From:	John Schmuck
To:	Lancaster, Thomas
Cc:	Burrows, Ronald; Rhonda Grantham; Doug Pavlick; Sabrina Fox
Subject:	Marsland TR Radiological Subject Matter RAI Summary
Date:	Monday, April 28, 2014 6:03:38 PM
Attachments:	NRC TR RAI Responses Radiological Subject Matter 4-28-2014.doc

Tom - Attached please find a table the summarizes the status for the Marsland TR radiological subject matter RAIs. The first part of the table are the RAI responses from December 23, 2013 with April 28, 2014 notes in red. The second part are the supplemental RAI responses submitted January 24, 2014.

I am submitting these as a group to support your review and for use as a discussion tool to track this group of RAIs.

Thanks. .john

RAI 12.A Description of Deficiency Staff can't complete its evaluation of NUREG-1569, Acceptance Criterion 2.9.3(1). Basis for Request 10 CFR Part 40, Appendix A, Criterion 7, requires: "At least one full year prior to any major site construction, a preoperational monitoring program must be conducted to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects." RG 4.14 provides guidance on preoperational environmental monitoring at uranium mills. NUREG-1569, Acceptance Criterion 2.9.3(1), states: "Monitoring programs to establish background radiological characteristics, including sampling frequency, sampling methods, and sampling location and density are established in accordance with pre-operational monitoring guidance provided in Regulatory Guide 4.14, Revision 1, Section 1.1 (NRC, 1980). Air monitoring stations are located in a manner consistent with the principal wind directions reviewed in Section 2.5 of the standard review plan." During its review, staff found multiple examples of gaps in data presentation on the proposed preoperational effluent environmental monitoring program for the MEA. Staff requires additional information on, or clarification of, noted deficiencies in the background radiological section to draw its safety conclusions. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: A. Please provide criteria consistent with RG 4.14, Regulatory Position 1.1.1, used for determining air monitoring locations, or indicate where this information can be found in the application.	Cameco Response: In the public meeting dated September 4, 2013, NRC requested additional siting justification for the air monitors, specifically, consideration of where maximum concentrations are expected. To that end, in addition to the revisions to Section 2.9.2.1 submitted by Cameco on June 26, 2013, further siting justification is provided in Section 2.9.2.1 as well as revisions to Figure 7.3.2 depicting the locations and the estimated doses.
RAI 12.E. Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: E. Please provide the laboratory reports for all radiological baseline monitoring results.	Cameco Response: All of the radiological baseline monitoring results for air, surface water, groundwater, sediment and fish tissue were reported in the Cameco 6/26/2013 submittal. The laboratory analytical reports for groundwater samples were included in Appendix J. Laboratory analytical reports for air (particulates, radon and gamma), Niobrara river surface water, Niobrara River and ephemeral sediments, and Niobrara River fish

	tissue were not included in the 6/26/2013 submittal. Therefore, these analytical reports are now included in: Appendices U (air particulate), V-2 (radon), and V-3 (gamma); Appendix W-1 and W-2 (surface water and sediments, respectively) and Appendix X (fish tissue) of the current December 2013 submittal.
RAI 12.F. Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: F. In TR Section 2.9.6, the applicant stated that transects will be made across the MEA to collect surface and subsurface soil samples in areas of the proposed well field. While general guidance in RG 4.10 was followed in preparing the proposed baseline soil sampling program, staff cannot determine that the full extent of operations within the proposed MEA will have the necessary baseline soil sampling performed to meet 10 CFR Part 40, Appendix A, Criterion 7, requirements. Please provide a more detailed description of where surface and subsurface oil sampling will be performed.	Cameco Response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.6 has been revised accordingly. The sampling plan was submitted on January 24, 2014 and is attached below for your information. Dependent on the variability detected during initial transects, the scan speed and transect spacing may be increased to utilize ATVs and up to a maximum of 50 meter spacing respectively.
RAI 12.G.1. Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: G. In TR Section 2.9.8, the applicant described its baseline direct radiation monitoring program. Please provide the following: (1) As noted in staff's review of the baseline soil sampling program, staff cannot determine that the full extent of operations within the proposed MEA will have the necessary baseline direct radiation monitoring performed to meet 10 CFR Part 40, Appendix A, Criterion 7, requirements. Please provide a more detailed description of where direct radiation monitoring will be performed.	Cameco Response: A sampling plan with details on where and how direct radiation monitoring will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.8.1 was revised accordingly. The sampling plan was submitted on January 24, 2014 and is attached below for your information. Dependent on the variability detected during initial transects, the scan speed and transect spacing may be increased to utilize ATVs and up to a maximum of 50 meter spacing respectively.
RAI 12.G.2. Description of Deficiency The information provided in TR Section 2.6	Cameco Response: A sampling plan with details on

does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: G. In TR Section 2.9.8, the applicant described its baseline direct radiation monitoring program. Please provide the following: (2) In TR Section 2.9.8, the applicant stated: "The type of survey instrument and procedures would be as described below..." However, there is no text provided that addresses these issues. Please provide the type of survey instrument used for performing baseline direct radiation monitoring and the procedures used, as indicated in TR Section 2.9.8.	where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. The plan will provide details on the type of instrumentation and procedures used. The sampling plan was submitted on January 24, 2014 and is attached below for your information. Dependent on the variability detected during initial transects, the scan speed and transect spacing may be increased to utilize ATVs and up to a maximum of 50 meter spacing respectively.
RAI 12.H. Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: H. RG 4.14 provides recommended values for the lower limit of detection (LLD) for radionuclides in various environmental media. The applicant provided a description of its laboratory measurements in regards to significant figures reported for environmental media measurements in TR Appendix Q. Several reported LLD values are not within RG 4.14 recommended values, even after taking into account the applicant's rationale described in TR Appendix Q (i.e., reporting LLD values with one significant figure, consistent with RG 4.14). The following examples are not consistent with RG 4.14 recommended LLD values: Recommended Reported Table 2.9-5 – Radiological Analysis for Private Water Supply Wells March 2011 Well 723, Pb-210 (pCi/L) (dissolved) 1 1.6 Table 2.9-26 – Niobrara River Dissolved Radiological Water Quality March 2011 sample at N1 for Th-230 (pCi/L) 0.2 0.3 April 2011 sample at N1 for Pb-210 (pCi/L) 1 1.6 July 2011 sample at N2 for Th-230 (pCi/L) 0.2 0.4 October 2011 sample at N1 for Th-230 (pCi/L) 0.2 0.3	Cameco Response: Table 2.9-5 On June 26th Cameco provided a revised Table 2.9-5 which included another additional round of sampling for Well 723. The well was not operational in the first and second quarter of 2012 and could not be sampled. Like Well 723, Well 721 is also completed in the Brule and is across the road, several hundred feet away. Data are available from the spring of 2013 for Well 721 which provides adequate seasonal Brule characterization in this area. Table 2.9-26 (Table 2.9-29 in the revisions) and Table 2.9-27 (Table 2.9-30 in the revisions) The relocation of surface water sampling location N-2 requires 1 year of concurrent sampling at both locations. See revised Figure 2.9-1 for the schedule. Table 2.9-33 (Table 2.9-37 in the revisions) Additional fish tissue samples will be collected during the winter of 2013/2014 and early summer 2014. See revised Figure 2.9-1 for the schedule. (Outstanding sampling obligation is highlighted).

