, Virginia. The purpose of the inspection was to inspect and assess the facts and circumstances surrounding the accumulation of uranium in desiccant vessels in the Research and Test Reactor (RTR) area. This event was reported to the NRC Operations Center on July 4, 2017 (Event Notice 52840), in accordance with the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 70, Appendix A, (a)(4) – An event or condition such that no items relied on for safety, as documented in the Integrated Safety Analysis summary, remain available and reliable, in an accident sequence evaluated in the Integrated Safety Analysis (ISA), to perform their function.

Based on preliminary information provided by the licensee in the Event Notice (EN), the NRC determined that a SI was the appropriate level of regulatory response to obtain additional information to fully assess the significance of the event (see Enclosure 2). The SI objectives were to (1) review the facts surrounding the accumulation in the desiccant vessels, (2) assess the licensee's response to the event, and (3) evaluate the licensee's immediate and planned long-term corrective actions to prevent recurrence. The SI consisted of facility walk-downs of several areas within the facility; multiple interviews with operators, area front line management, nuclear criticality safety (NCS) staff, and facility management; and selective document review including procedures and NCS analyses. The enclosed report documents the results of the SI. The inspection results were discussed with you and other members of your staff at an exit meeting held on August 30, 2017.

Based on the results of this inspection, the NRC identified three unresolved items associated with the event. The first item involved the long term correction actions stated in the final root cause report that the NRC will have to inspect to determine compliance with 11.6 of the license application. The second item involves the potential lack of process safety information for the

glovebox line involved in the event that is needed in order to conduct and maintain the ISA as required by 10 CFR 70.62(b). The final item involved the NRC's review of the risk of a criticality according to the licensee's integrated safety assessment methodology.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice and Procedure," a copy of this letter, its enclosures, and your response, will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal privacy, proprietary, or classified information so that it can be made available to the Public without redaction.

If you have questions, please call Eric C. Michel, Chief, Projects Branch 2 at (404) 997-4555.

Sincerely,

/RA/

Mark S. Lesser, Director
Division of Fuel Facility Inspection

Docket No. 70-27
License No. SNM-42

Enclosures:
1. Inspection Report 70-27/2017-007
2. Special Inspection Charter

cc:
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SUBJECT: BWXT NUCLEAR OPERATIONS GROUP - NUCLEAR REGULATORY COMMISSION SPECIAL INSPECTION REPORT NUMBER 70-27/2017-007

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U.S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.:	70-27
License No.:	SNM-42
Report No.:	70-27/2017-007
Licensee:	BWXT Nuclear Operations Group, Inc. (BWXT)
Location:	Lynchburg, VA
Inspection Dates:	July 6-14, 2017
Inspector:	Manuel Crespo, Senior Fuel Facility Inspector Timothy Sippel, Fuel Facility Inspector
Approved by:	Mark Lesser, Director Division of Fuel Facility Inspection

Enclosure 1

EXECUTIVE SUMMARY

BWXT NUCLEAR OPERATIONS GROUP
NRC INSPECTION REPORT 70-27/2017-007

BWXT Nuclear Operations Group (BWXT) is authorized to receive, possess, use, store, and ship special nuclear material pursuant to Title 10 of the Code of Federal Regulations (10 CFR) Part 70. The primary activity on the BWXT site is the production of fuel material containing highly enriched uranium (HEU) for naval reactors. In addition, BWXT has other operations including the production of uranium fuel for research reactors in the area of the plant known as Research and Test Reactors (RTR).

On July 4, 2017, during the licensee's summer maintenance shutdown, the licensee was performing maintenance work on the glovebox air purification system of the uranium aluminum (UAl_X) powder production line in RTR. During the removal of the two desiccant vessels attached to the air purification system, the licensee identified an accumulation of uranium bearing material within the vessels. After contacting nuclear criticality safety (NCS) to evaluate the situation, the licensee estimated that a potentially greater than critical mass of uranium-235 (^{235}U) may have accumulated within one of the vessels. The licensee subsequently declared an alert and made a one hour report to the NRC, per 10 CFR 70 Appendix A, due to having no controls, as documented in the integrated safety analysis (ISA), for the accumulation of material within the desiccant vessels.

The NRC evaluated the event and charted a special inspection (SI) to assess the facts and circumstances surrounding the event.

Assessment of the licensee's initial evaluations of how this system was treated in the ISA and relevant criticality safety analysis.

The licensee's ISA and relevant NCS evaluations did not consider the desiccant vessels in their analysis and were inconsistent in the application of ventilation controls on the purification system.

Assessment of any controls and/or process conditions were in place that could have provided barriers to prevent a criticality.

The licensee's purification system lacked geometry controls and barriers. The system did have controls and barriers in place for moderation and mass; however, the mass controls lacked sufficient management measures to ensure reliability and degraded such that mass accumulated in the desiccant vessels.

Assessment of any implication the event may have with regard to the facility's material control and accountability (MC&A) program.

The licensee was properly implementing the MC&A program such that there were no implications with regard to accumulation of material in the desiccant vessels.

Review and evaluation of the licensee's progress towards completion of the root cause analysis for adequacy of scope, depth, and identification of contributing causes.

The licensee has completed its root cause investigation, which was adequate in scope, depth, and the identification of contributing causes.

Review and evaluation of the licensee's immediate, short, and long term corrective actions, any safety culture implications, and restart criteria.

The licensee demonstrated conservative decision making in their immediate, short and long term corrective actions, including implementation of restart criteria. However, prior to the event, the licensee exhibited a tolerance for a lack of documentation for systems with potential safety implications. One unresolved item (URI) was identified to evaluate the adequacy of the licensee's long-term corrective actions.

Assessment of the adequacy of the licensee's measurement and modeling activities to evaluate the as-found conditions of the desiccant filters.

The licensee used conservative assumptions and techniques to arrive at the estimated maximum values for ^{235}U in the vessels and their corresponding reactivity coefficient (k_{eff}) value.

Review and evaluation of the licensee's extent of condition for adequacy of scope, depth, and identification of causal factors. Determination of if there are other systems where the licensee assumed no uranium accumulation or no uranium concentration.

The licensee implemented an extent of condition review with adequate scope and depth. The licensee's root cause analysis adequately identified the root causes of the event. The licensee and inspectors identified other systems and processes that were incorrectly assumed to contain no uranium. One URI was identified to evaluate the adequacy of process safety information for process systems.

Determination of the risk and safety significance of the event.

The actual safety significance of the event was low, however, the risk of a high consequence event was potentially significant due to the lack of designated controls. One URI was identified to assess the likelihood of criticality with respect to 10 CFR 70.61.

Attachment

Key Points of Contact
List of Items Opened, Closed, and Discussed
Inspection Procedures Used
Documents Reviewed

REPORT DETAILS

Summary of Plant Status

During the majority of this inspection period, BWXT was in a planned maintenance outage and therefore not producing uranium fuel. Operations in the majority of the plant were restarted in phases beginning on the morning of July 12. The facility produces uranium fuel for the research reactors in the area of the plant known as RTR. The majority of activities in the RTR are conducted in gloveboxes, where controls on limiting fissile and moderating material mass are implemented to prevent an inadvertent criticality. The RTR area was not restarted during the inspection period.

1. Develop a complete timeline and sequence of events related to the event, including the history of system configuration and nuclear criticality safety control.

