



**CAMECO RESOURCES
CROW BUTTE OPERATION**

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February 25, 2019

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

Semiannual Radiological Effluent and Environmental Monitoring Report
Source Materials License No. SUA-1534, Docket No. 40-8943

Dear Document Control:

Enclosed please find one copy of the Semiannual Radiological Effluent and Environmental Monitoring Report for the Crow Butte Uranium Project. The report is provided in accordance with License Condition 11.1(B) of Source Materials License SUA-1534 and 10 CFR Part 40. This report covers the third and fourth quarters of 2018.

If you have any questions concerning the report, please feel free to call me at (308) 665-2215 Ext 117.

Sincerely,
CAMECO RESOURCES
CROW BUTTE OPERATION

Walt Nelson
SHEQ Coordinator

cc: Ron Burrows – NRC
CBO – File
cc: Amanda Jones – NDEQ Program Coordinator
CR – Electronic File

IE25
IE48
NM5520
NM55



**CAMECO RESOURCES
CROW BUTTE OPERATION**

**Second Half 2018 Semiannual Radiological Effluent
and Environmental Monitoring Report**

**CROW BUTTE URANIUM PROJECT

RADIOLOGICAL EFFLUENT
AND
ENVIRONMENTAL MONITORING
REPORT**

for

THIRD AND FOURTH QUARTERS, 2018

USNRC Source Materials License SUA 1534



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1 WATER QUALITY MONITORING DATA

1.1 Excursion Monitoring

Biweekly excursion monitoring in the shallow aquifer and perimeter monitor wells was continued in Mine Units 2 through 11 during the third and fourth quarters of 2018.

On November 29, 2018, CM11-11 was placed on excursion status. Wellfield flows in the area were adjusted, and the results from the December 26, 2018 weekly excursion monitoring sample were below the excursion criteria.

Excursion reports have been submitted to NRC as required in License Condition 11.1.5. Complete excursion monitoring results are available on site for inspection. A summary table for monitor wells on excursion status during the second half of 2018 follows:

Monitor Well ID	Date On Excursion	Date Off Excursion	Biweekly Sampling Resumed	Causal Factor(s)
CM11-11	29 Nov 18	NA	NA	Wellfield flow imbalance

1.2 Water Supply Wells and Surface Water

Summary sheets of quarterly radiological analytical data for the reporting period from all surface waters and water supply wells within one kilometer of the active wellfield boundary are included in Appendix A.

The reported radiological data are within the expected ranges for each well and surface water sampling points. Samples were obtained from all sample locations with the exceptions noted in Appendix A.

2 OPERATIONAL



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2.1 Production Data Summary

Mining operations continued through the third and fourth quarters of 2018. The average operating production flow rate was 162 gpm for the third quarter and 139 gpm for the fourth quarter. Injection and production totals from the totalizers and the calculated bleed totals for the reporting period are included in Appendix B. Production injection pressures are included in Appendix C.

2.2 Restoration

Restoration activities continued in Mine Units 2, 3, 4, 5, and 6 during the second half of 2018. Additionally, restoration activities were initiated in Mine Unit 7 during this period. Stability monitoring was initiated in Mine Units 3, 4, and 5 when guideline 8 samples were collected in Mine Unit 5 in August and in Mine Units 3 and 4 in September from the baseline restoration wells in these Mine Units. Monthly stability sampling will continue in these Mine Units through February, 2019, in accordance with the approved restoration plan, then quarterly sampling will be initiated. Permeate continued to be injected into Mine Unit 6 throughout the reporting period, and was initiated in Mine Unit 7 in October. On June 19, 2013, Mine Unit 2 was placed into stabilization, and stability monitoring continued in Mine Unit 2 during the second half of 2018. Restoration injection and production totals are included in Appendix B. Restoration injection pressures are included in Appendix C.

2.3 Wastewater Summary

The total volume of wastewater discharged to the ponds was 2,122,640 gallons during the third quarter and 724,855 gallons during the fourth quarter. Currently, all five evaporation ponds contain wastewater.

