From:	John Schmuck
To:	Lancaster, Thomas
Subject:	FW: Marsland RAI Responses - RAI 12.A, 37.A.1, 37.C, Admin Section 5 #3 and #4 Email 1a of 3
Date:	Monday, July 14, 2014 3:07:36 PM
Attachments:	NRC TR RAI Additional Responses Radiological Subject Matter 7-11-2014 Status.pdf Marsland TR Section 2 Air Station Locations 7-11-2014.pdf TR Figure 2_9-2_reprint (2).pdf Marsland TR Section 5 RWP Designee redline 7-11-2014.pdf Marsland TR Section 7 Mildos redlines 7-11-2014.pdf Table 7 3-2 Public and Occupational Doses 7-11-2014.pdf TR Figure 7_3-2_MILDOS Receptors - Residences and Designated MEA License Boundary Locations_11x17_07022014_reprint (2).pdf

Tom - The first try exceeded NRC's limit. This is now Email 1a.

Thanks. .john

From: John Schmuck
Sent: Monday, July 14, 2014 12:10 PM
To: Lancaster, Thomas (Thomas.Lancaster@nrc.gov)
Cc: Rhonda Grantham; Doug Pavlick; Larry Teahon; Sabrina Fox; Larry McGonagle
Subject: Marsland RAI Responses - RAI 12.A, 37.A.1, 37.C, Admin Section 5 #3 and #4 Email 1 of

Tom - This series of 2 emails provides responses/clarifications to RAIs RAI 12.A, 37.A.1, 37.C and Admin Section 5 #3 and #4. A paper copy of this email and attached documents will be provided by mail so that a high-quality copy may be entered into Adams.

Email 1 includes:

- a table presenting the current status of the Marsland Radiological Subject Matter RAI responses
- revisions to Section 2 addressing justification and relocation of an air monitoring station and an associated Figure 2.9-2
- revisions to Section 5 addressing qualifications for designees that approve RWPs
- revisions to Section 7 summarizing the updated Mildos evaluation and an associated Table 7.3-2 and Figure 7.3-2
- a revised Appendix M presenting the updated Mildos evaluation dated July 1, 2014

Email 2 includedes:

- The 2-part Mildos printouts

Thank you very much. .john

RAI 5 Description of Deficiency Staff cannot confirm the value of the MILDOS default mixing height of 100 m proposed by the applicant. Basis for Request The applicant defines the mixing height as the height of the atmosphere above the ground that is well mixed due either to mechanical turbulence or convective turbulence, noting that the layer above this height is stable. Staff observes that this definition is consistent with the definition given by Holzman (refer to page 3 of EPA, 19721). On page 2-91 of the TR, the applicant stated that the MILDOS default mixing height is 100 m and used this default value in its dose calculations. However, on page 2.7 of NUREG/CR-2011, *MILDOS – A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations*, US NRC1981, a default mixing height of 1000 m is recommended. Request for Additional Information Please provide the following information: A. Provide the reference for the 100 m default mixing height value, or correct the statement in the TR regarding the default value of the mixing height; and B. Revise MILDOS calculations if the default value is different than what was originally used, or demonstrate that the calculations used are conservative.	Cameco 12/23/2014 Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been resolved by the revisions to Section 2.5.3.8 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
RAI 6 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.5.3(1). Basis for Request NUREG-1569, Acceptance Criterion 2.5.3(1), states, in part: "The on-site program should be designed in accordance with Regulatory Guide (RG) 3.63, 'Onsite Meteorological Measurement Program for Uranium Recovery Facilities—Data Acquisition and Reporting' (NRC, 1988)." RG 3.63 provides guidance on the siting of meteorological instruments, including the effects from, and the location of, instruments in relationship to natural or man-made obstructions. Staff has found no discussion on the characteristics of the site where the MEA meteorological instruments are, or were, located which would address the siting guidance in RG 3.63. Request for Additional Information Please provide a description of the location of the MEA meteorological instruments (topography, obstructions or lack thereof, etc.) consistent with RG 3.63.	Cameco 12/23/2014 Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been resolved by the revisions to Section 2.5.3.7 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. Cameco 5/27/2014 Status: No NRC update. Cameco 7/11/2014 Status: No update.
RAI 7 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.5.3(2).	Cameco 12/23/2014 Response: No response required. In the public meeting dated September 4, 2013, NRC

Basis for Request NUREG-1569, Acceptance Criterion 2.5.3(2), states, in part: "The impacts of terrain and nearby bodies of water on local meteorology are assessed, and the occurrence of locally severe weather is described and its impact considered." While staff found a discussion on severe thunderstorms in TR Section 2.5.1, staff found no discussion on any consideration of potential impacts of severe weather on MEA operations. Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 2.5.3(2), please provide a discussion on the occurrence of locally severe weather and a consideration of its impacts, or provide a location in the TR where this can be found.	stated the RAI had been resolved by the revisions to Section 7.5.6.1 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
RAI 8.A. Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.5.3(3). Basis for Request NUREG-1569, Acceptance Criterion 2.5.3(3), states: "The meteorological data used for assessing impacts are substantiated as being representative of expected long-term conditions at and near the site." In addition, RG 3.63 provides guidance on determining the long-term representativeness of the onsite meteorological data collected over a minimum of 12 months. This includes various aspects of the National Weather Service meteorological station chosen for comparison. In TR Section 2.5.1, the applicant indicated that the Scottsbluff meteorological station was chosen as the regional station to most represent MEA meteorology. This appears to be based mainly on distance (less than 50 miles) and the availability of hourly data for the last 15 years. Request for Additional Information Please address the following issues related to determining the long-term representativeness of the MEA meteorological data: A. Consistent with RG 3.63, please provide additional information on why the Scottsbluff station was chosen to represent the vicinity of the MEA site, including geographical and topographical descriptions, etc.	Cameco 12/23/2014 Response: In the public meeting dated September 4, 2013, NRC requested more discussion of the factors that lead to the selection of Scottsbluff over the other locations with Met stations. In addition to the revisions to Section 2.5.1 and Appendix S submitted by Cameco on June 26, 2013, further justification for selection of the Scottsbluff Met station is provided in revisions to Appendix S. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
RAI 8.B. The Scottsbluff station has only 15 years of data. This is not consistent with the RG 3.63 recommendation for long-term analysis (e.g., 30 years). Please provide justification for using only 15 years of data.	Cameco 12/23/2014 Reponse: In the public meeting dated September 4, 2013, NRC requested additional justification for using 15 years instead of 30 years for the long-term analysis. In addition to the new Appendix S submitted by Cameco on June 26, 2013, further

