

July 17, 2013

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Mr. Drew Persinko, Deputy Director
Decommissioning & Uranium Recovery Licensing Directorate
Division of Waste Management & Environmental Protection
Office of Federal and State Materials &
Environmental Management Programs
Mailstop T8-F5
Washington, DC 20555-0001

**Subject: License SUA-1314, Docket No. 040-08502
Willow Creek Project
ALARA Report**

Dear Mr. Persinko:

In accordance with 10 CFR 40.65 and per license conditions 12.1 and 12.6 of Source Materials License SUA-1341, please find enclosed the ALARA audit for 2012 to be inserted into the Semi-Annual Effluent and Environmental Monitoring Report for the period of July 1 through December 31, 2012.

Please contact me should you have any questions regarding this report. (307) 464-1427

Sincerely, 

Larry Arbogast
Radiation Safety Officer

cc: Jon Winter
Tim McCullough
Scott Schierman

**2012 Annual Radiation Protection and
ALARA Audit for Willow Creek Operations**

Prepared for:

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March 29, 2013



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EXECUTIVE SUMMARY

The 2012 Willow Creek Radiation Protection and As Low As Is Reasonably Achievable (ALARA) Audit was performed on February 18 and 19, 2013 by Krista Wenzel, an independent consultant. Larry Arbogast, Radiation Safety Officer (RSO); Scott Schierman, Senior Safety, Health and Environment (SHE) Specialist and Radiation Safety Technician (RST); and Jane Richards, Laboratory Supervisor, assisted with the audit. The audit is designed to review employee monitoring results and the overall radiation program to detect trends in radiation exposure and ensure that radiation exposure is maintained ALARA. The audit includes recommendations to minimize radiation exposures.

A significant number of additional measurements and studies were done throughout the facilities in 2012 to assess gamma radiation and airborne radioactivity levels. These are summarized in Section 1.3. This information was used to maintain an effective radiation protection and ALARA program and protect workers and the environment at Willow Creek. Radiation doses to workers are maintained ALARA and well below the annual occupational limit of 5 rem.

Recommendations include:

- Continue to develop electronic storage of radiation protection data that contributes to assessments of ALARA programs (see Sections 2.2 and 3.1),
- Responses to the recommendations in the Quality Assurance Audit for the laboratory should be documented, retained with the audit, and provided to the RSO (see Section 2.4).
- Continue to assess gamma and radon progeny exposures and controls for sock filters in module buildings to maintain exposures ALARA (see Sections 3.1.1 and 3.1.3.2),
- Standardize the use of notes on field sampling sheets to assist with assessments and trend analysis (see Section 3.1.3.1),
- It may be efficient to reduce air sampling in continually low exposure areas in the Irigaray Plant such as the locker rooms, this time may be better utilized towards higher priority areas of the program (see Section 3.1.3.1),
- As operations become more routine, Standard Operating Procedures (SOPs) should be formalized and used instead of Radiation Work Permits (RWPs), where possible (see Section 3.1.5),
- Update the bioassay SOP to reflect urinalysis spike samples frequency and rationale for the off-site laboratory (see Sections 2.2 and 3.2),
- As operations stabilize, it may be possible to reduce the number of bioassays for employees with lower potential for exposure to uranium (see Section 3.2), and
- The process to update SOPs should be formalized to assign responsibilities (see Sections 2.4 and 3.8).

1.0 INTRODUCTION AND SUMMARY OF ACTIVITIES

This audit was done in accordance with Nuclear Regulatory Commission (NRC) Regulatory Guide 8.31, *Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable*, and Uranium One USA, Inc. License Number SUA-1341, Amendment No. 22, License Condition 10.12.

Several actions occurred during 2012 which have impacted or have the potential to impact radiation exposure trends and programs. A short summary is provided here.