Table 2.9-27 - Niobrara River Suspended Radiological Water Quality June 2011 sample at N1 for Pb-210 (pCi/L) 1 9 Table 2.9-33 – Total Radionuclides and Metals in Tissue of Northern Pike Ra-226 (microCi/kg) 5×10^{-8} 2×10^{-7} Th-230 (microCi/kg) 2×10^{-7} 8×10^{-6} Please provide all environmental media samples with measured values that have an LLD consistent with RG 4.14 or justification for an alternate program.	
RAI 13 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.9.3(2). Basis for Request 10 CFR Part 40, Appendix A, Criterion 7, requires: "At least one full year prior to any major site construction, a preoperational monitoring program must be conducted to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects." RG 4.14 provides guidance on the preoperational and operational aspects of effluent and environmental monitoring at uranium mills. NUREG-1569, Acceptance Criterion 2.9.3(2), states: "Soil sampling is conducted at both a 5-cm [2-inch] depth as described in Regulatory Guide 4.14, Section 1.1.4 (NRC, 1980) and 15 cm [6 in] for background decommissioning data." During its review, NRC staff found no 15-cm soil samples proposed in the TR. Request for Additional Information Please provide justification for not performing soil samples at 15-cm depths, or indicate where this can be found in the TR.	Cameco Response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.6 has been revised accordingly. The sampling plan was submitted on January 24, 2014 and is attached below for your information.
Section 4 - Effluent Control Systems	
RAI 20 Description of Deficiency Elevated radon progeny levels experienced at the main facility are not addressed in the Marsland application. Basis for Request NUREG-1569, Acceptance Criterion 4.1.3(3), states, in part: "The application provides a demonstration that adequate ventilation systems are planned for process buildings to avoid radon gas buildup..." Consistent with NUREG-1569, Appendix A, staff examined the historical operations at the main facility relevant to effluent control systems. As documented in the 2011 inspection report (ML11216A179), the applicant experienced elevated radon progeny levels in the Central Processing Plant. Request for Additional Information Please provide a description of efforts to	Cameco Response: Contemporaneous with the construction and startup of the pond water treatment system in mid-2010, for the first time in several years Cameco exceeded 25 percent of the allowable limits for radon daughters in the CPF. Exceeding this action level triggered weekly instead of monthly radon daughter monitoring. An investigation was conducted and two potential sources were identified: the pond water treatment system and the bicarbonate mix tank. The pond water

determine the cause of, and mitigation efforts to reduce the elevated levels , radon progeny in the main facility as they may relate to the construction of the Marsland satellite facility. In particular, please discuss any additional efforts to maintain airborne radon progeny levels as low as is reasonably achievable (ALARA) within the Marsland satellite facility.	treatment area did not have hard-piped exhaust ventilation and although the bicarbonate mix tank had hard-piped exhaust ventilation that ventilation capacity was shared with other radon sources. In an effort to maintain ALARA radon progeny levels, Cameco installed independent hard-piped ventilation systems in both of these areas. This additional ventilation capacity was assessed by the report identified in RAI 19, immediately above. Since August 2012, radon progeny has not exceeded 25 percent of the allowable limit in the CPF. Although the existing MEA application already states that "separate ventilation systems will be installed for all indoor non-sealed process tanks and vessels where radon-222 or process fumes would be expected", Section 4.1.2.3 of the application has been revised to specifically identify areas where hard-piped ventilation will be required. To ensure the radon progeny levels are ALARA, Cameco is now including the bicarbonate mix tank as an example of an area requiring dedicated ventilation capacity.
Section 5 – Operations	
RAI 26 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 5.5.3(2) Basis for Request NUREG-1569, Acceptance Criterion 5.5.3(2), states: "The training program is acceptable if it meets the following criteria: It is consistent with Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure, Revision 3" (NRC, 1999). This guide provides guidance for protection of the fetus." RG 8.13, Regulatory Position C.2, provides guidance on the content of instruction concerning prenatal radiation exposure. In TR Section 5.5.1.3, the applicant discusses instructions regarding prenatal exposure risks in general, but does not provide specifics on these instructions for staff to evaluate their consistency with RG 8.13. RG 8.13, Regulatory Position C.3, provides guidance on a licensee's policy on declared pregnant women. The applicant did not provide its policy on declared pregnant women. Request for Additional Information Consistent with NUREG-1569, Acceptance	Cameco Response: In Attachment 1 please find a list of topics covered in the video entitled Radiation and Pregnancy: A Decision to Declare, Radiological Testing Services, LLC, 1998. This video is currently shown to all female workers and supervisors during initial radiation training and to female workers again upon declaration. This or an equivalent instruction will be provided. In addition to the video or equivalent instruction, the female workers are provided a copy of Regulatory Guide 8.13 and its appendix which is reviewed with the trainer and any questions are answered. Receipt of prenatal radiation exposure training is documented. Please see the form in Attachment 2. Consistent with Regulatory Guide 8.13, Appendix A, it is

Criterion 5.5.3(2), please provide the following information: 1. the content of instruction concerning prenatal radiation exposure, and 2. the applicant's policy on declared pregnant women	CBR policy to accommodate pregnant workers when possible. To that end, CBR uses the following approach to address potential and actual prenatal exposure risks. CBR's policies on declared pregnant women are consistent with Regulatory Guide 8.13, Appendix A. Specifically: • Instructions o all female new hires o supervisors in charge of female workers o video instruction o provision of RG 8.13 and its appendix and review with worker o opportunity to ask questions o possible effect on job status may involve adjustment of work duties as necessary o review worker- specific exposure monitoring (e.g. dosimetry, bioassay where appropriate) following declaration • Written declaration o view video again and review RG 8.13 o review worker- specific exposure monitoring (e.g. dosimetry, bioassay where appropriate) following declaration • Possible effect on job status o may involve adjustment of work duties as necessary The text of Section 5.5.1.3 has been revised accordingly.
RAI 27 Description of Deficiency The applicant did not provide details on its ventilation equipment related to minimum performance specifications and frequencies of tests and inspections. Basis for Request NUREG-1569, Acceptance Criterion 5.7.1.3 (4), states, in part: "The applicant describes minimum performance specifications for the operation of the effluent controls and the frequencies of tests and inspections to ensure proper performance to specifications..." The applicant stated in TR Section 5.7.1.1 that ventilation equipment will be	Cameco Response: As noted above, the ventilation systems in use at the CPF are not complex. Like the CPF, the MEA ventilation system will be designed with a combination of doors, wall fans and hard-piped ventilation systems that will achieve four to five air exchanges per hour. This may be supplemented with box fans when needed. Consistent with the CPF, this will ensure reduction of radon progeny to ALARA levels. The 10 foot by 30 foot well houses are continuously

