	UR-ENERGY USA, INC. LOST CREEK ISR, LLC STANDARD OPERATING PROCEDURE	
SURFACE CONTAMINATION (SWIPE) SURVEYS		
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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe radiological surveying to determine if surface contamination is present on fixed surfaces within the Processing Plant (Plant) at the Lost Creek ISR (LC-ISR) project. Other areas such as header houses in the wellfield may be surveyed as necessary. Surface contamination surveys are done in accordance with Regulatory Guide 8.30 Section 2.5 and include visual and swipe surveys to detect removable contamination. Areas where yellowcake may accumulate within the restricted area (aka yellowcake areas) are to be surveyed visually in conjunction with radiation safety inspections (see SOP_LC_HP-003: *Radiation Safety Inspections*). Non-restricted areas of the Plant and restricted areas where work with uranium is not performed will be swipe surveyed routinely. Surface contamination measurement for alpha and beta radiation is measured by the use of the alpha/beta counting system (see SOP_LC_HP-018: *Alpha/Beta Counting Systems*) for counting swipes.

Surveying for surface contamination on materials and equipment is described in SOP_LC_HP-014: *Screening and Decontamination of Materials for Unrestricted Use*.

2.0 RESPONSIBILITIES

The EHS Department and Radiation Safety Officer are responsible for:

- Ensuring regular inspections of Plant for contamination
- Ensuring regular surface contamination surveys are performed
- Evaluating swipes to determine compliance with contamination limits
- Evaluating data to determine trends in potential contamination levels

3.0 PREREQUISITES AND TRAINING

A functioning, properly calibrated instrument that measures alpha and beta-gamma radiation shall be used for counting swipes. Swipe media that are compatible with the counting system should be used.

Training includes reading and understanding this SOP and demonstrating the proper preparation and use of the meter. Practical demonstration of the proper use of the instrument shall be conducted under the supervision of the RSO.

4.0 DEFINITIONS

Counts per minute (cpm): The measure of radioactivity by which the number of nuclear disintegrations per minute (dpm) are detected and counted through detection of alpha, beta, or gamma radiation. Dpm is determined from cpm based on the detector's efficiency in measuring the radiation.

Disintegrations per minute (dpm): The actual radioactivity of a substance representing the number of atoms decaying per minute by alpha, beta, and/or gamma radiation. Dpm is a calculated value based on the detector's cpm and efficiency in measuring the radiation.

Fixed contamination: The radionuclides on a surface which are not easily removed through contact or easily re-suspended.

Removable contamination: The radionuclides on a surface that can be re-suspended in the air or transferred to another surface.

Restricted Area: An area of controlled access within the Plant, entry to which requires personnel to be radiation safety trained or to be accompanied by a trained individual when in the area, and which requires contamination screening of personnel upon exiting the area.

Swipe (Smear): A radiation survey technique which is used to determine levels of removable surface contamination. A medium (typically filter paper) is rubbed over a surface (typically of area 100 cm2), followed by a quantification of the activity on the medium (NUREG-1757).

Unrestricted Area: An area within the Plant where no training or screening of personnel is required other than site orientation such as the office area. Visitors may still need to be accompanied by an employee.

5.0 HAZARD ASSESSMENT AND PPE

The individual who performs contamination surveys should be mindful of the presence of the radiation and radioactive material which may be present. While surveying for contamination, the individual should minimize the time spent in an area that is determined to be a radiation area.

Standard Personal Protective Equipment (PPE) applies within the Plant restricted area including hard hat, safety eyewear, and safety footwear. Persons surveying for contamination may wear disposable gloves (e.g. nitrile) when conducting surveys. Decontamination in yellowcake areas may require respirators and coveralls as applicable.

6.0 PROCEDURE

Screening for surface contamination on fixed surfaces may occur as characterization surveys or as routine surveys conducted visually or by swipe testing. Routine surveys will be conducted as summarized in Table 6-1 below:

TABLE 6-1: Routine Survey Summary

Routine Survey Area	Survey Type	Frequency	Contamination Limit
Precipitation/Filter Press Circuit	Visual	Daily or each day of use	220,000 dpm/100cm^2 alpha (1E-03µCi/cm2)
Dryer Room			
Drum Storage			
Control Room	Swipe	Weekly	1,000 dpm/100 cm^2 alpha or beta
Lunchroom			
Change Rooms			
Laboratory			
Offices			

If appropriate, surface contamination may be detected or verified by the use of detector probes that can detect presence of fixed or removable alpha and beta radiation.