Process Description of the UAl_X Glovebox Line and Desiccant System

In the RTR controlled area, the licensee operated the UAl_X glovebox line. This glovebox line took HEU alloy 'buttons' and crushed them into a powder that was used to make fuel. The key operation for the glovebox line occurred in the "crushing box" that housed a jaw crusher and a hammer mill which were used in series to pulverize the alloy buttons into a powder and then sieve the powder into the right particle size, an operation that mobilizes a lot of material within the box. The next step in the process occurred in the blend glovebox, in which the licensee blended the powder coming from the crushing box into the right mixture for the fuel they were making.

The glovebox line operated under an inert argon atmosphere that was maintained using the air purification system that housed the two desiccant vessels that unknowingly accumulated uranium. The purification system utilized a vacuum pump to maintain the glovebox line at a negative pressure for radiological control purposes. The purification system was connected the glovebox line through a network of 3/8" to 5" ducts. The purification system recirculated the atmosphere to remove any oxygen and water that may have leaked in. The vacuum pump exhausted glovebox atmosphere through an air gap to the building ventilation system when it was removing atmosphere from the glovebox line.

Filters were present on the inlets and outlets of the five inch purification lines leading to and from the purifier system. Two type of filters were used inside the glovebox line for the purification lines: a carburetor type and a nine inch HEPA type. These filters were collectively referred to as pre-filters by the licensee. The crushing and blend gloveboxes, in which the most dust is mobilized, had a nine inch HEPA filter on the inlet to the recirculation line. The crushing box had an extra six inch filter (the auxiliary filter) outside the glovebox on the purification line immediately after the nine inch HEPA.

A simplified drawing of the purification system taken from, Dri-Train Technical Manual, Model MO-120-2, is shown below in Figure 1. The purification system used two desiccant vessels (labeled Purifier A and Purifier B in Figure 1) that were filled with desiccant beads that could absorb water and oxygen. The desiccant vessels are filled with two different types of beads as shown in Figure 2, which was also taken from the vendor manual.

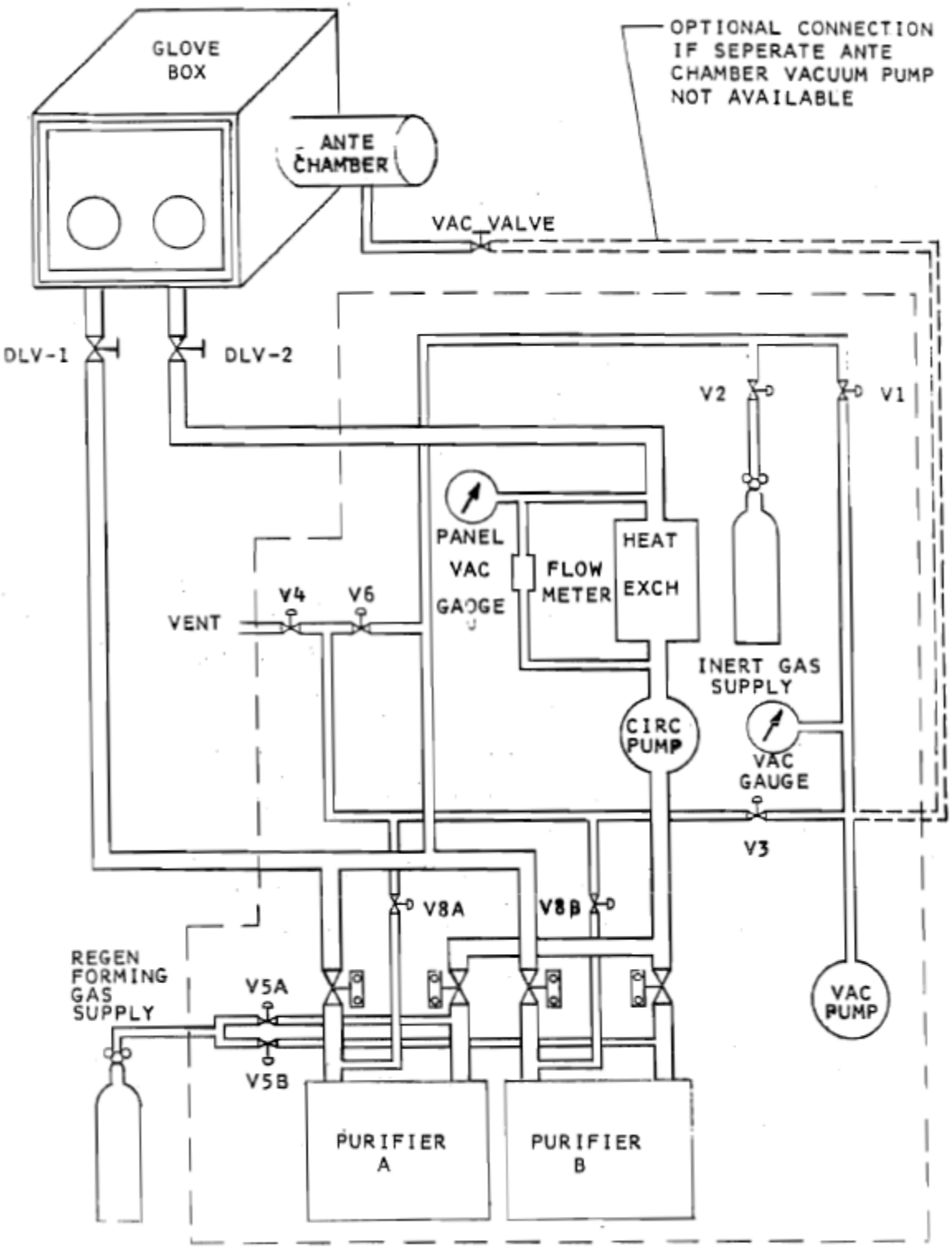

Figure 1: Conceptual Drawing of Purifier System

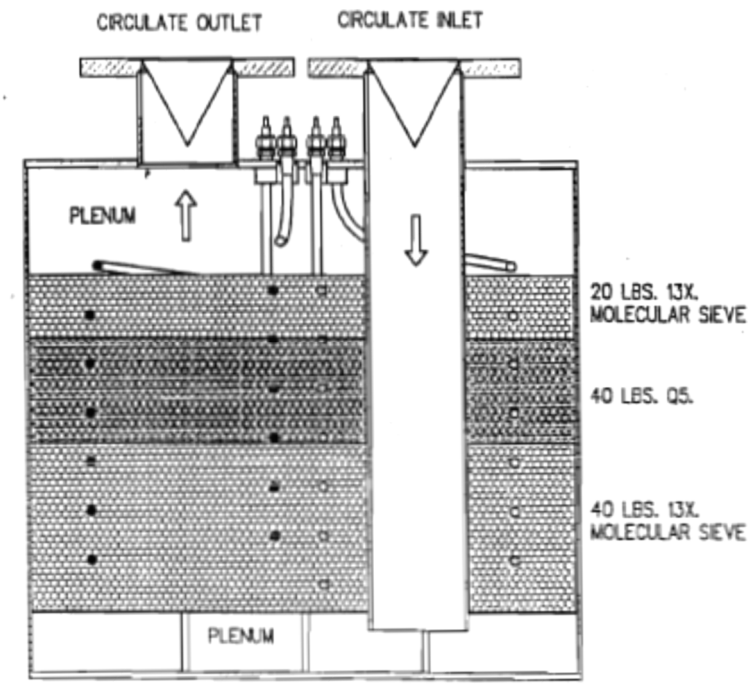

Figure 2: Purifier Vessel Desiccant Loading

Installation and first use of the UAl_X Glovebox Line

3/85	UAl_X glovebox system purchased. Only small carburetor type filters were used as pre-filters on purification piping connected to the desiccant vessels.
6/26–10/7/86	OP-0006506, “Crushing,” required the filters in the hammer mill glovebox to be changed for each new lot.
8/8/86	NCS-1986-065 established slab height, and tiered mass/moderator limits for the UAl_X glovebox line. The desiccant vessels were not considered.
1986 Event	After the first few lots were processed, a loss of powder (~500 grams ^{235}U) was noted and concerns were expressed of it accumulating in the attached purification systems. NCS was contacted and the operation shut down.
9/23/86	NCS issued NCS-1986-075 which considered “the possibility that the fuel is accumulating within ducts or within the gas purification system.”
10/15/86	NCS-1986-087 issued and established actions to remove accumulations in the purification system when cumulative losses approaches 600 grams ^{235}U. The system was cleaned up and the desiccant media replaced. New nine inch HEPA Filters were put into place for the crushing and blend gloveboxes. The auxiliary filter may have been added to the

crushing box at this time. The system was then returned to service. They checked for more accumulation for "6 months or so" then stopped checking once they found no accumulation.