	justification for use of 15 years data is provided in revisions to Appendix S. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
RAI 8.C.1. TR Figures 2.5-30 and 2.5-31 provide a statistical analysis of the 15-yr and baseline-year wind speed and wind direction for the Scottsbluff meteorological station. Please provide the following information on these analyses: 1. NUREG-1475, Rev.1, *Applying Statistics*, US NRC 2011, describes linear regression as a model that relates a dependent variable to a single, or multiple, independent variable(s). Please explain the validity of the proposed linear regressions when there appears to be no independent variable and it is unclear to staff what the regression equations in Figures 2.5-30 and 2.5-31 represent.	Cameco 12/23/2014 Response: In the public meeting dated September 4, 2013, NRC expressed concern that the regression analysis failed to include both dependent and independent variables. To that end, in addition to the new Appendix S submitted by Cameco on June 26, 2013, further discussion of the regression analysis is provided in revisions to this appendix. Cameco 5/22/2014 email to NRC: "Cameco's response to RAI 8.C.1 was provided in the first paragraph of redline text in the version of Appendix S submitted in December 2013." Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
RAI 8.C.2. TR Figures 2.5-30 and 2.5-31 provide a statistical analysis of the 15-yr and baseline-year wind speed and wind direction for the Scottsbluff meteorological station. Please provide the following information on these analyses: 2. p-values for the linear regression equations presented in TR Figures 2.5-30 and 2.5-31.	Cameco 12/23/2014 Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been resolved by the revisions submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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	Cameco 12/23/2014 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.

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 5/6/2014 Status: Awaiting NRC review. Cameco 5/16/2014 Status: Please also see the response to RAI 37A1. Because Cameco is updating Mildos to reflect a higher flow rate, we have also instructed our contractor to assess where the highest dose may be expected. Cameco will reassess the current Monitor locations and will relocate accordingly. We expect to submit the update Mildos estimate and associated monitor locations by June 1, 2014. Cameco 5/27/2014 Status: Cameco will provide a dose estimate for ranchers using property between the monitor well ring and license boundary for grazing and haying. We will include the underlying dose assumptions, particularly the estimated annual hours ranchers will be present in that vicinity. Cameco 7/11/2014 Status: Attached please find a Mildos assessment for a 6000gpm production/1500 gpm restoration plant. Consistent with Figure 5, for operational air monitoring, Cameco will relocate air monitor station MAR-2 on Figure 2.9-2 to a location approximately 1.5 km SE of the Satellite Plant. In addition, the text in Section 7.3.3.3 of the TR has been revised to reflect the dose to a rancher if the rancher grazed cattle and cut hay approximately 1.5 km SE of the Satellite Plant.
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 12/23/2014 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. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: LLDs exceedances for fish and surface water baseline sampling are being addressed by collecting a new round of data which, as described in the response to RAI 12.H. The data will be submitted in the fourth quarter of 2014. Cameco 7/11/2014 Status: No update.
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 12/23/2014 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 5/6/2014 Status: The sampling plan was submitted as a supplemental RAI response 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. The gamma surveys and soil sampling will be performed in June and a report submitted by September 1, 2014. Cameco 5/16/2014 Status: Weather permitting the gamma survey will occur the week of May 26th. It takes

	30 days for sample results, and our contractor expects to prepare a final report for submission in mid-July 2014. Cameco 5/27/2014 Status: The survey and sampling are underway. Cameco 7/11/2014 Status: Cameco now anticipates submission in early August.
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 12/23/2014 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. 5/6/2014 Status: The sampling plan was submitted as a supplemental RAI response 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. The gamma surveys and soil sampling will be performed in June and a report submitted by September 1, 2014. Cameco 5/16/2014 Status: Weather permitting the gamma survey will occur the week of May 26th. It takes 30 days for sample results, and our contractor expects to prepare a final report for submission in mid-July 2014. Cameco 5/27/2014 Status: The survey and sampling are underway. Cameco 7/11/2014 Status: Cameco now anticipates submission in early August.
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	Cameco 12/23/2014 Response: A sampling plan with details on where and how surface and subsurface soil

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.	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. 5/6/2014 Status: The sampling plan was submitted as a supplemental RAI response 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. The gamma surveys and soil sampling will be performed in June and a report submitted by September 1, 2014. Cameco 5/16/2014 Status: Weather permitting the gamma survey will occur the week of May 26th. It takes 30 days for sample results, and our contractor expects to prepare a final report for submission in mid-July 2014. Cameco 5/27/2014 Status: The survey and sampling are underway. Cameco will be performing sampling at a 1m depth in accordance with RG 4.14, Section 1.1.4 c., at that time. Cameco 7/11/2014 Status: Cameco now anticipates submission in early August.
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	Cameco 12/23/2014 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

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 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.	which provides adequate seasonal Brule characterization in this area. Cameco 5/6/2014 Status: Awaiting NRC review. *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. Cameco 5/6/2014 Status: All baseline radiological sampling with be submitted by the fourth quarter of 2014. *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. Cameco 5/6/2014 Status: All baseline radiological sampling with be submitted by the fourth quarter of 2014. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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.	Cameco 12/23/2014 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. Cameo 5/6/2014 Status: The sampling plan was submitted on January 24, 2014 and is attached below for your information. The gamma surveys and soil sampling

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.	will be performed in June and a report submitted by September 1, 2014. Cameco 5/16/2014 Status: Weather permitting the gamma survey will occur the week of May 26th. It takes 30 days for sample results, and our contractor expects to prepare a final report for submission in mid-July 2014. Cameco 5/27/2014 Status: The survey and sampling are underway. Cameco 7/11/2014 Status: Cameco now anticipates submission in early August
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 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.	Cameco 12/23/2014 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 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. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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 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	Cameco 12/23/2014 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 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. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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 inspected for proper operation as recommended in RG 3.56 and that this equipment	Cameco 12/23/2014 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

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. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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 12/23/2014 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. Cameco 5/6/2014 Status: No later than May 30, 2014, Cameco will submit Marsland-specific information regarding survey instrumentation. Cameco 5/16/2014 Status: Please see the 12/23/2014 response. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
RAI 29 Description of Deficiency The applicant did not provide any specifics on its ALARA policy.	Cameco 12/23/2014Response: CBR is providing Volume IV, SHEQMS Health Physics Manual under separate cover

