



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
REGION IV
1600 E. LAMAR BLVD
ARLINGTON, TX 76011-4511

August 7, 2015

Mr. Greg Kruse, Manager
U.S. Operations
Uranium One USA, Inc.
907 Poplar Street, Suite 260
Casper, WY 82601

SUBJECT: NRC INSPECTION REPORTS 040-08502/2014-002 AND 040-08502/2015-001

Dear Mr. Kruse:

This letter refers to the announced, reactive U.S. Nuclear Regulatory Commission (NRC) inspection conducted on September 23-25, 2014, to perform an independent review of a drum pressurization event that occurred on September 9, 2014, resulting in occupational worker uptakes and area contamination. Additionally, the enclosed inspection report documents the routine, announced inspection conducted on May 27-28, 2015, at your Willow Creek Project in Johnson and Campbell Counties, Wyoming. These inspections were examinations of activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Within these areas, the inspections consisted of selected examination of procedures and representative records, observations of activities, and interviews with personnel. The purpose of the inspections was to determine whether site activities were being conducted safely and in accordance with NRC requirements. The inspection findings were discussed with you and members of your staff during the on-site portions of the inspections. A final exit briefing was presented to you by telephone on July 13, 2015.

The NRC's inspection of the pressurization event identified a root cause of the event as the lack of management oversight of the drum venting process. The direct cause of the event, as well as additional contributing causes, are described in detail in the enclosed inspection report. The NRC acknowledges that the licensee conducted a thorough technical review of the procedural compliance, operational parameters, and chemical reactions associated with the 2014 incident. We have reviewed your corrective actions taken thus far and found them to be sufficient in the interim. Nonetheless, we request that you review the NRC-identified root cause and contributing causes, as discussed in the enclosure, and take actions as necessary to address these causes. The NRC will continue to review your implementation of the corrective actions during future inspections.

The NRC considered whether additional enforcement actions were warranted based on the recurrence of the drum pressurization event. The NRC is aware that you voluntarily notified the NRC of the event, no individual's dose exceeded a regulatory limit, and you implemented prompt and effective corrective actions. Accordingly, no violations were identified during the inspections, and no response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice and Procedure," a copy of this letter, its enclosure, and your response, if you choose to provide one, 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's 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 safeguards information so that it can be made available to the public without redaction.

Should you have any questions concerning this inspection, please contact Dr. Robert Evans at 817-200-1234 or Linda Gersey at 817-200-1299.

Sincerely,

/RA/

Mark R. Shaffer, Director
Division of Nuclear Materials Safety

Docket: 040-08502
License: SUA-1341

Enclosure:
NRC Inspection Reports 040-08502/2014-002 and
040-08502/2015-001

cc: S. Ramsey, Wyoming Office of Homeland Security
C. Anderson, Wyoming Department of Environmental Quality
K. Wendtland, Wyoming Department of Environmental Quality
M. Bennett, Wyoming Department of Environmental Quality

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice and Procedure," a copy of this letter, its enclosure, and your response, if you choose to provide one, 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's 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 safeguards information so that it can be made available to the public without redaction.

Should you have any questions concerning this inspection, please contact Dr. Robert Evans at 817-200-1234 or Linda Gersey at 817-200-1299.

Sincerely,

/RA/

Mark R. Shaffer, Director
Division of Nuclear Materials Safety

Docket: 040-08502
License: SUA-1341

Enclosure:
NRC Inspection Reports 040-08502/2014-002 and
040-08502/2015-001

cc: S. Ramsey, Wyoming Office of Homeland Security
C. Anderson, Wyoming Department of Environmental Quality
K. Wendtland, Wyoming Department of Environmental Quality
M. Bennett, Wyoming Department of Environmental Quality

DISTRIBUTION:

M. Dapas, RA:RIV	K. Kennedy, DRA:RIV	M. Shaffer, D:DNMS
L. Howell, DD:DNMS	R. Kellar, C:RSFS	R. Evans, SHP:RSFS
M. Poston, HP:RSFS	L. Gersey, HP:RSFS	R. Linton, PM:NMSS
B. VonTill, NMSS	M. Herrera, RITS	

DOCUMENT NAME: S:\DNMS\RSFS\LMG\2015 UR\Uranium One
ADAMS ACCESSION NUMBER: ML15219A458

■ SUNSI Review By: RJE		ADAMS ■ Yes □ No		■ Publicly Available □ Non-Publicly Available		■ Non-Sensitive □ Sensitive		Keyword:
OFFICE	RIV:RSFS	RIV:RSFS	NMSS:DURLD	C:RSFS	D:DNMS			
NAME	LMGersey	RJEvans	RCLinton	RLKellar	MRShaffer			
SIGNATURE	/RA/	/RA/	/RA By Email/	/RA/	/RA/			
DATE	07/14/15	07/14/15	07/14/15	07/14/15	08/07/15			

OFFICIAL RECORD COPY

**U.S. NUCLEAR REGULATORY COMMISSION
Region IV**

Docket: 040-08502

License: SUA-1341

Reports: 040-08502/2014-002
040-08502/2015-001

Licensee: Uranium One USA, Inc.

Facility: Willow Creek Project

Location: Johnson and Campbell Counties, Wyoming

Dates: September 23-25, 2014
May 27-28, 2015

Inspectors: Robert Evans, Ph.D., Senior Health Physicist
Repository and Spent Fuel Safety Branch
Division of Nuclear Materials Safety
Region IV

Linda Gersey, Health Physicist
Repository and Spent Fuel Safety Branch
Division of Nuclear Materials Safety
Region IV

Marti Poston, Health Physicist
Repository and Spent Fuel Safety Branch
Division of Nuclear Materials Safety
Region IV

Accompanied by: Kriss Kennedy, Deputy Regional Administrator
Office of Regional Administrator
Region IV

Mark R. Shaffer, Director
Division of Nuclear Materials Safety
Region IV

Ron C. Linton, Hydrogeologist
Uranium Recovery Licensing Branch
Division of Decommissioning, Uranium Recovery, and Waste
Programs
Office of Nuclear Material Safety and Safeguards

Enclosure

Accompanied by: Kellee Jamerson, Environmental Scientist
Environmental Review Branch
Division of Fuel Cycle Safety, Safeguards, and Environmental
Review
Office of Nuclear Material Safety and Safeguards

Office Review by: Ronald A. Burrows, Project Manager
Uranium Recovery Licensing Branch
Division of Decommissioning, Uranium Recovery,
and Waste Programs
Office of Nuclear Material Safety
and Safeguards

Approved by: Mark R. Shaffer, Director
Division of Nuclear Materials Safety
Region IV

Attachment: Supplemental Inspection Information
Appendix A: Event Chronology
Appendix B: Safety and Environmental Review Panels

EXECUTIVE SUMMARY

Uranium One, USA, Inc.
NRC Inspection Report 040-08502/14-002; 040-08502/15-001

The inspection performed on September 23-25, 2015, was an announced, reactive U.S. Nuclear Regulatory Commission (NRC) inspection conducted in response to an event involving a pressurized drum that was opened at the Honeywell uranium conversion facility in Metropolis, Illinois (Honeywell). This inspection was an independent review of the September 9, 2014 event with a focus on the direct, contributing, and root causes and the licensee's corrective actions.

The inspection performed on May 27-28, 2015, was a routine, announced inspection of licensed activities being conducted at the Willow Creek in-situ uranium recovery facilities in Johnson and Campbell counties, Wyoming. Corrective actions associated with the drum pressurization event that had been implemented by the licensee, were also reviewed during the inspection. In summary, the licensee was conducting site activities in accordance with procedures, license requirements, and regulations.