Development of Current Safety Basis

8/31/98 Original issuance of Safety Analysis Report (SAR) 15.22, no controls were established for ventilation in RTR or the UAl_X purification system.

12/9/05 NCS-2005-272, written in response to an NRC violation, established mass limits on ductwork accumulations that had not been formally considered before. New generic ductwork accident sequences were established in the SAR Appendix, and existing filters and ductwork surveys were credited as an item relied on for safety (IROFS). The IROFS included the filters in the hammer mill glovebox, which NCS had considered a radiation protection control. NCS was not aware of the desiccant vessels. The nuclear material control (NMC) group was not aware of, and did not survey, the desiccant vessels.

1/25/07 NCS-2007-012 established the routine change out of the pre-filters in the glovebox as IROFS in response to general concerns NRC inspectors raised in 2006.

Relocation of the UAl_X Glovebox line

2/26/13 – 5/13/14 The HEU UAl_X glovebox line was moved from one location in RTR area to another. The change package noted that there were no piping and instrumentation drawings (P&IDs) of the glovebox line.

1/9/14 CA201400057 was issued after a contractor was contaminated during the move of the UAl_X glovebox line. The contractor was reconnecting a pressure sensing line that he believed was an argon supply line when material spilled out and contaminated him. The licensee noted that no P&IDs were available for the glovebox being reassembled. But no corrective actions were assigned to address why it was contaminated, to find out where the contamination came from, or to generate P&IDs.

Replacement of Desiccant Media Planned

6/27/16 Radiation Work Permit (RWP) 16-0043, "Repair/Replace leak on Hammer Mill, Dri-Train Media Replacement, crusher guarding & DP gauge installation" was approved by the radiation control supervisor.

7/16 During shutdown, maintenance work was performed under RWP 16-043 on the hammer mill to install a new seal on the drive shaft that penetrated the glovebox wall into an enclosure that housed the hammer mill motor. An accumulation of material was found in the motor enclosure. The shaft seal had been leaking because a ventilation line intended to cool the motor had been routed into the motor enclosure and was applying more negative pressure than the glovebox. No corrective action was written. No pre-filter was present between the enclosure and the ventilation line, it

was not shown on drawings, and NCS was unaware of its existence. The hammer mill maintenance took longer than anticipated and resulted in deferment of the desiccant replacement until the 2017 shutdown.

Westinghouse Scrubber Event Response

11/2/16 NCS-2016-128 was issued to document BWXT's ongoing efforts to respond to the Westinghouse scrubber event and NRC Information Notice 2016-13. They initially focused on wet scrubber systems and expanded to include dry system ventilation, but desiccant systems were not considered ventilation. However, the pre-filters were verified to be in place for the UAl_X system; and the maintenance/replacement procedure was strengthened by specifically identifying the filters as needing periodic replacement.

Preparation for the Desiccant Media Replacement

6/16/17 During the development of RWP 17-0045, Replace Dri-Train Media and DP gauge installation, the Material Balance Area (MBA) Custodian surveyed the desiccant vessels and received an elevated count rate. This reading was used to determine that the vessels were contaminated and must be treated as potentially fuel bearing.

July 4 Unfavorable Geometry Accumulation

0700 - 1000 RTR UAl_X glovebox line pre-job briefing with maintenance, who then began respirator work and removed the desiccant vessels.

1000 Maintenance removed the actuator valves and flanges from the top of the desiccant vessels.

1015 Maintenance noticed black and powdery substance and stopped work.

1020 The front line manager requested radiation control take extra smears of the suspect flanges.

1030 - 1045 Smear results reported at 270,000 counts per second at flanges. NCS notified. Maintenance personnel removed from the room to other areas inside the RTR controlled area.

1100 - 1530 Radiation control checked the operator's breathing zone air samplers, area air samplers, and floor smears. No spread of fuel was detected.

1130 Maintenance and operations managers speak with NCS engineer A about condition. NCS engineer B plans to go in with a NMC instrumentation expert to investigate.

1300 NMC's preliminary E600 count of desiccant vessels using five gallon standard indicates upwards of 280 grams ^{235}U in one vessel and about half that in the other.

1315 NCS realized safety concern. Instructed maintenance team to seal and separate the two vessels.

1440 - 1522 Following consultation with NCS and management, NCS and NMC took more measurements, and using the 55 gallon drum standard determine that up to 1200 grams ^{235}U may be in the hotter vessel.

1523 - 1533 Management informed of the potential for kilogram quantities. Decision made to activate the Emergency Operations Center (EOC) and perform a 1 hour NRC report.

1536 EOC activated for RTR Unfavorable Geometry Event.

1551 Security checkpoint into RTR secured to prevent entry and all work within 150 feet of the checkpoint was stopped.

1556 Alert declared.

1616 RTR cleared of employees.

1630 NRC 1 hour notification report submitted.

1636 NCS and NMC to take additional measurements with gamma spectroscopy type detector to more accurately calculate the mass accumulation. Entry approved by EOC.

1650 Vehicle traffic halted through checkpoint 6.

1702 All notifications complete.

1735 Individual access through checkpoint 8 to be approved by EOC.

1843 The initial results from ISOCS modeling were: 937 grams ^{235}U in Container 1, and 592 grams ^{235}U in Container 2.

1845 Extent of condition to look for and survey other desiccant systems began.

2206 Conservative NCS analysis of Container 1, could go critical under proper conditions. EOC decides no further entry permitted that night.

<u>July 5, 2017</u>

0645 - 1200 EOC approves various maintenance work within the 150 foot radius and entry into controlled areas to perform the extent of condition.

1445 Radiation control personnel entered RTR for more measurements.

1703 NCS calculations using updated mass estimates of 715 grams U-235 from more realistic ISOCS modeling showed $k_{eff} < 0.92$ when the desiccant beads are credited with displacing ~15% of vessel internal

volume. Spacing and moderator were being controlled. Additional NCS calculations show that even more mass could be tolerated if more displacement from desiccant beads were credited.