1.1 SAFETY AND ENVIRONMENTAL REVIEW PANEL (SERP)

During the year, several SERP meetings were convened and completed. A list of SERP actions follows:

- SERP 12-01 – Christensen Ranch Mine Unit 8, evaluation for operations in the northeast area
- SERP 12-01A – Christensen Ranch Mine Unit 8, evaluation for operations in the northwest and southeast areas
- SERP 12-02 – Willow Creek SHE organizational structure change
- SERP 12-03 – Christensen Ranch Mine Unit 5, Module 52, resumption of operations
- SERP 12-04 – Christensen Ranch Plant review of test filter pod system
- SERP 12-05 – Willow Creek SHE organizational structure change
- SERP 12-06 – Christensen Ranch Satellite Facility expansion
- SERP 12-07 – not completed, in process
- SERP 12-08 – Christensen Ranch Mine Unit 10A, evaluation for operations

See individual SERP reports for complete details.

1.2 LICENSE RENEWAL

The license renewal is in draft form pending final comments.

1.3 FACILITY AND PROGRAM IMPROVEMENTS

Improvements during 2012 include:

- Studies and controls for pod filter socks related to gamma and radon progeny exposure,
- Studies and controls to optimally vent yellowcake drums prior to sealing,
- Studies and controls to reduce exposure to gamma radiation near the precipitation tank and the yellowcake trailer, and
- Updates to some SOPs to include figures and pictures.

2.0 2012 ASSESSMENTS AND AUDITS

2.1 NRC INSPECTIONS AND RELATED ACTIONS DURING 2012

NRC inspections and related actions at Willow Creek during 2012 are summarized here.

A routine, announced NRC inspection was conducted April 16-18, 2012. Two violations of NRC requirements were identified and subsequently closed. The violations concerned:

- failure to perform surveys, as required by 10 CFR 20.1501(a)(2)(i), and
- failure to ensure that the dose in any unrestricted area does not exceed 0.02 milliseiverts (2 millirem) in any one hour, as required by 10 CFR 20.1301(a)(2).

Willow Creek conducted studies and increased surveys and posting at the precipitation tank and at wellfield module buildings. Fences were also installed on the side of module buildings where sock filters are located and around the yellowcake trailer.

A Confirmatory Action Letter (CAL) was issued by the NRC on July 5, 2012, requiring several actions related to pressurization of drums and subsequent ejection of yellowcake during opening in June 2012 at Blind River, Ontario. Yellowcake shipments were halted at that time. Willow Creek investigated and increased drum venting time, dryer residence time and initiated enhanced inspection of drums prior to shipping.

A non-routine, announced inspection was conducted by the NRC on September 11-13 and October 23, 2012. The NRC was accompanied by two investigators from the US Department of Transportation (DOT). No violations were identified by the NRC or DOT. The CAL was closed by the NRC by memorandum dated December 5, 2012 allowing resumption of yellowcake shipments.

See the NRC inspection and CAL reports for complete details.

2.2 2011 ANNUAL ALARA AUDIT

The following provides the status of recommendations made in the 2011 ALARA audit.

- *A recommendation for improvement for collection and storage of monitoring data to include an electronic format for review, trend analysis, reporting and storage. (Re: 2011 ALARA Audit)*

This recommendation has been partially implemented. Electronic database storage methods are in draft form and being considered to optimize implementation.

- *A recommendation for the third party laboratory to provide lower limit of detection to meet the < 5 microgram per liter (ug/L) reporting limit. Develop a corrective action limit criteria and guidance for analytical results between 5 ug/L and 15 ug/L. Review NRC RG 8.22 regarding spiked sample submittals which states per batch, unless Willow Creek Project's SOPs specifically identifies that batches are unlimited number of submittals per month. The offsite laboratory analyzes 10-20% of sample submittals as duplicates and reports with bioassay results. (Re: 2011 ALARA Audit)*

This recommendation has been partially implemented. The Bioassay SOP should be updated to describe the spike program being implemented for the monthly group of samples.

- *A recommendation that shipping documents be revised to reflect the correct hazardous material Proper Shipping Name (PSN) listed in 49 CFR 172.101. In addition, the shipping documentation sequence should be changed to reflect the new requirement of UN Number, PSN, Hazard Class and Packing Group (Packing Group is not required by DOT for Radioactive Materials). The phase in period for the shipping paper sequence will end January 1, 2013. (Re: 2011 ALARA Audit)*

This recommendation has been considered and implemented to ensure DOT requirements are met.