Wastewater that is not disposed of in the evaporation ponds is injected into the two Deep Disposal Wells (DDWs). Currently, the wells are operated on a nearly continuous basis and 55,539,225 gallons of wastewater was injected into the wells during the second half of 2019. A summary of the total volume of wastewater injected and the average radionuclide content is contained in Appendix D.

2.4 Effluent Release

10 CFR §40.65 requires licensees to report quantities of radionuclides in liquid and gaseous effluent releases to the environment. In the Application for Renewal of Source Materials License SUA-1534,



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submitted December 1995, Table 7.3(A) presented calculations of the annual radon emissions for the Crow Butte Plant. These calculations assumed a 7.04×10^{-4} Curies/m³ radon release from leaching operations and the radon release calculations for the second half of 2018 use this release rate estimate.

During the third quarter, production occurred at an average flow rate of 162 gpm (613 lpm). Production was maintained continuously for 92 days during the third quarter with an operating factor of 100%. The production flow for the third quarter results in a calculated radon release of 41 Curies. During the fourth quarter, production occurred at an average flow rate of 139 gpm (526 lpm). Production was maintained continuously for 92 days during the fourth quarter with an operating factor of 100%. The production flow for the fourth quarter results in a calculated radon release of 35 Curies. Calculations for radon release from production operations are shown in Appendix E.

There were no additional wells brought on line during the second half of 2018.

The total radon emission due to leaching operations from the Crow Butte plant for the second half of 2018 was 76 Curies.

Radon gas is also released from restoration activities. For restoration water that is treated by ion exchange only, the radon concentration is 0.697 μ Ci/l. Of the total restoration production flow it is assumed that 25% of the radon is released through wellfield loss and 10% of the remaining radon is released during pressurized ion exchange treatment. For water that is treated by reverse osmosis, it is assumed that 100% of the remaining radon is released. For water treated by reverse osmosis the radon concentration is 0.470 μ Ci/l after adjusting for wellfield loss and ion exchange loss.

During the second half of 2018, a total of 110,548,852 gallons (418,472,927 l) of restoration water was produced from Mine Units 2, 3, 4, 5, 6, and 7. Based upon an estimated radon concentration of 0.697 μ Ci/l, the total amount of radon in the restoration solution was calculated to be 292 Curies as shown in Appendix E. The estimated release of radon through wellfield loss at 25% of this total was 73 Curies. The plant loss for ion exchange treatment of the restoration water is estimated at 10% of the remaining radon, or Curies. For water that is treated by reverse osmosis, it is assumed that 100% of the remaining radon is released. For water treated by reverse osmosis the radon concentration is 0.470 μ Ci/l after adjusting for wellfield loss and ion exchange loss.

Of the total amount of restoration water produced in the second half of 2018, 78,827,830 gallons (298,395,797 l) of the water was treated by reverse osmosis. The total estimated radon release from reverse osmosis treatment was 140 Curies.



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An additional 7.1 acres of wellfields were placed into restoration during the second half of 2018. The calculated radon released from start-up of 7.1 acres is 9 Curies. Calculations for the start-up of 7.1 acres of a wellfield placed in restoration are shown in Appendix E.

Based upon the calculations shown in Appendix E, the total estimated semiannual radon emission for the second half of 2018 from restoration activities was 244 Curies. This resulted in a total estimated radon release from the leaching operation during the second half of 2018 of 321 Curies.

This information is included for historical purposes as a comparison for the requirements in License Condition 11.11.

2.5 Radon Monitoring

By letter dated January 6, 2016, the NRC staff indicated that it had completed the technical review of the licensee's January 2, 2015 submittal describing the site's operational airborne effluent and environmental monitoring program.

The licensee identified three primary sources of airborne effluents at the Crow Butte Project. These sources included the main plant, wellfield, and the wellhouses.

Main Plant

Radon and radon progeny

The licensee will measure ambient radon gas concentrations using track etch detectors and working level measurements at six different locations.

The licensee will use scintillation cell measurements quarterly at each tank vent for radon gas measurements.