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 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.	and under a request for confidentiality. Specifically, the management commitment to ALARA is 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 Cameco 5/6/2014 Status: Awaiting NRC review. Cameco does not wish that these proprietary documents be disclosed. NRC has reviewed the program repeatedly over may years and can use the inspection reports as a basis for both compliance and licensing determinations. If necessary, Cameco will withdraw the documents from ADAMs, and provide a very brief summary in lieu of disclosure. Cameco 5/27/2014 Status: Cameco withdraws the non-disclosure request and asks that the documents be retained by NRC for Staff use only or destroyed. Cameco will revise the text of the application to summarize these documents in response to the RAI. Cameco 7/11/2014 Status: The text summaries will be provided by the end of July 2014.
RAI 30 Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 5.7.2.3(5).	Cameco 12/23/2014 Response: CBR is providing a copy of the documentation used for radiation exposures

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.	under separate cover and under a request for confidentiality. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco does not wish that these proprietary documents be disclosed. NRC has reviewed the program repeatedly over may years and can use the inspection reports as a basis for these licensing determinations. If necessary, Cameco will withdraw the documents, and provide a summary in lieu of disclosure. Cameco 5/27/2014 Status: Cameco withdraws the non-disclosure request and asks that the documents be retained by NRC for Staff use only or destroyed. Cameco will revise the text of the application to summarized these documents in response to the RAI. Cameco 7/11/2014 Status: The text summaries will be provided by the end of July 2014.
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 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.	Cameco 12/23/2014Response: Please see response to RAI 28, which appears identical to RAI 32. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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	Cameco 12/23/2014 Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte

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.	facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations. Cameco 5/6/2014 Status: No later than May 30, 2014, Cameco will submit Marsland-specific information regarding survey instrumentation. Cameco 5/6/2014 Status: Cameco again proposes to resolve this in the context of the license renewal. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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 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.	Cameco 12/23/2014 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. Cameco 5/6/2014 Status: At present, the draft license for the overlying facility includes condition 9.6. The reference in this license condition establishes a requirement identical to acceptance criteria 5.7.6.3(6). Since that license language will be directly applicable to Marsland operations, the inclusion of identical language in the application would be redundant.

	Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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 12/23/2014 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. Cameco 5/6/2014 Status: Similar to RAI 34, the draft license for the overlying facility includes condition 9.6. The reference cited in this license condition establishes a requirement identical to acceptance criteria 5.7.6.3(7). Since that license language will be directly applicable to Marsland operations, the inclusion of identical language in the application would be redundant. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.
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."	Cameco 12/23/2014 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. Cameco 5/6/2014 Status: Similar to RAIs 34 and 35, the draft license for the overlying facility includes condition 9.6. The reference cited in this license condition establishes a requirement identical to acceptance criteria 5.7.6.3(9). Since that license language will be directly applicable to Marsland operations, the inclusion of identical language in the application would be redundant. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No update.

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.	
RAI 37.A.1 Description of Deficiency Staff cannot verify the applicant's MILDOS 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	Cameco 12/23/2014 Response: The MILDOS model was rerun and the report was revised to eliminate the duplicate reduction in source term. Please see the revisions to Appendix M. Cameco 5/6/2014 Status: Cameco will be submitting an update to the Mildos reflecting a higher total flow rate. Please proceed with the review of this section and Appendix M as the only change will be an increase in flow and the dose estimates. We expect to provide the update no later than May 30, 2014. ~~Cameco 5/16/2014 Status: Weather permitting the gamma survey will occur the week of May 26th. It takes 30 days for sample results, and our contractor expects to prepare a final report for submission in mid-July 2014.~~ (Erroneous language deleted). Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: Attached please find a Mildos assessment for a 6000gpm production/1500 gpm restoration plant. The revised Mildos no longer includes the additional reduction in radon effluent concentration.

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. <u>Request for Additional Information</u> 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	Cameco 12/23/2014 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

	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 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.	revisions to Section 2.9.5.2. Cameco 5/6/2014 Status: Cameco has taken and analyzed soil samples from each garden in the area of review. At present we are 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. We expect to submit the justification, data and analysis with no later than September 1, 2014. Cameco 5/16/2014 Status: Cameco now expects to submit the justification, data and analysis no later than June 30, 2014. Cameco 5/27/2014 Status: Cameco will respond to RAI 37.A.2. a., b., and c., individually. Cameco 7/11/2014 Status: No change.
	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	Cameco 12/23/2014 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

not.	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. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No change.
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 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 12/23/2014 Response: The revised MILDOS-AREA assessment (Appendix M) presents the radiation doses for a 2,000-hour per year onsite full-time worker. Cameco 5/6/2014 Status: Cameco will be submitting an update to the Mildos reflecting a higher total flow rate. Please proceed with the review of this section and Appendix M as the only change will be an increase in flow and the dose estimates. We expect to provide the update no later than May 30, 2014. Cameco 5/16/2014 Status: As noted in the context of RAI 12.A., because Cameco is updating Mildos to reflect a higher flow rate, we have also instructed our contractor to assess where the highest dose may be expected. Cameco will reassess the current Monitor locations and will relocate accordingly. We expect to submit the update Mildos estimate and associated monitor locations by June 1, 2014. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: Attached please find a Mildos assessment for a 6000gpm production/1500 gpm restoration plant. The occupation dose rate estimates have been revised to reflect 2000 hours onsite during the year.
RAI 38 Description of Deficiency The applicant did not provide the criteria used for determining the proposed locations for the airborne effluent monitoring stations.	Cameco 12/23/2014 Response: Please see response to RAI 12.A., above.

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 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: 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-reclamation survey programs for diversion ditches, surface impoundments, and transportation routes, or identify where this commitment is already discussed.	Cameco 12/23/2014 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. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No change.
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	Cameco 12/23/2014 Response: A sampling plan with details on where and how Marsland site-specific cleanup criteria are to be determined will be submitted for NRC

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: 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	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. Cameco 5/6/2014 Status: 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. The gamma surveys and soil sampling will be performed in June and a report submitted by September 1, 2014. Cameco 5/16/2014 Status: Weather permitting the gamma survey will occur the week of May 26th. It takes 30 days for sample results, and our contractor expects to prepare a final report for submission in mid-July 2014. Cameco 5/27/2014 Status: The survey and sampling are underway. Cameco 7/11/2014 Status: Cameco now anticipates submission in early August.