2045 Downgraded emergency status. Notifications completed.

2. <u>Assess the licensee's initial evaluations of how this system was treated in the ISA and relevant criticality safety analysis.</u>

a. <u>Inspection Scope</u>

The inspectors reviewed the documents that represented the licensee's ISA, SAR 15.22, and the SAR Appendix 15.22, which covered the RTR UAl_X glovebox line and the series of nuclear criticality safety evaluations (NCSEs) that are referenced in the SAR for that glovebox line. The inspectors noted that the license-identified controls for the potential accumulation of uranium inside the gloveboxes themselves. The inspectors also noted that the SAR and NCSEs had identified a generic set of criticality safety controls designed to protect against an accumulation of material inside ventilation ducts. The inspectors noted them to be generic due to the fact that no specific glovebox process lines were identified as part of the analysis, and the same analysis, and identified controls, were used in effectively all the other SARs except for the recovery area. The SAR credited four controls for general protection against accumulation of material in ventilation systems: (1) Annual duct surveys with respect to a three gram ^{235}U standard; (2) Pre-filter installed prior to entering ductwork where accumulation of dispersible uranium is a potential; (3) Operators periodically change out pre-filters; and (4) Area design that places ductwork above the floor and in areas that are not capable of full flooding.

The inspectors noted that the SARs and NCSEs were silent regarding the purification system tied into the UAl_X glovebox line. The inspectors noted that licensee staff were not consistent in whether the purification system was considered part of the ventilation system referenced in the SAR. The UAl_X glovebox line did possess pre-filters on the recirculation lines going to the purification system which were periodically changed out. However, the annual survey only scanned the ventilation ductwork connected to the three antechambers of the glovebox line (which did not contain pre-filters); the purification system was not scanned as part of the formal survey. In addition, the desiccant vessels were located at the floor level and therefore not placed above a potential flood point. The inspectors noted that the SAR and the NCSEs it references had not evaluated or considered the unfavorable geometry collection point that the desiccant vessels represented. This topic is discussed further below in charter item #3.

b. <u>Conclusion</u>

The licensee's ISA and relevant NCSEs did not consider the desiccant vessels in their analysis and were inconsistent in the application of ventilation controls on the purification system.

3. Assess if any controls and/or process conditions were in place that could have provided barriers to prevent a criticality.

a. Inspection Scope

The inspectors evaluated circumstances with regard to the accumulation of uranium in desiccant vessels in terms of potential barriers or controls with regard to geometry, moderation, and mass that prevented a criticality.

The inspectors noted that the purification system was composed of a series of pipes ranging from 3/8" to 5" in diameter that resided over the UAl_X glovebox line and led to a cabinet that housed the equipment and instrumentation for the purification system. The pipes had an accumulation point, the two desiccant vessels staged side by side, that were unfavorable geometry (approximately 19" x 19" each) placed at the floor of the purification cabinet. The vessels were of sufficient size that the licensee would not be able to maintain k_{eff} less than 0.92 through geometry controls alone. The inspectors noted that the two vessels were at least partially filled with approximately 100 pounds of desiccant material each in the form of white and black desiccant beads, reducing the available space in the vessel. In addition, the desiccant vessels contained heating coils that also reduced the available volume. However, the licensee did not have a current safety analysis that considered the presence of the desiccant vessels, nor was the amount of desiccant material controlled. Therefore, the inspectors identified that the licensee had no controls on geometry in place to prevent a criticality.

The inspectors reviewed the UAl_X glovebox system's purification system to assess the availability of moderation controls or barriers. The area the glovebox system was in was a moderation controlled area that restricted and controlled how much moderating material was allowed to enter. In addition, the nature of the purification system ensured that little to no moisture remained in the purification system during normal processing. Although, the inspectors noted that the white desiccant beads, which occupied the majority of the space within the desiccant vessels, could retain a limited amount of water (up to 2.3 kilograms). The inspectors also noted that the purification system cabinet contained a heat exchanger and a vacuum pump. The heat exchanger was cooled with a borated water line that the inspectors noted was designated as an IROFS for potential accident sequences unrelated to the purification system (the sequences related to the Arc Melt Furnaces). However, no controls required the purification system to be connected to a borated water supply, nor has the licensee shown that it always had been. Licensee evaluations of the vessels flooded with borated water (NCS-2017-118) showed that the amount of boron would be insufficient to prevent a criticality but would increase the amount of mass needed. However, a breach of the heat exchanger would still be necessary to flood the desiccant vessels. Likewise, a failure of the vacuum pump would be needed to introduce oil into the vessels. The inspectors also noted that the purification system vented at the top of the panel to a small plant ventilation line which could provide a pathway for condensation, however, an air gap separated them. In total, the inspectors concluded that the desiccant vessels had uncredited barriers in place that prevented significant moderation intrusion into the vessels.

The inspectors reviewed the purification system to assess the presence of mass controls to prevent a criticality. The inspectors noted that the glovebox line had filters installed to prevent material from entering the purification system piping. The inspectors also noted that the crushing box, the unit with the largest source term for fine material, had two

larger filters installed in series (one external to the box) to prevent material from entering the purification piping. The returns from the purification system had smaller filters installed as well. The filters in the UAl_X glovebox line were considered IROFS by the licensee's NCS engineers for criticality safety and were periodically replaced as required by the generic ventilation IROFS. However, due to problems with their design and installation the filters did not prevent material from entering the desiccant vessels. It is notable that the six inch auxiliary filter showed no evidence of leaking. The inspectors reviewed the last six years of annual survey results credited as an IROFS for ventilation lines, but the lines associated with the purification system were not required to be surveyed as part of the annual survey for accumulation in the ventilation systems. In addition, the inspectors noted that the crushing box was subject to process monitoring tests by the facility's MC&A group (which the licensee refers to as the NMC group). The process monitoring test were weekly mass balances of material moving through the box and would have detected acute losses of material (on the order of hundreds of grams). Therefore, while mass controls were in place to prevent an accumulation of material into the purification system, insufficient management measures were utilized to ensure their availability and reliability over the process's several decades of operation. As a result material accumulated into the desiccant vessels unnoticed, which constituted a failure of the mass controls.

b. Conclusion

The licensee's purification system lacked geometry controls and barriers. The system did have uncredited controls and barriers in place for moderation and mass; however the mass controls lacked sufficient management measures to ensure reliability and degraded such that mass accumulated in the desiccant vessels.

4. Assess any implication the event may have with regard to the facility's MC&A program.

a. Inspection Scope

The inspectors reviewed the MC&A records with regard to the RTR area and crushing box, which was the glovebox in the UAl_X glovebox line with the most significant source term due to the crushing and hammer milling operation. The inspectors reviewed the last six years of process monitoring results. The process monitoring tests were weekly mass balances of material moving through the box and would have detected acute losses of material (on the order of hundreds of grams). The inspectors noted no instances of an acute loss of material. In addition, for the current inventory period, the process monitoring results were within the calculated control limits established. These records indicated to the inspectors that the measurement activities were properly controlled.

The inspectors also reviewed the cumulative differences identified for process unit for the last six years of process monitoring results and discussed them with the licensee's MC&A personnel. The inspectors noted that the cumulative differences were reset to zero after every six month inventory period. The inspectors questioned the licensee regarding actions taken during the physical inventories and noted that more thorough clean out activities were conducted to account for all material within the material balance area (although the purification system was not cleaned out). Therefore, the inspectors

reviewed the inventory results for the RTR area for the last eight years. The inspectors noted that the inventory results provided no indications or suspicions of material loss to unmonitored spaces and were well within regulatory limits.

b. Conclusion

The licensee was properly implementing the MC&A program such that there were no implications with regard to accumulation of material in the desiccant vessels.

5. Review and evaluate the licensee's progress towards completion of the root cause analysis for adequacy of scope, depth, and identification of contributing causes.

a. Inspection Scope

The inspectors discussed the licensee's progress towards completion of the root cause investigation with the root cause team leader. The inspectors noted that the root cause investigation was at first narrowly focused on the aspects of reportable event. However, on July 13, the licensee significantly expanded the scope of the investigation with additional post incident review team (PIRT) reviews of other related events, specifically: 1) the 1998 SNM-42 Chapter 3 "Integrated Safety Analysis (ISA)" development for the HEU UAl_X glovebox system; 2) the RTR-RWP 13-058 contractor contamination event; and 3) the SERs, NCS evaluations, and Ops for adequate SER references to desiccant container based ancillary atmosphere re-circulation systems for RTRT box-lines.