inspected for proper operation as recommended in RG 3.56 and that this equipment will be inspected during radiation safety inspections as discussed in TR Section 5.3.1. Staff observes that RG 3.56 does not specifically address ventilation systems and only provides a general description of maintenance and testing, relying on manufacturer's recommendations and minimum timeframes. In addition, the applicant does not address ventilation systems operations in its radiation safety inspections discussed in TR Section 5.3.1. Request for Additional Information Please provide details on the applicant's testing, maintenance, and inspection program for ventilation systems at the Marsland satellite facility, including wellhouse ventilation units. Specifically, please provide minimum performance specifications and frequencies of tests, inspections, and maintenance activities for these ventilation systems or indicate where this information can be found in the application. Consistent with RG 3.56, please also describe any specialized training for those performing inspections on the ventilation systems.	ventilated using 800 CFM wall or ceiling fans. The fans are visible from the door so that operability is verified prior to entry. Daily inspections identify fans that require maintenance or have failed. Testing is not routinely performed as function is readily observable and the fans at the CPF are proven to have very long life expectancy. Specialized training is not required to assess the operational status of the ventilation units. As noted in response to RAI 27, Cameco has provided a copy of SOP P.16 and the associated inspection form as well as updates to Section 4.1.3.
RAI 28 Description of Deficiency The applicant did not provide information on beta survey instruments. Basis for Request NUREG-1569, Acceptance Criterion 5.7.2.3(3), states: "Monitoring equipment is identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety. The ranges of sensitivity for the proposed external radiation monitors are consistent with those appropriate to the facility operation." In TR Section 3.3, the applicant discusses various survey equipment but does not address equipment for performing beta surveys. In TR Section 5.7.2, the applicant discusses beta surveys, but does not discuss instruments for performing these surveys. Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.2.3(3), please provide a description of beta monitoring equipment for the applicant's external radiation monitoring program identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety, or indicate where this information can be found in the application.	Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations.
RAI 29 Description of Deficiency The applicant did not provide any specifics on its ALARA policy. Basis for Request NUREG-1569, Acceptance Criterion 5.7.2.3(7), states: "Radiation doses will be kept as low as is reasonably achievable by following Regulatory Guide	Cameco Response: CBR is providing Volume IV, SHEQMS Health Physics Manual under separate cover and under a request for confidentiality. Specifically, the management commitment to ALARA is

8.10 (NRC, 1977) and Regulatory Guide 8.31 (NRC, 2002b).” RG 8.10, Regulatory Position C.1.a, recommends that plant personnel should be made aware of management’s commitment to keep occupational exposures ALARA and that the commitment should appear in policy statements, instructions to personnel, and similar documents. In TR Section 4.1.4, the applicant stated that it maintains a strict ALARA policy to keep exposures to all radioactive materials as low as possible as defined in SHEQMS, Volume IV, Health Physics Manual. However, the applicant did not provide any specifics from this reference or others, such as ALARA exposure goals and action levels associated with exposures to radioactive materials. Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.2.3(7), please provide specific information on the applicant’s ALARA policy statements, instructions, or other similar documents, including goals and action levels, as it relates to exposures to radioactive materials.	evidenced by: • Management ALARA responsibilities are required reading during initial training, §2.5.3 • Documented annual ALARA audit §2.5.4.2 • Topic and possible test question in initial and annual radiation safety training In the interest of ALARA exposures, CBR has established action level at 25 percent of the exposure limit for: • Facility equipment and design, §2.5.10 • Radon progeny, §3.7 • Surface contamination control, §5.4 • Bioassay, §8.5.6 • Yellowcake slurry shipment (50 percent of action levels requires resurvey), §9.6.4.4
RAI 30 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 5.7.2.3(5). Basis for Request NUREG-1569, Acceptance Criterion 5.7.2.3(5), states: “Plans for documentation of radiation exposures are consistent with the approach in Regulatory Guide 8.7, “Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1" (NRC, 1992b).” In TR Section 5.7.2, the applicant discusses its external radiation exposure monitoring program, but does not provide information on its documentation for external radiation exposure monitoring. Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.2.3(5), please provide information on the applicant’s documentation for external radiation exposure monitoring.	Cameco Response: CBR is providing a copy of the documentation used for radiation exposures under separate cover and under a request for confidentiality.
RAI 32 Description of Deficiency The applicant did not provide information on beta survey instruments. Basis for Request NUREG-1569, Acceptance Criterion 5.7.3.3(3), states: “Monitoring equipment is identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety. The ranges of sensitivity for the proposed external radiation monitors are consistent with those appropriate to the facility operation.” In TR Section 3.3, the applicant discusses various survey equipment but does not	Cameco Response: Please see response to RAI 28, which appears identical to RAI 32.

address equipment for performing beta surveys. Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.3.3(3), please provide a description of beta monitoring equipment for the applicant's airborne radiation monitoring program identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety, or indicate where this information can be found in the application.	
RAI 33 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 5.7.6.3(4). Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(4), states: "Monitoring equipment by type, specification of the range, sensitivity, calibration methods and frequency, availability, and planned use is adequately described. The application demonstrates that the ranges of sensitivity for monitoring equipment will be appropriate to expected facility operation." In TR Section 5.7.6, the applicant provides a description of survey equipment to be used in its contamination control program. However, it does not address the issues related to NUREG-1569, Acceptance Criterion 5.7.6.3(4). Request for Additional Information Please address the following issues related to the proposed survey equipment described in TR Section 5.7.6: A. Please provide the information requested in NUREG-1569, Acceptance Criterion 5.7.6.3(4). B. Staff observes that the proposed Ludlum Model 44-38 probe is rated with a beta cutoff energy of 200 keV (refer to ADAMS accession No. ML13086A183). Some of the uranium decay products have beta energies that are below this cutoff energy. Please provide information on how surface contamination with beta-emitting radionuclides will be evaluated. C. Please state whether the practice of washing the soles of shoes prior to exiting the restricted area will be used at the MEA. If this practice will be used, please demonstrate the minimum detectable concentration for contamination surveyed on the wet soles of shoes.	Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations.
RAI 34 Description of Deficiency The applicant did not address NUREG-1569, Acceptance Criterion 5.7.6.3(6). Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(6), states: "The licensee will ensure that radioactivity on equipment or surfaces is not covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 5.7.6.3-1 of this	Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations.

standard review plan before application of the covering. A reasonable effort will be made to minimize the contamination before the use of any covering." Request for Additional Information Please address NUREG-1569, Acceptance Criterion 5.7.6.3(6), for operations or indicate where this can be found in the application.	
RAI 35 Description of Deficiency The applicant did not address NUREG-1569, Acceptance Criterion 5.7.6.3(7). Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(7), states: "The radioactivity of the interior surfaces of pipes, drain lines, or duct work will be determined by making measurements at all traps and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or duct work." Request for Additional Information Please address NUREG-1569, Acceptance Criterion 5.7.6.3(7), for operations or indicate where this can be found in the application.	Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations.
RAI 36 Description of Deficiency The applicant did not address NUREG-1569, Acceptance Criterion 5.7.6.3(9). Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(9), states: "Appropriate criteria are established to relinquish possession or control of equipment or scrap having surfaces contaminated with material in excess of the limits specified in Table 5.7.6.3-1: (a) The applicant will provide detailed information describing the equipment, or scrap; the radioactive contaminants; and the nature, extent, and degree of residual surface contamination. (b) The applicant will provide a detailed health and safety analysis that reflects that the residual amounts of contaminated materials on surface areas, together with other considerations such as prospective use of the equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public. (c) The applicant includes materials created by special circumstances including, but not limited to, the razing of buildings, transfer of structures or equipment, or conversion of facilities to a long-term storage facility or to standby status." Request for Additional Information Please address NUREG-1569, Acceptance Criterion 5.7.6.3(9), for operations or indicate where this can be found in the application.	Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations.
RAI 37.A.1 Description of Deficiency Staff cannot verify the applicant's MILDOS	Cameco Response: The MILDOS model was rerun and

