

# APPENDIX B

## ALARA Audit



**R AND D ENTERPRISES, INC.**

PROVIDING ENVIRONMENTAL AND TECHNICAL SOLUTIONS

4495 SQUAW CREEK RD (82604) • P.O. BOX 3321 • CASPER, WY 82602

LAND 307.237.4188 • CELL 307.277.3861 • WWW.RDEINC.BIZ • RAGARLING@RDEINC.BIZ • SAGARLING@RDEINC.BIZ

**2015 ANNUAL ALARA AUDIT REPORT**  
***AS LOW AS IS REASONABLY ACHIEVABLE***

**PREPARED FOR:**  
**URANIUM ONE AMERICAS, INC.**  
907 N. POPLAR STREET, SUITE 260  
CASPER, WYOMING 82601

**USNRC LICENSE NUMBER: SUA-1341**  
**WILLOW CREEK PROJECT**

**PREPARED BY:**  
**SHERYL AND ROGER A. GARLING**  
R AND D ENTERPRISES, INC.  
P.O. BOX 3321  
CASPER, WY 82602  
307 277 3861

July 13, 2016



## TABLE OF CONTENTS

	Page No.
1.0 EXECUTIVE SUMMARY	3
2.0 2015 ALARA SUMMARY	3
2.1 ALARA PHILOSOPHY - REGULATORY GUIDE 8.31, SECTION 1	4
2.2 SAFETY AND ENVIRONMENTAL REVIEW PANEL (SERP)	4
2.3 NRC LICENSING ACTIVITIES	5
2.4 FACILITY AND 2015 PROGRAM IMPROVEMENTS	6
3.0 2015 ASSESSMENTS AND AUDITS	6
3.1 NRC INSPECTIONS AND RELATED ACTIONS DURING 2015	6
3.2 2013 ANNUAL ALARA AUDIT	7
3.3 SELF-IDENTIFIED VIOLATIONS (SIV)	7
4.0 RADIATION PROTECTION AND ALARA PROGRAM	7
4.1 EMPLOYEE EXPOSURE RECORDS AND TRENDS IN PERSONNEL EXPOSURES	7
4.1.1 EXTERNAL RADIATION AND DEEP DOSE EQUIVALENT (DDE)	8
4.1.2 EXTERNAL RADIATION	9
4.1.3 AIRBORNE RADIATION	9
4.1.4 COMMITTED EFFECTIVE DOSE EQUIVALENT	11
4.1.5 TOTAL EFFECTIVE DOSE EQUIVALENT	11
4.1.6 RADIATION WORK PERMITS (RWPs)	12
4.1.7 DOSE TO THE PUBLIC	12
4.2 BIOASSAY RESULTS	12
4.3 REPORTS OF DAILY, WEEKLY, AND MONTHLY INSPECTIONS	13
4.3.1 DAILY WALK-THROUGH INSPECTION REPORTS	13
4.3.2 WEEKLY INSPECTION REPORTS	13
4.3.3 MONTHLY RSO REPORTS	13
4.4 DOCUMENTED TRAINING PROGRAM ACTIVITIES	13
4.4.1 RADIATION PROTECTION	13
4.4.2 DOT	13
4.5 RADIATION SAFETY MEETING REPORTS	14
4.6 RADIOLOGICAL SURVEY AND SAMPLING DATA	14
4.6.1 PERSONAL AND EQUIPMENT CONTAMINATION SURVEYS	14
4.6.2 SURFACE CONTAMINATION SURVEYS	14
4.7 REPORTS ON OVEREXPOSURES OF WORKERS	14
4.8 OPERATING PROCEDURES	14
4.9 EQUIPMENT FOR EXPOSURE CONTROL	14
5.0 CONCLUSIONS AND RECOMMENDATIONS	15
5.1 SUMMARY OF RECOMMENDATIONS	15