2.3 SELF-IDENTIFIED VIOLATIONS

There were three self-identified violations reported for 2012. The self-identified violations were made available to the NRC during routine inspections. Corrective actions have been implemented. The violations did not result in significant impact to worker health or the environment.

- March 23, 2012, failure to maintain at least 2 feet of freeboard for Evaporation Pond #2 located at the Christensen Ranch site.
- March 23, 2012, failure to complete weekly evaporation pond inspections.
- January 18, 2013, failure to suspend dry/pack operations on December 9, 2012 when scrubber control equipment was operated outside the parameters specified by Wyoming Department of Environmental Quality Air Quality Permit OP254.

2.4 QUALITY ASSURANCE AUDIT

Inter-Mountain Laboratory (IML) conducted a Quality Assurance Audit on July 31, 2012. According to the Laboratory Supervisor, recommendations have been closed out except two. The first recommends adding detail to standard logs, the information is posted on the wall rather than in the log. The second recommends formalizing a procedure for creating and revising SOPs. This

recommendation also applies to other SOPs at Willow Creek. Responses to the recommendations in this audit should be documented, retained with the audit and provided to the RSO.

See the IML Quality Assurance Audit for complete details.

3.0 ASSESSMENT

3.1 EMPLOYEE EXPOSURE RECORDS AND TRENDS IN PERSONNEL EXPOSURES

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

It is early in this operational cycle of the mine to assess trends for year 2012 data for three reasons: 1) exposures are relatively low, many in the range of background, 2) there are a relatively low number of employees exposed, and 3) operating conditions have changed throughout the year when compared to previous years. For preliminary consideration, some trend analysis and calculations may be useful and are provided.

Trend analysis is expected to become more meaningful as operations continue. In the meantime, the RSO continuously assesses survey results to maintain exposures ALARA. Electronic storage of employee exposure data may assist with trend analysis as operations stabilize and become more comparable.

3.1.1 External Radiation and Deep Dose Equivalent

Monitoring is done for employees that may exceed 10% of the allowable limit as required. Results are provided in Table 1 by primary occupation.

The average Deep Dose Equivalent (DDE) to plant operators that worked a full year in 2012 at the Irigaray Plant is 0.05 ± 0.02 rem and at the Christensen Ranch Satellite Plant it is 0.10 ± 0.02 rem. Gamma surveys substantiate the slightly higher levels in the Christensen Ranch Satellite Plant. Actions throughout the year indicate these levels are ALARA.

The average DDE to wellfield operators that worked a full year in 2012 is 0.14 ± 0.06 rem. The maximum external dose for the year was 0.24 rem for a wellfield operator. Based on gamma measurements from the sock filters in the module buildings, levels in this range may be attributed to the sock filters. The RSO took action to reduce gamma exposure from these operations during 2012 and levels may be lower on average in the future from this source of exposure. This continues to be an interest item for the RSO to maintain exposures ALARA.

Table 1. 2012 Employee Deep Dose Equivalent (DDE) Summary

Primary Occupation	Primary Work Location ^a	DDE (rem)	comments ^b
Irigaray Plant Operator	IR	0.07	
	IR	0.07	
	IR	0.07	
	IR	0.05	
	IR	0.03	
	IR	0.02	
	IR	0.01	half year
	IR	0.04	
	IR	0.04	
	IR	0.00	half year
	CR/IR	0.07	half, each location
Christensen Ranch Satellite Plant Operator	CR	0.09	
	CR	0.12	
	CR	0.19	
	CR	0.09	
	CR	0.00	
Wellfield	CR	0.17	
	CR	0.21	
	CR	0.24	
	CR	0.11	
	CR	0.04	
	CR	0.15	
	CR	0.14	
	CR	0.10	
	CR	0.00	half year
Plant Operator/ Maintenance	IR/CR	0.10	half year, each position
Maintenance	IR/CR	0.09	
Maintenance	IR/CR	0.02	
Electrician	IR/CR	0.00	half year
Electrician	IR/CR	0.00	
Instrumentation	IR/CR	0.00	
Radiation Safety	IR/CR	0.00	
Radiation Safety	IR/CR	0.03	
Radiation Safety/Admin	Admin	0.00	
Laboratory	Laboratory	0.00	
Laboratory	Laboratory	0.00	
Laboratory	Laboratory	0.00	
Secretary/ Laboratory	Admin/Laboratory	0.00	