calculations for the maximally exposed individual and its basis for not collecting vegetation, food, and fish samples during operations for the environmental monitoring program. Basis for Request 10 CFR Part 40, Appendix A, Criterion 7, requires, in part: "...Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects." 10 CFR 20.1301(a) requires, in part: "(a) Each licensee shall conduct operations so that – (1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation, from any administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003..." 10 CFR 20.1302(b) requires, in part: "A licensee shall show compliance with the annual dose limit in § 20.1301 by — (1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit..." NUREG-1569, Acceptance Criterion 5.7.7.3(1), states: "The proposed airborne effluent and environmental monitoring program is consistent with Regulatory Guide 4.14, Sections 1.1 and 2.1 (NRC, 1980) and as low as is reasonably achievable requirements as described in Regulatory Guide 8.37, Section 3 (NRC, 1993)". RG 4.14, Section 2.1, provides guidance for conducting an operational environmental monitoring program including the collection of vegetation, food, and fish samples. Furthermore, RG 4.14 provides guidance that these media are relevant when a significant pathway to man is identified in individual licensing cases. A significant pathway is defined in RG 4.14, Footnote (o) to Tables 1 and 2, when a predicted dose to an individual would exceed 5 percent of the applicable radiation protection standard. RG 3.51, Calculational Models for Estimating Radiation Doses to Man from Airborne Radioactive Materials Resulting from Uranium Milling Operations, provides guidance on calculating dose for individuals including ingestion of vegetables, milk and meat.	the report was revised to eliminate the duplicate reduction in source term. Please see the revisions to Appendix M. Cameco will be submitting an update to the Mildos reflecting a higher total flow rate. Please do not proceed with the review of this section and Appendix M.

Request for Additional Information A. In TR Sections 5.7.7.5 and 5.7.7.6, the applicant stated that it will not collect vegetation, livestock, crop, or vegetable garden samples as part of its operational environmental monitoring program based on the results of its MILDOS calculations presented in TR Appendix M. In order for staff to verify the technical bases for this approach, please address the following issues: 1. In Appendix M1, page 7 of the report by Noel Savignac, the applicant describes the MILDOS operational input data. In addition to the assumed values of one percent for the radon venting rate of the wellfields (refer to NUREG-1569, Appendix D, and TR Appendix M, Table 2 of the report by Noel Savignac) and 20 percent of the radon released from the purge water, the applicant appears to further reduce the radon effluent by applying a 25 percent (radon venting from header houses) and 75 percent (radon venting from satellite plant) proportion factor in one scenario, and a 10 percent (radon venting from header houses) and 90 percent (radon venting from satellite plant) proportion factor in another scenario. Please provide additional clarification and justification for this apparent additional reduction in radon effluent concentration over and above the MILDOS-assumed value for wellfield venting and the applicant-assumed value for purge water venting.	
37.A.2. In Appendix M2, the applicant calculates the maximum dose to man from the vegetation pathway. Please address the following issues regarding the vegetation pathway analysis: a. The applicant stated that it used the food production rate for Colorado from RG 3.51, Table 7, page 35, as Nebraska was not listed in this table. Staff observes that this tabulated data is from 1973 and that guidance on page 24 of RG 3.51 states that if other means are not available, it is acceptable to assume that regional agricultural productivity will remain in constant proportion to the U.S. population. Consistent with RG 3.51, please provide a discussion on efforts to derive site-specific (e.g., State, regional) agricultural productivity data and comparison of the tabulated agricultural productivity data with the U.S. population to derive an appropriate proportion factor. b. The applicant calculated the maximum dose to an individual using the ratios of population exposures to vegetation, milk, and meat pathway to the total population exposure times the maximum resident dose at the Marsland operation. This approach does appear to address the requirements of 10 CFR	Cameco Response: Consistent with the Powertech Dewey Burdock alternate proposal at ML11208B714, Cameco proposes to take a soil sample from each garden in the area of review and then apply concentration factors to estimate the radionuclide concentrations in vegetables. Similar to Dewey Burdock, the large quantity of vegetables required to meet LLDs would decimate each home owner's crop. The specifics of this alternate approach are presented as revisions to Section 2.9.5.2. Cameco is working with Inter Mountain Laboratories in Casper, Wyoming to develop a justification for an LLD for Polonium 210 in soil for submission and NRC written verification.

20.1302(b), dose to an individual, or be consistent with RG 3.51, Regulatory Position C.2, which provides guidance for dose calculations for individuals. Please provide justification for applying a population exposure ratio to derive a maximum individual exposure. c. Staff observes that the maximum resident dose at the Marsland operation was calculated assuming the highest radon air concentrations during operations. For maximum total individual dose, this approach appears consistent with RG 3.51, Regulatory Position C.2 which states that the 1-yr exposure period is taken to be the year when environmental concentrations resulting from plant operations are expected to be at their highest level. However, the applicant stated that the dose from the vegetation pathway was calculated from the consumption of vegetables, meat, and/or milk that may have been impacted by the release of radon and its decay products on vegetation or forage from uranium in situ operations. Staff observes that the maximum vegetation concentrations will not necessarily occur during the same timeframe as the maximum radon air concentrations. Consistent with RG 3.51, please provide the exposure period resulting in the maximum radiation dose from the vegetation pathway and reanalyze the maximum individual dose from the vegetation pathway if necessary.	
37.B. In TR Section 5.7.7.6, the applicant stated that it will not collect fish samples as part of its operational environmental monitoring program based on the results of the MILDOS analysis for vegetation uptake. Staff observes that the correlation between vegetation uptake and the potential for a significant fish pathway is unclear. Consistent with RG 4.14, Section 2.1, please provide a direct dose analysis for the fish pathway to enable staff to determine if a significant pathway to man from fish exists or not.	Cameco Response: The incorrect vegetation uptake language has been removed from Section 5.7.7.6. In addition, alternative language in Section 5.7.7.6 was modified to trigger operational fish sampling if upward trends in radionuclides are observed in sediment samples as the result of surface spills at the site. This alternative approach is justified because surface water flow is absent, the distance to the Niobrara River is significant, and the absence of sufficient fish in the Niobrara River above Box Butte Reservoir for sampling. It should also be noted that the perimeter monitoring wells and excursion control practices preclude a groundwater pathway to fish in the Niobrara River.
37.C. In Appendix M1, page 15 of the report by Noel Savignac, the applicant provides the maximum occupational dose using 1500 hours onsite for a full time worker. Staff observes that a normal work week is 40 hours, resulting	Cameco Response: The revised MILDOS-AREA assessment (Appendix M) presents the radiation doses for a 2,000-hour per year onsite full-time worker.