## 1.0 EXECUTIVE SUMMARY

The annual 2015 ALARA audit was performed on May 18 and 19, 2016 for Uranium One USA, Inc. (U1) Willow Creek ISR Project (WC), located in Johnson and Campbell counties, Wyoming. Per Regulatory Guide (RG) 8.31, Section 2.3.3 Radiation Protection and ALARA Program Audit the review should address *trends in personnel exposures for identifiable categories of workers and types of operational activities, whether equipment for exposure control is being properly used, maintained, and inspected, and provide recommendations on ways to further reduce personnel exposures from uranium and its daughters.*

The start up of the current WC ISR Project was on December 22, 2010 followed by dryer operations beginning September 30, 2011. Christensen Ranch (CR) satellite recovery and Irigaray (IR) Central Processing Plant (CPP) have been in continuous operation since. The IR facility began reprocessing U1 Honeymoon Australian yellowcake product in late 2014 with the drying campaign running through the first quarter of 2015. The reprocessing utilizing the high temperature dryer was required to reduce the elevated organic carbon concentration to an acceptable limit. This process probably presented the greatest potential for occupational exposure (due to decrease in product solubility) and radiation safety risk (higher potential for airborne releases with drum tipping operations) for 2015. Upon completion of the Honeymoon product drying campaign, U1 continued on with drying their own product. CR continued to circulate water at the satellite while the IR plant was being prepared to process loaded IX resin from a third party uranium in-situ recovery (ISR) facility.

The Radiation Safety Staff continued to assess the operations and make recommendations for improvement using engineering techniques (process isolation, ventilation, controls, etc.) to reduce further occupational exposures. Corporate and Site managers are committed to maintaining the ALARA principle and the Radiation Safety Staff has the full cooperation of management regarding the protection of their employees to limit occupational exposure. Specific findings and recommendations are identified within the ALARA report.

The audit results indicate that U1 is operating in a manner consistent with the ALARA principle, represented by the overall site's 2015 average TEDE of 0.10 rem, compared to 0.19 rem reported for 2014.

## 2.0 2015 ALARA SUMMARY

The audit team was comprised of Sheryl Garling and Roger A. Garling of R and D Enterprises, Inc. (RDE). U1 WC Project's Senior Radiation Safety Technician (RST) Larry Arbogast and David Rynders, Radiation Safety Officer and Site Safety, accompanied the audit team. This audit serves as the annual review of the content and implementation of the radiation protection program for 2015 as required by 10 CFR Part 20.1101(c) and License Condition (LC) 12.3.



Prior to, during and post audit visit, the following documents were reviewed:

- ✓ ALARA audit reports from 2014,
- ✓ USNRC License SUA-1341, Amendment No.4, Dated August 20, 2015
- ✓ USNRC Regulatory Guides and other relevant documents including, but not limited to, 1.86, 8.10, 8.22, 8.30, 8.31, 10 CFR Part 20, NUREG -1400, etc.,
- ✓ USNRC Inspection Reports 040-08502/2014-002 and 040-08502/2015-001 (August 7, 2015),
- ✓ 2015 Monthly Radiation Safety Summary Reports, and
- ✓ Licensee documentation, site records and reports generated by the Radiation Safety Officer and Health Physics staff.

Regulatory Guide 8.31, Revision 1, May 2002: *Information Relevant To Ensuring That Occupational Radiation Exposure At Uranium Facilities Will Be As Low As Is Reasonably Achievable* (ALARA), Section 2.3.3, *Radiation Protection and ALARA Program Audit*, audit guidelines were followed.