Notes: a. Abbreviations: IR=Irigaray, CR=Christensen Ranch

b. "half year" indicates that the employee worked in this position approximately half of the year

The average DDE for all locations, excluding administrative and laboratory areas, for employees that worked a full year for 2012 is 0.08 ± 0.07 rem. The uncertainty is almost as high as the average due to the reasons mentioned above. The average level for all locations, excluding administrative and laboratory areas, for the previous year, 2011, is 0.01 ± 0.02 rem. This lower average is not unexpected based on a lower level of operations in 2011.

Routine gamma surveys are conducted to ensure that conditions do not develop which could cause unacceptable levels of external radiation exposures. Extensive and numerous surveys have been done throughout the year and controls implemented, in particular for sock filters in module buildings, around the yellowcake trailer, around the precipitation tank and in uranium drum storage areas.

Operational notes on gamma survey reports are useful to assess short-term trends (e.g., IX column status, operating status of modules, etc.). ALARA assessments have been done by the radiation staff using these results throughout the year. Spot measurements of gamma exposure rates during this audit showed posting meets requirements. Assessments have been effective in maintaining doses ALARA as substantiated by the external dose monitoring results above.

3.1.2 External Radiation - Beta

External dose rate surveys for beta radiation are conducted annually at areas with the highest contamination potential inside the modular buildings, the deep disposal well building, contaminated dumpsters, the Christensen Ranch Satellite Plant and Irigaray Plant. The maximum level was 3 mrem/hr in one modular building; all other levels were less than 1 mrem/hr. The Shallow Dose Equivalent (SDE) and Lens Dose Equivalent (LDE) to workers from whole body dosimeter results were reviewed and found to be consistent with the DDE to workers.

3.1.3 Airborne Radiation

3.1.3.1 Uranium Particulates

Air sampling for airborne particulate uranium is performed on a continuous basis with filter changes performed on Monday, Wednesday, and Friday when the dryer is in operation at eleven standard locations. Breathing zone air sampling is also done for nonroutine operations such as tank entries that are not represented by the standard locations. The Derived Air Concentration (DAC) at the Irigaray Plant 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 ($\mu\text{Ci/mL}$).

During drying and packaging operations the dryer enclosure is posted as an Airborne Radioactivity Area and access is prohibited unless respiratory protection is worn. An operational trend analysis for 2012 was done for three of the air sampling locations: #5 Drum Loading

Room, #7 Furnace Room 2nd Level, and #9 Furnace Room Top Level. These locations were chosen because results at other locations were on average far less than the DAC and no trends would be evident.

A basic trend analysis for the three locations of interest is shown in Figure 1. The linear trend lines show a minor downward trend. Since this is an operational analysis specific to the dryer room that shows air sampling results that include times that workers are not present, exposures to workers were far below these levels. It is a useful analysis to monitor the efficacy of controls or to identify unusual occurrences. In this case, the graph shows that controls are, on average, effectively maintaining low levels of airborne uranium.