in a more typical 2000 hours onsite during the year. This is also the number of hours assumed for a working year in the DAC and ALI values given in 10 CFR Part 20, Appendix B (refer to the Introduction to Appendix B to Part 20). Please provide a justification for assuming 1500 hours onsite for a full time worker.	Cameco will be submitting an update to the Mildos reflecting a higher total flow rate. Please do not proceed with the review of this section and Appendix M.
RAI 38 Description of Deficiency The applicant did not provide the criteria used for determining the proposed locations for the airborne effluent monitoring stations. Basis for Request NUREG-1569, Acceptance Criterion 5.7.7.3(2), states: "The proposed locations of the airborne effluent monitoring stations are consistent with guidance in Regulatory Guide 4.14, Sections 1.1.1 and 2.1.2 (NRC, 1980). The license applicant adequately considers site-specific aspects of climate and topography in determining the number and locations of off-site airborne monitoring stations and environmental sampling areas. The criteria used in selecting sampling locations should be given. All sampling locations should be clearly shown relative to the proposed facility, nearest residences, and population centers on topographic maps of the appropriate scale." Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.7.3(2), please provide the criteria used for determining the proposed locations for the airborne effluent monitoring stations.	Cameco Response: Please see response to RAI 12.A., above.
Section 6 – Ground-water Quality Restoration, Surface Reclamation, and Facility Decommissioning	
RAI 40 Description of Deficiency The applicant did not provide a commitment to implement pre-reclamation survey programs for diversion ditches, surface impoundments, and transportation routes. Basis for Request NUREG-1569, Acceptance Criterion 6.2.3(2), states that the pre-reclamation radiological survey program survey areas should include diversion ditches, surface impoundments, and transportation routes. Although in Section 6.2 of the TR, the third bullet states that the applicant will do radiological survey of all facilities, equipment, and materials on the site to identify the potential for personnel exposure during decommissioning, the list does not include the areas identified as missing. Although Section 6.4.5 of the TR states the applicant will adopt survey and sample protocols on a case by case basis, this appears to only apply to temporary ditches and impoundments and appears to only address confirmation of restoration rather than pre-reclamation surveys. Request for Additional Information Please provide a commitment to implement pre-	Cameco Response: Section 6.2, pages 6-12 and 6-13 were revised to include a commitment to implement pre-reclamation survey programs for diversion ditches, surface impoundments (if any), and transportation routes.

reclamation survey programs for diversion ditches, surface impoundments, and transportation routes, or identify where this commitment is already discussed.	
RAI 41 Description of Deficiency In TR Section 6.4, the applicant refers to its RESRAD calculations in TR Appendix N for Marsland site-specific cleanup criteria. However, staff can't verify that the applicant utilized Marsland site-specific input data (e.g., soil type, wind speed, precipitation, etc.) for RESRAD appropriate for the site. Basis for Request NUREG-1569, Acceptance Criterion 6.4.3(1), states: "The cleanup criteria for radium in soils are met as provided in 10 CFR Part 40, Appendix A, Criterion 6(6)." This criterion states that the design requirements for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over areas of 100 m2, which as a result of byproduct material, does not exceed the background level by more than: (i) 5 picocuries per gram (pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 cm [5.9 in.] below the surface, (ii) 15 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm [5.9-in.] thick layers more than 15 cm [5.9 in.] below the surface." NUREG-1569, Acceptance Criterion 6.4.3(3), states: "Acceptable cleanup criteria for uranium in soil, such as those in Appendix E of this standard review plan, are proposed by the pplicant. This is the radium benchmark dose approach of 10 CFR Part 40, Appendix A, Criterion 6(6)." NUREG-1569, Acceptance Criterion 6.4.3(4), states: "For areas that already meet the radium cleanup criteria, but that still have elevated thorium levels, the applicant proposes an acceptable cleanup criterion for thorium-230. One acceptable criterion is a concentration that, combined with the residual concentration of radium-226, would result in the radium concentration (residual and from thorium decay) that would be present in 1,000 years meeting the radium cleanup standard." NUREG-1569, Acceptance Criterion E2.1.3(2), states, in part: "...The code/calculation input data are appropriate for the site and represent current or long-term conditions, whichever is more applicable to the time of maximum dose. When code default values are used, they are justified as appropriate (representative) for the site..." Request for Additional Information Please address the following issues related to the soil cleanup criteria for the MEA:	Cameco Response: A sampling plan with details on where and how Marsland site-specific cleanup criteria are to be determined will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Any required sampling will be conducted in late spring or early summer of 2014, prior to construction. The sampling plan was submitted on January 24, 2014 and is attached below for your information.

A. In TR Section 6.4.1, the applicant stated that the ALARA goal for natural uranium in the top 15 cm soil layer is 150 pCi/g averaged over *more than* 100 m2. The averaging of radionuclides over more than 100 m2 is not consistent with the requirements of 10 CFR Part 40, Appendix A, Criterion 6(6) or NUREG-1569, Acceptance Criterion 6.4.3(1). Please provide a justification for averaging the natural uranium concentration over more than 100 m2. B. Consistent with NUREG-1569, Acceptance Criteria 6.4.3(3) and E2.1.3(2), please confirm that site-specific parameters relevant to the MEA (e.g., soil type, wind speed, precipitation, etc.) were used for the RESRAD analysis and thus deriving the radium benchmark dose. If the MEA site-specific parameters are different from what was analyzed, please provide a relevant RESRAD and radium benchmark dose analysis. C. In TR Section 6.4, the applicant refers to its analysis of Th-230 at its main facility for the Marsland analysis without assessing if this analysis is applicable to the MEA. Consistent with NUREG-1569, Acceptance Criterion 6.4.3(4), please provide a MEA site-specific discussion on Th-230, or indicate where this information can be found.	
RAI 42 Description of Deficiency In TR Section 6.4.2, the applicant provided a gamma action level of 17,900 cpm as the level corresponding to the Marsland soil cleanup criterion. In TR Appendix N, the applicant described its derivation of the gamma action level of 17,900 cpm. However, the gamma action level was derived from data at the main facility (i.e., background levels, etc.) and there is no justification addressing why this data can be applied to Marsland, an unrelated land area. Basis for Request NUREG-1569, Acceptance Criterion 6.4.3(5), states: "The survey method for verification of soil cleanup is designed to provide 95-percent confidence that the survey units meet the cleanup guidelines. Appropriate statistical tests for analysis of survey data are described in NUREG–1575, 'Multi-Agency Radiation Survey and Site Investigation Manual' (NRC, 2000)." Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 6.4.3(5), please provide a technical justification for applying a gamma action level of 17,900 cpm to the Marsland facility when data used to derive this action level is based on site-specific data for the main facility, an unrelated land area.	Cameco Response: RAI 42 - A sampling plan with details on where and how a Marsland site-specific gamma action level is to be determined will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. The sampling plan was submitted on January 24, 2014 and is attached below for your information.
ADMINISTRATIVE ISSUES	
Section 2 – Site Characterization	
Admin §2 #1. In Section 2.1, the application states that Figure 1.7-2 shows the Restricted Areas for the current license area. This is not readily identified in Figure	Cameco Response: Figure 1.7-2 has been revised to show the Restricted Areas for the current license area.

1.7-2. It appears that this reference may have been intended for Figure 1.1-1 of the ER. This statement should be removed from the text or the restricted area should be identified in Figure 1.7-2 or the proper figure should be included in the TR.	
Admin §5 #3. The applicant did not provide details of its qualification program for designees approving Radiation Work Permits (RWPs) and Standing Radiation Work Permits (SRWPs) in the absence of the RSO. In TR Section 5.2.1.2, the applicant stated that qualified designees will review and approve RWPs and SRWPs in the absence of the RSO, but did not provide any description of its qualification program for such designees. Please provide a description of the qualifications of the designees that will be allowed to review and approve RWPs and SRWPs in the absence of the RSO.	Cameco Response: The minimum training requirements have been added to Section 5.4.1 in accordance with RG 8.31.
Admin §5 #4. The applicant did not provide minimum amount of specialized training required for the RSO qualifications. License Condition 9.12 of the applicant's current license (Amendment No. 26, ADAMS accession No. ML110320358) requires the applicant to follow the guidance set forth in Regulatory Guide 8.31. NUREG-1569, Acceptance Criterion 5.4.3(1), states, in part: "The personnel meet minimum qualifications and experience for radiation safety staff that are consistent with Regulatory Guide 8.31, Section 2.4 (NRC, 2002)." In TR Section 5.4.1, the applicant discusses specialized training in general but does not specify a minimum amount of this training for the RSO qualifications. Consistent with RG 8.31, please provide a minimum amount of specialized training required for the RSO qualifications.	Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations.