## 2.1 ALARA PHILOSOPHY – REGULATORY GUIDE 8.31, SECTION 1

*A major purpose of the occupational radiation protection program at a uranium recovery facility is to maintain radiation [occupational] exposure ALARA for all employees, contractors and visitors. The implementation and effectiveness of a successful ALARA program is the responsibility of everyone involved in the processing of uranium ores. Responsibilities for conducting a radiation protection and ALARA program are shared by licensee management, the radiation safety officer and all workers in the uranium recovery facility.*

The ALARA program is predicated on timeliness of sampling, measurement and documentation of occupational exposure and effluent monitoring. RG 8.30 recommends...*Sample analysis should usually be completed within two working days after sample collection...to determine employee occupational exposures.*

IN 2015, U1 sampling, measurement and analysis was performed within time constraints in accordance with the sampling procedures and analytical methods required for the analytical and monitoring programs.

## 2.2 SAFETY AND ENVIRONMENTAL REVIEW PANEL (SERP)

The following table represents the Safety and Environmental Review Panel (SERP) proposed changes evaluated during 2015. LC 9.4(b) allows U1 to make changes in the facility, procedures and conduct tests or experiments that are not presented in the approved application as long as such changes follow the specified criteria identified in the LC.



Date	SERP ID	Proposed Changes
January 15, 2015	Evaluation Report – SERP 15-01	Review and Approval of Increasing Dryer to Above 1200 Degree Fahrenheit
-	Evaluation Report – SERP 15-02	Canceled
October 23, 2015	Evaluation Report – SERP 15-03	Review and Approval of Resin Toll Milling Circuit Irigaray Modifications

## 2.3 NRC LICENSING ACTIVITIES

- 2.3.1 January 7, 2015 – U1 responded to the Notice of Violation from the August 2013 through July 31, 2014 NRC inspection.
- 2.3.2 February 25, 2015 - NRC were on site, but were unable to perform an inspection due to travel complications.
- 2.3.2 May 4, 2015 - U1 received request for additional information for license condition 11.3 a-d.
- 2.3.3 May 21, 2015 - U1 submitted a request to the NRC to extend the due date for decommissioning of the Irigaray Wellfield to August 1, 2015.
- 2.3.4 May 27-28, 2015 – NRC performed an announced on site inspection of the WC Project.
- 2.3.5 June 8, 2015 NRC approves the extension request of IR Mine Unit 1-9 decommissioning report
- 2.3.6 Amendment No. 4, to the renewed license, was received August 2015, which accepted surety commitments.

The license renewal for SUA-1341 was issued on March 7, 2014. License Condition 9.8 and 9.12 contain obligations for submittal of information within 90 days of license renewal regarding Standard Operating Procedures (SOPs) for training of personnel other than HPT's. Information on the following was submitted and U1 has not received correspondence from the NRC regarding approval.

- Perform surveying on resin trucks and conducting inspections in the absence of the RSO or HPT. This information was submitted on June 5, 2013.
- LC 9.8 requires the submittal of a Contamination Control Plan ("CCP") to NRC within 90 days of license renewal. Implementation of the CCP is contingent on the licensee receiving written verification from NRC prior to implementation. The Contamination Control Plan ("CCP") was submitted on August 8, 2014.
- LC 11.3 identifies that the licensee may provide alternative procedures specific to in-plant air particulate sampling to show compliance with 10 CFR 20.1204 to NRC for review and verification within 6 months of license renewal. In September 2013 and August 2014 U1 provided additional information justifying the current method of



counting in-plant air particulate sampling for gross alpha was compliant with 10 CFR 20.1204.

- LC 11.3 requires the licensee to collect environmental air particulate sampling for the Christensen Ranch Satellite facility. U1 provided NRC justification for using Irigaray environmental air particulate sampling result for the Christensen Ranch Satellite as a conservative estimate to demonstrate compliance with 10 CFR 40.31(h) in September 2014. Denial of the submittal was documented in a November 12, 2014 NRC letter and further correspondence has been initiated.
- LC 9.15 requires a review and comparison of regional weather station data with onsite meteorological data to determine if the onsite data is representative of long-term conditions. U1 submitted an evaluation on September 5, 2013.