Inspection of Material Licensees Involved in an Incident or Bankruptcy Filing

- A drum of uranium that was packaged and shipped by the licensee experienced a pressurization event on September 9, 2014, at Honeywell, resulting in occupational worker uptakes and area contamination. This event was the third time a sealed drum packaged by the licensee had become pressurized and upon opening experienced a rapid depressurization, resulting in worker uptakes and area contaminations. The licensee conducted a thorough review of the technical and procedural aspects, in an attempt to identify the root cause. The licensee concluded that the root cause of the event was the decomposition of uranyl hydrates resulting in the generation of oxygen gas in the drum resulting in the drum pressure. The reason why the drum became pressurized was not clearly identified but was partially attributed to inconsistencies in the methods of venting and cooling of drums, specifically, involving how the lids were being placed on the drums during the cooling process to allow for proper venting of the drum. (Section 1.2)
- The NRC conducted an independent review and concluded that a root cause of the event was lack of management oversight of the drum venting process. The licensee implemented corrective actions to vent the drums in response to a similar pressurization event that occurred in 2012. This corrective action to vent the drums to avoid pressurization included modifying the operating procedures and providing training to the employees. However, management failed to ensure that the operating procedure provided an adequate level of instruction to ensure that the employees were providing positive venting of the drums and management failed to validate that the employees were venting the drums correctly by performing direct observation of the venting process. The NRC also concluded that contributing causes included lack of questioning attitudes by employees and non-optimal operation of the dryer. (Section 1.2)
- Corrective actions taken by the licensee associated with the September 9, 2014, pressurization event included revising site procedures to extend the drum venting and cooling time, requiring the use of a screened lid during venting and cooling, increasing dryer temperature, temporarily suspending all shipments, and implementing a policy that all drums will be positively vented prior to shipment. During the May 2015 inspection, the NRC inspectors confirmed that the licensee had implemented the corrective actions specified in

its March 2, 2015, letter to the NRC. The inspectors concluded that the corrective actions taken thus far should prevent future drum pressurization in the interim. (Section 1.2)

Management Organization and Controls

- Although the licensee recently reduced site staffing, the organizational structure and staffing levels met the requirements specified in the license. Staffing levels were sufficient for the work in progress. The licensee continued to conduct routine audits and visual inspections in accordance with license and regulatory requirements. The licensee's safety and environmental reviews were performed in accordance with license requirements. One Unresolved Item was reviewed, but was left open, related to the licensee's authority to change the NRC-approved mine unit boundaries through its performance-based license. (Section 2.2)

In-Situ Leach Facilities

- The licensee was operating the Irigaray and Christensen Ranch facilities as required by license requirements. In particular, the licensee was operating the yellowcake dryer in accordance with procedure requirements. The licensee also dried the Honeymoon Project yellowcake as allowed by the amended license. The licensee continued to conduct decommissioning work in the Irigaray mine units, and the inspectors will review this work during a future inspection. The inspectors conducted site tours and confirmed that area postings were in compliance with regulatory requirements. (Section 3.2)

Radiation Protection

- The licensee implemented a radiation protection program that met the requirements of 10 CFR Part 20 and the license. Annual occupational doses were less than regulatory limits. Two previously identified Notices of Violation were reviewed and were closed. The licensee implemented corrective actions that should prevent repeat violations. (Section 4.2)

Inspection of Transportation Activities and Radioactive Waste Management

- The licensee's records indicate that it transported radioactive material in accordance with U.S. Department of Transportation requirements. The licensee continued to maintain a waste disposal agreement as required by the license. The licensee continued to monitor the evaporation ponds for potential leakage and continued to implement pond repairs as required by the license. (Section 5.2)

Implementation of the Decommissioning Planning Rule

- The licensee established and implemented radiological monitoring and response programs for spills and releases. The licensee also maintained records of releases of radioactive materials, and the licensee maintained financial assurance as required by the license. The licensee was found to be in compliance with the requirements of the Decommissioning Planning Rule. (Section 6.2)

Report Details

Site Status

At the time of the routine inspection, in May 2015, the licensee was producing uranium at its Willow Creek Project using the in-situ uranium recovery process. At the Irigaray central processing plant (CPP), the licensee was producing uranium yellowcake product. In addition, the licensee was completing surface decommissioning work in former Irigaray Mine Units 1-9.

At the Christensen Ranch satellite facility, the licensee had suspended injection flow but continued to maintain a recovery flow from Mine Units 7, 8, and 10. In the past few months, the licensee reduced the injection and recovery flow rates at the Christensen Ranch facility, essentially shutting down the facility. In the near future, the licensee plans to implement repairs and upgrades at the satellite facility and conduct mechanical integrity tests of wells in the mine units.

The NRC amended Materials License SUA-1341 on October 21, 2014 (ADAMS accession number ML14212A154), authorizing the licensee to redry yellowcake product from the Honeymoon Project in Australia. Between October 2014 and March 2015, the licensee re-dried the Honeymoon yellowcake product. The licensee's records indicate that it redried 13 lots of yellowcake material, consisting of 1,163 drums of product. Further discussion about the licensee's redrying of the Honeymoon material is provided in Section 3.2 of this inspection report.

1 Inspection of Materials Licensees Involved In An Incident or Bankruptcy Filing (87103)

1.1 Inspection Scope

The inspectors conducted interviews with licensee personnel and Honeywell employees, observed demonstrations of yellowcake drumming and lid closures, and reviewed records to independently ascertain the direct, contributing, and root causes of the September 9, 2014, pressurized drum event.

1.2 Observations and Findings

a. Program Overview/Background Information

The Irigaray CPP receives wet resins loaded with uranium from the Christensen Ranch satellite facility. The licensee's uranium recovery process includes elution, precipitation, dewatering, and drying circuits. The licensee uses several chemicals, including hydrogen peroxide, in the elution and precipitation of the yellowcake product. The licensee also uses a high temperature, multi-hearth dryer to dry the wet uranium product. After drying, the hot uranium product is packaged in 55-gallon drums for eventual shipment to a uranium conversion facility.

Over time, the licensee has changed dryer operating parameters, product cooling times, drum sealing times, and drum inspection procedures in response to internal technical reviews and several drum pressurization events. The licensee experienced its first drum depressurization event in April 1998. While attempting to open a drum within the Irigaray CPP, an operator unexpectedly discovered that the drum was pressurized.

When the lid was unsealed, the pressure release resulted in uranium being expelled from the drum. The rapid depressurization resulted in an uptake of uranium by the site operator and the contamination of the drum room. The licensee's investigation concluded that the incident was caused by oxygen buildup in the drum. The oxygen was apparently generated by the decomposition of hydrogen peroxide into water and free oxygen within the sealed drum. For additional details about the April 1998 event, see NRC Inspection Report 040-08502/1998-002 dated June 26, 1998 (M15174A192).

In response to the 1998 drum pressurization event, the licensee established procedural instructions that the drum lid will not be fully closed and sealed for at least three hours after being filled with yellowcake. This time delay was to allow the contents of the drum to continue to off-gas during the cool-down of the uranium product. After a delay of at least three hours, the drum lid was then secured onto the drum.

A second incident involving a pressurized drum occurred in June 2012. This drum was shipped from the Willow Creek mine to Cameco's Blind River conversion facility in Canada (Blind River). When the Blind River operator loosened the seal ring clamp on the drum, the drum experienced a rapid depressurization resulting in yellowcake being expelled from the drum. Similar to the 1998 incident, the pressurization event resulted in worker uptakes and room contamination. For additional details about the June 2012 event, see NRC Inspection Report 040-08502/12-002 dated December 5, 2012 (ML12340A473).

The licensee concluded that the cause of the 2012 drum pressurization event was build-up of oxygen gas generated by the decomposition of residual uranyl peroxide hydrates and/or hydrogen peroxide in the dried yellowcake product. In response, the licensee updated its operating procedure to increase the product venting time from three hours to 24 hours and increased the dryer residence time to at least 4.5 hours per drum. In addition, the licensee implemented a new drum inspection procedure. This procedure provided instructions for workers to visually inspect the drums for abnormal conditions such as deformation or puncture holes.

In addition to changes in drum venting and cooling times, the licensee changed the operating temperature of the dryer over time. Changes in dryer temperature have a direct impact on the dried product. Prior to 2013, the dryer operated at approximately 1,000-degrees Fahrenheit. During 2013, the licensee conducted a technical review and through its performance-based license, the licensee approved an increase in dryer temperature to 1,200-degrees Fahrenheit. The licensee's technical review included a uranium solubility study. The licensee elected to increase dryer temperature to 1,100-degrees Fahrenheit, instead of the approved temperature of 1,200-degrees Fahrenheit. As discussed below, the licensee subsequently increased dryer operating temperatures from 1,100-degrees to 1,300-degrees, in part, in response to the September 2014 drum pressurization event.

b. Description of the Event

On September 9, 2014, a third drum pressurization incident occurred involving a drum that the licensee had shipped to the Honeywell's Metropolis Works facility for processing. When an operator opened Drum 43 from Lot 51 to collect a sample, the drum experienced a rapid depressurization. The resulting escape of gas pressure from the drum lifted the drum lid, and a significant amount of dried yellowcake was expelled.

from the drum. The yellowcake powder spilled onto the floor resulting in the contamination of two operators and nearby equipment. The two operators were not wearing respiratory protection; however, Honeywell reported to the NRC that both employees were found to have received less than the allowable intake of yellowcake (less than 10 milligrams of soluble uranium in one week) as a result of the incident. On September 10, 2014, the licensee voluntarily notified the NRC Region IV office via telephone about the drum pressurization incident. The licensee also submitted an email notification on the same date (ML14258A133).