6.1 Characterization Surveys

An initial survey to characterize the Plant shall be performed before use of radioactive materials to determine the background levels. Characterization surveys by swipe method shall occur periodically after startup to determine if there are areas of concern for contamination. The frequency of characterization should be at least monthly or as necessary based on the results of routine surveys at the discretion of the RSO. The characterization surveys will be a more thorough survey of potential areas of contamination than routine surveys and include detections for alpha and beta radiation. Locations for the characterization swipes will be at the discretion of the RSO but will at least include the routine survey locations. Also, additional areas for routine surveys may be added at the discretion of the RSO based on the characterization surveys. Areas outside of the Plant such as header houses may be surveyed for characterization as appropriate.

6.2 Visual Survey

Visual surveys will be conducted in conjunction with the routine health physics inspections (see SOP_LC_HP-003: *Health Physics Inspections*). The visual inspection is mostly for the restricted area of the facility where uranium is handled, such as the precipitation/filter press area, dryer room, and drum storage. ALARA shall be met if a limit of 10^{-3}µCi/cm^2 (or 220,000 dpm/100 cm^2) of alpha contamination is used which should be readily visible on surfaces (RG 8.30 pg 11). This should ensure that a contribution to airborne radioactivity will be kept well below limits.

The following steps will be taken for visual surveys:

- Visual inspection shall occur on a daily basis;
- Visual inspection shall occur in the restricted area including precipitation circuit (including filter press), yellowcake dryer room, and drum storage for evidence of yellowcake dust on surfaces;
- Visible yellowcake should be cleaned up promptly especially where contamination could be disturbed and re-suspended such as walkways, railings, tools, vibrating machinery, and similar surfaces;
- Clean visible yellowcake as described in Section 6.4;

- Spills with wet yellowcake should be cleaned up before drying to limit suspension of dried yellowcake.

6.3 Swipe Surveys

Unrestricted areas of the Plant and restricted areas where work with uranium is not performed will be surveyed weekly (RG 8.30 Table 3) for removable contamination using swipe methods. Areas that exceed the removable contamination limit of 1,000 dpm alpha or beta per 100 cm^2 will be cleaned and re-surveyed. The ALARA target for contamination control is background level. Swipe tests will be focused on areas where the contamination is more likely, such as high traffic areas.

To conduct a swipe test on a surface:

1. Put on disposable gloves as necessary;
2. Select swipe media; glass filter paper or other equivalent media compatible with the counting system should be used. Glass filter or paper fiber disks typically have the best collection efficiency (Frame and Abelquist).
3. With moderate pressure, smear the target area of approximately 100cm^2. One method is to perform an S-shaped wipe with a length of 40cm using a 3cm diameter filter paper (Frame and Abelquist);
4. If stored, swipe samples should be individually placed in a paper envelope, or equivalent. The envelope should be labeled with at least the sample ID, sampler name or initials, and date/time of sample.
5. When swiping is complete, bring swipe samples to the counting instrument;
6. Record sampling information on FORM_LC_HP-010A: *Swipe Sampling Record*;
7. Place the swipe in a counting device that has been calibrated and efficiency determined;
8. Record the counts from the detector on FORM_LC_HP-010A;
9. Calculate the dpm of the surface surveyed. This is determined by adjusting for the collection efficiency and the counting efficiency. When the radionuclide is not known use the most conservative counting efficiency. For alpha radiation contamination, efficiency for plutonium (approximately 5.15 MeV) is given for many detectors and can be used. A conservative collection efficiency of 10% may be assumed; however, attention must be given to the definition of the limits

on which action is determined. Use the following equation to determine the dpm (Frame and Abelquist);

$$dpm = \frac{cpm - cpm_{background}}{E_{counting} \times E_{collection}}$$

10. Determine if decontamination is necessary based on the dpm, and the allowable ratio of removable and fixed contamination;
11. Decontaminate as described in Section 6.4;
12. After the area is cleaned up, the surface should be smear tested again.

6.4 Decontamination Procedures

Cleaning should be performed by wetting the area first. Sweeping and vacuuming may disturb the dust and create more of a hazard than if the contamination had been left alone.

To decontaminate a surface:

1. Wear disposable gloves.
2. If dry, then wet the area with water, which will prevent re-suspension.
3. Wipe up or wash down the area until the contamination is no longer visible, or until the contamination is likely removed. Paper towels are recommended, but anything can be used, such as a mop, and will finally be disposed of as 11e2 waste.
4. An adhesive material such as masking tape can be used to remove contamination that is not easily removable.
5. Anything used to clean up the contamination such as gloves or paper towels must be disposed of as 11e2 waste.
6. Verification swipe tests will be performed to ensure contamination was cleaned up to appropriate limits.
7. Dispose of any cleaning media in the 11e2 byproduct waste container

Decontamination in yellowcake areas:

1. Wear respirator and other PPE as appropriate;
2. The dryer room has a water supply hose for washing down equipment and drums;

3. Lightly rinse visible yellowcake from surface using gentle water spray;
4. Rinsate will be collected into the Plant sump system which in turn is either disposed as wastewater into the Deep Disposal Well or recycled to the precipitation circuit if the quantity of product warrants.