RAI 12.F. Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: F. In TR Section 2.9.6, the applicant stated that transects will be made across the MEA to collect surface and subsurface soil samples in areas of the proposed well field. While general guidance in RG 4.10 was followed in preparing the proposed baseline soil sampling program, staff cannot determine that the full extent of operations within the proposed MEA will have the necessary baseline soil sampling performed to meet 10 CFR Part 40, Appendix A, Criterion 7, requirements. Please provide a more detailed description of where surface and subsurface oil sampling will be performed.	Cameco December 23, 2013 Response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.6 has been revised accordingly.

Cameco January 24, 2014 Supplemental Response for RAI 12.F.

NUREG-1569, Acceptance Criterion 2.9.3(1), states: "(m)onitoring programs to establish background radiological characteristics, including sampling frequency, sampling methods, and sampling location and density are established in accordance with pre-operational monitoring guidance provided in Regulatory Guide 4.14 (RG 4.14), Revision 1, Section 1.1 (NRC, 1980). The recommendations for soil sampling in RG 4.14 are intended for use at conventional uranium mill sites rather than at ISR sites with satellite facilities and mine units.

Rather than using the fixed position soil sampling locations specified in RG 4.14, Cameco requests the use of an alternate preoperational surface soil sampling method at the Marsland Expansion Area (MEA). This alternate method will use three work phases:

1. Conducting preoperational comprehensive gamma scanning surveys throughout the satellite area and the mine units,
2. Using the gamma scanning survey results to direct the soil sampling at selected locations to establish the correlation between the Ra-226 soil concentration and the gamma scanning radiation levels, and
3. Applying the soil sampling Ra-226 correlation results to the comprehensive gamma scanning data to predict the Ra-226 soil concentration throughout each of these areas.

For the first phase of work Cameco will conduct comprehensive gamma scanning surveys to characterize the gamma radiation levels within the license areas of interest. Gamma exposure rates will be measured with sodium iodide (NaI) scintillation detectors conveyed over the areas of interest using vehicular-based gamma scanning survey systems. The vehicle-based systems will typically deploy multiple detectors to optimize survey coverage. Backpack-based single detector systems will be used when vehicle use is not feasible or not safe. These survey systems pair the NaI detectors with global positioning system (GPS) receivers. They include an onboard personal computer or a handheld data logger to display, record, and map thousands of gamma measurements each hour for each gamma detector that is deployed.

The typical gamma detector data collection rate is 1 gamma count rate measurement reading per second, the survey system scanning rate is approximately 0.75 meters per second (m/s), and the distance between adjacent lanes is approximately 2.5 m. This gamma scanning protocol produces approximately 50 gamma measurement readings for each 100 m2 area. The resulting data density of these gamma scanning survey results greatly exceeds that required by RG 4.14. In comparison to the limited set of measurement points designated in RG 4.14, the proposed

comprehensive gamma scanning survey coverage facilitates the production a comprehensive map of all of the areas surveyed.

NaI detectors are energy dependent and respond differently to radionuclides with higher or lower gamma energies compared to its calibration radionuclide. True gamma exposure rates are best measured with an energy independent system such as a high-pressure ionization chamber (HPIC). NaI detectors are more durable so they are a better choice under the field conditions at the MEA. To address this issue, the NaI detectors will be cross-calibrated with an HPIC. Cross-calibration allows a direct means for comparison of the preoperational data with data obtained later without relying on identical detectors. This will also facilitate conversion of the gamma detector count rates to gamma exposure rates for subsequent comparison to MILDOS AREA dose predictions.

The planned gamma scanning surveys will be performed using commercially available radiation detection equipment such as a Ludlum Model 44-10 sodium iodide (NaI) detector coupled to a Ludlum Model 2350 rate-meter with RS-232 data output, or equivalent. A GE Reuter-Stokes High Pressure Ion Chamber (HPIC), or equivalent, will be used to cross-calibrate the gamma scanning detectors before each day's surveys. This will establish the correlation between the scanning gamma detector measurements in counts per minute and the exposure rate measured by the HPIC in micro-Roentgens per hour (µR/hr).

The second phase of work will collect composite soil samples from ten (10) 10-x-10 m grids within each area of interest. The ten grids will be selected based on having average gamma scanning results that are representative of the range of the gamma scanning levels in the area of interest and which are located in a roughly radial pattern that extends outward from near the center of the area of interest.

These grids will be the basis for developing a statistical correlation between the measured soil Ra-226 concentrations and the gamma exposure rates measured at the center of the grid, and are therefore called "correlation" grids.

A composite sample of 10 subsamples to a depth of 15 cm will be collected using standardized equidistant subsampling locations within each correlation grid. The composites will be analyzed for Ra-226, natural uranium, Th-230, and Pb-210. The average gamma exposure rate will be measured at the center of each correlation grid and the gamma exposure rate reading and the corresponding GPS coordinates at the center of each sampling grid will be recorded.

The soil sampling results will be used to establish the correlation between the composite sample Ra-226 concentration in the surface soil and the average exposure rate at the center of the grid.

The third phase of work for the alternate surface soil sampling method is to produce a comprehensive map of the predicted Ra-226 soil concentration in each area of interest. The data obtained from the correlation grids will be applied to the gamma scanning survey data set to create comprehensive maps of the predicted Ra-226 soil concentration throughout the satellite area and the mine units of interest. The NaI/HPIC cross calibration data will be combined with the soil Ra-226 concentration data and the gamma exposure rate correlation data to correct the gamma scanning data for any differences in detector height to a standard height of 1 meter above grade. Given that sites that may have been surveyed at different heights due to terrain and brush issues, this standard height above grade will serve as the common point of reference to facilitate direct comparison of the final survey results.

The Radium-226 concentrations in soil throughout each area of interest will be estimated by kriging methods. Kriging is a geostatistical interpolation procedure that fits a mathematical function, such as the statistical correlation, to a specified number of nearest points within a defined radius to determine an output value for each location. The result will be continuous maps of the areas of interest that show the variation of the range of the Ra-226 concentrations throughout the areas of interest and the corresponding predicted gamma exposure rates at

1 meter above grade.

In addition to the above soil sampling, soil samples will also be collected at each of the 5 MEA air monitoring stations (AMS). Surface samples to a depth of 15 cm and subsurface samples from 15 cm to 30 cm will be collected. Each of these samples will be analyzed for Ra-226, natural uranium, Th-230, and Pb-210. The average gamma exposure rate will be measured at the sampling location with a HPIC at 1 meter above grade. The resultant gamma exposure rate measurement will be recorded with the GPS coordinates for each soil sampling location.

Three top-soil samples will also be collected at each of the AMS to a depth of 5 cm. These top-soil samples will be used to establish the baseline conditions for subsequent assessment of potential impacts on the surface soils due to AMS indications of an airborne release of potential concern. Findings of elevated top-soil sample concentrations above the baseline conditions could serve to validate any elevated AMS indications and could also aid in the assessment of potential ground deposition impacts.

