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PERSONNEL SURVEYS			
Edition: 10Jul2013 Rev2	SOP Number: SOP_LC_HP-007	Author: MDG/CJP	

CTK 4/24/2013; CTK 6/6/2013; CJP 6/6/2013; MDG 6/7/2013	Final Approval:

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to detail the procedure for the radiological survey of personnel for contamination control at the Lost Creek ISR (LC-ISR) Processing Plant (Plant). Primarily, surveying involves the scanning of personnel by performing a radiological survey when leaving the restricted area to prevent the spread of contamination to non-restricted areas. The survey is performed by the individual using a device that can detect alpha and beta-gamma activity on their hands, feet, or any other part suspected of contamination. If activity is detected over the action limit, an attempt will be made to decontaminate the person or items of clothing. Personnel surveys will also be conducted when an individual may likely have been exposed to contamination in the wellfield.

## 2.0 **RESPONSIBILITIES**

The Radiation Safety Officer, Health Physics Technician, or the Health Physics designee is responsible for:

- Ensuring that personnel perform surveying at any one of the four Plant Monitors prior to exiting the restricted area;
- Ensuring that personnel perform surveying whenever they may have become contaminated with 11e2 byproduct material, such as personnel who have been in mine units, the byproduct storage area, or near the deep well or storage ponds. RSO ensures they will perform and document an alpha/beta-gamma survey immediately upon entering non-restricted Plant areas (e.g., offices and restrooms), before eating, or before leaving the mine site, whichever comes first.
- Setting action limits for surveying;
- Ensuring scanning equipment is calibrated and maintained;
- Maintaining records of surveying and instrument calibration;
- Training individuals on the proper methods of surveying and decontamination.
- Performing daily calibration function checks of the survey instruments;
- Performing verifications to ensure personnel are performing surveys and performing them properly.

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Employees are responsible for:

• Properly performing personnel surveys whenever they exit the restricted area; or whenever they may have become contaminated with 11e2 byproduct material, such as personnel who have been in mine units, the byproduct storage area, or near the deep well or storage ponds. They will perform and document an alpha/beta-gamma survey immediately upon entering non-restricted Plant areas (e.g., offices and restrooms), before eating, or before leaving the mine site, whichever comes first.

# 3.0 PREREQUISITES AND TRAINING

Equipment that is calibrated and functioning properly must be maintained for each surveying station. The equipment must be able to detect alpha and beta/gamma radiation at the designated release limit.

All workers shall receive training regarding how to properly perform and document alpha/beta surveys. The RSO or HPT shall post by each alpha/beta survey meter the written instructions for use of the system and the release limits in counts per minute.

The stations will have Ludlum Model 43-93 Alpha/Beta Detectors or equivalent as approved by the RSO. There will be four (4) survey stations spread among the exits of the restricted area of the Plant as shown on TR Figure 5.7-1 (reproduced in the appendix). One station will be located at the north door (North Monitor), one at the south door (South Monitor), one at the east shop door (East Monitor), and one at the entrance to the office (Office Monitor) from the Plant (see generalized map included with this SOP).

Training includes understanding the requirements of this SOP and a practical demonstration by the trainee under the supervision of qualified personnel, such as the RSO or HPT. Training shall be documented. An individual that is trained should demonstrate:

- Proper use of the equipment;
- Survey technique;
- Understanding of the alarms, action limits, and decontamination methods;
- Proper documentation of the survey; and

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• Where the survey stations are and when to use them.

Personnel who perform work in a restricted area shall have received radiation safety training in accordance with the LC-ISR Health Physics Program (HPP).

### 4.0 **DEFINITIONS**

<u>11e.(2) (or 11e2) byproduct material</u>: is the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

<u>Controlled area</u>: An area, outside of a restricted area but inside a site boundary which access can be limited by the licensee for any reason. Controlled areas include mine unit boundaries and the fenced Plant area. Visitors may need to be accompanied by an employee.

<u>Counts per minute (cpm)</u>: The measure of radioactivity by which the number of 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.

<u>Disintegrations per minute (dpm)</u>: The actual radioactivity of a substance representing the number of atoms decaying per minute and emitting alpha, beta, and/or gamma radiation.