## **2.4 FACILITY AND 2015 PROGRAM IMPROVEMENTS**

Improvements during 2015 include:

- Progress continued on incorporating exposure calculations into an electronic format, revising forms so they are consistent between site monitoring programs;
- Continued and improved charting of uranium particulate and radon progeny for the WC site results which are incorporated into the RSO monthly reports;
- The RSO continues the practice of conducting investigation/evaluation of monitoring data anomalies or detection that could identify a compromise in an operational or personnel procedure resulting in a potential occupational exposure;
- The radiation safety staff continued to revise and update SOPs and survey/monitoring data forms. This is a dynamic process to migrate forms and calculations to electronic/digital format.
- U1 recruited a replacement for a WC site RSO to fill the void of their previous RSO.

## **3.0 2014 ASSESSMENTS AND AUDITS**

### **3.1 NRC INSPECTIONS AND RELATED ACTIONS DURING 2015**

The following summarizes NRC inspections and related actions at Willow Creek during 2015:

- 3.1.1 February 25, 2015 – two NRC inspectors visited the site, but were unable to perform an inspection due to travel complications.
- 3.1.2 May 27-28, 2015 – the NRC performed an announced onsite inspection with the following results:
  - 3.1.2.1 No violations were assessed.



3.1.2.2 Two items; 040-08502/1401-02 (failure to perform monthly gamma surveys) and 040-08502/1401-03 (failure to use radiation work permit) were closed.

3.1.2.3 One unresolved item was discussed; 040-08503/1301-01 (SERP approval of monitoring wells outside of permit boundary).

### 3.2 2014 ANNUAL ALARA AUDIT

All recommendations from the 2014 ALARA audit were implemented and incorporated into U1's Willow Creek Project Radiation Safety and Health Physics program and operating procedures.

### 3.3 SELF-IDENTIFIED VIOLATIONS (SIV)

There were no SIVs reported in 2015.

## 4.0 RADIATION PROTECTION AND ALARA PROGRAM

Radiation detection equipment used for monitoring occupational exposure is appropriate for the operation and application of use, is properly maintained and calibrated, and the Radiation Safety Staff demonstrated accurate and correct information on the use and operation of instrumentation.

### 4.1 EMPLOYEE EXPOSURE RECORDS AND TRENDS IN PERSONNEL EXPOSURES

The Total Effective Dose Equivalent (TEDE) is defined as the sum of the Deep Dose Equivalent (DDE, for external exposures) and the Committed Dose Equivalent (CDE, for internal exposures). The dose limit for TEDE (TEDE = DDE + CDE (CEDE)) is 5 rem/year. [RG 8.30]

Historically, employee exposures have been very low due to stand-by operations, non-operational or renovation mode. The following table summarizes the 2015 employee occupational exposures with 2014 data in parenthesis for comparison.

2015 Employee Occupational Exposure Summaries –Willow Creek Site (2014 Data Provided in Parentheses)				
Exposure Category	rem		% of Regulatory Limit Limit = 5 rem/year	
	Average	Maximum	Average %	Maximum %
External (DDE)	0.020 (0.074)	0.087 (0.243)	0.40	1.74
Radon Progeny (CEDE)	0.101 (0.097)	0.113 (0.151)	2.02	2.26
Airborne Uranium (CEDE)	0.013 (0.014)	0.014 (0.024)	0.26	0.28
Dry Pack Airborne Uranium (CEDE)	0.009 (0.024)	0.074 (0.047)	0.18	1.48
CEDE combined	0.124 (0.135)	0.201 (0.222)	2.48	4.02
Total Equivalent Dose Equivalent (DDE+CEDE = TEDE)	0.103 (0.187)	0.288 (0.379)	2.06	5.76