During the September 2014 NRC inspection, the licensee discussed their plans for conducting the root cause investigation. The NRC staff agreed with the licensee's approach. The licensee subsequently submitted its root cause analysis plan to the NRC by letter dated September 29, 2014 (ML14276A107). The licensee retained Golder Associates Inc. (Golder) to assist in the investigation and root cause analysis. The licensee selected Golder, in part, because Golder assisted the licensee during the pressurized drum event that occurred in June 2012.

The licensee committed to perform the investigation in two phases. During the first phase, the licensee would investigate the physical conditions and operating procedures. This phase included detailed review of the processing, packaging, shipping, and storage of the pressurized drum. The second phase included an analysis of the chemical characteristics of the dried yellowcake product to determine if any unstable intermediate uranium oxides or peroxides are being formed that could contribute to the buildup of pressure in sealed drums. The NRC reviewed and acknowledged receipt of the licensee's proposed root cause analysis plan by letter dated October 8, 2014 (ML14281A229).

In its September 29, 2014, letter, the licensee committed to suspend shipments of dried yellowcake product originating from the Willow Creek mine until the licensee's root cause analysis report had been completed and corrective actions had been implemented by the licensee to avoid this type of incident in the future. During early November 2014, the licensee conducted an internal review of the root cause findings. The short-term corrective actions included increasing the venting time from 24 to 48 hours, using drum lid screens during venting, and adding a new requirement to monitor the drum temperature prior to sealing the lid onto the drum. The licensee's evaluation concluded that the recommendations provided in their root cause analysis report had been sufficiently incorporated into the licensee's program, and that the licensee could resume shipment of drums of yellowcake material to the conversion facility. The licensee resumed shipments of Willow Creek product on November 5, 2014.

The licensee submitted its initial root cause analysis report to the NRC on November 11, 2014 (ML14323B008). The NRC staff reviewed the report and held a discussion with the licensee and requested that the licensee further review and expand on the conclusions of the x-ray diffraction (XRD) analysis and the chemical conversion of uranyl peroxide to uranium oxides at elevated temperatures. In response to NRC comments, the licensee conducted additional evaluations. The licensee subsequently submitted the revised Root Cause Analysis Report dated February 24, 2015, to the NRC (ML15089A443) via email, and the results of the report were summarized in the licensee's letter to the NRC dated March 2, 2015 (ML15063A255).

A detailed summary of the event chronology can be found in Appendix A.

c. Causes of the Incident

Licensee's Root Cause Analysis

The licensee summarized its root cause analysis in its letter to the NRC dated March 2, 2015 (ML15063A255). The root cause for the pressurized drum was attributed to the decomposition of uranyl hydrates, which resulted in the generation of oxygen gas within the drum. The licensee noted in the March 2, 2015, letter that the reason that the gas generation occurred was likely the placement of the lid on the yellowcake drum in such a way that resulted in incomplete venting of gases during the cool-down period. The licensee also identified potential inconsistencies in the implementation of the venting and cooling procedures. The drums were not vented in a consistent manner by their employees. Some lids were off-set on the drum, while others were placed directly on top of the drum during venting and cooling. Drum lids that were placed directly on top of the drum may not allow adequate venting during the cool-down period. As a corrective action, the licensee designed and started using temporary lids with mesh screens to allow for consistent venting of the drum while the uranium product is cooling.

The licensee investigated several potential causes as part of their root cause analysis. These included: 1) whether there had been deviations from standard operating procedures, 2) if there had been deviations in the implementation of the venting and cooling procedure, 3) impact of dryer temperature increases and refurbishments on the drying process, 4) if water could seep into the yellowcake drums during the wash-down process, and 5) if the lid gasket material might have degraded at elevated temperatures premature sealing the drums. The licensee determined that none of these potential causes were the root cause. However, the licensee determined that these potential causes could have contributed to the event and have implemented corrective actions to address each identified concern. Additionally, the licensee performed drum temperature profiles and pressure readings to gain a more comprehensive understanding of the process.

Golder conducted a detailed analysis of the dried uranium product. The analysis concluded that drying temperature plays a significant role in the chemical changes of the uranium product. Increasing the dryer temperature to approximately 1,300 degrees Fahrenheit will most likely eliminate the presence of residual amorphous uranyl oxide, a potential source of oxygen gas. The licensee subsequently increased dryer temperature to 1,300-degrees Fahrenheit in January 2015.

To better understand the yellowcake product produced at its facility, the licensee sent several samples of dried yellowcake to two independent contractors to perform XRD studies on the samples. As discussed in Enclosure 1 to NRC Information Notice 1999-03, Rev. 1 (ML14028A175), hydrogen peroxide precipitated yellowcake with amorphous compounds are less stable (i.e., more likely to decompose and release oxygen) than $\text{UO}_4 \cdot 2\text{H}_2\text{O}$ (uranyl peroxide dihydrate) or crystalline UO_3 (uranium trioxide). The end product is basically controlled by adjusting dryer temperature and drying time. The analysis of one sample, dried at 1,300-degrees Fahrenheit, showed that the presence residual amorphous uranyl oxide was virtually eliminated. Higher dryer temperatures will result in lower oxide compounds such as UO_3 or U_3O_8 (triuranium octoxide) that are non-peroxide containing compounds. These lower oxide compounds do not generate oxygen and therefore, there is a very small potential that any oxygen will be generated during the cooling process to pressurize the drums. In summary, the XRD analyses of

yellowcake samples indicate that actions taken by the licensee have resulted in a more stable product (i.e., less likely to decompose and release oxygen).

As noted earlier, the chemical cause of the drum pressurization was build-up of oxygen gas generated by the decomposition of residual uranyl oxides in the dried yellowcake product. The cause for the pressure build-up was not clearly identified by the licensee other than the chemical reactions present. The licensee identified several potential conditions that could have caused the drum to become pressurized along with corrective actions that have been implemented:

- Premature closure of the drum lid during the cooling and venting period; in response the licensee increased the cooling and venting time and started using vent screens
- Potential contact of the dried yellowcake with water; the licensee implemented a new drum decontamination procedure to help eliminate the possibility of water being introduced into the drum
- Non-optimal dryer burner system and dryer controls ; the licensee has since upgraded the dryer components
- Low drying temperature; in response the licensee increased the drying temperature to 1,300-degrees Fahrenheit

Collectively, implementation of these corrective actions should significantly reduce the probability of another pressurized drum event.

NRC's Independent Root Cause Analysis

The NRC conducted an independent root cause analysis using, in part, the Management Oversight and Risk Tree (MORT) tool as the analytical procedure for determining causes and contributing factors that led to the pressurized drum event. While the inspectors generally agreed with the licensee's conclusions and recommendations provided in its March 2, 2015, root cause analysis, the inspectors' independent analysis concluded that the build-up of oxygen gas generated by the decomposition of residual uranyl oxides in the dried yellowcake product was the direct cause of the event, not a root cause. The NRC staff identified a root cause of the event as lack of management oversight of the drum venting process. The licensee implemented corrective actions to vent the drums in response to a similar pressurization event that occurred in 2012. This corrective action to vent the drums to avoid pressurization included modifying the operating procedures and providing training to the employees. However, management failed to ensure that the operating procedure provided an adequate level of instruction to ensure that the employees were uniformly providing positive venting of the drums. The inspectors found that the changes to the operating procedures made after the 2012 event focused more on the increase in venting time requirements and were not specific on the method the employees were to follow to vent the drums.

Additionally, there was a lack of management oversight during the production process to validate that the employees were venting the drums correctly by performing direct observations of the venting process. The licensee discovered during the investigation that some lids were off-set on the drum, while others were placed directly on the drum,

which may not have allowed adequate venting. The inspectors interviewed the operators that performed the venting process and found that each operator was placing lids on the drums for the venting/cooling process in a different manner.

The NRC staff also identified two contributing causes of the 2014 incident:

- Licensee employees failed to have a questioning attitude. The operators indicated to the inspectors that they knew the drum lidding procedure was being inconsistently implemented, although none of the operators brought this inconsistency to management's attention.
- As recognized by the licensee during its root cause analysis, the dryer was not operating at optimal conditions. The dryer temperature was not heating the yellowcake sufficiently to ensure that the amorphous content was being minimized. There was also an inability to accurately determine the dryer operating temperature. Additionally, the dryer burners were not operating at optimal parameters.