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 12/23/2014 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. Cameco 5/6/2014 Status: 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. Cameco 5/16/2014 Status: Weather permitting the gamma survey will occur the week of May 26th. It takes 30 days for sample results, and our contractor expects to prepare a final report for submission in mid-July 2014. Cameco 5/27/2014 Status: The survey and sampling are underway. Cameco 7/11/2014 Status: Cameco now anticipates

	submission in early August.
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 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.	Cameco 12/23/2014 Response: Figure 1.7-2 has been revised to show the Restricted Areas for the current license area. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: No change.
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 12/23/2014 Response: The minimum training requirements have been added to Section 5.4.1 in accordance with RG 8.31. Cameco 5/6/2014 Status: Awaiting NRC review. Cameco 5/27/2014 Status: Cameo will revise the application to describe the qualifications of designees. Cameco 7/11/2014 Status: Section 5.2.1.2 has been revised to reflect the qualifications for designees allowed to review and approve RWPs and SRWPs in the absence of the RSO.
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 12/23/2014 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. Cameco 5/6/2014 Status: The RAI response will be provided no later than May 30, 2014. Cameco 5/27/2014 Status: No update. Cameco 7/11/2014 Status: Cameco does not expect to change the application. Reference to the RG 8.31 provides an adequate "tie down" and avoids unnecessary, identical and redundant language in the application.

In regard to collection of air particulate samples, RG-4.14 states that air particulates should be:

- Collected continuously at a minimum of three locations at or near the site boundary
- Collected continuously at or near the residence or occupiable structure within 10 kilometers of the site that is most likely to be impacted by the milling operation
- Collected from a remote location representing background, usually upwind from the project site and milling operation

RG-4.14 also enumerates five criteria that should be considered when determining the sampling locations:

1. Average meteorological conditions
2. Prevailing wind direction
3. Site boundaries nearest to mill
4. Direction of nearest occupiable structure
5. Location of estimated maximum concentrations of radioactive materials

In accordance with these criteria, **Figure 2.9-2** shows three sampling sites at the project boundary (Sites MAR-1, MAR-4 and MAR-3). One of these (Site MAR-1) also coincides with the nearest, and most likely to be impacted, occupiable structure. A fourth sampling site (Site MAR-5) is intended to represent background conditions. Because the on-site wind rose indicates northeasterly winds to be the least frequent, this background monitoring site is located southwest of the project boundary at a distance of approximately 4 miles (6.4 km). A summary of monitor locations and elevations for each of the monitors is shown in **Table 2.9-1**.

During baseline monitoring, Site MAR-2 was located directly south of the proposed mill, and slightly outside the project boundary. For operational monitoring Site MAR-2 is being relocated, as described below. Sites MAR-3 and MAR-4 on the southernmost boundary of the project represent prominent downwind locations. The on-site wind rose shows north-northwesterly, northwesterly, and northerly winds to be the most frequent, accounting for more than 25 percent of the time. Hence, these three monitoring sites are located south-southeast, southeast and south of the proposed milling operation. The wind roses are shown in **Figures 2.5-20** and **2.5-21**.

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When selecting air monitor locations, it was expected that the maximum short-term concentrations of radioactive materials would be found in the vicinity of the combined satellite facility and mine unit source terms. Similarly, long-term maximum concentrations are also expected in the vicinity of the satellite plant, given the larger proportion source term present at that location. In addition, maximum concentrations were expected where the radon has the longest residence time with the least mixing, allowing the ingrowth of Radium 226. It was believed that this would occur where the wind was less frequent and at lower velocity. Based upon the wind rose, this would occur WSW and SW of the satellite facility. That information was considered in selecting the location for MAR-1.

Following completion of preoperational baseline monitoring, the Mildos Area assessment was significantly refined. Those revisions are now included as part of Section 7. The location of estimated maximum contaminant concentrations due to dose associated with radon progeny is located approximately 1.5 km southeast of the Sattellite Plant (see **Figure 5** in Appendix M). To

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satisfy RG 4.14, for operational air monitoring air monitoring station MAR-2 will be relocated according to criteria 5, noted above.

The wind rose was developed from data generated at an MEA onsite MET station. The MET monitoring station monitored temperature, precipitation, evaporation, wind speed and direction, and the standard deviation of the wind direction. The local meteorological station was operated from August 28, 2010 through August 29, 2011. From this information, joint frequency data were compiled. Further information on meteorological conditions is provided in Section 2.5.

2.9.2.2 Air Particulate Monitoring Program

RG 4.14 recommends that a total of five particulate monitoring stations be established as discussed above in Section 2.9.2.1. The locations of the air particulate samplers are shown on **Figure 2.9.2**. There are no operations at the satellite facility that could cause a significant release of airborne particulate radionuclides (e.g., lack of yellowcake drying). Therefore, radiological-contaminated air particulates are expected to be minimal.

Five quarters of air particulate monitoring have been conducted and are discussed in this section. The PPMP monitoring program will be incorporated into the operations monitoring program. The results of the air monitoring data at sampling sites MAR-1 through MAR-5 for the fourth quarter of 2011 through the fourth quarter 2012 are presented in **Table 2.9-2** are summarized as follows:

- Lead 210 measurements were a consistent 2E-14 microCuries per milliliter (µCi/ml) at all monitor sites (reporting limit of 2E-15 µCi/ml) for all quarters except for the second quarter of 2012, when the lead level was 1E-14 µCi/ml (reporting limit of 2E-15 µCi/ml).

- Radium 226 levels at all monitor sites for all quarters exhibited a level at or less than 1E-16 µCi/ml (reporting limit of 1E-16 µCi/ml), except for the third quarter of 2012 when the radium-226 µCi/ml level was 5E-10 µCi/ml. Thorium 230 levels at monitor sites M-1 through M-4 for all quarters were at or less than 1E-16 µCi/ml, while the thorium 230 level at M-3 was 2E-16 µCi/ml (reporting limit of 1E-16 µCi/ml).

