

# CAMECO RESOURCES CROW BUTTE OPERATION



## Quality Assurance Program

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### 6 ENVIRONMENTAL AND EFFLUENT SAMPLING

CBR performs environmental and effluent monitoring at the Crow Butte project as required by NRC regulations and CBR's source materials license. Measurements are performed for the following purposes:

- To allow CBR to estimate the maximum annual radiation dose to the public;
- To ensure that the regulatory requirements and license conditions for dose and release limitations and meeting "as low as reasonably achievable" objectives are met;
- To evaluate the performance of effluent controls;
- To evaluate the environmental impact of mining operations; and
- To establish baseline data to aid in decommissioning or remediation efforts.

CBR's environmental and effluent sampling program was prepared in accordance with the guidance contained in Regulatory Guide 4.14, "*Radiological Effluent and Environmental Monitoring at Uranium Mills*", (Revision 1, 1980). Regulatory Guide 4.14 and 4.15 contain guidance for quality assurance and quality control measures to ensure the accuracy of effluent and environmental sampling and analysis activities. It has been CBR's practice, and will continue to be CBR's practice, to submit all samples collected to meet the requirements described in Regulatory Guide 4.14 to an independent third party accredited laboratory for analysis.

#### 6.1 SAMPLE COLLECTION

The quality assurance program for environmental sampling is implemented in the following areas:

- Procedures are used which define the details of sample location, sample frequency, number of samples, duration of sampling, sample volume, sample collection methods, and equipment to be used for sample collection.
- Procedures have been prepared for calibration and maintenance of equipment used for measurement. These procedures provide details for the standardization, use and maintenance of the instruments.

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- Taking duplicate samples and submitting these to thea third party accredited analytical laboratory makes random control checks. These checks allow evaluation of the performance of the analytical laboratory and to some extent, the validity of sampling procedures. In the event that the results of the duplicate samples do not agree within predetermined limits, an audit will be performed to determine whether the problem is in the sampling or analysis.

CBR collects samples of environmental media within the NRC license area. Samples are also obtained from the surrounding area. Specific CBR SOPs are used to provide instructions for obtaining each type of environmental sample.

#### 6.1.1 Air Sampling

The airborne effluent and environmental monitoring program is designed to monitor the release of airborne radioactive effluents from the Crow Butte project. To evaluate the effectiveness of the effluent control systems, the results of the monitoring program are compared with the background levels and with regulatory limits.

The accuracy of monitoring data is critical to ensure that the air monitoring program precisely reflects air quality in each phase of the program. Regulatory Guide 4.14 specifies the following lower limits of detection (LLD):

Radionuclides	LLD ( $\mu\text{Ci/ml}$ )
Natural Uranium	$1 \times 10^{-16}$
Thorium-230	$1 \times 10^{-16}$
Radium-226	$1 \times 10^{-16}$
Radon-222	$2 \times 10^{-10}$
Lead-210	$2 \times 10^{-15}$

##### 6.1.1.1 Radon Gas Sampling

The radon gas effluent released to the environment is monitored using Track-Etch radon cups provided by Landauer Corporation. The cups are exchanged on a semiannual basis. In addition to the manufacturer's quality assurance program, CBR exposes two duplicate radon Track Etch cups during each monitoring period.

Radon-222 is monitored continuously at the environmental monitoring locations. Monitoring is performed using Landauer RadTrak detectors. These detectors are an alpha-track radon gas detector

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Samples of soil and sediment are collected at the Crow Butte project to monitor radioactivity concentrations in these media. To evaluate the effectiveness of the effluent control systems, the results of the soil and sediment monitoring program are compared with the background levels and with regulatory limits.

#### *6.1.3.1 Soil Sampling*

Preoperational surface soil has been sampled. Surface soil samples will be taken at the air monitoring locations following conclusion of operations and will be compared to the results of the preoperational monitoring program.

Preoperational subsurface soil has been sampled at the plant. Subsurface soil samples will be taken following conclusion of operations and will be compared to the results of the preoperational monitoring program.

