CAMECO RESOURCES
CROW BUTTE OPERATION

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December 19, 2014

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Attn: Document Control Desk, Director
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Source Materials License SUA-1534
Response to License Condition 11.10

Dear Director:

By letter dated November 5, 2014, the U.S. Nuclear Regulatory Commission renewed Source Material License SUA-1534 issued to Crow Butte Resources, Inc., Crow Butte Uranium In-Situ Recovery Project, Dawes County, Nebraska (TAC J00555).

License Condition 11.10 states, "The licensee shall develop a survey program for beta/gamma contamination for personnel exiting from restricted areas, and beta/gamma contamination in unrestricted and restricted areas that will meet the requirements of 10 CFR Part 20, Subpart F and submit the program to NRC for review and written verification".

"The licensee shall provide for NRC review and written verification the surface contamination detection capability (minimum detection concentration (MDC)) for radiation survey instruments, including scan MDC for portable instruments, used for contamination surveys to release equipment and materials for unrestricted use and for personnel contamination surveys. The detection capability in the scanning mode for the alpha and beta radiation expected shall be provided in terms of dpm per 100 cm^2".

Enclosed is a proposed Survey Program for Beta/Gamma Contamination for the Crow Butte Resources, Inc. operation. The proposed program will be used for surveying personnel and equipment exiting restricted areas at the Crow Butte facility to meet the requirements of 10 CFR Part 20, Subpart F.

NMSS01

If there are any further questions or concerns feel free to contact me at (308) 665–2215 ext. 112.

Sincerely,

Doug Pavlick
General Manager

Enclosure

cc: Deputy Director
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Crow Butte Resources, Inc.
d/b/a Cameco Resources
Crow Butte Operation

SURVEY PROGRAM FOR BETA/GAMMA CONTAMINATION

December 19, 2014

SURVEY PROGRAM FOR BETA/GAMMA CONTAMINATION

The Survey Program for Beta/Gamma Contamination will be used for beta/gamma surveys of personnel and equipment exiting restricted areas at the Crow Butte facility to meet the requirements of 10 CFR Part 20, Subpart F. The program includes surface contamination detection capability (minimum detection concentration (MDC)) for radiation survey instruments, including scan MDC for portable instruments, used for contamination surveys to release equipment and materials for unrestricted use and for personnel contamination surveys. The detection capability in the scanning mode for alpha and beta radiation are in terms of dpm per 100 cm^2.

Training

The Survey Program for Beta/Gamma Contamination will be conducted by an RSO or a qualified HPT. The training will be included as part of New Employee Radiation Safety Training and Annual Refresher Training.

Survey Equipment

The following equipment will be used for personnel monitoring; either Ludlum model 177 counters and 43-5 probes or Ludlum model 2241 scalar/ratemeter or equivalents along with a 43-5 probes or equivalents will be used. For equipment alpha scanning, a Ludlum 2241 scaler/ratemeter or equivalent and, nominally, a 43-65 probe are used. There are several probes that are compatible with these meters that may be used in the future. If these meters are used with alternate compatible probes, the MDC will be verified by the RSO to ensure it meets the requirements. To meet the requirement for measurement of beta radiation, where ambient background conditions permit, monitoring for both alpha and beta radiation will be performed using a 2224 scaler/ratemeter or equivalent along with a 43-93 probe or equivalent equipment.

Personnel Surveys

Personnel leaving a restricted area will be required to perform alpha and beta/gamma surveys and record and sign the logs prior to exiting the area. At a minimum the hands and soles of the boots/shoes will be surveyed. The release limit for personnel scanning will be 1000 dpm/100 cm^2 for alpha and beta/gamma radiation. Scanning stations will be posted with the limit in terms of either the total counts allowed in specified time and/or count rate, depending on the available meter. The limits will be established based on routine background measurements taken at the scanning stations. If a reading above the limit occurs, decontamination and resurveying will be required along with notification to the RSO. Surveys of personnel will generally be performed using scalar, or integrated, counting instead of scanning.

The minimum detectable concentration (MDC) for scalar alpha and beta/gamma measurements using hand held probes will be determined based on the method in NUREG 1507, shown in equation (1). The typical beta/gamma efficiency for a 43-93 probe is 18% – 23%, therefore a value of 18% will be used in the nominal MDC calculations. For alpha efficiency, typical alpha detector efficiencies measured at site, which generally range from 13% to 22%, depending on the detector. A value of 13% has been assumed for the nominal calculations. The actual detector efficiency is determined for each probe on a routine basis, as per site procedures, using a natural uranium check source to ensure the efficiency is accurate and based on the applicable energy range for the contamination it is being used to measure.

$$MDC\left(\frac{DPM}{100cm^2}\right) = \frac{3+3.29\sqrt{R_b\, t_g(1+\frac{t_g}{t_b})}}{\varepsilon_i t_g(\frac{SA}{100cm^2})} \quad (1)$$

where: R_b = the background count rate
t_g = the sample count time
t_b = the background count time
ε_i = the instrument efficiency
SA = probe surface area (cm^2)

Using equation (1), with an efficiency of 13%, a background count time of 5 minutes, a scalar sample time of 30 seconds and an assumed probe area of 50 cm^2, the maximum allowable background counts to achieve an MDC of 500 dpm alpha/100 cm^2 is approximately 150 counts in 5 minutes or 20 counts in 1 minute. Alpha background count rates are typically in the range of 50 counts in 5 minutes. To eliminate the possibility of attenuated alpha particles from the scanning of wet boots, boot wash stations will not be utilized prior to exiting the restricted areas.