<u>Non-restricted area</u>: An area that is not restricted that may include a controlled area or an unrestricted area.

<u>rad</u>: (Radiation absorbed dose): A measurement of the energy absorbed by tissue of a person.

<u>rem</u>: (Roentgen equivalent man): A measurement of radioactivity to representing the biological effects of ionizing radiation (i.e. effect of one roentgen of x-rays). *Rem* is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).

<u>Restricted area</u>: An area of controlled access within the Plant, entry to which requires personnel to be radiation safety trained or be accompanied by a trained individual

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when in the area, and which requires contamination surveying of personnel upon exiting the area.

<u>Unrestricted area</u>: An area, access to which is neither limited nor controlled by the licensee. Unrestricted area includes area within the Permit boundary but outside the controlled areas.

## 5.0 HAZARD ASSESSMENT AND PPE

Hand-washing: In a work environment where radiological contamination may exist anywhere and on any co-worker, constant hazard consciousness is critical for everyone's protection. Frequent hand-washing is as important to stop the spread of contamination as it is during flu season to stop the spread of germs. Please wash hands frequently, especially as soon as possible after any possible contact with radiological contamination, and if, contamination is at all suspected especially prior to handling the personnel survey probe.

In this LC-ISR environment, the concern exists that, if a person does not survey properly when leaving a restricted area, contamination may be introduced into a non-restricted area (**possibly your home**) which would require additional surveys and decontamination of the area.

Personal Protective Equipment (PPE) that is used within the restricted area may be removed prior to surveying and stored in the restricted area.

PPE is not required to perform a scan. A second individual who scans another may wear protective gloves (e.g. nitrile) when scanning if contamination is suspected.

## 6.0 PROCEDURE

Documented alpha/beta-gamma personnel surveys must be performed anytime an individual exits the restricted area. These personnel surveys must also be performed by those who may have become contaminated with 11e2 byproduct material, such as personnel who have been in mine units, the byproduct storage area, or near the deep well or storage ponds. They will perform and document an alpha/beta-gamma survey immediately upon entering non-restricted Plant areas (e.g., offices and restrooms),

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before eating, or before leaving the mine site, whichever comes first. Personnel surveys will be performed at one of the four Monitors in the figure included in the appendix.

All exit doors from the restricted area without a permanent or temporary survey station will be designated and labeled as "Emergency Exit Only". A temporary survey station can be set up for a limited period using an alpha/beta-gamma detector or other survey system approved by the RSO.

The ALARA goal of the surveys is no personal contamination above background. Components of the personnel survey process include instrument checks, personnel survey, decontamination, and resurvey (if contamination is indicated).

Table 1 below (Table 1, NRC Regulatory Guide (RG) 1.86) provides surface contamination limits. The values from this table are the same values used for alpha and beta-gamma surface material and area release surveying and decontamination limits (SOP\_LC\_HP-014). Table 2 below (Table 2, RG 8.30) clarifies which values apply to skin and clothing. RG 8.30 also provides that, "All alpha contamination on skin and clothing should be considered to be removable so that the limit of 1,000 dpm alpha per 100 cm<sup>2</sup> applies."



#### Table 1: Acceptable Surface Contamination Limits (RG 1.86)

NUCLIDEa	AVERAGE <sup>b c</sup>	MAXIMUM <sup>b</sup> d	REMOVABLE <sup>b e</sup>
U-nat, U-235, U-238, and associated decay products	5,000 dpm a/100 cm <sup>2</sup>	15,000 dpm a/100 cm <sup>2</sup>	$1,000 \text{ dpm } a/100 \text{ cm}^2$
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm <sup>2</sup>	300 dpm/100 cm <sup>2</sup>	20 dpm/100 cm <sup>2</sup> .
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm <sup>2</sup>	3000 dpm/100 cm <sup>2</sup>	200 dpm/100 cm <sup>2</sup> .
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm β-γ/100 cm <sup>2</sup>	15,000 dpm β-γ/100 cm <sup>2</sup>	1000 dpm β-γ/100 cm <sup>2</sup>

<sup>a</sup>Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

<sup>b</sup>As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

<sup>C</sup>Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

<sup>d</sup>The maximum contamination level applies to an area of not more than 100 cm<sup>2</sup>.