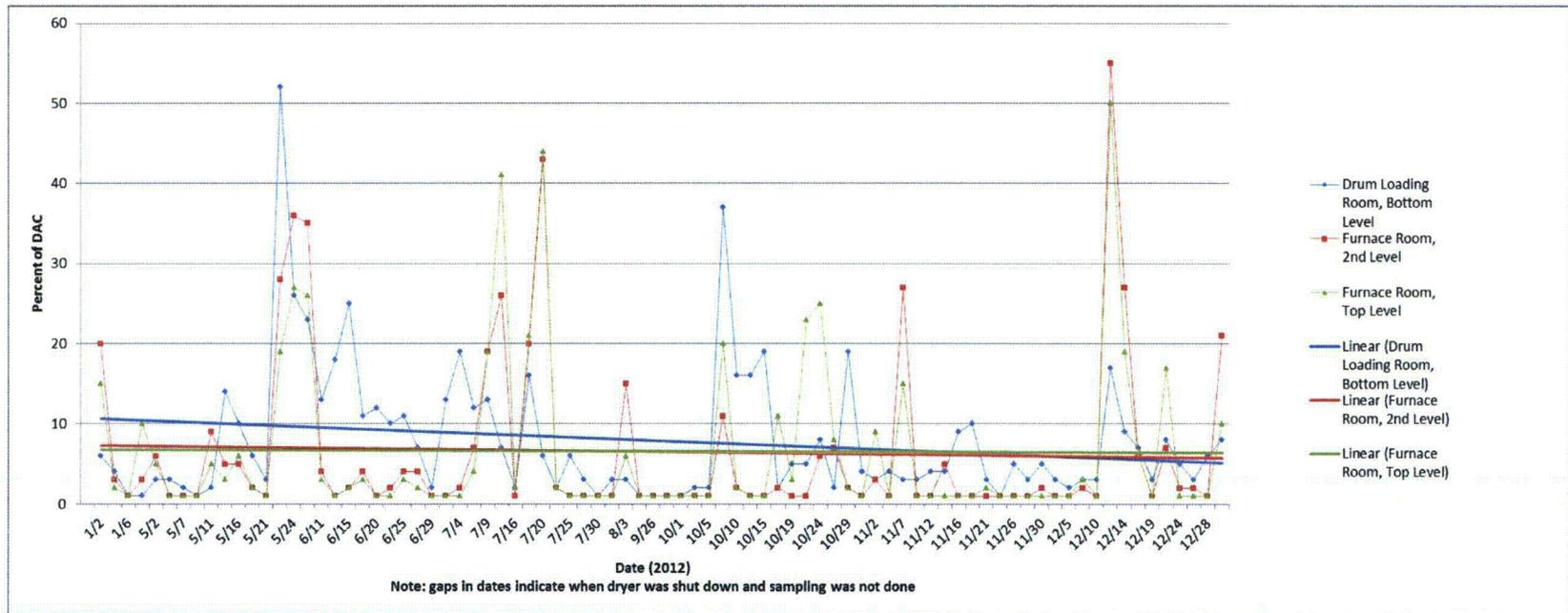
Results of air monitoring in other areas of the building indicate that controls are effectively containing airborne uranium to the dryer room. Review of results from areas outside the dryer including in the drum storage area show an average of less than 1 percent of the 85% Class D/15% Class W DAC.

It will continue to be useful to include notes on air sampling forms to correlate higher results with activities. Notes regarding activities were included on some of the higher results for 2012 but not all of them. A specific level of interest could be considered and notes could be included for any results above those levels for review by the RSO. For example, a note could be added when a specific percentage of the DAC is exceeded for an air sample result, whether a worker was exposed at this level or not.

Three of the air sampling locations were less than 1% of the DAC for all sampling events, these locations were the #1 Locker Room, #2 Locker Room, and #3 Control Room Bottom Level. The other five locations showed levels of up to 5% of the DAC on eight sampling dates. Levels during the previous year, 2011, did not exceed 1.1% of the DAC, however, the dryer began operating in September of 2011.

It is recommended that sample locations and durations be assessed for possible reallocation of sampling durations. One suggestion is to analyze samples at the current duration for the drum loading, furnace room, and drum storage locations and increase sampling times for some of the other areas. For instance, locker room air samples could be analyzed if used by a contaminated person or weekly whichever comes first. Filter loading could also be tracked to ensure interference from dust loading is minimized.

Figure 1. 2012 Airborne Uranium Sampling in the Drum Loading and Furnace Room



3.1.3.2 Radon Progeny

Radon progeny levels and associated controls are a high interest item for the site. In 2012 radon progeny sampling was done more frequently to gain a better understanding of radon progeny levels. Sampling frequency and controls are changing as needed to address issues as quickly as necessary to maintain exposures ALARA.