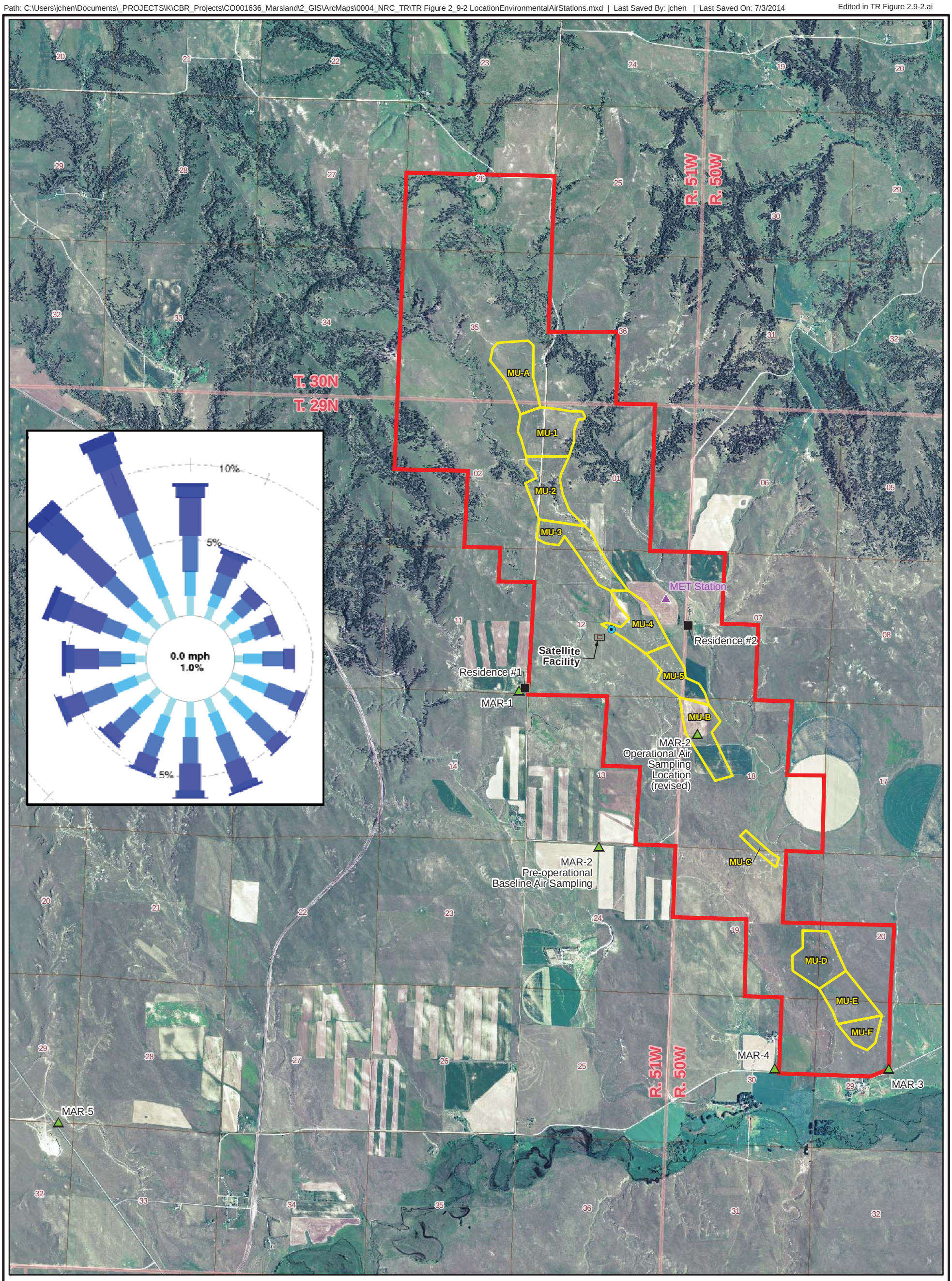
- Uranium levels all monitor sites for all quarters were measured at <1E-16 µCi/ml (reporting limit of 1E-16 µCi/ml), with the exception of the first quarter of 2012, when levels of 3E-16 µCi/ml (reporting limit of 1E-16 µCi/ml) were measured at MA-2, MA-3 and MA-4, with MA-5 exhibiting a level of 2E-16 µCi/ml (reporting limit of 1E-16 µCi/ml.

The air sampling analytical laboratory reports and QA/QC summary reports are shown in **Appendix U**.

The airborne particulate samples are collected on the inlet filter of a regulated vacuum pump on a Type A/E 47 mm glass fiber filter paper. The low volume air samplers employed is the F&J Portable DF-75L-BL-AC brushless powered air sampler, 60 liter/min, 24 voltage current direct (VCD). This air particulate sampler runs on solar power and batteries. The sampler has a filter holder and a set flowrate maintained automatically in case of dust loading. It does not require operator attention.

Path: C:\Users\jchen\Documents_PROJECTS\K\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0004_NRC_TR\TR Figure 2_9-2 LocationEnvironmentalAirStations.mxd | Last Saved By: jchen | Last Saved On: 7/3/2014

Edited in TR Figure 2.9-2.ai



LEGEND

- Proposed Deep Disposal Well
- Pre-operational Baseline/ Operational Air Sampling Station
- Residence
- Mine Unit
- Proposed Marsland Expansion Area

Map Updated on: 7/3/2014

N

0 3,000 6,000

Feet

PROJECTION: NAD1983, STATE PLANE NEBRASKA NORTH, FIPS 2600
SOURCES: USDA NAIP IMAGERY 2010

CROW BUTTE RESOURCES, INC.

FIGURE 2.9-2
LOCATION OF ENVIRONMENTAL AIR SAMPLING STATIONS AT MARSLAND EXPANSION AREA

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

Written operating procedures have been developed for all process activities including those involving radioactive materials. Where radioactive material handling is involved, pertinent radiation safety practices are incorporated into the operating procedure. Additionally, written operating procedures have been developed for non-process activities including environmental monitoring, health physics procedures, emergency procedures, and general safety.

The procedures enumerate pertinent radiation safety procedures to be followed. A copy of the written procedure will be kept in the area where it is used. All procedures involving radiation safety will be reviewed and approved in writing by the RSO or another individual with similar qualifications prior to being implemented. The RSO will also perform a documented annual review of the operating procedures.

5.2.1.2 Radiation Work Permits

When employees are required to conduct activities of a non-routine nature where there is the potential for significant exposure to radioactive materials and for which no operating procedure exists, an RWP will be required. The RWP will describe the scope of the work, precautions necessary to maintain radiation exposures to ALARA, and any supplemental radiological monitoring and sampling to be conducted during the work. The RWP shall be reviewed and approved in writing by the RSO or designated HPT in the absence of the RSO prior to initiation of the work. The HPT is instructed to assess the complexity of the activity and to contact the RSO by phone if any questions arise.

To become designated, the HPT must demonstrate competency by preparing a minimum of six RWPs under the supervision of the RSO. The RSO will document the competency determination.

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The RSO may also issue Standing Radiation Work Permits (SRWPs) for periodic tasks that require similar radiological protection measures (e.g., maintenance work on a specified facility system). The SRWP will describe the scope of the work, precautions necessary to maintain radiation exposures to ALARA, and any supplemental radiological monitoring and sampling to be conducted during the work. The SRWP shall be reviewed and approved in writing by the RSO prior to initiation of the work.