2015 Employee Category Occupational Exposure Summaries Regulatory Limit 5 rem/year (2014 Data Provided in Parentheses)								
Employee Category	TEDE		External - DDE		CEDE			
					Rn Daughters		U Particulate	
	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Irigaray (IR)	0.127 (0.306)	0.287 (0.379)	0.027 (0.104)	0.087 (0.164)	0.071 (0.097)	0.113 (0.151)	0.011 (0.012)	0.014 (0.024)
Christensen Ranch	0.083 (0.112)	0.115 (0.252)	0.013 (0.032)	0.049 (0.121)	0.071 (0.097)	0.095 (0.151)	0.006 (0.012)	0.008 (0.024)
Wellfield	* (0.173)	* (0.329)	* (0.096)	* (0.243)	* (0.160)	* (0.160)	-	-
Dry Pack	IR	IR	IR	IR	IR	IR	0.016 (0.024)	0.074 (0.047)

\*Wellfield staff exposures are compiled in the 2015 CR data.

Dose assessments from routine and non-routine operations are included in the table summaries. Routine operations generally include those covered by an SOP. Non-routine operations are those covered by a Radiation Work Permit (RWP).

The RSO is timely in assessing employee occupational exposures, which complies with the ALARA principle.

In 2015, the average TEDE for occupational exposure for Irigaray operators was 0.127 rem compared to 2014 TEDE of 0.306 rem, which represents a 59% reduction.

In 2015, the average TEDE for occupational exposure for Christensen Ranch operators was 0.083 rem compared to 2014 TEDE of 0.112 rem, which represents a 26% reduction.

The above data demonstrates U1's commitment to operating in a manner consistent with the ALARA principle.

#### 4.1.1 EXTERNAL RADIATION AND DEEP DOSE EQUIVALENT (DDE)

Monitoring is provided for employees that may exceed 10% of the allowable limit as required in 10 CFR Part 20.1502, Conditions requiring individual monitoring of external and internal occupational dose.

The RSO continues to evaluate gamma occupational exposure levels for wellfield personnel to determine if there are any engineering controls or SOPs that can be incorporated to further reduced gamma exposure. Gamma occupational exposure levels continue to be below 10% of the allowable limits.



Gamma surveys are conducted quarterly to verify operating conditions do not develop which could cause elevated external occupational exposures.

The addition of operational notes on gamma survey reports provides useful information to assess short-term trends (e.g., IX column status, operating status of modules, etc.). Throughout the year, the radiation safety staff refers to this information when making assessments to determine if trends are developing. This activity supports the ALARA principle.

All postings were current.

#### **4.1.2 EXTERNAL RADIATION**

##### **4.1.2.1 BETA**

Beta dose measurements were conducted once in 2015. Seventeen (17) locations were measured at the IR CPP, thirty (30) locations were measured at the CR Satellite and twenty-one (21) measurements were taken in the wellfield MOD buildings. The maximum reading of 1.1 mrem/hr was observed in the dry pack area.

##### **4.1.2.2 GAMMA**

Gamma readings were taken monthly for the first half of 2015 during active operations. The second half of 2015, U1 suspended the use of chemical introduction and continued to circulate, gamma measurements were taken quarterly. During the first half of the year, gamma measurements fluctuated at the wellfield MOD buildings. Gamma measurement fluctuation is attributed to process flow, radon daughters, and precipitate in filter media. The maximum gamma measurement observed was 5.6 mrem/hour at contact. The second half of 2015 maximum gamma measurements observed were less than (<) 0.1 mrem/hr.

U1 complies with Subpart J-Precautionary Postings, 10 CFR Part 20.1902. Due to the fluctuation of gamma measurements and the site action level of 2 mrem/hour, U1 continually maintains postings in areas where gamma measurements have been observed greater than site action levels.