6.5 Evaluation of Characterization Data

A map will be produced of all the locations surveyed. Data will be plotted on trend charts over time. After a sufficient amount of data for alpha and beta activity has been established, trends will be evaluated.

Survey data will be entered into the Plant database. The data for each sampling location should be compared to previous measurements in the same location. The sample value will be compared with the average value. The database may be set up to look for a long or short term linear trend. Significant trends should be explainable. Explanations of previous trends to facilitate the analysis of future trends should be discussed in the Annual RPP/ALARA Report. Periodically, trends should be plotted and placed in the files with the data sheets.

One potential trend to look for is if the general contamination levels of the facility are increasing. A gradually increasing contamination across the facility could be an indicator of need for more intensified general cleaning and improved radiation control.

6.6 Quality Assurance/Quality Control

The QA/QC specific to Ludlum Model 3030P and Protean ASC-950-DP used to count swipes is included in SOP_LC_HP-018: *Alpha/Beta Counting Systems*.

6.6.1 Data Objectives

Data in dpm per unit area is collected from the alpha-beta counters and compared to surface contamination control limits shown on Table 6-1. In accordance with RG 8.30 Table 3, the lower limit of detection should be 500 dpm/100cm^2 of alpha.

6.6.2 Measurement Quality Control

Instruments are checked daily or prior to use to verify the proper function and calibration of the instrument. Perform the following instrument checks for the instrument:

- *Function check*. Turn on instrument and verify battery power and response to a radiation source.
- *Calibration check*. Set up instrument to detect a check source and measure source for the recommended interval. The result should fall within the acceptable range determined for the source (see Section 6.3 SOP_LC_HP-004).
- *Background measurement*. The background should be measured for the day of operation. The results should be added to the background control chart for the instrument.
- *Efficiency Calculation*. Calculate the efficiency for the instrument for the day using the formula:

$$E = \frac{cpm}{dpm} * 100$$

E: Efficiency value in percent
cpm: counts per minute the detector records
dpm: disintegration per minute value of the calibration source

The efficiency should be added to the control chart data and monitored.

6.6.3 Calibration

Calibration of alpha-beta counters is discussed in SOP_LC_HP-018: *Alpha/Beta Counting Systems*. The detector units will be sent to the manufacturer or an authorized service technician for calibration at least annually.

6.6.4 Data Verification and Validation

The individual collecting data shall verify that routine data values are reasonable. Data can be compared to previous data sets or to characterization data with the use of trend charts to quickly assess if data is consistent. The RSO may review the trend chart data sets to validate whether the data is acceptable.

6.6.5 Audits/Corrective Actions/ALARA

If trends in data are observed, the Health Physics staff should perform an ALARA audit to determine the cause. The results along with recommendations for improvements in contamination control or measurement techniques may be included in the Annual Radiation Protection Program/ALARA Report. The RSO will ensure corrective actions are completed as necessary.

7.0 DOCUMENTS AND RECORDS

Records that shall be retained for surface contamination surveys include:

- Instrument calibration and maintenance records;
- Instrument background and efficiency determination;
- Records of visual inspections;
- Records of swipe tests and associated analytical data;
- Records of surface scans and resulting data;
- Annual RPP/ALARA reports and corrective actions of any surface decontamination and follow-up survey results.

8.0 REFERENCES

Code of Federal Regulation Title 10 Part 20: *Standards for Protection Against Radiation*

Detecting Removable Surface Contamination. Robert C. Klein, et al. https://hps.org/membersonly/publications/hpj/0004032-199202000-00010.pdf

FORM_LC_HP-010A: *Swipe Surveys*

NRC, Regulatory Guide 1.86: *Termination of Operating Licenses for Nuclear Reactors*, June 1974

NRC, Regulatory Guide 8.30: *Health Physics Surveys in Uranium Recovery Facilities,* May 2002

NRC License Application Technical Report, Section 5.7.6.2: *Area Surveys*, April 2010

SOP_LC_HP-004: *Instrument Calibration*

SOP_LC_HP-014: *Screening and Decontamination of Materials for Unrestricted Use*

SOP_LC_HP-018: *Alpha/Beta Counting Systems*

Use of Smears for Assessing Removable Contamination. Paul W. Frame and Eric W. Abelquist. http://www.hps1.org/sections/rso/ophpinfo/smears.PDF