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5.2.1.3 Record Keeping and Retention

The SHEQMS Volume II, Management Procedures, provides specific instructions for the proper maintenance, control, and retention of records associated with implementation of the program. The program is consistent with the requirements of 10 CFR 20 Subpart L and 10 CFR §40.61 (d) and (e). Records of surveys, calibrations, personnel monitoring, bioassays, transfers or disposal of source or byproduct material, and transportation accidents will be maintained on site until license termination. Records containing information pertinent to decommissioning and reclamation, such as descriptions of spills, excursions, contamination events, as well as information related to site and aquifer characterization and background radiation levels, will be maintained on site until license termination. Duplicates of all significant records will be maintained in the corporate office or other offsite locations.

5.4.2 Health Physics Technician Qualifications

In addition to the RSO, there should be a minimum of one full-time health physics technician at any full-scale operating uranium recovery facility. The health physics technician should have **one** of the following combinations of education, training, and experience:

- Education: An associate's degree or 2 or more years of study in the physical sciences, engineering, or a health-related field
- Training: A total of at least 4 weeks of generalized training (up to 2 weeks may be on-the-job training) in radiation health protection applicable to uranium recovery facilities
- Experience: One year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in a uranium recovery facility

OR

- Education**:** A high school diploma;
- Training: A total of at least 3 months of specialized training (up to 1 month may be on-the-job training) in radiation health protection relevant to uranium recovery facilities; and
- Experience**:** Two years of relevant work experience in applied radiation protection.

The health physics technician should demonstrate a working knowledge of the proper operation of health physics instruments used in the uranium recovery facility, surveying and sampling techniques, and personnel dosimetry requirements. The HPT's qualifications are reviewed and documented by a Safety and Environmental Review Panel in accordance with Seciton 5.2.3.

5.5 Radiation Safety Training

All site employees and contractor personnel at the CPF are administered a training program based upon the SHEQMS covering radiation safety, radioactive material handling, and radiological emergency procedures. The CBR Training Program in the SHEQMS Volume VII, Training Manual, provides requirements for radiation safety training. The training program is administered in keeping with standard radiological protection guidelines and the guidance provided in RG 8.29, RG 8.31, and RG 8.13 (NRC 1996, 2002a, and 1999a). The technical content of the training program is under the direction of the RSO. The RSO or an HPT conducts all radiation safety training. CBR will implement this training program for activities at the MEA.

5.5.1 Training Program Content

5.5.1.1 Visitors

Visitors to the site who have not received training are escorted by onsite personnel properly trained and knowledgeable about the hazards of the facility. At a minimum, visitors are instructed specifically on what they should do to avoid possible hazards in the area of the facilities that they are visiting.

5.5.1.2 Contractors

Any contractors having work assignments at the facilities are given appropriate radiological safety training. Contract workers who will be performing work on heavily contaminated

7.3 Radiological Effects

An assessment of the radiological effects of the satellite facility must consider the types of emissions, the potential pathways present, and an evaluation of potential consequences.

The satellite facility will have a production flow capacity of approximately 6,000 gpm and will use fixed-bed downflow IX columns to separate uranium from the pregnant production fluid. The facility will also have a capacity to treat 1,500 gpm of restoration solution. The restoration process will use fixed-bed downflow IX columns to remove the uranium and RO to remove the dissolved solids. Waste disposal at the satellite facility will be via a deep injection well. The satellite facility will not have precipitation equipment. The loaded IX resin will be transferred from the columns to a resin trailer for transport to the CPF for regeneration and stripping. The reclaimed resin will be transported back to the satellite facility and reused in IX columns.

The uranium-bearing regenerant at the CPF is treated in the uranium precipitation circuit. The precipitated uranium is vacuum dried.

The primary airborne radiological emission from the facility will be radon-222 gas (radon) and its decay products. Radon is present in the ore body and is formed from the decay of radium-226. Radon is dissolved in the lixiviant as it travels through the ore body to a production well, where the solution is brought to the surface. The concentration of radon in the production solution is calculated using methods found in RG 3.59, "Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations" (March 1987). The details of this calculation are found in **Appendix M.**

MILDOS-AREA was used to model radiological impacts on human and environmental receptors (e.g., air and soil) using site-specific radon release estimates, meteorological and population data, and other parameters (Savignac 2014). The following sections briefly discuss the assumptions and methods used to estimate the potential radiological impacts of the satellite facility coupled with the CPF. A detailed presentation of the source term and other MILDOS-AREA parameters is included in **Appendix M**. The anticipated effects are compared to the naturally occurring background levels. This background radiation, arising from cosmic and terrestrial sources, as well as naturally occurring radon gas, comprises the primary radiological impact to the environment in the region surrounding the proposed project.

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7.3.1 Exposure Pathways

The proposed satellite is an *in-situ* uranium recovery facility. The only source of planned radioactive emissions from the facility is radon gas and its decay products, which dissolves in the leaching solution. Radon gas may be released as the solution is brought to the surface and processed in the satellite facility. Unplanned emissions from the site are possible as a result of accidents and engineered structure failure, but are not addressed in the MILDOS-AREA modeling. A human exposure pathway diagram addressing planned and unplanned radiological emissions is presented in **Figure 7.3-1.**

The satellite facility will have pressurized downflow IX columns capable of processing 6,000 gpm of production solution. The satellite facility will also have IX and RO equipment with a

capacity of 1,500 gpm to process restoration solutions. Up-flow IX columns are not planned for the MEA.

Within the pressurized columns, most of the radon will remain in solution and will be returned to the formation. There will be minor releases of radon during the air blowdown prior to resin transfer. The air blowdown and the gas released from the vent during column filling will be vented into the exhaust manifold and discharged via the main radon exhaust stack. It is estimated that less than 1 percent of the total radon contained in the process solutions will be vented to atmosphere.

In the source term calculation, Cameco estimates that in the absence of evaporation ponds, 75 percent of the radon released will be vented from the satellite facility, and 25 percent of the radon will be released from the wellfields.

After the IX resin is loaded, it will be transferred to a resin trailer. The trailer will transfer the resin to the CPF for additional processing. The stripped and regenerated resin will be transferred to the trailer, returned to the satellite facility, and transferred into a process column. It is anticipated that one round trip will occur every other day.

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The injection wells will generally be closed and pressurized, but periodically vented. A sensitivity analysis demonstrated that radiation doses using a 25 percent/75 percent distribution of radon released from the MU wellhouses and from the satellite facility did not appear to be significantly different from the doses calculated using a 10 percent/90 percent distribution, respectively (Savignac 2014). See discussions in Section 7.3.3.3 and **Appendix M**.