Particulates

The licensee shall conduct isotopic analyses for alpha- and beta-emitting radionuclides on airborne samples at each in-plant air particulate sampling location at a frequency on once every six months for the first two years after the license renewal (November 2014) and annually thereafter to ensure compliance with 10 CFR 20.1204(g). For any changes to operations, the licensee shall conduct an evaluation to determine if more frequent isotopic analyses are required for compliance with 10 CFR 20.1204(g).



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In-plant air particulate sampling was performed during the first half of 2018. The results of this sampling were reported in the semiannual report submitted for the first half of 2018.

The summary of the Main Plant samples are shown in Appendix F.

Wellfield

The licensee identified two potential sources of radon in the wellfield. The first potential source of radon is when wellheads are opened to the atmosphere to depressurize a wellhead that has become pressurized. When these wellheads are depressurized, the licensee will obtain a grab sample using a scintillation cell. Wells become pressurized when oxygen is being injected. During the second half of 2018, oxygen was not injected and so no wells became pressurized, therefore this type of sample was not collected during the second half of 2018.

The other potential sources of radon in the wellfield include unplanned releases of process fluids from spills. The amount of radon released will be estimated based on the amount of fluid released and an estimate of the concentration of radon in the process fluid. The licensee will assume that all radon in the fluid is released to the atmosphere.

The summary of the Wellfield samples are shown in Appendix G.

Wellhouses

Radon and radon progeny

The licensee will measure radon in the wellhouses using track etch detectors with a six-month exposure time. The licensee will use the average radon concentration (collected quarterly) along with the flow rate of the wellhouse exhaust fans to determine the total radon released from the wellhouses. Four production and four restoration wellhouses will be monitored annually in this manner.

Radon daughters will be measured semi-annually in the wellhouses where radon gas is being measured. The licensee will determine the total radon daughters released in the same manner as the radon gas using the flow rate of the wellhouse exhaust fan.

Particulates



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The licensee will estimate the emission of particulate releases based on isotopic analyses of semiannual air particulate samples performed in each of the wellhouses that are monitored for radon. The exhaust rate of the wellhouses will be the same as described above for the radon emissions.

The summary of the Wellhouse samples are shown in Appendix H.

Estimated emissions for the second half of the year are summarized in the following table. The estimated emissions is 507.95 curies.

Second Half of 2018

Emissions in Ci for Second 6 Months by Source

Source	Radon Progeny (Ci)	Radon Gas (Ci)	Particulate (Ci)	Total by Source	% by Source
Plant Floor Vents	0.17	2.96	3.66E-05	3.13	0.6%
Wellhouses (64)	0.09	1.67	5.80E-05	1.76	0.3%
Well Fields (Wellheads)	N/A	N/A	N/A	0.00E+00	0.0%
Plant Tanks/vents	33.8	469.3	N/A	503.1	99.0%
Spills	N/A	1.10E-03	N/A	1.10E-03	0.0%
Deepwells	N/A	N/A	1.13E-06	1.13E-06	0.0%
Total by Type	34.06	473.9	9.57E-05		

Estimated Emissions for Second Half of the Year = 507.95 Curies (Ci)

Data Summary

	First Half of 2018 (Ci)	Second Half of 2018 (Ci)	Total 2018 (Ci)
In Plant Particulate	3.66E-05	3.66E-05	7.32E-05
Wellhouse Particulate	1.66E-05	5.80E-05	3.81E-05
In Plant RnP	0.12	0.17	0.29
Wellhouse RnP	0.07	0.09	0.16
Tank RnP and RnG	1067.6	503.1	1570.62
Wellhouse RnG	1.96	1.67	3.63
In Plant RnG	1.53	2.96	4.49
Wellhead RnG	0.00E+00	0.00E+00	0.00E+00
DeepWells	5.45E-07	2.98E-07	2.04E-06



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Estimated emissions for 2018 are summarized in the following table. The estimated emission is 1579.20 curies.