The inspectors concluded that the licensee's analysis, although thorough, focused primarily on the technical aspects of the event. The inspectors concluded that the licensee could have focused more of its attention on the human factors that may have contributed to the event.

d. Corrective Actions

In its letter dated September 29, 2014, the licensee voluntarily ceased all shipments of dried yellowcake originating from the Willow Creek mine to the conversion facility until the root cause analysis had been completed and the recommended corrective actions were in place to avoid this type of incident in the future. In addition, the licensee requested that Honeywell cease processing all Willow Creek drums until Honeywell had drilled holes in the remaining unopened drums of Lot 51 to release any potential pressure buildup. Honeywell did not identify pressure buildup in any of the remaining drums. Honeywell also sampled the yellowcake in the drum for analysis.

As noted earlier, the licensee subsequently resumed shipments of Willow Creek product in early November 2014, after licensee management review of the root cause analysis and the implementation of short-term corrective actions. The short-term corrective actions included revision of the drying, drumming, and shipping procedures. In particular, the licensee updated standard operating procedure IR-12, "Drypack–Yellowcake Drying and Drumming," on September 18, 2014, to increase the venting and cooling period for filled yellowcake drums from 24 to 48 hours, or until the temperature of the yellowcake in the drum is approximately 90 degrees Fahrenheit. The procedure required use of a temporary screen lid on newly filled drums to allow for off-gassing.

In addition to drumming and drying procedure changes, the licensee conducted pressure tests of filled drums, water intrusion tests, and dryer operability tests and modifications. The licensee also had samples of yellowcake product from various lots analyzed, to further understand the chemistry of the samples versus drying temperature. The licensee implemented a change to the drum washing instructions to minimize the potential for water intrusion. Further, the licensee completed rework on the dryer burner system and upgraded the dryer controls to enable the dryer to work at optimal levels to eliminate amorphous uranyl oxide in the final product.

Longer-term corrective actions included increasing dryer operating temperatures. During October 2014, the licensee increased the dryer temperature from 1,100 to 1,200-degrees, in part, in response to the September 2014 drum pressurization event. The licensee made the change to help eliminate the amorphous uranyl oxide compounds, to minimize the potential for oxygen generation in filled drums. During January 2015, the licensee increased the dryer operating temperature to 1,300-degrees through its performance-based license. This increase in temperature will also help ensure that the amorphous uranyl oxide compounds have been eliminated from the uranium product. At the time of the May 2015 inspection, the inspectors observed that the dryer was operating at 1,300-degrees Fahrenheit.

During the May 2015 inspection, the inspectors reviewed the licensee's implementation of procedure changes, implemented in response to the drum pressurization event that occurred in September 2014. The inspectors confirmed that the licensee increased the time that the drum lid remained unsealed from 24 to 48 hours, to allow for additional off-gassing of the product. The inspectors observed the licensee's use of screened lids during the site tour. The licensee also added a temperature limit of 90-degrees Fahrenheit before the drum lid could be sealed onto the drum. During the site tour, the licensee's staff demonstrated to the inspectors how it measured drum temperature.

The NRC concluded that the licensee's corrective actions, including implementation of revised venting and cooling instructions, shipping instructions, and dryer parameters, should greatly reduce the potential for a recurrence of the pressurized drum event. The inspectors confirmed that the licensee had implemented the proposed corrective actions specified in its March 2, 2015, letter to the NRC (ML15063A255).

1.3 Conclusions

A drum of uranium that was packaged and shipped by the licensee experienced a pressurization event at Honeywell in September 2014, which resulted in a non-reportable occupational worker uptakes and limited area contamination. This event was the third time a sealed drum packaged by the licensee had resulted in rapid depressurization upon opening, worker uptakes, and area contaminations. The licensee conducted a thorough review of the technical and procedural aspects, in an attempt to identify the root cause. The licensee concluded that the root cause of the event was the decomposition of uranyl hydrates resulting in the generation of oxygen gas in the drum. The reason why the drum became pressurized was not clearly identified, but was attributed to potential inconsistencies in the venting and cooling of drums, specifically, how lids were being placed on the drums during cooling and venting.

The NRC conducted an independent review of the licensee's root cause analysis, operating procedures, and interviewed staff involved in the event. The NRC's review concluded that the direct cause of the event was the decomposition of uranyl hydrates that resulted in the generation of oxygen gas in the drum (as noted above, the licensee identified this as a root cause of the pressurization event). The NRC concluded that the root cause of the event was the lack of management oversight of the drum venting process. Specifically, management failed to provide oversight to ensure that the operating procedure provided an adequate level of instruction such that the employees were uniformly providing positive venting of the drums. Additionally there was a lack of

management oversight during the production process to validate that the employees were venting the drums correctly.

The lack of specific instructions in the operating procedure on how vent the drums during the cooling period combined with lack of oversight during the production process allowed the workers to use ineffective venting methods which led to the pressurization event in September 2014. The NRC also identified contributing causes that included lack of questioning attitudes by employees, and non-optimal operation of the dryer.

Corrective actions taken by the licensee included revising site procedures to extend the drum venting and cooling time, requiring the use of a screened lid during venting and cooling, increasing dryer temperature, and implementing revised shipping instructions, should greatly reduce the potential for a recurrence of the pressurized drum event. During the May 2015 inspection, the NRC inspectors confirmed that the licensee had implemented the corrective actions specified in its March 2, 2015, letter to the NRC.

2 Management Organization and Control (88005)

2.1 Inspection Scope

The inspectors reviewed whether the licensee had established and implemented organizational controls to administer the technical programs.

2.2 Observations and Findings

a. Organizational Structure

The inspectors reviewed the licensee's current organizational structure and compared it to the structure presented in Figure 5.1 of the amended license application (ML103280266). This figure describes the organizational structure of the radiation safety and environmental protection staff. The licensee made one management change during the previous inspection period that continues to remain in place. The former senior vice president has retired but continued to provide support as an executive advisor. The duties of the senior vice president were reassigned to the manager, U.S. operations. The former health, safety and environmental director retired and was replaced with another qualified individual. This position was retitled as the health, safety, and environmental manager, consistent with the organizational structure specified in the license. The remainder of the positions specified in the license, including the Radiation Safety Officer (RSO) position, continued to be staffed with qualified individuals.

In recent months, the licensee significantly reduced its onsite staff. The staff in place during the May 2015 inspection was about half of the staff that was in place during the previous inspection. In the radiation safety program area, the site environmental and health manager position was combined with the RSO position, and the licensee eliminated one radiation safety technician position. The mine manager continues to remain responsible for site operations, although the licensee eliminated some operations positions. Despite the reduction in site staffing, the licensee appeared to have sufficient staff for the work in progress at the time of the May 2015 inspection.

b. Audits and Inspections

License Condition 11.5 states, in part, that the RSO or designee shall document daily and weekly walk-throughs of Irigaray and Christensen Ranch facilities to ensure that radiation control practices are being followed. The inspectors noted that daily and weekly walk-through observations are being conducted by the health physics technician or the RSO. The inspectors concluded that the documentation of the walk-throughs complied with license requirements. The RSO provided monthly summaries of the radiation safety program to licensee management, in accordance with License Condition 9.12. The inspectors reviewed the monthly reports and found them to meet license commitments.

The inspectors reviewed the annual radiation protection and As Low As Reasonably Achievable (ALARA) audit for calendar year 2013 dated June 25, 2014. The audit included reviews of occupational exposures as well as compliance with regulations and the license application. The audit also included recommendations for improvement of the radiation safety program. Overall, the inspectors found the audit to be comprehensive.

At the time of the May 2015 onsite inspection, the audit for calendar year 2014 had been completed by a contractor, but the audit report had not been approved by the licensee. The auditors completed the audit in March 2015 using Regulatory Guide 8.31, Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities will be As Low As Is Reasonably Achievable, as a basis for the audit. The inspectors will review the annual radiation protection program audit for 2014 during a future inspection.

c. Safety and Environmental Review Panel

License Condition 9.4 of the performance-based license requires, in part, that the licensee establish a Safety and Environmental Review Panel (SERP) to evaluate if program changes require an NRC license amendment prior to implementation. The inspectors reviewed 11 SERP evaluations performed by the licensee since the previous inspection. The inspectors concluded that the licensee had implemented the SERP determinations in accordance with the performance-based license conditions. Details of the 11 SERP evaluations can be found in Appendix B.