•The amount of removable radioactive material per 100 cm<sup>2</sup> of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

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### Table 2: Surface Contamination Levels (RG 8.30)

#### Surface Contamination Levels for Uranium and Daughters on Equipment To Be Released for Unrestricted Use, on Clothing, and on Nonoperating Areas of UR Facilities\*

Average**	5,000 dpm alpha per 100 cm <sup>2</sup>	Average over no more than 1m <sup>2</sup>
Maximum**	15,000 dpm alpha per 100 cm <sup>2</sup>	Applies to an area of not more than 100 cm <sup>2</sup>
Removable	1,000 dpm alpha per 100 cm <sup>2</sup>	Determined by smearing with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the smear

\* These values are taken from Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors" (Ref. 23), and from "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct Source. or Special Nuclear Material," Division of Fuel Cycle and Material Safety, USNRC, Washington, DC 20555, August 1987 (Ref. 24). Available in NRC Public Document Room for inspection and copying for a fee.

\*\* The value includes both fixed and removable contamination.

(The contamination levels in Table 2 are given in units of dpm/100 cm<sup>2</sup> because this is the minimum area typically surveyed. When performing a smear or wipe test, the area should roughly approximate 100 cm<sup>2</sup>. However, there is no need to be precise about the area to be smeared.)

### 6.1 Instrument Preparation

Calibration checks, background determination, and efficiency calculation, and action limit setting of the instrument will be performed at least once daily by the RSO, HPT, or HP designee (See SOP\_LC\_HP-004: *Radiation Detection Instrumentation*). The alarm on the personnel survey detector will be set by the RSO or HPT after determining the efficiency of the system so that contamination above the limit will be detected and alarmed. The RSO or HPT will also perform a source check at the end of the day-shift as a constancy check. Both the daily check source readings, acceptable range and the action limits will be recorded on the FORM\_LC\_HP-007A\_Personnel Surveys maintained at each survey station.

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# 6.2 Surveying

### Wash hands before surveying if contamination is possible.

The limits for contamination for skin, clothing, and other items to leave the restricted areas are presented in RG 1.86, Table 1, and RG 2.30, Table 2, (both above). Surveying will be performed by placing the surface (palm of hand, or sole of the boot) within approximately ¼" (6 mm) of the detector window. Try to avoid touching the detector, but keep your hand as close as possible.

### Computer Interface Exit Survey Procedure (Skip to Manual Procedure if Tablet or Interface is not working)

- 1. Verify the instrument is turned on;
- 2. Insert ID card into the card reader and follow the prompts on the tablet;
- 3. Follow the prompts on the tablet. You will survey your hands and feet in the following order:
  - a. Left Hand
  - b. Right Hand
  - c. Left Foot
  - d. Right Foot
- You will be instructed to push the button in the black handle of the instrument to start a survey. Colons will be displayed on the digital screen indicating the survey has began;
- 5. Wait for the colons to disappear and for the tablet to tell you to proceed;
- 6. Repeat steps 5 and 6 for each hand and foot, when prompted by the tablet;
- 7. When finished surveying, the tablet will indicate if there is any contamination, or if you are contamination free.
- 8. If the tablet indicates contamination, follow the decontamination procedure below, and resurvey.

## Manual Exit Survey Procedure

- 1. Wash hands to remove possible contamination, and dry thoroughly.
- 2. Verify that the instrument is on, by hearing an audible click or seeing the needle move.
- 3. Perform survey of the palm of each hand and the sole of each foot (boots on).



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- 4. To start a survey, push and hold the button inside the black handle. Colons should appear on the digital display.
- 5. When you release the button the timer will start.
- 6. Hold the face (the mesh) of the detector within a ¼ of an inch of what you are surveying. Make sure the detector is level with what you are surveying.
- 7. Record results, time, date, and your name on the survey log, FORM\_LC\_HP-007A\_Personnel Surveys.
- 8. If an alarm light turned on, or you exceeded the limit then follow the decontamination procedure.