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Atmospheric emissions of radon will distribute to all quadrants of the area surrounding the MEA and the CPF. Radon itself impacts human health or the environment marginally, because it is an inert noble gas. Radon has a relatively short half-life (3.8 days), and its decay products are short-lived, alpha emitting, non-gaseous radionuclides. These decay products have the potential for radiological impacts to human health and the environment. **Figure 7.3-1** shows that all exposure pathways, with the possible exception of absorption, can be important depending on the environmental media impacted. All of the pathways related to air emissions of radon were evaluated using MILDOS-AREA (Savignac 2014).

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7.3.2 Exposures from Water Pathways

The solutions in the zone to be mined will be controlled and adequately monitored to ensure that migration does not occur. The overlying aquifers will also be monitored.

The satellite facility will not have surge/evaporation ponds or surge tanks to store waste solutions, thereby eliminating the potential of releases and exposures via water pathways. Wastewater tanks located in the satellite building will discharge to a DDW, which will be the primary method of waste disposal at the satellite facility. The deep well will be completed at a depth of approximately 4,000 to 5,000 ft, isolated from any underground source of drinking water by approximately 1,500 ft of Pierre Shale. The well will be constructed under a permit from the NDEQ and meet all requirements of the UIC program.

The satellite facility will be located on a curbed concrete pad to prevent any liquids from entering the environment. Solutions used to wash down equipment will drain to a sump and will be pumped to the DDWs. The pad will be of sufficient size to contain the contents of the largest tank if it ruptures.

Because no routine liquid discharges of process water are expected, there are no definable water-related pathways.

7.3.3 Exposures from Air Pathways

The only source of radionuclide emissions is radon released into the atmosphere through the satellite vent system or from the wellfield. As shown on **Figure 7.3-1**, atmospheric releases of radon can result in radiation exposure via three pathways: inhalation, ingestion, and external exposure.

Radiation dose rates were determined using the NRC computer code MILDOS for the proposed MEA project (Savignac2014). The objective of this evaluation was to:

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- Determine the radiation doses to members of the public within a 50-mile (80-km) radius of the MEA using the NRC computer code MILDOS.
- Determine the potential annual dose rate to workers on the site.
- Determine the sensitivity of the MILDOS estimates of radiation dose.

This section summarizes the major findings of the MILDOS evaluation. For more detailed information on assumptions, inputs, outputs, and other elements of the model, the MILDOS report is provided in **Appendix M**.

For comparison, naturally occurring background radiation, from cosmic and terrestrial sources, is approximately 365 mRem/yr.

7.3.3.1 MILDOS Output – Radiation Dose Rates

Table 7.3-1 presents the dose rates calculated for the major cities and towns within a 50-mile (80-km) radius of the MEA; eight residences; two unoccupied structures; and for the north, south, east, and west property boundaries. Residences #1 and #2 are not currently occupied but are occupiable. Locations of the nearby and regional receptors are shown on **Figures 7.3-2** and **7.3-3**, respectively. The dose rates were calculated using the MEA onsite meteorological data and using the 315 gpm maximum wastewater flow rate expected in years nine through twenty.

Because radon is released from both the mine units wellhouses and from the satellite plant, the doses were proportioned 25 percent from the mine units and 75 percent from the satellite. **Table 7.3-1** presents the total dose from the satellite facility, MEA MUs 1 through 5 and A through F under typical operating conditions from both sources of radon. Conclusions from those dose rates are as follows:

- All dose rates to the public at the property boundaries, the cities and towns within a 50-mile (80-km) radius from the MEA, and at the nearest residence were below the 100 mRem/yr limit specified in 10 CFR 20 (TEDE).

- The highest cumulative MEA boundary dose rate was 5~~6~~5 mRem/yr at the south property boundary.
- The highest cumulative dose rate at the nearest Residence #2 (unoccupied) ~~an occupiable but currently unoccupied residence~~ was 2~~7~~5 mRem/yr ~~at Residence # 2~~.
- The highest cumulative dose rate from all existing and proposed ISR facilities at cities and towns within a 50-mile (80-km) radius from the MEA was 6.0 mRem/year at Crawford, and ~~2.4 and~~ 3~~3.2~~ mRem/yr at both the Towns of Hemingford and Marsland~~, respectively~~.
- The 10 CFR 190 dose rate was 0 mRem/yr which was below the 10 mRem/yr dose limit for emissions that exclude radon and its progeny.
- The total population effective dose rate was 411 ~~3,060~~ person-rem/year.

For comparison naturally occurring background radiation, from cosmic and terrestrial sources, is approximately 365 mRem/yr.

The radiation doses from the production wells and from the wells in restoration are identical. ~~The doses from the new wells are all zero.~~ See **Appendix M** for production well doses, restoration well doses, and new well doses. ~~The doses presented in these appendices have not been proportioned between the mine unit emissions and the satellite stack emissions.~~

7.3.3.2 MILDOS Output – Public and Occupational Radiation Dose Rates

Dose rates for the invited public inside the license boundary apply to delivery personnel, regulatory inspectors, visitors, or other personnel that may spend up to 10 hours per month on site. Occupational dose rates apply to personnel that may spend an estimated 2,000 hours per year working on site such as company employees or contractors.

Table 7.3.2 shows the MEA invited public and occupational dose rates. At maximum flow during years nine through twenty, the maximum dose rate to the invited public attributable to Marsland was ~~00.4~~0.16 mRem/yr, and the maximum occupational dose rate to employees and contractors was 32~~42.6~~ mRem/yr with an average of 17~~20.9~~ mRem/yr.

In addition, ranchers holding the leases for the MEA may graze cattle and cut hay within the license boundary, but only outside the perimeter monitor well ring. For simplicity, and to ensure a conservative result, we will assume that the rancher will perform the grazing and haying at the point 1.5 km southeast of the satellite plant where the maximum dose is expected. This will not occur as this location is within a mine unit and will be off limits. Regardless, it is reasonable to assume a rancher will spend 416 hours per year attending grazing cattle (8 hours per day, 1 day per week, 52 weeks per year) and up to 160 hours per year cutting hay (8 hours per day, 5 days/week, 4 weeks per year).

At the point 1.5km southeast of the plant the incremental dose to the rancher would be 8.5mrem/year for grazing and 3.3mrem/year for haying. As noted earlier, this situation cannot occur and any dose to ranchers performing these activies will be significantly less.

7.3.3.3 Radon Release Points

The radiation dose rates from typical operations used the following:

- 25 percent radon released from the MU wellhouse

That distribution has been used historically in MILDOS assessments. For comparison, dose rates were calculated using:

- 10 percent radon released from the MU wellhead houses.
- 90 percent radon released from the satellite plant vent stack.