#### **4.1.3 AIRBORNE RADIATION**

##### **4.1.3.1 URANIUM PARTICULATES**

Air sampling for airborne particulate uranium is performed on a continuous basis at eleven standard locations with filter changes performed on Monday, Wednesday,



and Friday when the dryer is in operation. Breathing zone air sampling is also performed for non-routine operations such as tank entries that are not represented by the standard locations. The Derived Air Concentration (DAC) at the IR CPP is based on lung solubility studies showing the yellowcake product is 85% Class D and 15% Class W resulting in a DAC of 4.7E-10 microcurie per milliliter (uCi/mL). During the Honeymoon product drying campaign, occupational exposures were evaluated using the Y-class Unat DAC of 1E-10 uCi/ml. The conservative Y-class DAC was used due to the lack of supporting scientific solubility data available on the yellowcake product at the new drying parameters.

During drying and packaging operations, the dryer enclosure was posted as an Airborne Radioactivity Area and access is prohibited unless respiratory protection is worn.

Operational and data analysis, specific to the dryer room, identify that dryer atmosphere engineering controls are effective in maintaining uranium air particulate concentration ALARA. Data collected in the Control Area for 2015 indicates an average of 1% and a maximum of 11% of the IR mixture DAC (85% Class D/15% Class W).

Routine air particulate sampling results for 2015 from the dryer and packaging enclosure and areas outside the YC circuit are summarized in the following table. Sample locations identified as locker room, control area, drum loading room furnace room and drum storage area are equipped with continuous air sampling pumps and data collected is used to assess the employee occupational exposure.

<b>Dryer and Packaging Enclosures and Areas Outside the YC Circuit used to assess Employee Occupation Exposures - 2015</b>		
<b>Sampler Location</b>	<b>Average Result % DAC (uCi/ml)</b>	<b>Maximum Result % DAC (uCi/ml)</b>
Locker Room	0.05 (2.59E-12)	3.9 (1.87E-11)
Control Area	1.0 (4.81E-12)	11.2 (5.29E-11)
Drum Loading Room	17.4 (8.2E-11)	137 (6.45E-10)
Furnace Room	15.4 (7.26E-11)	58 (2.73E-10)
Drum Storage	1.3 (6.36E-12)	8.7 (4.11E-11)

Review of the continuous air sampling data indicates that airborne radioactivity levels demonstrates that the furnace and drum loading rooms are at negative pressure to the rest of the facility, which confirms that the engineering controls maintain doses



ALARA. The air particulate concentrations outside of the drying facility are at a small fraction of the DACs.

Airborne uranium sampling from the Christensen Satellite facility is collected on a monthly basis at three sampling locations. The DAC at the Christensen Satellite is based on a solubility classification of 100% Class D or a DAC of 5 E-10  $\mu\text{Ci}/\text{ml}$ . No sample location exceeded 0.27% (2014=5%) of the DAC during 2015.

In 2015, no employee exceeded 10 CFR Part 20.1201(e) limits, *...In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see footnote 3 of appendix B to part 20).*

#### 4.1.3.2 RADON PROGENY

In 2015, radon progeny sampling was conducted on a monthly basis. There were no occurrences at IR and CR where radon daughters exceeded 0.08 WL, which is 25% of the regulatory limit of 4WLM, or 0.33 WL in one month.

Trend analysis for the wellfield modular buildings show radon daughter levels were maintained below 25% of the DAC in 2015. Review of radon progeny data indicates that levels are being maintained ALARA.

#### 4.1.4 COMMITTED EFFECTIVE DOSE EQUIVALENT

The Committed Effective Dose Equivalent (CEDE) was calculated for employees for 2015, which is the combined internal dose due to inhalation of airborne uranium and radon progeny. Other routes of potential internal exposure such as ingestion or absorption in wounds are considered negligible as substantiated by surface and personnel contamination sampling, bioassay sampling, and implementation of good hygiene practices.

The average CEDE for all locations, excluding administrative and laboratory areas, for employees that worked a full year for 2015 was 0.08 rem. The average level for all locations, excluding administrative and laboratory areas, in 2014 was 0.10 rem.