Soil samples are obtained with a clean auger, spade, or shovel. At the sampling location, remove the vegetation and collect a grab soil sample of the top 15 cm (6 inches) of soil. Samples may also be collected at successive 15 cm intervals for comparison with the decommissioning criteria contained in 10 CFR Part 40 Appendix A, Criterion 6-(6). Samples are placed in appropriate plastic bags. The amount of sample should be sufficient to provide the laboratory with at least 50 grams of soil. This quantity of sample is necessary to meet the LLD requirements. Any non-soil material such as rocks, sticks, vegetation, and large amounts of roots should be removed from the sample. Remove the air in the bag and seal it.

The plastic bags must be clearly labeled at the time of sampling with a permanent marker, identifying the project location, sample site, the depth interval of the sample (e.g. 0-6"), and the sample date. It is important that the type of soil extraction method to be used for the various chemical analyses be clearly identified on the chain of custody to the ~~contract~~independent third party accredited laboratory.

#### *6.1.3.2 Sediment Sampling*

Sediment in local surface water features was sampled on a semiannual basis for one year prior to any construction in the area. Operational samples are taken upstream and downstream of the Crow Butte project site to monitor for impacts to the sediments from mining operations.

At the sampling location, collect a grab sample of the stream or impoundment sediment. Remove any vegetation, rocks, or other debris that may be present; place the sample in a plastic bag and seal. After allowing the bag to set, pour off any liquid that has decanted, remove the air, and re-seal the bag. The laboratory requires at least 50 grams of sample to meet the LLD requirements.



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The sample bag should be pre-labeled with the sample identification, sample location, sample analysis required, date, and company initials. Prepare a Chain of Custody form and submit the sample to the independent third party accredited laboratory.

#### 6.1.4 Vegetation Sampling

Vegetation samples from Crow Butte project were collected on an annual basis in animal grazing areas in the direction of the prevailing wind through 1997. Sampling was normally performed during the summer months. In 1998, routine vegetation sampling was discontinued with NRC approval due to the determination that exposure from grazing animals was not a potentially significant pathway.

Vegetation sampling may be required at some time in the future. Circumstances that would indicate the necessity for vegetation sampling include land application for waste disposal or characterization of impacted areas.

When obtaining vegetation samples, select mainly grasses or leafy plants that would normally be used as forage by domestic and wild animals as opposed to woody plants such as sagebrush. Samples should be comprised mainly of stems, leaves, and fruit and should be representative of the current year's growth. Cut the plants with a trimmer within a few inches of the ground and place in the sample bag until the bag contains a minimum of 8-10 kilograms (wet weight) of vegetation. Do not include any root material. The sample should be representative of dominant vegetation present at the sample location.

The plastic bags must be weighed and clearly labeled at the time of sampling with a permanent marker, identifying the project location, sample site, and the sample date. It is important that the sample wet weight and type of analytical method to be used for the various analyses be clearly identified on the chain of custody to the contract laboratory. Vegetation samples should be submitted to the ~~contract~~independent third party accredited laboratory as quickly as possible.

#### 6.1.5 Direct Radiation Measurement

Environmental gamma radiation levels are monitored continuously at the air quality monitoring stations. Dosimeters that fully meet ANSI N545 performance, testing, and procedural specifications will be used.

The dosimeters are supplied by the vendor before the end of each quarter. Each shipment of dosimeters contains a control dosimeter that measures exposure rates during processing and

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exposures. Breathing zone samples may also be collected for an entire work shift, resulting in a composite sample for an employee performing his normal duties. The breathing zone sample, in the latter case, may be used as a means of judging the adequacy of the area air monitoring program. The RSO typically determines under which circumstances a breathing zone sample should be obtained.

Samples should be obtained using the following steps:

- Obtain a lapel sampler (Sensidyne BDX or equivalent). Ensure that it is fully charged and properly calibrated.
- Obtain a glass fiber filter(s), or equivalent, of the proper size and an appropriate filter holder. Place filter in holder and attach to sampler hose.
- Secure the pump to belt and the filter holder to the shirt collar or lapel. Make sure the pump is in the upright position at all times. Consolidate the tubing to minimize restriction of motion.
- Turn the pump on (recording the time and flow rate) and continue monitoring until the task is completed. Record the time and flow rate at which the job is completed.
- Lapel samplers are to be analyzed within two working days of sampling, where possible. Ensure that the SHEQ Department obtains the filter and information in a timely manner so analysis can be completed.