2.3 Conclusions

Although the licensee recently reduced site staffing, the organizational structure and staffing levels met the requirements specified in the license. Staffing levels were sufficient for the work in progress. The licensee continued to conduct routine audits and visual inspections in accordance with license and regulatory requirements. The licensee's safety and environmental reviews were performed in accordance with license requirements.

3 In-Situ Leach Facilities (89001)

3.1 Inspection Scope

The inspectors attempted to determine if in-situ recovery activities were being conducted in accordance with regulatory and license requirements.

3.2 Observations and Findings

a. Review of Operations at Christensen Ranch Satellite Facility

License Condition 10.4 allows the licensee to conduct operations at a maximum flow rate of 9,000 gallons per minute (gpm), exclusive of restoration flow. In recent months, the licensee reduced uranium production operations at the Christensen Ranch satellite facility. During late-March 2015, the injection and recovery flow rates were approximately 4,000 gallons per minute (gpm). By late-April 2015, the flow rates were reduced to approximately 2,200 gpm. By late-May 2015, the licensee had reduced the injection flow rate to essentially zero, but continued to maintain a wellfield bleed rate (recovery flow) of about 71 gpm. The licensee decided to reduce production at the Christensen Ranch satellite facility for completion of repairs, upgrades, and mechanical integrity tests.

Since the previous inspection, the licensee conducted uranium recovery operations in Mine Units 7, 8, and 10. In these three mine units, the licensee conducted wellfield operations in 20 modules and associated header houses.

License Condition 10.7 states that all liquid effluents from process buildings and other process waste streams shall be returned to the process circuit, discharged to the solution evaporation ponds, or disposed as allowed by NRC regulations. Four disposal ponds are located at the Christensen Ranch satellite facility. At the time of the inspection, Pond CR-2 contained liquid effluents, but the licensee had discontinued adding water to the pond. The licensee was allowing the fluid in the pond to evaporate. When the fluid has been removed, the licensee plans to investigate and repair a leak in this pond. (Further details about this leaking pond are provided in Section 5.2 of this inspection report.)

In addition to the disposal of liquid effluents via pond evaporation, the licensee continued to operate two deep disposal wells (DDWs) at the Christensen Ranch satellite facility, DDW-1 and DDW-18-3. At the time of the May 2015 inspection, approximately 35 gpm was being disposed into DDW-18-3, while approximately 28 gpm was being disposed into DDW-1.

License Condition 10.1 requires, in part, that the licensee maintain an inward hydraulic gradient by maintaining a bleed in each individual wellfield starting when lixiviant is first injected into the production zone and continuing until the groundwater restoration stability monitoring has begun. The inspectors conducted a limited review of the total bleed rate in the Christensen Ranch satellite facility mine units. The bleed rate was approximately 52 gpm in late-March 2015, 55 gpm in late-April 2015, and 71 gpm in late-May 2015. During the May 2015 inspection, the licensee's bleed rate for Mine Unit 7 was 11 gpm, the bleed rate for Mine Unit 8 was 22 gpm, and the bleed rate for Mine

Unit 10 was 25 gpm. In summary, the licensee's records indicate that the licensee continued to maintain an inward hydraulic gradient across the wellfields.

One excursion was reported to the NRC since the September 2014 inspection. Monitor well 7MW27 entered the excursion status in late December 2014. In response, the licensee turned off or reduced the flow in several injection wells near the monitor well. The licensee also returned to service several recovery wells near the monitor well. The licensee subsequently notified the NRC that the monitor well was no longer in excursion status effective early-March 2015.

b. Review of Operations at the Irigaray Central Processing Plant

The Irigaray plant contains the equipment needed to accept uranium-bearing resins from the Christensen Ranch satellite facility for chemical processing and drying into powdered yellowcake. The Irigaray plant was in operation during the inspection including the precipitation circuit and yellowcake dryer. The inspectors toured the facility and observed plant equipment and operational parameters (flow, pressure, temperature, etc.). In summary, the licensee appeared to be operating the Irigaray plant in accordance with site procedures.

The inspectors reviewed the operating parameters of the dryer and compared these parameters to the limits specified in the operating procedure. The inspectors concluded that the licensee was operating the dryer in accordance with the requirements specified in site procedure IR-12, "Drypack-Yellowcake Drying and Drumming," Revision 13.

The licensee was operating the dryer at 1,300-degrees Fahrenheit during the inspection. As discussed in Section 2.2 of this inspection report, the licensee elected to raise dryer temperature, from 1,100 to 1,300-degrees Fahrenheit, through its performance-based license. The increase in dryer temperature was expected to result in a more stable product that was less likely to result in off-gassing that could lead to pressurized drums. The dryer operated at approximately 1,600-degrees Fahrenheit in the early 1980s; therefore, the increase in dryer temperature was not exceeding the original design criteria. The inspectors noted that the high-temperature alarm was set at 1,400-degrees Fahrenheit.

The licensee estimated that the current drying time was approximately 6 hours, a drying time that was greater than the 4.5 hour limit specified in Procedure IR-12.

c. Redrying of Honeymoon Project Material

By letter dated February 28, 2014 (ML14066A112), as supplemented, the licensee requested authorization to re-dry dried yellowcake from the Honeymoon Project in Australia. The licensee planned to re-dry the material using its high-temperature dryer to remove organics from the product. The NRC reviewed the licensee's request and subsequently approved the request by license amendment dated October 21, 2014 (ML14212A154). The license amendment revised License Condition 9.3 and added a new Condition 10.22. The inspectors reviewed the status of the Honeymoon operations during the May 2015 inspection.

The licensee implemented a new procedure, Standard Operating Procedure IR-12A, "Honeymoon-Yellowcake Drying and Drumming," Revision 0, in part, to determine the

correct temperature for removing organics from the product. After several tests, the licensee concluded that a dryer temperature of 675-degrees Fahrenheit, at a feed rate of 424 pounds per hour, was sufficient to remove the organics. The licensee began processing the Honeymoon material in late-October 2014.

The licensee conducted an analysis of the Honeymoon product prior to shipment offsite. The purpose of this analysis, in part, was to demonstrate that the product was chemically stable for shipment. As required by License Condition 10.22, the licensee submitted a revised Honeymoon Data Package to the NRC by email dated November 17, 2014 (ML14323A571). By letter dated November 21, 2014 (ML14323A957), the NRC notified the licensee that the NRC concluded that the requirements of the license had been met and that the licensee could commence shipping re-dried Honeymoon product.

The NRC inspectors discussed the Honeymoon product drying operations with licensee staff. According to the licensee, the tipping station experienced one failure, but the equipment was repaired and returned to service. There were no observable organic vapor issues inside the containment enclosure constructed to house the tipping equipment. The licensee subsequently terminated the requirement for use of respirators with organic filtration while working in the Honeymoon equipment enclosure. The licensee made the change through its performance-based license (SERP 14-07).

The licensee's records indicate that it completed re-drying operations on March 18, 2015. The licensee processed 13 lots consisting of 1,163 drums of material. The last shipment of drums left the facility on April 2, 2015. The inspectors concluded that the licensee processed and shipped the Honeymoon material as required by License Conditions 9.3 and 10.22.

d. Review of Decommissioning Activities at Irigaray Wellfields

License Condition 9.3 states, in part, that the land and structures will be decommissioned according to the Decommissioning Plan submitted December 19, 2000 (as amended). Surface decommissioning work includes removal or release of all surface structures and subsurface piping, plugging of wells, and performance of final status surveys.

By letter dated September 12, 2013 (ML13261A033), the licensee presented two proposed alternative decommissioning schedules to the NRC for Irigaray Mine Units 1-9. The first schedule was the licensee's planned decommissioning schedule, with all work and documentation to be completed by September 2014. The second schedule was an alternate schedule that assumed that the fieldwork would be impacted by inclement weather. This second scheduled indicated that all work and documentation would be completed by May 2015. By letter dated January 19, 2015 (ML15022A527), the licensee notified the NRC that it would be implementing the alternate, weather-delayed schedule. However, by letter dated May 21, 2015 (ML15154A999), the licensee notified the NRC that it would not be able to complete all work and documentation by the end of May 2015, and the licensee requested a delay until August 1, 2015. The NRC subsequently granted the licensee an extension of the alternate decommissioning schedule until August 3, 2015 (ML15159A675).

During the May 2015 site inspection, the inspectors conducted a review of the licensee's decommissioning of Irigaray Mine Units 1-9. At that time, the licensee had completed most field activities including final status surveys. The remaining activities included physical removal of a building structure, which had been surveyed and released, removal of five cement pads, filling of excavated areas, removal of remaining subsurface piping, cleanup of residual debris, seeding and disking of the area, and fencing of the area.