For beta/gamma contamination, using an efficiency of 18%, a background count time of 5 minutes, a scalar sample time of 30 seconds and an assumed probe area of 100 cm^2, the maximum allowable background counts to achieve an MDC of 500 dpm/100 cm^2 beta/gamma is 1475 in 5 minutes. With a background count time of 1 minute, the maximum allowable background counts to achieve an MDC of 500 dpm/100 cm^2 is 215 counts in 1 minute. Note, these are nominal calculations, actual probe efficiencies may be used to determined limits for each detector and/or location.

The requirements to be free of visible uranium and to meet the limit for alpha contamination prior to leaving the restricted area will reduce the potential for the spread of contamination outside of the restricted area. The monitoring will consist of a visual examination to detect any visible yellowcake and an alpha meter survey to ensure that any suspected contamination is below the acceptable limits. All contamination on skin and clothing is considered removable, so the limit of 1,000 dpm/100cm^2 is applied to personnel monitoring. If this limit is exceeded, personnel must decontaminate their skin and/or clothing and repeat the alpha survey. As stated in Regulatory Guide 8.30, if the action level is exceeded, the RSO will perform an investigation of the cause of the contamination and take corrective action if appropriate.

Personnel must complete the beta/gamma scanning process and be below the limit of 1000 dpm/100 cm^2 before entering the office areas, eating areas, or leaving the site. If the background beta/gamma count rate exceeds the allowed values, personnel will be required to pass the 1000 dpm/100 cm^2 limit for alpha contamination and then move to a lower background area to monitor for beta/gamma radiation.

Material & Equipment Surveys

For materials and equipment, Regulatory Guide 8.30 indicates the removable release limit is 1000 dpm/100cm^2, the average total activity limit is 5000 dpm/100cm^2 and the total maximum activity limit is 15,000 dpm/100 cm^2. Using the previously mentioned assumptions, if the background levels for beta/gamma reach 3450 counts in 5 minutes or 500 counts in 1 minute, this will result in MDCs of 745 dpm/100cm^2 and 741 dpm/100cm^2, respectively. If this background count rate is exceeded then smears will be required in order to release the equipment, as per existing site procedure, or the equipment will need to be moved to a lower background area for surveying. If contamination levels exceed 750 dpm/100cm^2, an alpha smear will be required. Prior to leaving the restricted zone, the equipment must meet the alpha release limits outlined in Regulatory Guide 8.30.

Surveys of materials and equipment will be performed by the RSO, a qualified HPT, or a trained and qualified employee in the Controlled Release Survey Program (CRSP). Equipment must meet the limits for both alpha and beta contamination prior to being assigned controlled release status.

Though scanning is not the preferred method, it is a potential survey option. For instruments used in ratemeter mode, the beta/gamma MDC will be based on Regulatory Guide 1507. The beta/gamma scan MDC is calculated as follows:

$$Scan\ MDC\ \left(\frac{DPM}{100cm^2}\right) = \frac{d'\left(\frac{60}{t_s}\right)\sqrt{b\left(\frac{t_s}{60}\right)}}{\sqrt{p}\epsilon_i\epsilon_s\frac{Probe\ Area}{100\ cm^2}} \quad (2)$$

Where: t_s = Scan time (sec)
d' = level of performance (Table 6.1 from NUREG 1507) (false negative portion =0.6, true positive = 0.95)
b_i = average number of bkg counts in interval (cpm)
p = surveyor efficiency; assumed 0.5
ϵ_i = instrument efficiency (18%)
ϵ_s = surface efficiency (0.5) from section 5 of NUREG 1507

From NUREG-1575, the level of performance value, d', will be 1.38. This is based on a true positive proportion of 0.95 and false negative portion of 0.60. As described above, the beta/gamma efficiency of 18% will be used in the nominal MDC calculations. The surface efficiency is 0.50, based on the beta emission energy of 2.195 MeV from Pa234m, the primary beta emitter of Uranium 238. The planned scan rate is 1 cm/sec. With a 15 cm probe length, this scan rate equates to a scan time of 15 seconds. Using this method, a background count rate of 575 cpm will result in an MDC of 750 dpm/100cm^2. If the background count rate is exceeded, either smears will be required in order to release the equipment or the equipment will need to be moved to a low background area and resurveyed. If a different scanning rate is used, the MDC will be recalculated based on actual values.

In rooms where work with uranium is not performed, a lower level of surface contamination is likely to be present such as eating rooms, change rooms, control rooms, and offices. Therefore, weekly spot checks will be performed for removable surface contamination using smear tests. All eating rooms, change rooms, control rooms, and offices will be spot checked monthly. If surface contamination levels exceed the values shown in Regulatory Guide 8.30, Table 2, the RSO will be notified and the contaminated area will be promptly cleaned and resurveyed.

The instrument used to quantify removable beta/gamma contamination is the Ludlum model 2929 counter or an equivalent. The typical efficiency for this instrument is 25%. A background count will be taken daily prior to use for 50 minutes and samples will be counted for 1 minute. Using the equation (3), to achieve an MDC of 250 dpm/100 cm^2, the background count must be below 15,000 counts in 50 minutes. Actual MDC values will be calculated based on measured instrument efficiencies.

$$MDC = \frac{3+3.29\sqrt{R_b\ t_g\left(1+\frac{t_g}{t_b}\right)}}{\varepsilon_i t_g} \quad (1)$$

Where: R_b = the background count rate
t_g = the sample count time
t_b = the background count time
ε_i = the instrument efficiency