The dose rates from both distributions are presented in **Appendix M**. A comparison of the 25 percent/75 percent distribution of radon in column 2 with the 10 percent/90 percent distribution of radon release shows that the averages and standard distributions are nearly identical. That similarity suggests that, within the range of values selected for the radon distribution between releases at the mine units and releases at the satellite plant, the distribution is not important to assessing the doses to people around the MEA site.

A MILDOS sensitivity analysis was conducted. Such an analysis identifies how input parameters affect the calculated radiation dose. Input parameters and variables are discussed in **Appendix M.**

The sensitivity analysis demonstrated that:

- Neither the occupational or public dose rates exceeded 100 mRem/yr.
- Radiation doses calculated using a 25 percent/75 percent distribution of radon released from the MU wellhouses and from the satellite plant did not appear to be significantly different from the doses calculated using a 10 percent/90 percent distribution, respectively.
- The maximum dose to the invited public on site 10 hours/month is 0.12 mRem/yr.
- The average and maximum occupational dose rates to employees and contractors on site 2,000 hours/yr is 17 and 32 mRem/yr, respectively.

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7.3.4 Exposure to Flora and Fauna

There are two primary potential pathways for radiological exposures to flora and fauna: radon emissions and accidental spills of radiological containing fluids (e.g., lixiviant).

7.3.4.1 Radon Releases

Radon emissions at satellite uranium *in-situ* facilities such as the proposed satellite facility (i.e., no yellowcake dryer and associated facilities) are considered the primary air contaminant during operations. Radon emissions during normal operations are considered the most important pathway for exposure to flora and fauna due to deposition of radon-222 decay products on surface water, surface soils, and vegetation. The MILDOS-AREA model provides an estimate of surface deposition rate as a function of distance from the source for the radon-222 decay products and calculates surface concentrations.

The exposure to flora and fauna was evaluated in the Environmental Report submitted in September of 1987 (Ferret Exploration Company of Nebraska 1987), and the doses were found to be negligible. Based on this evaluation, the proposed MEA, TCEA, and NTEA projects are not expected to have a measurable impact on dose to flora and fauna.

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Table 7.3-2 Public and Occupational Doses for Marsland Expansion Area

Radon Sources Distribution	Invited Public Dose/Deliveries	Occupational
Location of Dose	**mRem/yr from 10 hrs/month Onsite**	**mRem/yr from 2,000 hrs/yr Onsite**
North Boundary #1	0.08	15
East Boundary	0.02	3
South Boundary	0.13	25
West Boundary	0.09	17
MU-1	0.10	20
MU-2	0.16	32
MU-3	0.13	25
MU-4	0.14	27
MU-5	0.10	19
Satellite	0.02	3
Average		**17**

Notes:
mRem/yr = millirems per year

Table 7.3-2 Public and Occupational Doses for Marsland Expansion Area

Radon Sources Distribution	Invited Public Dose/Deliveries	Occupational
Location of Dose	**mRem/yr from 10 hrs/month Onsite**	**mRem/yr from 2,000 hrs/yr Onsite**
North Boundary #1	0.08	15
East Boundary	0.02	3
South Boundary	0..13	25
West Boundary	0.09	17
MU-1	0.10	20
MU-2	0.16	32
MU-3	0.13	25
MU-4	0.14	27
MU-5	0.10	19
Satellite	0.02	3
Average		**17**

Notes:
mRem/yr = millirems per year

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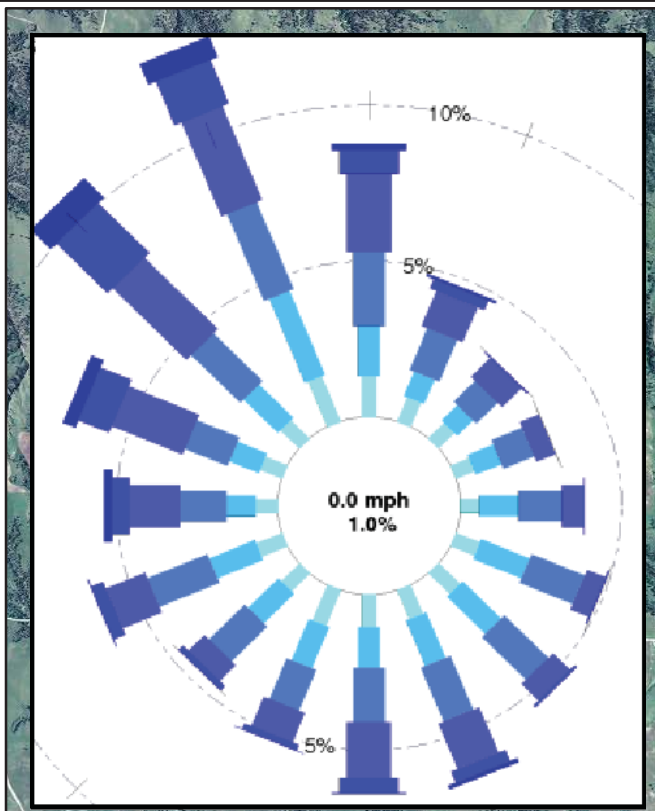

North Boundary DOSE #1 (18)
North Boundary DOSE #2 (17)
Residence #7 (10)
Unoccupied #2 (13)
MU-A
MU-1
Unoccupied #1 (32)
Residence #6 (9)
MU-2
MU-3
MET Station
West Boundary DOSE (42)
Residence #2 (27)
MU-4
East Boundary DOSE (16)
Residence #1 (18)
SAT Facility
MU-5
MAR-1
MAR-2
Marsland License Boundary
South Boundary DOSE (55)
MU-B
Residence #3 (10)
MU-C
Residence #4 (7)
MU-D
MU-E
MU-F
Residence #5 (9)
MAR-3
Residence #8 (5)
MAR-4
MAR-5
Residence #9 (7)
Residence #10 (6)

LEGEND

- Air Sample Station
- Boundary Dose Point
- Residence (Occupiable)
- Unoccupied Structure (Unoccupiable)
- Proposed Satellite Plant Location
- MEA Met Station
- Project Boundary
- Mine Unit
- (10) MEA Mildos Estimated Radiation Dose Rate (in mrem/yr)

MEA = Marsland Expansion Area
mrem = millirems per year

Map Updated on: 7/2/2014

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Feet

PROJECTION: NAD1983, STATE PLANE NEBRASKA NORTH, FIPS 2600
SOURCES: USDA NAIP IMAGERY 2010

CROW BUTTE RESOURCES, INC.

FIGURE 7.3-2
MILDOS RECEPTORS RESIDENCES AND DESIGNATED MEA LICENSE BOUNDARY LOCATIONS

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

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