## 6.3 Decontamination

If surveying shows significant contamination, individuals will perform a decontamination procedure within the restricted area as follows:

- 1. If skin is contaminated, wash affected area with soap and water (shower if necessary);
- 2. If clothing is contaminated, remove affected clothing (leave clothes on site until washed and below the contamination limits);
- 3. Perform a resurvey.
- 4. If contamination persists, use mild abrasive methods such as a soft brush or washcloth and detergent to clean affected skin;
- 5. Resurvey
- 6. If contamination still persists, have the plant operator contact the RSO or HPT

More aggressive methods, i.e. use of detergents, may be used but abrasion of the skin should be avoided. The ALARA objective is background and all detected activity is assumed to be removable. If release limits cannot be achieved without abrasion of the skin or other potentially harmful impact to the employee, the RSO may need to refer the employee for medical intervention.

## 6.4 Quality Assurance/ Quality Control/ ALARA

The quality assurance/quality control (QA/QC) described below refers to the Ludlum 43-93 Detector and 2360 survey meter.

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### 6.4.1 Data Objectives

Data is collected and compared to surface contamination control limits as described in Section 6.0. The following table provides a summary of the type of data collected with particular survey instruments:

Detector*	Measure	Units
Ludlum Model 2360 Survey Meter with Model 43-93 100cm <sup>2</sup> Alpha/Beta Scintillator	Alpha and Beta surface radiation over 100cm <sup>2</sup>	0-500,000 cpm

\* Detectors equivalent to these mentioned may be used. Data quality may vary dependent upon the make and model.

## 6.4.2 Measurement Quality Control

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

- *MDC*. This is determined based on methods and equations in SOP\_LC\_HP-004: *Radiation Detection Instrumentation*. MDC shall be low enough to meet the action limits required for surveying out.
- *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 (approximately 20% is expected) cpm: counts per minute the detector records dpm: disintegration per minute value of the calibration source

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

## 6.4.3 Calibration

Calibration of instruments is also discussed in SOP\_LC\_HP-004: *Radiation Detection Instrumentation*. The detectors and meters will be sent to the manufacturer or an authorized service technician for calibration at least annually.

## 6.4.4 Data Verification and Validation

The individual collecting data shall verify that the values (efficiency, background and check source) are reasonable. Data can be compared to previous datasets with the use of trend charts to quickly assess if data is consistent. The RSO or HPT will periodically review the trend chart datasets to validate whether the data is acceptable.

## 6.4.5 Audits/Corrective Actions/ALARA

If trends in data or unreasonable values are observed, the Health Physics staff should perform an 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 or HPT will ensure corrective actions are completed as necessary.

Quality assurance spot checks will be performed to ensure or validate that employees are performing self surveys prior to leaving the restricted areas. Health Physics staff will survey selected individuals to verify there is no surface contamination on the individual. Unannounced quarterly spot surveys of personnel will be performed by the RSO or HPT as recommended by NRC RG 8.30, Section 2.6. The spot surveys will take place in a non-restricted area and will include personnel who work in mine unit and process areas.

Verification of surveying may be facilitated by use of a personnel tracking system integrated into the Plant data system. The system will digitally track an individual as they survey and pass through the station and associate the survey data with that individual. RSO or HPT will periodically check to ensure personnel are surveying as required.

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Resulting data will be reviewed to determine if any trends exist. If an upward trend in monitoring results occurs, an ALARA investigation shall be performed to determine if mitigation is necessary. Results of any investigations will be included in the Annual RPP/ALARA Report.

# 7.0 DOCUMENTS AND RECORDS

Documents and records that shall be retained either electronically or hardcopy associated with personnel surveys include:

- Instrument calibration and maintenance records;
- Instrument background and efficiency determination;
- Surveying records and data;
- Annual HPP/ALARA Report

### 8.0 **REFERENCES**

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

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, Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, April 1993

NRC License Application Technical Report, Section 5.7.6.1: Personnel Surveys, April 2010

NRC License Application Technical Report, Figure 5.7-1: *Locations of In-Plant Radiologic Sampling*, January 2012

SOP\_LC\_HP-004: Radiation Detection Instrumentation

SOP\_LC\_HP-014: Screening and Decontamination of Materials for Unrestricted Use

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# Appendix: MAP OF PERSONNEL SURVEY LOCATIONS