The final status survey included ambient gamma radiation measurements, soil sampling, and building surface surveys. The licensee had established approximately 250-300 grids, each consisting of 10 meters by 10 meters, for radiological surveying and sampling. At the time of the May 2015 inspection, the licensee was still compiling the data. NRC staff will review the licensee's final status survey report at a later date.

In summary, the licensee had conducted decommissioning, including the performance of a final status survey, in the former Irigaray mine units. The inspectors were unable to tour the area, and collect confirmatory survey samples, due to inclement weather during the inspection. The inspectors will review the licensee's survey results, tour the remediated area, and collect confirmatory samples at a later date.

e. Site Tours

The inspectors conducted site tours to observe in-situ recovery operations in progress. Areas toured included the Irigaray CPP, Christensen Ranch satellite facility, and various header houses. The inspectors noted that radiation protection postings were located as appropriate and in accordance with License Condition 9.11. Plant parameters were within required operating intervals and plant equipment appeared to be in good condition. In summary, the licensee was maintaining control of the areas and equipment in accordance with license and regulatory requirements.

The inspectors conducted independent radiological surveys of the gamma exposure rates in the plant. The surveys were conducted using a Ludlum Model 19 microRoentgen survey meter calibrated with radium-226 (NRC No. 015546, calibration due date of 07/22/15), and a Ludlum Model 2401-EC survey meter (NRC No. 35484G, calibration due date of 03/13/16). In summary, the inspectors' survey results were comparable to the licensee's results, and all areas were properly posted based on the observed survey measurements.

3.3 Conclusions

The licensee was operating the Irigaray and Christensen Ranch facilities as required by license requirements. In particular, the licensee was operating the yellowcake dryer in accordance with procedure requirements. The licensee also dried the Honeymoon Project yellowcake as allowed by the amended license. The licensee continued to conduct decommissioning work in the Irigaray mine units, and the inspectors will review this work during a future inspection. The inspectors conducted site tours and confirmed that area postings were in compliance with regulatory requirements.

4 Radiation Protection (83822)

4.1 Inspection Scope

The inspectors attempted to determine whether the licensee's radiation protection program was being conducted in compliance with the license and 10 CFR Part 20 requirements.

4.2 Observations and Findings

a. Occupational Exposures

The inspectors reviewed the licensee's dose assessment records for calendar year 2014. Thirty-seven employees were monitored for external exposures using thermoluminescent dosimeters that were exchanged on a quarterly basis. Occupationally monitored employees include Irigaray CPP operators, satellite operators, wellfield operators, plant supervisors, well field utility employees, and laboratory personnel. The highest deep dose equivalent for calendar year 2014 was 0.243 milliSievert (243 millirem).

The licensee conducted air sampling, in part, for assessment of internal exposures as required by License Condition 10.10. The inspectors reviewed the licensee's radon-222 air sampling records and uranium particulate and worker breathing zone sample results for calendar year 2014. The highest committed effective dose equivalent, based on a summation of the derived air concentration-hour monitoring results for radon and uranium particulates, was 0.221 milliSievert (221 millirem). The inspectors confirmed that the licensee had conducted sampling at the required intervals and the sample results were included in the worker's total effective dose equivalent exposure records.

The inspectors reviewed the bioassay program to verify compliance with License Condition 10.2. The licensee collected urine bioassay samples to assess the potential for intakes of uranium. The inspectors confirmed that bioassay samples were taken at the required frequency and in accordance with the collection procedure. Since the May 2014 inspection, the licensee collected roughly 525 bioassay samples. Two samples exceeded the action level of 15 micrograms of uranium per liter of urine in January 2015. The licensee conducted investigations of the causes of the two action level exceedances. The first sample measured 17.9 micrograms per liter. This individual was impacted by mechanical failure of the drum tipper assembly, being used to dry the Honeymoon Project yellowcake product. The second elevated sample, 22.1 micrograms per liter, was attributed to poor worker hygiene.

The inspectors noted that the highest total effective dose equivalent (summation of the internal and external radiation exposure) for calendar year 2014 was 0.378 milliSievert (378 millirem) for an operator at Irigaray CPP. For comparison, the highest occupational exposure during calendar year 2013 was 0.54 milliSievert (540 millirems). In summary, occupational exposures for calendar year 2014 remained below the regulatory limit of 50 milliSievert (5,000 millirem).

The inspectors also reviewed the licensee's implementation of the radiation protection program for processing the Honeymoon Project yellowcake. The inspectors reviewed the drum tipping station enclosure air monitoring results and dose conversion

calculations. The inspectors concluded that the licensee used conservatism in its dose assessments for workers assigned to conduct this non-routine work.

b. Radiation Protection Surveys

Section 5.7.6 of the license application requires, in part, that the licensee perform quarterly gamma radiation surveys in specific locations throughout the satellite buildings and central processing plant to verify radiation area postings and assess external radiation conditions.

During the May 2014 inspection, one violation (VIO 040-08502/1401-02) was identified related to the licensee's failure to perform monthly gamma surveys at modular buildings in accordance with license requirements. Specifically, 21 modular buildings were not surveyed on a monthly basis from November 2013 to January 2014. The licensee provided a response to the Notice of Violation by letter dated January 9, 2015 (ML15012A561). The corrective actions included updating field forms and developing a compliance calendar. The inspectors concluded that the licensee's proposed corrective actions were adequate and should prevent recurrence of the violation.

Alpha contamination surveys were conducted by the licensee on a weekly frequency in clean areas of the site and monthly in process areas. The inspectors reviewed the survey results and found them to meet the requirements of the license.

c. Radiation Work Permits

License Condition 10.9 states, in part, that the licensee shall use radiation work permits (RWPs) for all work or non-routine maintenance jobs where a potential for significant radiation exposure to radioactive material exists or for which no standard written operating procedure exists. All RWPs shall be accompanied by a breathing zone air sample, and all RWPs shall be issued by the RSO or designee.

Between January 1, 2015, and May 25, 2015, 42 RWPs were used by the licensee. The licensee's process requires supervisors to determine the need for a RWP. The current policy does not issue standing RWPs, rather, the safety requirements associated with routine tasks are detailed in procedures, and RWPs are only required for non-routine tasks or tasks for which a procedure does not exist. The RWPs were reviewed in conjunction with the licensee's internal procedures and license commitments and were found to have met these requirements.

During the May 2014 inspection, one violation (VIO 040-08502/1401-03) was identified related to the licensee's failure to use RWPs in accordance with the requirements of the license. Specifically, the inspectors found two instances where non-routine work was performed, under conditions where the potential existed for significant radiation exposure and no standard operating procedure existed, and a RWP was not issued by the RSO or designee. The licensee responded to the Notice of Violation by letter dated January 9, 2015. The proposed corrective actions included training and disciplinary action. The inspectors reviewed the licensee's corrective actions associated with this violation and found them to be adequate.

d. Instrumentation

The inspectors spot-checked the calibration of portable survey instruments during the site tours. All survey instruments found in use during the site tours were in calibration, and the calibration stickers were clearly legible. On an annual basis, the licensee sends portable survey instruments to an outside vendor for calibration. The inspectors observed survey meters being used by the licensee's employees when exiting the restricted areas. The inspectors also verified that radiations survey meters were being operationally checked with a radiation source each day, as required by License Condition 10.13. The survey instruments examined by the inspectors were found to be in calibration and were being used appropriately by the licensee's staff.

e. Respiratory Protection

The inspectors examined the respiratory protection equipment and reviewed the licensee's procedures for respiratory protection. All respirators being used at the facility are National Institute for Occupational Safety and Health certified, and the respirators examined by the inspectors appeared in like-new condition. The licensee's respiratory protection procedures include fit-testing of respirators for employees, inspection and storage of respirators, and annual audits of the respiratory protection program. The inspectors found the licensee's respiratory protection program to be in accordance with the license application and regulatory requirements.

4.3 Conclusions

The licensee implemented a radiation protection program that met the requirements of 10 CFR Part 20 and the license. Annual occupational doses were less than regulatory limits. Two previously identified Notices of Violation were reviewed and were closed. The licensee implemented corrective actions that should prevent repeat violations.

5 Inspection of Transportation of Activities and Radioactive Waste Processing, Handling, Storage, and Transportation (86740 and 88035)

5.1 Inspection Scope

The inspectors attempted to determine if transportation and disposal activities were being conducted by the licensee in compliance with regulatory and license requirements.