The final report (PIRT Report 17-01 CA201700895 – July 4th, RTR) was completed on August 14, 2017. The inspectors noted that the investigation was thorough and included reviews of records from the 1980's and interviews of former employees that operated the process during this time. The licensee established that the operation of the glovebox was always conducted with some form of filter system at all times. In addition, the licensee had identified that the first few runs of the process had triggered a shutdown in 1986 that resulted in a clean out of the desiccant vessels due to the amount of material unaccounted for. Since then, the operation has proceeded with the filter system similar to the one present in 2017. Therefore, the licensee concluded that the material accumulation occurred through a chronic buildup through the last three decades of operation that went unnoticed due to the annual ventilation survey not formally incorporating the purification system into the survey population and the potential sequence being missed when developing the ISA.

The licensee identified the following three root causes: 1) Less than adequate design and installation of the nine inch HEPA pre-filter assemblies in the Crusher and Blend Gloveboxes; 2) Not monitoring for buildup of ^{235}U or changing out the desiccant in the system purifiers on a periodic basis to ensure accumulations above the NCS limit did not occur as recommended by NCS in 1986; 3) In 1998 the Dri-Train Vacuum system was not included in the original ISA review of the HEU UAl_X Glovebox System.

b. Conclusion

The licensee has completed its root cause investigation, which was adequate in scope, depth, and the identification of contributing causes.

6. Review and evaluate the licensee's immediate, short, and long term corrective actions, any safety culture implications, and restart criteria.

a. Inspection Scope

The inspectors assessed the licensee's immediate and short term corrective actions through observations, interviews, and walk downs of process areas. Upon identification of what appeared to be uranium alloy powder in the desiccant vessels, the maintenance personnel performing the desiccant media replacement task immediately stopped work and notified NCS. NCS ensured the two vessels were adequately separated and sealed and obtained rough survey estimates using an E600 survey device. The measurements indicated the accumulation was possibly greater than a minimum critical mass, therefore the licensee declared an Alert and staffed the EOC. The licensee restricted access to the area with the two desiccant vessels and halted all maintenance activities within 150ft of the checkpoint. Fuel handling operations were already shutdown due to the scheduled maintenance outage. The inspectors noted these actions demonstrated conservative decision making and a questioning attitude.

The inspectors noted that shortly after the identification of the accumulation in the desiccant vessels, the licensee began an extent of condition review throughout the plant to identify all the desiccant systems and determine if material was accumulating in them. The licensee initially identified 17 other desiccant vessels (four more were identified later), which mostly consisted of two configurations: 6" x 16" cylinders clearly visible near gloveboxes and 10" x 10" x 18" vessels normally hidden from view under gloveboxes and behind covers. One was a larger vessel, with a volume of about 200 liters, which had never been associated with fissile operations. None of these vessels were included in the annual ventilation surveys. The licensee conducted surveys using an E600, the instrument normally used for the annual surveys, and identified no accumulations. In addition, the licensee confirmed that all the gloveboxes connected to the desiccant vessels had pre-filters installed and tagged the box out of service if they were not already so. Only one desiccant system was connected to an operation that would be expected to mobilize fissile material, and that system had no accumulation.

Following the initial extent of condition involving desiccant systems, the licensee conducted a more global extent of condition walk down of the various inputs and outputs of gloveboxes used throughout the facility. The focus of reviews was to assess and identify any potential accumulation points that were not already a part of the annual surveys. The inspectors observed the licensee conduct several of these reviews, especially in the Filler area, where the licensee verified overhead piping that was above drop ceilings and other rarely accessed locations.

After the licensee identified that material leaking past filters was a root cause of this event they conducted a third extent of condition review. This review compared other glovebox filters to the ones on the UAl_X glovebox line in order to identify any other filters that were not adequately performing their function. The problem with the filters was that they were installed such that a gap existed behind the filter through which material was bypassing the filter and entering the purification system.

The inspectors noted that the licensee was utilizing the new Conduct of Operations (ConOps) procedure to properly assess any decisions involving restart of the various process areas. To obtain a restart authorization, the licensee's area owners had to

provide a technical justification to a committee consisting of a Senior Manager, Department Manager, and General Manager. The level of rigor for restart was based on which ConOps level the process area coincided with, Level 3 being the least restrictive and Level 1 being the most restrictive. Most of the areas that the licensee authorized for restart by the end of the scheduled maintenance shutdown were Level 3, in that they had little to no similarity to the process area or conditions identified in RTR (i.e. effectively no glovebox systems in these areas). The Level 2 ConOps required pre-job briefs and potentially a list of pre-requisites to be completed prior to restart. The Level 2 areas were effectively those that had glovebox systems, which constituted the majority of the radiological controlled areas. The inspectors noted that the Level 2 ConOps areas also received walk downs by the senior manager restart committee. The Level 1 ConOps applied to RTR and required that the root cause investigation and necessary corrective actions to be completed. The inspectors noted that the licensee's restart actions and criteria were thorough and the licensee demonstrated significant questioning attitudes during the process.

After the licensee had derived a realistic estimate of the amount of ^{235}U present in the desiccant vessels, the licensee began development of series of RWPs to empty the two vessels. The inspectors observed portions of the development and again noted conservative decision making, particularly in the plan to use a borescope to visually inspect the inside of the vessels before attempting to empty them, and to empty the vessel with less uranium first to validate the modeling and assumptions used up to this point. The inspectors also noted significant management oversight of the process. The licensee performed the work of emptying the vessels in a nearby glovebox system that could fit the vessel on its side. The licensee modified the glovebox with HEPA filters and ensured an inert argon atmosphere to reduce the risk of fire. The licensee then emptied the lighter vessel, through two emptying sessions, using a vacuum into 2 liter bottles. The licensee determined that approximately 251 grams of ^{235}U was present in the vessel, confirming that the conservative nature of the NDA modeling used to estimate the amount. The licensee then proceeded with emptying the second vessel and determined that approximately 663 grams was present.

While the inspectors noted adequate safety culture practices with effectively all facets of the licensee's response and corrective actions with regard to the event, the inspectors did note issues prior to the accumulation's discovery on July 4th that indicated poor safety culture practices. The licensee had tolerated a lack of plant specific documentation for the UAl_X glovebox line and its purification system. The licensee relied solely on the purification system's vendor manual and a valve layout diagram in the operating procedure for maintaining configuration control. The licensee had no drawings or specifications that detailed which of the purification lines in the gloveboxes were to have the nine inch HEPA filters installed. In addition, the external filter on the crushing box was not captured in any formal maintenance plan for routine change out. The inspectors noted two specific examples of the tolerance of no documentation. The first was the 2013 – 2014 move of the UAl_X glovebox system from one room to the other. No drawings for the glovebox system were present and after taking the system apart and reassembling it, no drawings were generated. Even though, in 2014, a person was contaminated during this process with material from a tube that was believed to have been clean. The tube was deemed to have been mislabeled and the licensee noted at the time no P&IDs were available to verify the origin of the tubing. In addition, the licensee did not demonstrate a questioning attitude as to why material was in the pipe to begin with.