Levels greater than the action level of 25% of the DAC or 0.08 Working Levels (WL) were investigated immediately and controls were implemented. As an example, an investigation was conducted in the tank house for Deep Disposal Well No. 18-3 after sampling results indicated levels were 1.16 WL. The area was vented immediately by opening doors and it was discovered that the main blower system was not working. Doses were assigned to workers based on averages of sampling results and time spent in the area. The blowers were fixed within 19 days.

Trend analysis for these results was not done due to the variance in results and controls. It may be useful to assess for trends after controls have stabilized and houses and operations have been in use for longer periods.

3.1.3.3 Committed Effective Dose Equivalent

The Committed Effective Dose Equivalent (CEDE) was calculated for employees for 2012 as shown in Table 2. The CEDE 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 to plant operators that worked a full year in 2012 at the Irigaray Plant is 0.17 ± 0.04 rem and at the Christensen Ranch Satellite Plant it is 0.15 ± 0.01 rem. The average CEDE to wellfield operators that worked a full year in 2012 is 0.12 ± 0.06 rem. The maximum CEDE for the year ranged from 0.17 to 0.20 rem for plant and wellfield operators. Numerous assessments and inspections and subsequent actions were taken throughout the year and this continues to be an interest item for the RSO to maintain exposures ALARA.

The average CEDE for all locations, excluding administrative and laboratory areas, for employees that worked a full year for 2012 is 0.12 ± 0.07 rem. The uncertainty is high due to the relatively low doses and low number of employees. The average level for all locations, excluding administrative and laboratory areas, for the previous year, 2011, is 0.04 ± 0.05 rem. This lower average is not unexpected based on a lower level of operations in 2011.

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Table 2. 2012 Employee Committed Effective Dose Equivalent (CEDE) Summary

Primary Occupation	Primary Work Location ^a	CEDE (rem)	comments ^b
Irigaray Plant Operator	IR	0.19	
	IR	0.20	
	IR	0.19	
	IR	0.19	
	IR	0.10	
	IR	0.09	
	IR	0.07	half year
	IR	0.19	
	IR	0.19	
	IR	0.01	half year
	CR/IR	0.17	half, each position
Christensen Ranch Satellite Plant Operator	CR	0.15	
	CR	0.15	
	CR	0.17	
	CR	0.13	
	CR	0.15	
Wellfield	CR	0.17	
	CR	0.17	
	CR	0.17	
	CR	0.12	
	CR	0.05	
	CR	0.17	
	CR	0.10	
	CR	0.03	
	CR	0.00	half year
Plant Operator/ Maintenance	IR/CR	0.09	half year, each position
Maintenance	IR/CR	0.05	
Maintenance	IR/CR	0.01	
Electrician	IR/CR	0.00	half year
Electrician	IR/CR	0.00	
Instrumentation	IR/CR	0.00	
Radiation Safety	IR/CR	0.00	
Radiation Safety	IR/CR	0.00	
Radiation Safety/Admin	Admin	0.00	
Laboratory	Laboratory	0.00	
Laboratory	Laboratory	0.00	
Laboratory	Laboratory	0.00	
Secretary/ Laboratory	Admin/ Laboratory	0.00	

Notes: a. Abbreviations: IR=Irigaray, CR=Christensen Ranch

b. "half year" indicates that the employee worked in this position approximately half of the year

3.1.4 Total Effective Dose Equivalent

The Total Effective Dose Equivalent (TEDE) was calculated for employees for 2012 as shown in Table 3. The TEDE is the sum of external (DDE) and internal (CEDE) doses. ALARA discussions are provided in the external and internal dose sections above.

The average TEDE to plant operators that worked a full year in 2012 at the Irigaray Plant is 0.22 ± 0.06 rem and at the Christensen Ranch Satellite Plant it is 0.25 ± 0.07 rem. The average TEDE to wellfield operators that worked a full year in 2012 is 0.27 ± 0.11 .