RAI 12.G.1. Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: G. In TR Section 2.9.8, the applicant described its baseline direct radiation monitoring program. Please provide the following: (1) As noted in staff's review of the baseline soil sampling program, staff cannot determine that the full extent of operations within the proposed MEA will have the necessary baseline direct radiation monitoring performed to meet 10 CFR Part 40, Appendix A, Criterion 7, requirements. Please provide a more detailed description of where direct radiation monitoring will be performed.	Cameco December 23, 2013 Response: A sampling plan with details on where and how direct radiation monitoring will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.8.1 was revised accordingly.

Cameco January 24, 2014 Supplement Response for RAI 12.G.1.

RG 4.14 recommends 80 direct radiation measurements at 150-meter (m) intervals up to a distance of 1500 m in eight directions from the center of the milling area. In addition, direct radiation measurements should also be made at the same locations used for the collection of particulate air samples once prior to site construction. RG 4.14 was designed for a conventional mill rather than an ISR facility. Conventional mill operations are centralized between the mill complex and tailings disposal impoundments, whereas ISR operations are dispersed in the licensed area with multiple wellfields and header houses at each wellfield.

Rather than using the fixed position direct radiation measurement locations recommended in RG 4.14, Cameco requests the use of an alternate method for conducting the preoperational direct radiation measurements at the MEA. This alternate method will use comprehensive preoperational gamma scanning surveys throughout the satellite area and mine units.

The three phases of work are detailed above in response to MEA RAI 12.F, which addresses the baseline soil monitoring program. The three phases of work described for the baseline soil monitoring program will produce detailed survey maps of the gamma exposure rate radiation levels throughout the satellite area and mine units.

The planned gamma scanning surveys will use commercially available radiation detection equipment such as a Ludlum Model 44-10 sodium iodide (NaI) scintillation detector coupled to a Ludlum Model 2350 rate-meter with RS-232 data output, or equivalent. A GE Reuter-Stokes High

Pressure Ion Chamber (HPIC), or equivalent, will be used to cross-calibrate the gamma scanning detectors before each day's surveys. This will establish the correlation between the scanning gamma detector measurements in counts per minute to the exposure rate measured by the HPIC in micro-Roentgens per hour (µR/hr).

This alternate method yields maps of the gamma radiation measurement data in gamma counts per minute (CPM) and in gamma exposure rate or dose rate, with units of micro-Roentgens per hour (µR/hr) or micro-rem per hour (µrem/hr), respectively. This alternate method will follow the site characterization methodology recommended in NUREG-1575, Revision 1, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC, 2000b).

RAI 12.G.2. Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA: G. In TR Section 2.9.8, the applicant described its baseline direct radiation monitoring program. Please provide the following: (2) In TR Section 2.9.8, the applicant stated: "The type of survey instrument and procedures would be as described below..." However, there is no text provided that addresses these issues. Please provide the type of survey instrument used for performing baseline direct radiation monitoring and the procedures used, as indicated in TR Section 2.9.8.	Cameco December 23, 2013 Response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. The plan will provide details on the type of instrumentation and procedures used.

Cameco January 24, 2014 Supplemental Response for RAI 12.G.2.

With regard to the recommendations for performing baseline direct radiation monitoring in Regulatory Guide 4.14 Revision 1, Section 1.1 (NRC, 1980) and in NUREG-1569, Acceptance Criterion 2.9.3(1), CBR now requests the use of an alternate method as described above in response to RAI 12.G.1. Vehicular-based and backpack-based gamma survey systems will be used to conduct gamma scanning surveys throughout the satellite area and mine units to document the gamma background levels prior to the construction in those areas. Both of these survey systems utilize:

- a calibrated High Pressure Ion Chamber (HPIC) to accurately measure the ambient radiation level in micro-Roentgen per hour (µR/hr) and to cross-calibrate the gamma scintillator detectors used in the gamma scanning surveys for conversion of the gamma count rate to µR/hr;
- one or more gamma detection assemblies, each consisting of a calibrated radiation NaI scintillation detector and ratemeter to measure, time-stamp and transmit the radiation readings for data logging;
- a GPS positioning system to determine and map the real-time positioning and mapping of the survey coverage (typically to within 30 cm each second), time stamp and transmit the GPS coordinate readings for data logging; and
- a handheld data logger or a laptop computer loaded with the software needed to display, log and map the gamma radiation survey data in real-time.

Person-carried backpack systems will be used where the access for vehicular-based systems is restricted due to site features, terrain, or brush

issues. These systems use a single detector and ratemeter assembly to minimize weight.

The vehicular-based systems typically use multiple detector and ratemeter assemblies. The vehicles used range from 4-wheeled ATV's to full-size trucks or vans. They generally are deployed with two or three detectors assemblies. Deploying more detectors can increase the area survey coverage rate or the scanning gamma survey data density for a given scan rate. The gamma radiation readings from each detector assembly are typically recorded at one second intervals and are time-stamped accordingly.

During the conduct of a gamma scanning survey with either the handheld data logger or the laptop, the display updates the map of the surveyor GPS coordinates each second and shows the survey coverage. Subsequent to field data surveying and mapping, additional data processing is performed to accurately correlate the gamma radiation readings with the GPS positioning coordinates based on their respective time stamps and to confirm the quality of the gamma radiation survey data.

The planned gamma scanning surveys will be performed using commercially available radiation detection equipment such as a Ludlum Model 44-10 sodium iodide (NaI) scintillation detector coupled to a Ludlum Model 2350 rate-meter with RS-232 data output, or equivalent. A GE Reuter-Stokes High Pressure Ion Chamber (HPIC), or equivalent, will be used to cross-calibrate the gamma scanning detectors for each day's surveys.

The gamma scanning detectors are typically positioned from from 0.5 m to 1.5 m above grade, depending on the required height to avoid gamma detector impacts with terrain or brush. A height of 1 m results in a scanning field of view for each deployed 2x2 NaI detector of approximately 2.5 meters in diameter. This is generally suitable for detection of a planar 10 m^2 source with slightly elevated concentrations of Ra-226 above the typical environmental levels of gamma radiation that are encountered.

The major procedural steps required to perform these gamma scanning surveys include the following:

1. At a designated location for periodic equipment calibration purposes, determine the relationship between the background gamma exposure rate reading in micro-Roentgens per hour (µR/hr) and the gamma detector count rate in counts per minute (CPM) at 0.3 meters (m), 0.5 m, 1 m, and 1.5 m above grade for each of the gamma survey detectors to be used. Use a calibrated HPIC, GE Reuter Stokes RSDetection Environmental Radiation Monitor, or equivalent) and calibrated gamma scintillation detectors (Ludlum Model 44-10 2x2 (5 cm x 5 cm) sodium iodide (NaI) detector with a Ludlum Model 2350 ratemeter, or equivalent). Plot and analyze the results to establish the correlation between HPIC exposure rate in micro-Roentgens per hour (uR/hr) to gamma detector count rate in counts per minute (CPM) over this range of detector heights.
2. Conduct routine performance checks for quality assurance prior to and during each use of the gamma scanning system.
3. Conduct comprehensive gamma scanning surveys using the gamma survey detector systems throughout the MEA satellite and well field areas to measure and record the gamma radiation levels using commercially available systems for gamma detection, GPS tracking, data logging, analysis, and mapping. Set the gamma survey detector height above grade to provide sufficient clearance for brush and terrain. Set the gamma detector data collection rate to 1 second. Perform the gamma scanning surveys throughout the area of interest at a scan rate of approximately 0.75 m/s with adjacent lanes of approximately 2.5 m.
4. Create color-coded maps that document the gamma count rate survey coverage and illustrate the intensity of the gamma count rates each second.
5. Apply Kriging methods to create comprehensive color coded maps of the gamma scanning survey data to show the spatial variation in the