The inspectors identified the second example of the tolerance for no P&IDs during the review of the change request package to better seal the crushing box's hammer mill motor shaft. The change request package noted that the configuration of the ventilation system connections to the motor enclosure were modified and that the P&ID's should be modified to reflect them. The licensee closed the comment by stating that P&ID's of that level of detail did not exist.

The inspectors reviewed the licensee's recommended corrective actions in PIRT Report 17-01 CA201700895 – July 4th, RTR. The PIRT Report recommended 18 different corrective actions, including such items as: "Evaluate changing the QWI 14.1.01, *Preventative Correction Action System*, to require documentation for all long-term resolutions in Level 1 and Level 2 events…" And "Complete "Extent of Cause" review for applicable Process/Facilities." Overall, the recommended corrective actions documented in the PIRT Report are not finalized or sufficiently detailed to permit the inspectors to reach a conclusion on the adequacy of the long-term corrective actions. Therefore, the inspectors opened an URI on this issue.

b. Conclusion

The licensee demonstrated conservative decision making in their immediate and short term corrective actions, including implementation of restart criteria. However, prior to the event, the licensee exhibited a tolerance for a lack of documentation for systems with potential safety implications. The inspectors opened the following URI:

URI 70-27/2017-007-01, Evaluate the Adequacy of the Licensee's Long-Term Corrective Actions

Introduction: The inspectors identified a URI associated with evaluating the adequacy of the licensee's long-term corrective actions when finalized and implemented.

Description: The licensee identified 18 recommended corrective actions in PIRT Report 17-01 CA201700895 – July 4th, RTR, which included a number of recommended corrective actions to evaluate, review, investigate, implement, complete, or revise different aspects of the licensee's facility and programs. The recommended corrective actions address the three root causes the licensee identified as well as some of the casual factors identified in the supplementary incident investigations the licensee documented in Appendixes 1.3, 1.4, and 1.5 of the PIRT Report. The NRC will evaluate the final corrective actions that address each of the root causes and causal factors the licensee identified in the PIRT Report to verify that corrective actions to prevent recurrence were implemented as required by Section 11.6 of the license application.

7. Assess the adequacy of the licensee's measurement and modeling activities to evaluate the as-found conditions of the desiccant filters.

a. Inspection Scope

The inspectors evaluated the licensee's initial assessment of the amount of ^{235}U that could be in the desiccant vessels; and evaluated the licensee's NDA of the two desiccant vessels to assess the validity and assumptions used to estimate the amount of ^{235}U present, particularly for the more heavily loaded vessel.

Upon discovery of the accumulation licensee staff attempted to quantify the amount of material that could be in the vessels. This was first done by simply comparing the observed count rate on the detector to a reference standard of a known amount of ^{235}U in a known container. Based on this comparison the licensee determined that there was between 280 and 1200 grams ^{235}U in the more heavily loaded vessel. The licensee next performed more detailed measurements with a more accurate detector. The licensee used modeling software that could derive the amount of radioactive material present through back calculating what level of ^{235}U would produce the measured radiological response based on a computer model of the shielding and geometry of the vessel materials. The licensee assumed in the computer model that the ^{235}U was spread among the various layers of desiccant media, with the concentration decreasing towards to top the vessel. The licensee used standard density values for the stainless steel wall of the vessel, and used laboratory analysis of new desiccant media as the assumed composition of the desiccant inside the vessels. Using the software's complex cylinder simulation, and multiple measurements at various positions around the vessels, the licensee arrived at an estimated maximum of 642 grams of ^{235}U in the more heavily loaded desiccant vessel and 390 grams in the other. The inspectors noted that the licensee properly peer reviewed the results and methodology. However, during cleanout, the licensee determined that approximately 663 and 251 grams of ^{235}U had actually been present in the two vessels, respectively. The fact that the more heavily loaded vessel had more than the licensee's calculated maximum indicates that at some point during the refinement of the calculation some conservatism was lost. However, this had no effect on the licensee's safety basis or operations because the NCS model assumed a larger amount of material.

The inspectors evaluated the licensee's NCS modeling of the vessels to verify the validity of assumptions used to derive the reactivity coefficient (k_{eff}) for ^{235}U in the more loaded vessel, which at that time, the licensee believed to contain approximately 700 grams of ^{235}U. The licensee calculated k_{eff} would be below 0.92, the licensee's regulatory limit for normal conditions, when the displacement of about 15% of the volume of the vessel by the desiccant media was credited. The inspectors noted this value to be conservative in that a more realistic estimate of the desiccant media's packing fraction would be over 40% based on the loading instructions of the vendor manual. In addition, the modeling assumed a fully flooded vessel, and a thin close fitting reflector to account for operator's hands. The licensee also performed a series of calculations to determine the effect of increased ^{235}U loading and increased reflector. The inspectors noted that the licensee was conservative in its NCS modeling.

b. Conclusion

The licensee used adequate assumptions and techniques to arrive at the estimated maximum values for ^{235}U in the vessels and their corresponding k_{eff} value.

8. Review and evaluate the licensee's extent of condition for adequacy of scope, depth, and identification of causal factors. Determine if there are other systems where the licensee assumed no uranium accumulation or no uranium concentration.

a. Inspection Scope

The inspectors evaluated the licensee's extent of condition review for adequacy of scope and depth. The inspectors noted that the licensee had conducted extent of condition reviews throughout the facility. The inspectors noted that the licensee focused the reviews on all inputs and outputs from gloveboxes and hoods. As part of the process, the licensee identified 21 other desiccant systems that they had assumed no uranium would enter (i.e. no controls were identified to prevent or monitor for accumulations). Scans of the systems indicated that no accumulations were present. In addition, the powder production that occurs in the RTR line that experienced the event was unique to that process line. Therefore, an accumulation in any of the other desiccant vessels was not expected. Upon identification of the other desiccant systems, the licensee placed them out of service until a more formal safety evaluation of the systems could be performed. The inspectors also observed several of the various walk downs conducted as part of the restart activities for areas other than RTR. The inspectors noted that the licensee identified additional points in the ventilation system for inclusion in the annual survey due to the points being a potential accumulation location. No additional accumulations were noted.

After the licensee identified that material leaking past filters was a root cause of this event they conducted an third extent of condition review. This review compared other glovebox filters to the ones on the UAl_X glovebox line in order to identify any other filters that were not adequately performing their function.

The inspectors reviewed the licensee's root cause investigation into the event and noted that the licensee identified the following three root causes: 1) less than adequate design and installation of the nine inch HEPA pre-filter assemblies in the Crusher and Blend Gloveboxes; 2) not monitoring for buildup of ^{235}U or changing out the desiccant in the system purifiers on a periodic basis to ensure accumulations above the NCS limit did not occur as recommended by NCS in 1986; and 3) in 1998, the Dri-Train Vacuum system was not included in the original ISA review of the HEU UAl_X glovebox system.

The inspectors noted that the licensee's various SARs were built on a series of independent safety evaluations, some of which dated back to the 1980's. In lieu of consolidating the analysis into a core safety basis document, the licensee daisy chained the independent analysis and only compiled the conclusions of the documents into the SARs. The inspectors noted that accident sequences and SARs for ventilation systems (outside of recovery) were absent prior to 2005, when NRC issued a violation for the lack of documentation and analysis of ventilation systems. The creation of the generic ventilation system SAR did not prompt the licensee to gather existing evaluations from 1986 that had already identified accumulations in the desiccant vessels already. The inspectors noted that partly the reason was that the purification system was not universally acknowledged as a ventilation system at the plant. Therefore, accident sequences and other potential assessments overlooked the system.