The average TEDE for all locations, excluding administrative and laboratory areas, for employees that worked a full year for 2012 is 0.20 ± 0.12 rem. The uncertainty is high due to the reasons mentioned above. The average level for all locations, excluding administrative and laboratory areas, for the previous year, 2011, is 0.05 ± 0.06 rem. This lower average is not unexpected based on a lower level of operations in 2011.

3.1.5 Radiation Work Permits

As noted in the 2011 audit, RWPs continue to be issued conservatively. This gives the radiation safety staff additional oversight as operations continue to be refined to maintain doses ALARA. As operations become more routine, SOPs should be formalized and used instead of RWPs, where possible. This may also benefit the overall training program because workers will be trained on and become accustomed to using standardized procedures associated with routine operations.

3.1.6 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.

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Table 3. 2012 Employee Dose Summary

Primary Occupation	Primary Work Location	DDE (rem)	CEDE (rem)	TEDE (rem)	comments
Irigaray Plant Operator	IR	0.07	0.19	0.26	
	IR	0.07	0.20	0.28	
	IR	0.07	0.19	0.26	
	IR	0.05	0.19	0.24	
	IR	0.03	0.10	0.13	
	IR	0.02	0.09	0.11	
	IR	0.01	0.07	0.08	half year
	IR	0.04	0.19	0.23	
	IR	0.04	0.19	0.23	
	IR	0.00	0.01	0.01	half year
	CR/IR	0.07	0.17	0.24	half, each position
Christensen Ranch Satellite Plant Operator	CR	0.09	0.15	0.24	
	CR	0.12	0.15	0.27	
	CR	0.19	0.17	0.35	
	CR	0.09	0.13	0.22	
	CR	0.00	0.15	0.15	
Wellfield	CR	0.17	0.17	0.34	
	CR	0.21	0.17	0.39	
	CR	0.24	0.17	0.41	
	CR	0.11	0.12	0.22	
	CR	0.04	0.05	0.09	
	CR	0.15	0.17	0.33	
	CR	0.14	0.10	0.24	
	CR	0.10	0.03	0.13	
	CR	0.00	0.00	0.00	half year
Plant Operator/Maint	IR/CR	0.10	0.09	0.19	half, each position
Maintenance	IR/CR	0.09	0.05	0.13	
Maintenance	IR/CR	0.02	0.01	0.03	
Electrician	IR/CR	0.00	0.00	0.00	half year
Electrician	IR/CR	0.00	0.00	0.00	
Instrumentation	IR/CR	0.00	0.00	0.00	
Radiation Safety	IR/CR	0.00	0.00	0.00	
Radiation Safety	IR/CR	0.03	0.00	0.03	
Radiation Safety/Admin	Admin	0.00	0.00	0.00	
Laboratory	Laboratory	0.00	0.00	0.00	
Laboratory	Laboratory	0.00	0.00	0.00	
Laboratory	Laboratory	0.00	0.00	0.00	
Secretary/ Laboratory	Admin/ Laboratory	0.00	0.00	0.00	

Notes: a. Abbreviations: IR=Irigaray, CR=Christensen Ranch

b. "half year" indicates that the employee worked in this position approximately half of the year

3.2 BIOASSAY RESULTS

Bioassay (urinalysis) samples are collected monthly at the Christensen Ranch Site from plant operators, wellfield operators, laboratory personnel, wellfield maintenance personnel and electricians. At the Irigaray Plant samples are collected monthly from the plant operators except during yellowcake drying operations. During drying operations samples are collected once per rotation every 4 days. Analysis is conducted by an outside laboratory. During 2012 no bioassay samples exceeded the 15 ug/L uranium action level.

Quality Control (QC) blanks and spikes are sent monthly to represent that month's batch of bioassay samples. Review of the QC data indicates that the variability of the actual laboratory data compared to the spike value exceeded the 30% guidance criteria on one occasion August 13, 2012. Spikes were redone on August 16, 2012, and again on August 29, 2012 using old and new spike solutions. Both sets came back within the guidance criteria and no cause was determined. Spikes after that time came back within the guidance criteria as well.