<table>
<tr><td colspan="2">background gamma radiation levels throughout the areas of interest.
6. Analyze the resulting gamma scanning survey results for identification of ten 100 m^2 grids within each of the surveyed MEA areas that are characterized by gamma count rates that range from low to high readings. The soil sampling results from these grids will be used to establish the correlation between the soil Ra-226 concentrations and their respective exposure rates.
7. Collect soil samples at 10 prescribed standard locations within each of the ten 100 m^2 correlation grids and collect a 60 second static gamma count rate measurements at 1 m above grade at each sampling location.
8. Collect a 15 cm deep surface soil sample and a subsurface 15 cm soil sample (15 cm to 30 cm below grade) at each soil sampling location within each of the ten 100 m^2 grids.
9. Submit the soil samples for analysis by an accredited laboratory for the measurement of radium-226 and uranium-238. Measure approximately 10% of the soil samples for thorium-232 and lead-210.
10. Use the results to establish correlation plots to demonstrate the correlation between Ra-226 concentration and the detector gamma count rate.
11. Review and report the soil sampling results with graphs that show the results in comparison to the regulatory limits and plots of the correlation between the soil sampling results and the gamma detector radiation readings.
12. Include a detail narrative discussion of the findings.</td></tr>
<tr><td>RAI 13 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.9.3(2).
Basis for Request 10 CFR Part 40, Appendix A, Criterion 7, requires: “At least one full year prior to any major site construction, a preoperational monitoring program must be conducted to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects.” RG 4.14 provides guidance on the preoperational and operational aspects of effluent and environmental monitoring at uranium mills. NUREG-1569, Acceptance Criterion 2.9.3(2), states: “Soil sampling is conducted at both a 5-cm [2-inch] depth as described in Regulatory Guide 4.14, Section 1.1.4 (NRC, 1980) and 15 cm [6 in] for background decommissioning data.” During its review, NRC staff found no 15-cm soil samples proposed in the TR.
Request for Additional Information Please provide justification for not performing soil samples at 15-cm depths, or indicate where this can be found in the TR.</td><td>Cameco December 23, 2013 response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.6 has been revised accordingly.</td></tr>
<tr><td colspan="2">Cameco January 24, 2014 Supplemental Response for RAI 13.
Please refer to RAI response 12.F, above.</td></tr>
<tr><td>RAI 41 Description of Deficiency In TR Section 6.4, the applicant refers to its RESRAD calculations in TR Appendix N for Marsland site-specific cleanup criteria. However, staff can’t verify that the applicant utilized Marsland site-specific input data (e.g., soil type, wind speed, precipitation, etc.) for RESRAD</td><td>Cameco December 23, 2013 Response: A sampling plan with details on where and how Marsland site-specific cleanup</td></tr>
</table>

appropriate for the site. Basis for Request NUREG-1569, Acceptance Criterion 6.4.3(1), states: "The cleanup criteria for radium in soils are met as provided in 10 CFR Part 40, Appendix A, Criterion 6(6)." This criterion states that the design requirements for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over areas of 100 m2, which as a result of byproduct material, does not exceed the background level by more than: (i) 5 picocuries per gram (pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 cm [5.9 in.] below the surface, (ii) 15 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm [5.9-in.] thick layers more than 15 cm [5.9 in.] below the surface." NUREG-1569, Acceptance Criterion 6.4.3(3), states: "Acceptable cleanup criteria for uranium in soil, such as those in Appendix E of this standard review plan, are proposed by the applicant. This is the radium benchmark dose approach of 10 CFR Part 40, Appendix A, Criterion 6(6)." NUREG-1569, Acceptance Criterion 6.4.3(4), states: "For areas that already meet the radium cleanup criteria, but that still have elevated thorium levels, the applicant proposes an acceptable cleanup criterion for thorium-230. One acceptable criterion is a concentration that, combined with the residual concentration of radium-226, would result in the radium concentration (residual and from thorium decay) that would be present in 1,000 years meeting the radium cleanup standard." NUREG-1569, Acceptance Criterion E2.1.3(2), states, in part: "...The code/calculation input data are appropriate for the site and represent current or long-term conditions, whichever is more applicable to the time of maximum dose. When code default values are used, they are justified as appropriate (representative) for the site..." Request for Additional Information Please address the following issues related to the soil cleanup criteria for the MEA: A. In TR Section 6.4.1, the applicant stated that the ALARA goal for natural uranium in the top 15 cm soil layer is 150 pCi/g averaged over *more than* 100 m2. The averaging of radionuclides over more than 100 m2 is not consistent with the requirements of 10 CFR Part 40, Appendix A, Criterion 6(6) or NUREG-1569, Acceptance Criterion 6.4.3(1). Please provide a justification for averaging the natural uranium concentration over more than 100 m2. B. Consistent with NUREG-1569, Acceptance Criteria 6.4.3(3) and E2.1.3(2), please confirm that site-specific parameters relevant to the MEA (e.g., soil type, wind speed, precipitation, etc.) were used for the RESRAD analysis and thus deriving the radium benchmark dose. If the MEA site-specific parameters are different from what was analyzed, please provide a relevant RESRAD and radium	criteria are to be determined will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Any required sampling will be conducted in late spring or early summer of 2014, prior to construction.

benchmark dose analysis. C. In TR Section 6.4, the applicant refers to its analysis of Th-230 at its main facility for the Marsland analysis without assessing if this analysis is applicable to the MEA. Consistent with NUREG-1569, Acceptance Criterion 6.4.3(4), please provide a MEA site-specific discussion on Th-230, or indicate where this information can be found.	
Cameco January 24, 2014 Supplemental Response for RAI 41 A. The averaging of radionuclides will be performed over areas of not more than 100 m2. The text will be revised accordingly. B. An MEA site-specific radium benchmark dose analysis will be provided to NRC for written verification when the soil sampling described in RAI Response 12.F. is completed. C. An MEA site-specific discussion on Th-230 will be provided to NRC for written verification when the soil sampling described in RAI Response 12.F. is completed.	
RAI 42 Description of Deficiency In TR Section 6.4.2, the applicant provided a gamma action level of 17,900 cpm as the level corresponding to the Marsland soil cleanup criterion. In TR Appendix N, the applicant described its derivation of the gamma action level of 17,900 cpm. However, the gamma action level was derived from data at the main facility (i.e., background levels, etc.) and there is no justification addressing why this data can be applied to Marsland, an unrelated land area. Basis for Request NUREG-1569, Acceptance Criterion 6.4.3(5), states: "The survey method for verification of soil cleanup is designed to provide 95-percent confidence that the survey units meet the cleanup guidelines. Appropriate statistical tests for analysis of survey data are described in NUREG–1575, 'Multi-Agency Radiation Survey and Site Investigation Manual' (NRC, 2000)." Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 6.4.3(5), please provide a technical justification for applying a gamma action level of 17,900 cpm to the Marsland facility when data used to derive this action level is based on site-specific data for the main facility, an unrelated land area.	Cameco December 23, 2013 Response: A sampling plan with details on where and how a Marsland site-specific gamma action level is to be determined will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction.
Cameco January 24, 2014 Supplemental Response for RAI 42 A site-specific Marsland gamma level for soil cleanup criteria will be provided to NRC for written verification when the soil sampling described in RAI Response 12.F is complete.	