Following interviews with RTR personnel, the inspectors identified that notable maintenance work had occurred on the UAl_X line during the 2016 shutdown. The maintenance work involved placing a more effective seal around the shaft between the crushing box hammer-mill and its motor that resided outside the glovebox. The motor was housed in an enclosure that had accumulated a small amount of uranium powder. The inspectors also noted that due to the expectation that powder would be found during the motor enclosure work, no corrective action reports were written for the powder collected as scrap from the enclosure during the 2016 maintenance work. The inspectors also verified that the enclosure was directly connected to the main ventilation, but the enclosure did not have any pre-filters installed, even though dispersible uranium had accumulated in the enclosure. When the inspectors brought this to the licensee's attention, their NCS staff were not aware of the connection to the ventilation system. The inspectors observed the NCS staff inspect the inside of the enclosure using a flashlight and peering through the vent holes of the enclosure. The NCS staff noted that material still appeared to be plating out inside the enclosure.

b. Conclusion

The licensee implemented an extent of condition review with adequate scope and depth. The licensee's root cause analysis adequately identified the root causes of the event. The licensee and inspectors identified other systems and processes that were incorrectly assumed to contain no uranium. The inspectors opened the following URI to evaluate the potential lack of process safety basis documents:

URI 70-27/2017-007-02, Adequacy of Process Safety Information for Process Systems

Introduction: The inspectors identified a URI associated with the adequacy of the licensee's documentation of process safety information needed in order to conduct and maintain the ISA.

Description: The licensee has historically tolerated a lack of specificity with respect to the configuration of equipment and controls associated with the UAl_X glovebox system and potentially ancillary systems for other processes. The inspectors questioned if sufficient process safety information was readily available to enable the performance and maintenance of the ISA, as required by 10 CFR 70.62(b). In combination with the NRC observation of the ventilation line connection to the motor enclosure of the crushing box not being identified in any safety evaluation, the inspectors noted that process safety information as it related to the UAl_X system was potentially insufficient. Examples include, a lack of drawings of the UAl_X glovebox line and associated systems, including the purification system and hammer-mill motor enclosure; not specifically identifying which filters were IROFS; and the lack of requirements for those filters.

9. Determine the risk and safety significance of the event.

a. Inspection Scope

The inspectors determined that the actual safety significance of the event was low as no exposures or criticalities occurred. The inspectors determined that the licensee responded swiftly and conservatively to ensure the conditions discovered remained stable by isolating the area and sealing the desiccant vessels. However, based on the amount of material present in the desiccant vessels, the inspectors determined that the

risk of the event was potentially significant and may not have met the regulatory requirement of having a high consequence accident sequence (specifically a criticality) be "highly unlikely" as defined in the ISA. The licensee had not considered an accumulation of material in the vessels in the ISA. Therefore, no mass, moderator, or geometry controls were designated to prevent the accumulation of material in the vessels. The inspectors determined that pre-filters, generically designated as an IROFS preventing an accumulation in ventilation systems and present in the crushing box, lacked the necessary management measures to assure that no accumulation was occurring within the purification system. In addition, the desiccant vessels represented unfavorable geometry vessels, therefore, the inspectors determined that no geometry controls were in place. Finally, the UAl_X glovebox system was in a moderator controlled area and the purification system's heat exchanger was tied to a borated water supply. The heat exchanger was later determined to be an especially robust design because the purification system manufacture was concerned with a violent chemical reaction between the desiccant material and water in the event of a heat exchanger leak. Therefore, the inspectors determined that the risk of a criticality was primarily mitigated by process controls and conditions that prevented an accumulation of moderator within the vessels.

b. Conclusion

The actual safety significance of the event was low, however, the risk of a high consequence event was potentially significant due to the lack of designated controls. One URI was identified:

URI 70-27/2017-007-03, Assess the Likelihood of Criticality with Respect to 10 CFR 70.61

Introduction: The inspectors identified a URI to assess the likelihood of criticality resulting from this event with respect to 10 CFR 70.61 in accordance with the licensee's ISA methodology.

Description: The licensee had not considered accident sequences related to the purifier systems, including an accumulation of material in desiccant vessels, in the ISA. As a result the licensee had not evaluated potential accident sequences for compliance with 10 CFR 70.61(b), (c), and (d); as required by 10 CFR 70.61(a). Nor had the licensee established controls to protect against these potential accident sequences and identified them as IROFS. Although, IROFS and others controls existed, and prevented a criticality; the resulting likelihood of criticality was not assessed using the licensee's ISA methodology. The NRC will evaluate the risk analysis developed by the licensee as part of the 60 day report using the licensee's ISA methodology to assign credit to the initiating event and available controls, commensurate with the management measures applied, and assess the resulting likelihood of criticality with respect to the performance requirements of 70.61.

10. Exit Meeting

The inspection scope and results were presented to the licensee's management and staff on August 30, 2017. No dissenting comments were received from the licensee. Proprietary information was discussed but not included in the report.

SUPPLEMENTARY INFORMATION

1. Key Points of Contact

Licensee personnel

Name	Title
D. Faidley	Unit Manager, Nuclear Criticality Safety
T. Faix	Operations Engineer
J. Jamerson	Manager, UPRR Maintenance
R. Johnson	Licensing Engineer
J. McNeel	Health Physicist
B. Thilking	NCS Engineer
B. O'Donnell	NCS Engineer
G. Pritchett	NMC Engineer
L. Ragland	Unit Manager, Recovery
D. Spangler	Manager, Nuclear Safety and Licensing
C. Terry	Unit Manager, Licensing and Safety Analysis
R. Vohden	Recovery Engineer
M. Wade	Manager, RTRT Operations
D. Ward	Department Manager, Environmental, Safety, Health and Safeguards

NRC personnel

Name	Title
M. Ruffin	Fuel Facility Inspector
C. Stancil	Senior Resident Inspector
G. Wertz	Project Manager, RTR Licensing Branch

2. List of Items Opened, Closed, and Discussed

Item Number	Status	Description
URI 70-27/2017-007-01	Opened	Evaluate the Adequacy of the Licensee's Long-Term Corrective Actions
URI 70-27/2017-007-02	Opened	Adequacy of Process Safety Information for Process Systems
URI 70-27/2017-007-03	Opened	Assess the Likelihood of Criticality with Respect to 10 CFR 70.61

3. Inspection Procedures Used

IP 88003	Reactive Inspection for Events at Fuel Cycle Facilities
IP 93812	Special Inspection

4. Key Documents Reviewed

Records:
CR-1042792, Fuel Fabrication Glove Box Hammer Mill Shaft Seal, Revision (Rev.) 0
NCS-1986-075, Fuel Deficit in the UAl_X Powder Line, dated September 29, 1986
NCS-1986-087, Fuel Deficit in the UAl_X Powder Line, dated October 15, 1986
NCS-2007-012, Level Two Criticality Safety Analysis to Determine the Safety of Pre-Filters in the RTR gloveboxes that Protect Ductwork from the Dispersible Forms of Uranium, dated January 25, 2007
NCS-2016-128, NCS Review of Ventilation Systems in Response to the Westinghouse S-1030 Scrubber Uranium Build-up Event, dated November 2, 2016
NCS-2017-108, NCS Calculations for RTR Desiccator Unit – 1050g U235 cylinder geometry, dated July 4, 2017
NCS-2017-109, NCS Calculations for RTR Desiccator Unit – 715g U235 cylinder geometry, dated July 5, 2017
NCS-2017-110, Safety Concern Analysis for RTR UAl_X Glovebox Purification System – Desiccator Unit Uranium Accumulation (CA201700895), dated July 6, 2017
NCS-2017-118, NCS Calculations for RTR Purifier Unit – 2 cylindrical units in Cabinet, dated July 31, 2017
NCS-2017-120, RTR Desiccant Unit U235 Accumulation Flow Path Review, dated August 9, 2017
PIRT Report 17-01 CA201700895 – July 4th, RTR, dated August 14, 2107
RPTWR 2017-017, RTR DRI-TRAIN Vessel U-235 Estimation, dated July 6, 2017, and July 9, 2017
RTR Process Monitoring 2017-002, Process Unit 2 – HEU Jaw Crusher
RTR Process Monitoring 2017-001, Process Unit 2 – HEU Jaw Crusher
RTR Process Monitoring 2016-002, Process Unit 2 – HEU Jaw Crusher
Safety Analysis Report 15.22, RTRT (Research Test Reactor and Targets) Fuel Powder and Compact Processes, Rev. 80, dated September 12, 2016
SER 13-008 Phase 01