More bioassay assessments were done than are required, making for a solid program to document the minimal exposures related to significant changes to operations and as personnel adapt to new or changed work activities. As operations become more routine, it may be possible to reduce the number of bioassays for employees with lower potentials for uranium exposures. Wellfield workers have the potential to fall into this category. Random bioassays could be instituted for those employees.

Spikes are done for a batch of samples taken during a given month; this is not reflected specifically in the bioassay SOP. As noted during last year's audit, the bioassay SOP should be updated to define a batch of samples and reflect urinalysis spike sample frequency.

3.3 REPORTS OF DAILY, WEEKLY, AND MONTHLY INSPECTIONS

3.3.1 Daily Walk-through Inspection Reports

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

3.3.2 Weekly Inspection Reports

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

3.3.3 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.

3.4 DOCUMENTED TRAINING PROGRAM ACTIVITIES

3.4.1 Radiation Protection

Review of training records indicates compliance with license commitments and NRC Regulatory Guide 8.31. 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-21. Contractor training is tailored to the specific work to be done by the contractor.

Annual radiation protection refresher training in 2012 was provided during the first quarterly SHE training of the year. Additional training topics are included each quarter. Other radiation topics covered during training in 2012 include:

- Prior year radiation monitoring summaries for employees,
- Vent fans in modular buildings,
- Restricted Area policy,
- Bioassay program,
- Respiratory protection refresher,
- Radiation Areas in modular buildings,
- SOP changes,
- Locking doors and gates,
- Monitoring stations for employees and contractors,
- Spills and leaks clean-up, and
- Resin shipment forms.

3.4.2 DOT

Operators and drivers are given function-specific DOT training as well as others assigned tasks associated with preparation of materials for transport. Others involved with DOT activities are given Hazmat DOT training.

3.5 RADIATION SAFETY MEETING REPORTS

Meetings are documented and records are maintained on site.

3.6 RADIOLOGICAL SURVEY AND SAMPLING DATA

Survey programs described below were reviewed and are effectively used to maintain exposure ALARA.

3.6.1 Personal and Equipment Contamination Surveys

Personnel surveys are documented at scan stations and reviewed by radiation safety personnel. Spot checks (measurements) were done for 25% of employees or vehicles per quarter and no contamination was found. Respirators are wipe-tested after each use.

3.6.2 Surface Contamination Surveys

Surface contamination surveys are conducted as required and issues are resolved in a timely manner. 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.

3.7 REPORTS ON OVEREXPOSURES OF WORKERS

There were no employee overexposures during the 2012 report period.

3.8 OPERATING PROCEDURES

The RSO reviews SOPs annually as required. The RSO tracks the status of updates and manages the review process. Substantial work has been done and is in progress to further improve SOPs by including pictures. Recommend that the process to update SOPs be formalized in an SOP to assign responsibilities. This is a good practice in the event there is a change in personnel or responsibilities.

3.9 EQUIPMENT FOR EXPOSURE CONTROL

Spot checks of equipment at the Irigaray Plant indicate that equipment is properly used, maintained, and inspected.

4.0 CONCLUSIONS AND RECOMMENDATIONS

A significant number of additional measurements and studies were done throughout the facilities in 2012 to assess gamma radiation and airborne radioactivity levels. These are summarized in Section 1.3. This information was used to maintain an effective radiation protection and ALARA program and protect workers and the environment at Willow Creek. Radiation doses to workers are maintained ALARA and well below the annual occupational limit of 5 rem.

4.1 SUMMARY OF RECOMMENDATIONS

A summary of recommendations is provided in the Executive Summary at the beginning of this report.

4.2 RECOMMENDATIONS TO FURTHER REDUCE PERSONNEL EXPOSURES

In addition to recommendations above, it may be useful to consider site ALARA-related goals for 2013. ALARA-related goals can vary across the broad range of topics discussed above and are usually aligned with operational goals. A suggestion for a goal is to reduce the annual dose for the maximally exposed individual by 10% and maintain the average annual dose to employees while planning for new and increased operations.