5.2 Observations and Findings

a. Inspection of Transportation Activities

Regulation 10 CFR 71.5 states, in part, that each licensee who transports licensed material outside the site of usage, as specified in the NRC license, shall comply with the applicable requirements of the U.S. Department of Transportation regulations. At the time of the onsite inspection, no transportation activities were in progress. The inspectors reviewed the licensee's records for recent transportation shipments. Previous shipments included routine uranium product shipments, Honeymoon product shipments, and resin transfers. In summary, the licensee's records indicate that the shipments had been conducted in accordance with U.S. Department of Transportation regulations.

The last shipment of routine uranium product occurred on May 22, 2015. The shipment consisted of 52 drums of product. The records indicate that the material was shipped as exclusive use. The packages were labeled as Radioactive Yellow II based on the radiation levels on the external surface of the packages. The vehicle was conservatively placarded as Radioactive, hazardous material category 7. The shipping records included a 24-hour emergency contact and driver emergency instructions. Surveys of the drums, trailer, and vehicle were conducted and documented. The records also indicate that the drums were opened three days prior to shipment, to verify that they were not pressurized. These drums were shipped to Honeywell.

The last shipment of Honeymoon product occurred on April 2, 2015. This shipment consisted of 29 drums. These drums were shipped in a manner similar to the methods used to ship routine uranium product (described above), with one exception. The shipment paperwork did not include a drum venting certificate form, because a final drum vent was not required by procedure prior to shipment. However, the licensee's paperwork indicated that the drums had been examined for potential pressurization as part of the drum inspection and survey procedure.

Finally, the inspectors reviewed resin shipment forms, used to authorize the transfer of resins between the Christensen Ranch and Irigaray sites. The shipping papers included manifests, vehicle surveys, and driver instructions. The last shipment occurred on May 2, 2015, and the resins were shipped as low-specific activity, exclusive-use shipments.

b. Solid Radioactive Waste

License Condition 9.7 requires, in part, that the licensee possess a waste disposal agreement to dispose of 11e.(2) byproduct material at an offsite location. The inspectors reviewed the waste disposal agreement and determined that it was valid from January 25, 2010, through January 26, 2016. The disposal site is a different NRC licensed site that is authorized to receive and dispose of byproduct material. In summary, the licensee continues to maintain a disposal agreement as required by the license for disposal of byproduct material wastes.

c. Review of Pond Leaks

License Condition 10.6 provides the pond freeboard requirements, and License Condition 11.4 provides the pond leak detection requirements. If a pond is discovered to be leaking, License Condition 11.4 specifies that the licensee will lower the pond fluid level by transferring its contents to another pond and repair the leaking pond as needed. The inspectors reviewed the status of the evaporation and holding ponds. In summary, the licensee continues to monitor for potential pond leakage, and the licensee continues to implement pond repairs as required by the license.

Since the May 2014 inspection, the licensee conducted work on two leaking ponds. Pond IR-RA, located at the Irigaray CPP, was recently repaired. Fluid was detected in the pond leak detection system in February 2013. The licensee repaired and returned the pond to service in July 2013. However, additional fluid was detected in the leak detection system in February 2014. The licensee subsequently repaired and returned the pond to service in March 2015.

Pond CR-2 is located at the Christensen Ranch satellite facility. This pond was repaired in April 2013 and July 2013. Fluid was subsequently detected in the pond leak detection system in December 2013 and March 2014. The licensee could not identify the source of the leak. At the time of the inspection, the licensee was in the process of allowing the pond level to drop via evaporation. Once the fluid has evaporated from the pond, the licensee plans to investigate the source of the leak and repair the pond.

5.3 Conclusions

The licensee's records indicate that it transported radioactive material in accordance with U.S. Department of Transportation requirements. The licensee continued to maintain a waste disposal agreement as required by the license. The licensee continued to monitor the evaporation ponds for potential leakage and continued to implement pond repairs as required by the license.

6 Implementation of the Decommissioning Planning Rule (TI 2600/017)

6.1 Inspection Scope

The inspectors conducted a review of the licensee's implementation of the Decommissioning Planning Rule (DPR).

6.2 Observations and Findings

The NRC issued the DPR on June 17, 2011 (76 *Federal Register* 35512) with an effective date of December 17, 2012. The DPR requires certain licensees to establish programs to: (1) minimize the introduction of radiological contamination into the site environment; (2) ensure that releases of radioactivity to the environment are promptly identified and characterized; (3) document radiological survey data which identifies the location and concentrations or quantities of contamination that may require remediation at the time of license termination; and (4) report updated financial assurance information as required by the DPR.

The inspectors reviewed the licensee's implementation of the DPR requirements. To begin with, licensees are required to minimize the introduction of radiological contamination into the site environment. The most likely sources of radiological contamination into the environment would be spills and leaks. To counter the potential for spills and leaks, the licensee installed wellfield leak detection systems, pond leak detection systems, differential flow alarms, high/low tank level alarms, tank level indicators, as well as sumps, berms, and containments within structures. The licensee established procedures for responding to leaks and documenting leaks. To avoid the potential for build-up of long-term gaseous effluent releases to the environment, the licensee established and implemented an NRC-approved environmental monitoring program.

Section 5.7.1.2 of the license application (referenced in License Condition 9.3) provides the NRC-approved spill contingency plans, while Section 7.2.3.2 provides the requirements for responding to accidental wellfield leaks and spills. To ensure that releases are promptly identified and characterized, the licensee established emergency response Procedures E.1, "Plant Solution Spills," and E.2, "Wellfield Solution Spills." Operators are trained to respond to alarms, including identification and termination of

spill events. Depending on the circumstances of the spill, the licensee's response may include gamma radiation surveys, soil sampling, solution sampling, spill containment, and recovery of spilled fluids. The licensee maintains records of spills, including contingency actions taken in response to spills.

License Condition 12.2 provides the spill, leak, excursion, and incident/event reporting requirements. The licensee established and implemented a program for recording radiological survey data. For example, Emergency Procedure E.2, "Wellfield Solution Spills," requires documentation of spills within wellfields. Based on the circumstances of each spill, the licensee may choose to clean the spill up at that time, or delay cleanup until a later date. The licensee must maintain records important to decommissioning in accordance with the requirements of 10 CFR 40.36(f). The inspectors commonly review the licensee's spill records as part of the inspection program.

Finally, the licensee is required by the DPR to update its financial assurance for spills that have not been cleaned up. The licensee's representatives stated that remediated spills are not added to the surety estimates, but the remainder are added to the surety estimates. License Condition 9.5 provides the requirements for maintaining financial assurance. This condition specifically includes cost of decommissioning, decontamination, and offsite disposal costs. The licensee is required to update the financial assurance at least annually.

Operating uranium recovery sites are required to meet the survey and recordkeeping requirements of 10 CFR 20.1501(a-b). Surveys, including subsurface surveys, which are reasonable under the circumstances, must be performed if there is a potential radiological hazard at a given site. The licensee will conduct subsurface surveys as necessary in response to spills and leaks, but the licensee does not plan to implement a routine subsurface radiological survey program without indications of a leak or spill. For example, the licensee does not plan to conduct subsurface surveys under the processing plant unless there are indications of a spill or leak within or adjacent to the plant. At the time of the inspection, the only known subsurface contamination was due to pond leaks, but these reclamation costs have been included in the most recent surety estimate.

6.3 Conclusions

The licensee established and implemented radiological monitoring and response programs for spills and releases. The licensee also maintained records of releases of radioactive materials, and the licensee maintained financial assurance as required by the license. The licensee was found to be in compliance with the requirements of the DPR.