#### 4.1.5 TOTAL EFFECTIVE DOSE EQUIVALENT

The Total Effective Dose Equivalent (TEDE) was calculated for employees for 2015 as shown in the tables located in 4.1 above. The TEDE is the sum of external (DDE) and internal (CEDE) doses. ALARA discussions are provided in the external and internal dose sections above.



#### 4.1.6 RADIATION WORK PERMITS (RWPs)

In 2015, there were no incidents documented associated with RWPs. RWPs are primarily issued for maintenance related activities (not covered under an SOP) where a potential of an occupational exposure could occur. Depending on the task, data collected during an RWP may include air particulate for uranium or radon progeny, bioassay, and or surface contamination. The RWP is another method that supports the ALARA principle. The RSO is migrating tasks that have become routine and performed under a RWP to tasks with written SOPs.

#### 4.1.7 DOSE TO THE PUBLIC

The off-shift operations personnel that utilize the man-camps for Irigaray and Christensen are used to demonstrate compliance with public dose limits. These individuals have been identified as the member of the public likely to receive the highest dose from Willow Creek operations. Monitoring indicates that potential doses to the public are far below allowable limits and ALARA.

In 2015, the dose to public, using the Irigaray Man Camp location, was 0.48 mrem, or 0.5% of the 100 mrem limit, compared to 2014 reported dose to public of 9.2 mrem. In 2015, the Christensen Man Camp location was documented at 8.64 mrem, compared to 0 mrem in 2014. The increase in public dose at CR was attributed to radon daughters.

### 4.2 BIOASSAY RESULTS

Bioassay analyses are performed by a third party outside laboratory. Routine samples are typically collected on a monthly schedule from plant operators, technician and electrician when dryer maintenance is required, and when an RWP is issued. Routine bioassay samples are collected prior to the start of the first day on shift and 36 hours after completion of their last shift. During yellowcake drying operation, samples are collected once per shift rotation or every 4 days.

In 2015, there were 18 bioassay results reported in excess of 5 ug/L, but less than 15 ug/L, and no bioassays were reported in excess of 15 ug/L but less than 35 ug/L. The elevated bioassay samples reported between 5-15 ug/L resulted from inappropriate personal hygiene practices. The RS staff investigated the root cause of the events and provided additional consultation to the two employees regarding the issues of properly donning and removing PPE and proper personal hygiene procedures.

Spiked samples are prepared in accordance with RG 8.22, 1988 version, one at 10-20 ug/L and one 40-60 ug/L, and submitted monthly. The SOP (HP-4) was revised to reflect that the monthly sampling delivery group reflects Section 8.1 requirements of a specimen batch for spiked sample



submittal, analytical rechecks, and protocol when the spikes are reported outside the prescribed 30% QA limit. Review of the current RG 8.22, 2014 version may provide a more efficient procedure for submitting spikes to the third party laboratory.

The bioassay program is compliant with SUA 1341 license conditions, referenced regulatory guidance and the ALARA principle.

#### **4.3 REPORTS OF DAILY, WEEKLY, AND MONTHLY INSPECTIONS**

##### **4.3.1 DAILY WALK-THROUGH INSPECTION REPORTS**

Daily walk-through inspections are accomplished as required and items are resolved in a timely manner.

##### **4.3.2 WEEKLY INSPECTION REPORTS**

Weekly inspections are accomplished as required and items are resolved in a timely manner.

##### **4.3.3 MONTHLY RSO REPORTS**

The RSO provides a monthly report to management to summarize employee exposure and other relevant radiation survey reports and items are resolved in a timely manner.

#### **4.4 DOCUMENTED TRAINING PROGRAM ACTIVITIES**

##### **4.4.1 RADIATION PROTECTION**

In 2015, employees and contractors were trained throughout the year, which included initial (new hire) and annual radiation safety refresher, DOT Hazmat, routine safety meetings (to include tailgate style meetings), and SOP training. In addition to standard site radiation safety, DOT and industrial safety training, Job Safety Analysis (JSA), industrial safety inspections and emergency drills are periodically performed. The radiation safety staff is compliant with their required training.