Procedures:
E41-134, Annual Ductwork Survey, Rev. 15
OP-0006506, Crushing and Blending UAl_X, Rev. 9
OP-1001087, Safety Procedures for Boxline Operations/Repairs, Rev. 14
Maintenance Plan 2265
RWP 17-0045, Replace Dri-Train Media and DP Gauge Installation, Rev. 0

Condition Reports Reviewed:
CA201400057

Other Documents:
Email from O'Donnell to Ward, dated July 6, 2017
Dri-Train Technical Manual, Model MO-120-2
Post Incident Statement, by S-1 MBA Custodian, dated July 9, 2017
Post Incident Statement, by Former MBA Custodian, dated July 10, 2017
Post Incident Statement, by Former NCS Engineer, dated July 9, 2017
Requisition No. TCF-14-11, dated April 29, 2014

July 6, 2017

MEMORANDUM TO: Manuel G. Crespo, Team Leader
BWXT Nuclear Operations Group, Inc., Special Inspection

FROM: Catherine Haney ***/RA/***
Regional Administrator

SUBJECT: SPECIAL INSPECTION TEAM CHARTER FOR BWXT NUCLEAR OPERATIONS GROUP, INC., DOCKET NUMBER. 70-27 (INSPECTION REPORT 70-27/2017-007)

This memorandum confirms the establishment of a Special Inspection Team (SIT) at BWXT Nuclear Operations Group, Inc. (BWXT) to inspect and assess the facts and circumstances surrounding the unanalyzed accumulation of uranium in a ventilation system. On July 4, 2017, BWXT identified that two desiccant filters serving a dry train ventilation system on a uranium processing glovebox line in the Research and Test Reactor {RTR) facility contained approximately 100 to 1200 grams of aluminum uranium compound in powder form. This section of the ventilation system was considered to be non-uranium bearing, therefore had no documented controls in the Integrated Safety Analysis to prevent accumulations and was not included in annual duct surveys to identify such accumulations. BWXT staff reported the occurrence to the Nuclear Regulatory Commission (NRC) Operations Center on, July 4, 2017, as a 1-hour reportable event (Event #52840). There were no actual safety-related consequences resulting from the accumulation of uranium in the desiccant filters.

Inspection Manual Chapter 2601, "Reactive Inspection Decision Making Process for Fuel Facilities," was used to evaluate the level of NRC response for this operational event. Based on the deterministic criteria, the staff concluded that this issue involved a condition where no items relied on for safety or safety controls had been established to ensure a high consequence event was highly unlikely. The NRC determined that the appropriate level of response was to conduct a Special Inspection to determine the facts surrounding this event.

The inspection will be performed in accordance with the guidance of Inspection Procedure (IP) 88003, "Reactive Inspection for Events at Fuel Cycle Facilities" and the applicable provisions of IP 93812, "Special Inspection." The report will be issued within 30 days of the completion of the inspection.

CONTACTS: Eric Michel, RII/DFFI
404-997-4555

Mark Lesser, RII/DFFI
404-997-4 700

Enclosure 2

A copy of the Charter is enclosed for your use. The objectives of the inspection are to gather information and make appropriate findings and conclusions in the areas listed in the Charter. These results will be used as a basis for any necessary follow-up and regulatory enforcement actions. It is not your responsibility to examine the regulatory process. As indicated in the Charter, the foremost objective is to determine the safety implications and adequacy of the licensee's immediate corrective actions for the issues which resulted in the event.

Before the end of the first day on site, you are to provide a recommendation to the Regional Administrator as to whether the SIT inspection should continue, or be upgraded to an Augmented Investigation Team (AIT) response. If appropriate, this recommendation may be made later in the inspection.

The team should notify Region II management of any potential generic issues identified as a result of this event for discussion with the Office of Nuclear Material Safety and Safeguards. Safety or security concerns identified that are not directly related to the event should be reported to the Region II office for appropriate action.

This Charter may be modified should you develop significant new information that warrants review.

Enclosure: SIT Charter

Special Inspection Team Charter BWXT Nuclear Operations Group, Inc.
Unanalyzed Accumulation of Uranium in a Ventilation System

Event

On July 4, 2017, BWXT discovered uranium in two desiccant filters serving a dry train ventilation system on a uranium processing glovebox line in the Research and Test Reactor (RTR) facility. The filters contained approximately 100 to 1200 grams of an aluminum uranium compound in powder form. The filter containers were located within close proximity to one another prior to knowledge of the uranium mass presence. This section of the ventilation system was considered to be non-uranium bearing, therefore had no documented controls in the Integrated Safety Analysis (ISA) to prevent accumulations and was not included in annual duct surveys to identify such accumulations. Later that day, BWXT reported to the NRC Operations Center a 1-Hour Event Notification (Event 52840) based on 10 CFR 70 Appendix A(a)(4) *"An event or condition such that no items relied on for safety,* as *documented in the Integrated Safety Analysis summary, remain available and reliable, in an accident sequence evaluated in the Integrated Safety Analysis, to perform their function ... "*

Objectives

The objectives of the inspection are to: 1) review the facts surrounding the failure to identify the necessary controls that would have prevented the accumulation of uranium; 2) assess the licensee's response to the failures; and 3) evaluate the licensee's immediate and planned long term corrective actions to prevent recurrence. In order to determine the risk and safety significance of the event, the team should focus on the areas listed below.

1. Develop a complete timeline and sequence of events related to the event, including the history of system configuration and nuclear criticality safety control.

2. Assess the licensee's initial evaluations of how this system was treated in the ISA and relevant criticality safety analysis.

3. Assess if any controls and/or process conditions were in place that could have provided barriers to prevent a criticality.

4. Assess any implication the event may have with regard to the facility's material control and accounting program.

5. Review and evaluate the licensee's progress towards completion of the root cause analysis for adequacy of scope, depth, and identification of contributing causes.

6. Review and evaluate the licensee's immediate, short, and long term corrective actions, any safety culture implications, and restart criteria.

7. Assess the adequacy of the licensee's measurement and modeling activities to evaluate the as-found conditions of the desiccant filters.

8. Review and evaluate the licensee's extent of condition for adequacy of scope, depth, and identification of causal factors. Determine if there are other systems where the licensee assumed no uranium accumulation or no uranium concentration.

9. Determine the risk and safety significance of the event.

Documentation

Document the inspection findings and conclusions in Inspection Report 70-27/2017-007 within 30 days of the completion of the inspection.

Team Composition

Manuel Crespo, Senior Fuel Facility Inspector, Safety Branch (SB), Division of Fuel Facility Inspection (DFFI), Region II (RII)
Timothy Sippel, Fuel Facility Inspector, SB, DFFI, RII