7 **Exit Meeting Summary**

The inspectors presented the inspection results to the licensee's representatives at the conclusion of the onsite inspections. A final exit briefing was presented to the licensee by telephone on July 13, 2015. During the inspection, the licensee did not identify any information reviewed by the inspectors as proprietary that was included in the report

SUPPLEMENTAL INSPECTION INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

S. Graham, Process Plant Supervisor
G. Kruse, Manager of U.S. Operations
R. Kukura, Willow Creek Mine Manager
S. Schierman, Manager, Health, Safety and Environment
R. Schierman, Radiation Safety Officer
D. Wichers, Executive Advisor

INSPECTION PROCEDURES USED

IP 83822	Radiation Protection
IP 89001	In-Situ Leach Facilities
IP 86740	Inspection of Transportation Activities
IP 88035	Radioactive Waste Processing, Handling, Storage, and Transportation
IP 88005	Management Organization and Control
IP 87102	Maintaining Effluents and Materials Facilities ALARA
IP 87103	Inspection of Material Licensees Involved in an Incident or Bankruptcy Filing
TI 2600/017	Review of the Implementation of the Decommissioning Planning Rule

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

None

Closed

040-08502/1401-02	VIO	Failure to perform monthly gamma surveys
040-08502/1401-03	VIO	Failure to use radiation work permits

Discussed

040-08502/1301-01	URI	SERP approval of monitoring wells outside of permit boundary
-------------------	-----	--

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As Reasonably Achievable
CPP	central processing plant
CFR	Code of Federal Regulations
DDW	deep disposal well
DPR	Decommissioning Planning Rule
gpm	gallons per minute
IP	NRC Inspection Procedure
NRC	U.S. Nuclear Regulatory Commission
RSO	Radiation Safety Officer
RWP	radiation work permit
SERP	Safety and Environmental Review Panel
TI	NRC Temporary Instruction
URI	Unresolved Item
VIO	Violation
XRD	X-ray diffraction

Appendix A

Event Chronology

April 15, 1998	First pressurized drum incident occurs at Irigaray CPP; in response, licensee implements procedure change to ensure drums are vented at least 3 hours prior to sealing
June 26, 1998	NRC issues reactive Inspection Report 040-08502/98-002 in response to the first pressurized drum event
January 29, 1999	NRC issues Information Notice 99-03, Rev. 0
June 23, 2012	Second pressurized drum incident occurs at Blind River conversion facility; in response, licensee extends drum venting time from 3 hours to 24 hours and implements new drum inspection procedure
April 2013	Licensee approves increase in dryer temperature using its performance-based license from 1,000 to 1,200-degrees Fahrenheit; licensee subsequently raises dryer temperature to 1,100-degrees Fahrenheit
March 4, 2014	NRC issues Information Notice 99-03, Rev. 1
April 18, 2014	Drum 43 from Lot 51 was filled with yellowcake; drum vent time was 28 hours, 15 minutes
June 23, 2014	Lot 51 was shipped to Honeywell
September 9, 2014	Third pressurized drum incident occurs at Honeywell
September 10, 2014	Licensee voluntarily notifies NRC Region IV about the Honeywell incident and temporarily suspends shipments
September 18, 2014	Licensee revises yellowcake drying and drumming procedure to include instructions to vent drums a minimum of 48 hours using a screened lid or until product temperature is \leq 90-degrees Fahrenheit
September 23-25, 2014	NRC reactive inspection at Willow Creek
September 29, 2014	Licensee submits root cause analysis plan to NRC; licensee commits to suspend shipments of yellowcake until root cause analysis is complete and corrective actions are implemented to prevent recurrence of incident

October 2014	Licensee increases dryer operating temperature from 1,100 to 1,200-degrees Fahrenheit
October 8, 2014	NRC Region IV staff interviews Honeywell representatives
October 27, 2014	Licensee provides non-public copy of Golder Associates Root Cause Analysis Report to NRC
November 5, 2014	Licensee resumes shipments of Willow Creek yellowcake product after internal review of Golder's root cause analysis and implementation of corrective actions
November 11, 2014	Licensee submits summary of root cause analysis to NRC; NRC requests additional information from licensee in subsequent telephone call
December 2, 2014	Licensee implements new policy that all drums be opened prior to shipment to ensure that no pressure exists in drums
January 2015	Licensee increases dryer operating temperature from 1,200 to 1,300 degrees Fahrenheit to help eliminate amorphous uranyl oxides in dried yellowcake product
March 2, 2015	Licensee submits Completion of Root Cause Analysis letter to NRC
March 16, 2015	Licensee submits revised Golder Associates Root Cause Analysis Report dated February 24, 2015, to NRC

Appendix B

Safety and Environmental Review Panels

License Condition 9.4 allows the licensee to make changes to the facility and procedures in certain circumstances. The inspectors reviewed the following Safety and Environmental Review Panel (SERP) evaluations conducted by the licensee as authorized under License Condition 9.4:

- SERP 13-02 dated February 12, 2013, reviewed and approved mining operations in Mine Unit 10B. (Further discussion of this SERP is provided below.)
- SERP 13-03 dated April 11, 2013, reviewed and approved a controlled test on the Irigaray dryer. The test involved increasing the operating temperatures and product feed rates to determine if the changes improved moisture removal and increased production. Based on the results of this test, the licensee chose to increase dryer temperature by 100-degrees Fahrenheit.
- SERP 13-04 dated May 8, 2013, was an evaluation to determine if an individual met the qualifications as a health physics technician based on education, training, and work experience. This individual eventually left the site.
- SERP 13-06 dated July 18, 2013, was an evaluation to determine if an individual met the qualifications as RSO, to allow the individual to perform the duties of the position as a designee. This individual also eventually left the site.
- SERP 14-02 dated March, 26, 2014, was an evaluation to determine if an individual met the qualifications of a health physics technician based on education, training, and work experience. This individual eventually transferred to another department.
- SERP 14-03 dated April 1, 2014, reviewed and approved the addition of a spray system to wet the yellowcake scrubber screen, as recommended by the dryer vendor, to improve scrubber efficiency and to extend the operational life of the screens.

As part of the NRC's review of SERP 14-03, the inspectors discussed License Condition 10.14 with the licensee's staff. This condition requires scrubber material to be compatible with the uranium recovery process prior to re-processing of that material. The inspectors noted that neither the license, license application, nor the licensing basis document explains what is meant by the term "compatible" material. The licensee's staff agreed to review this subject and to define the physical and chemical criteria that has to be met to allow scrubber material to be removed from the scrubber and returned to the process circuit.

- SERP 14-04 dated August 4, 2014, was a review related to the construction of a new flow line connection to the reverse osmosis unit. The purpose of this new flow line was to discharge brine solution back into the injection stream. This change will decrease the amount of brine solution transferred to the storage ponds and deep disposal wells.

The inspectors reviewed this SERP analysis in detail. This proposed change introduced a change in the NRC-approved flow path as shown on Figure 3.13, Christensen Ranch Satellite Process Flow Diagram. The inspectors subsequently accepted the licensee's proposed change based on the wording of License Condition 10.7. This license condition specifies, in part, that all liquid effluents shall be returned to the process circuit, discharged to the evaporation ponds, or disposed as allowed by NRC regulations. In this particular situation, the licensee planned to direct some or all of the brine from the reverse osmosis unit back into the process circuit. Thus, the licensee's proposed change to the process flow path was allowed by License Condition 10.7.

- SERP 14-05 dated September 22, 2014, was an annual review of license application Section 7.5, Effects of Accidents. This review is required by License Condition 9.18. This review included nine events that occurred in 2013. The events included wellfield leaks, pond leaks, and non-radiological chemical spills. The SERP evaluation concluded that no license application updates were needed.
- SERP 14-06 dated November 4, 2014, was a review and implementation of root cause findings regarding the September 2014 drum pressurization incident. The SERP evaluation concluded that the recommendations provided in the root cause analysis report has been sufficiently incorporated into the licensee's program, and that it can resume shipment of drums to the conversion facility.
- SERP 14-07 dated December 10, 2014, was a proposal to discontinue the use of organic filters while redrying the Honeymoon Project yellowcake product. This SERP evaluation approved a change to discontinue using respirators equipped with organic vapor filters, and discontinue the requirement for gas monitoring prior to entering the containment enclosure. The SERP approved the change, in part, based on previous monitoring results, which did not identify any organics in the containment air. The licensee continued to monitor the enclosure for gases on a weekly basis. The licensee subsequently completed the project in March 2015.
- SERP 15-01 dated January 15, 2015, was a proposal to increase the dryer temperature to remove excess moisture from the yellowcake slurry. This SERP evaluation approved an increase in dryer temperature from 1,100 to 1,300-degrees Fahrenheit. The inspectors noted that the licensee was operating the dryer at 1,300-degrees Fahrenheit during the May 2015 inspection.

The NRC inspectors reviewed the technical evaluation for SERP 15-01 in detail. The licensee implemented the change without completing the solubility studies to demonstrate the solubility classification of the product. The solubility class (day,

week, or year) impacted the licensee's derived air concentration dose assessments. The licensee chose to use the most conservative classification (year) in its dose assessments, until the solubility studies are completed.

The SERP evaluations and associated documents were initiated for SERPs 13-05 and 14-01, but the panels did not approve the evaluations by the conclusion of the May 2015 onsite inspection. If approved, the NRC inspectors will review these SERPs during a future inspection.