#### 7.1.3 Natural Uranium Radiometric Analysis

Natural uranium air sample filter(s) must be aged a minimum of three (3) hours in order to eliminate the short-lived radon daughters. These include  $^{214}\text{Pb}$  (26.8 min),  $^{214}\text{Bi}$  (19.7 min), and  $^{214}\text{Po}$  (164  $\mu\text{sec}$ ) in the shorter-lived decay chain. A sample counted immediately after collection will not only contain possible uranium ore dust and a possible static charge, but it may also contain radon daughters. Counting the sample too soon after sample collection will result in an overestimation of airborne uranium.

Samples may also be sent as individual samples or as part of a composite sample, to an approved outside ~~vendor~~independent third party accredited laboratory for analysis for specific isotopes.

## 7.2 RADON DAUGHTER MEASUREMENT

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The RSO will investigate the cause of the contamination and implement corrective action to minimize the potential for a recurrence.

Direct measurement of total contamination is performed using alpha scintillation detectors. Measurement of loose contamination is performed by gross alpha counting of the smears using an alpha scaler such as an Eberline MS-3 or equivalent.

### 7.4 BIOASSAY PROGRAM

CBR has implemented a bioassay program to monitor for internal exposure to natural uranium. The bioassay program has been prepared in accordance with the guidance contained in Regulatory Guide 8.22, *"Bioassay at Uranium Mills"*, (Revision 2, 2014). All plant personnel are included in the bioassay program. The program is implemented by the RSO.

CBR routinely performs bioassay by urinalysis for natural uranium. A baseline urinalysis is performed on all employees prior to their initial assignment at the plant. Routine bioassay samples are collected at a frequency that is based upon the employee's work assignment. Diagnostic bioassays may be required by the RSO based upon specific work activities. Upon termination of employment, a final urinalysis will be performed on all employees.

Records of bioassay results are maintained to document the sample collection and analysis dates as well as the individual's record to allow the most recent results to be compared to the employee's previous history.

Analysis of bioassay samples is performed at ~~an-qualified-contract~~ independent third party accredited analytical laboratory. CBR submits spike and blank samples with each batch of bioassay samples to monitor the laboratory for accuracy and sample contamination. Analytical results for spiked samples must be within 30 percent of the spiked value. Otherwise, the most recent batch of samples will be re-run. The RSO will conduct an investigation to determine whether the CBR spiking procedure or the analytical laboratory was the cause of the inaccurate results.

Duplicate samples are obtained for submission to a different laboratory to monitor precision. These samples are submitted by CBR on a periodic basis. These duplicate samples are in addition to the duplicate samples analyzed by the analytical laboratory.



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## 8 SAMPLE MANAGEMENT AND QUALITY CONTROL

### 8.1 SAMPLE HANDLING AND DELIVERY

Chain of Custody (COC) forms should accompany every sample sent to off-site laboratories. The chain of custody should contain at a minimum the type of sample, the sample identification number, the preservation techniques (if any), the name of the sampler, the date and time the sample was taken, the name(s) of individuals who handled the sample and when they passed it on to another person, and the required analysis. Once the laboratory is finished with the chain of custody, it is sent back to the SHEQ Department with the analytical package so it can be filed for future reference.

### 8.2 CONTRACT INDEPENDENT THIRD PARTY ACCREDITED LABORATORY QUALITY CONTROL

CBR has implemented a quality control program to determine the precision and accuracy of the monitoring processes. Quality control sampling includes replicate samples to determine precision, spiked samples with a known concentration to determine accuracy, and blank samples to detect and measure contamination of analytical samples.

Inter-laboratory duplicate samples are analyzed by a second laboratory to determine the precision of the original laboratory. In addition, intra-laboratory duplicate samples may be collected and sent to the primary laboratory to assure internal laboratory precision. The RSO selects the locations, media and number of inter-laboratory and intra-laboratory duplicate samples. A minimum of one duplicate sample is collected per sampling period.

In addition to the quality control samples prepared and submitted by CBR to contract analytical laboratories, each qualified laboratory will have an acceptable QA/QC program in place. The CBR QA Coordinator will review the vendors QA/QC Program and will be responsible for approving the use of the vendor. Qualified laboratories will submit verification of participation in the EPA's Quality Control Program and the laboratory certification programs for environmental waters.