New employees at Willow Creek are trained in radiation protection prior to reporting to their workstation. Training is provided as described in NRC Regulatory Guide 8.31 and Willow Creek SOP S-2 1. Contractor training is tailored to the specific work task assigned to the contractor.

In 2015, annual radiation protection refresher and DOT Hazmat training was completed in the second quarter.

##### **4.4.2 DOT**

DOT Hazmat training, 49 CFR Part 172, Subpart H, requires the following areas to be included: General Awareness/Familiarization, Function Specific, Safety Training, and Security. Annual DOT Hazmat training is provided to the operators and drivers



associated with Hazmat material transportation. This schedule is compliant with the US DOT training requirements.

#### **4.5 RADIATION SAFETY MEETING REPORTS**

Meetings are documented and records are maintained on site.

#### **4.6 RADIOLOGICAL SURVEY AND SAMPLING DATA**

U1 survey programs are effectively used to maintain exposure ALARA.

##### **4.6.1 PERSONAL AND EQUIPMENT CONTAMINATION SURVEYS**

Personnel surveys are documented at scan stations and reviewed by radiation safety personnel. Spot checks (measurements) were performed on 25% of employees or vehicles per quarter and no contamination was found.

In 2015, no unusual monitoring incidences were identified.

##### **4.6.2 SURFACE CONTAMINATION SURVEYS**

Surface contamination surveys are conducted weekly in eating areas, change rooms, control rooms and offices as identified in RG 8.30. The RSO or designee will be notified if any samples exceed the action level 100 dpm/cm<sup>2</sup> so clean up can occur and the area can be resurveyed.

Shipping surveys, surveys in restricted and clean areas, and surveys for release of equipment for unrestricted use surveys are accomplished and documentation is maintained by radiation safety personnel.

#### **4.7 REPORTS ON OVEREXPOSURES OF WORKERS**

There were no employee overexposures during the 2015 report period.

#### **4.8 OPERATING PROCEDURES**

The RSO reviews SOPs annually as required. The RSO tracks the status of updates and manages the review process. SOPs are a dynamic process and work continues to further add and improve SOPs to better provide guidance for staff to keep occupational exposures ALARA.

In 2015, the RS staff reviewed the SOPs and documented the task.

#### **4.9 EQUIPMENT FOR EXPOSURE CONTROL**

Interviews with employees and radiation safety staff, and observation of equipment in use indicated that equipment was properly being utilized.



## **5.0 CONCLUSIONS AND RECOMMENDATIONS**

In 2015, the preparation and reprocessing of the Honeymoon yellowcake product was completed in March. There were minimal incidents relating to the re-drying of the Honeymoon product while maintaining the ongoing Willow Creek Project's ISR uranium recovery process. This underscores U1's commitment to the ALARA principle.

The radiation safety staff continues to improve on engineering controls, monitoring and documentation to affect a more efficient transfer of information and data flow to the appropriate staff.

U1 should create a policy that describes how Lower Limit of Detection (LLD) or Minimum Detectable Activity (MDA) are calculated and used across the different program areas (ALARA radiation safety, environmental monitoring and public dose reporting). Topics to be covered include QA/QC applications and criteria for when to use actual results vs. calculated values.

A Review of the current RG 8.22, 2014 version may provide a more efficient procedure for submitting spikes to the third party laboratory.

David Rynders, site RSO, is not current on DOT HazMat training in accordance with 49 CFR Part 172, Subpart H.

### **5.1 SUMMARY OF RECOMMENDATIONS**

The RS is continuing to revise and improve forms and documentation. Verify that all forms are revised accordingly.

Training information was submitted to Uranium One to provide David Rynders the proper DOT HazMat General Awareness and Security training in accordance with 49 CFR Part 172 Subpart H. Upon completion of training and proper testing, a certificate will be issued.

The RS staff should continue to improve and revise SOPs.