2018 Annual Emissions

Emissions in Ci/Yr by Source

Source	Radon Progeny	Radon Gas	Particulate	Total by Source	% by Source
Plant Floor Vents	0.29	4.49	7.32E-05	4.79	0.3%
Wellhouses (64)	0.16	3.63	3.81E-05	3.79	0.2%
Well Fields (Wellheads)	N/A	0.00E+00	N/A	0.00E+00	0.0%
Plant Tanks/vents	85.1	1485.6	N/A	1570.6	99.5%
Spills	N/A	0.00E+00	N/A	0.00E+00	0.0%
Deepwells	N/A	N/A	2.04E-06	2.04E-06	0.0%
Total by Type	85.52	1493.68	1.13E-04		

Total Emissions for 2018 = 1579.20 Curies (Ci)

3 ENVIRONMENTAL MONITORING

3.1 Air Monitor Stations

Eight air monitoring stations are used to monitor the Crow Butte Plant. Ambient radon-222 concentrations and radionuclide concentrations in air for each monitoring site are listed in Appendix I. Six track etch cups were deployed at the background monitoring station and the nearest residence to check for potential variability in data using only one track etch cup. All air monitoring results were within expected historical ranges.

3.2 TLD Monitors

Environmental TLD monitors are located at each air monitoring station. The results of the area TLD monitors fall within the expected ranges and are listed in Appendix J.

The site is provided with both a deployment and a transient dosimeter by the provider. The process used by the dosimeter provider, Landauer, is to subtract the deployment badge result from the badges



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used for environmental monitoring. If the deployment badge is lost, damaged, etc. the transient badge result is subtracted instead. If neither is available to be read, the average of a set number of previous quarter's background results is subtracted. Only one of the badge results is subtracted, not multiple. The purpose of these deployment and transient badges is to subtract off any radiation that was accumulated on the environmental badges during times when they were not deployed to ensure that only dose accumulated while in the prescribed monitoring location is returned to the site as a final result.

3.3 Mechanical Integrity Testing (MIT)

Mechanical integrity tests shall be performed on each injection and production well before the wells are utilized and on wells that have been serviced with equipment or procedures that could damage the well casing. Additionally, each well shall be retested at least once each five (5) years it is in use. The following table summarizes the MIT's performed during the second half of 2018.

Five (5) Year Retesting			
Required Testing	Number Tested	Number Passed	Number Failed
286	286	286	0

Wells Serviced			
Required Testing	Number Tested	Number Passed	Number Failed
0	0	0	0

3.4 Annual Dose to the Public

License Condition 11.2 (November 2014 renewal) requires the licensee to submit the results on the annual review (ALARA Audit) of the radiation protection program content and implementation performed in accordance with 10 CFR 20.1101(c). These results shall include an analysis of dose to individual members of the public consistent with 10 CFR 20.1301 and 10 CFR 20.1302 and a land use survey.

The ALARA audit will be performed during the month of May and will be submitted separate from this report.

3.5 Operational Soil Sampling Program consistent with Regulatory Guide 4.14



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Regulatory Guide 4.14 requires annual operational soil sampling at each of the air particulate sampling locations. The results of these samples for 2018 are included in Appendix K.

3.6 Stream Sediments

Sediment samples are collected from three locations on Squaw Creek (S-1, S-2, and S-5), two locations on English Creek (E-1, and E-5), and from three impoundments on English Creek (I-3, I-4, and I-5) on an annual basis during the third quarter. The results of sediment sampling for 2018 are included in Appendix L.

Appendix A

Private Well and Surface Water Radiological Monitoring Results

Third and Fourth Quarter, 2018

CROW BUTTE RESOURCES, INC.

PRIVATE WELL AND SURFACE WATER RADIOLOGICAL MONITORING RESULTS

Third Quarter, 2018

SAMPLE ID	DATE SAMPLED	URANIUM mg/l	URANIUM μCi/ml	RADIUM-226 pCi/l	RADIUM-226 precision \pm
Well #8	08/13/18	0.0129	8.70E-09	0.3	0.1
Well #11	Well Off				
Well #12	08/13/18	0.0031	2.10E-09	<.2	0.05
Well #26	08/13/18	0.0050	3.40E-09	0.2	0.1
Well #28	08/13/18	0.0048	3.30E-09	<.2	0.05
Well #38	08/13/18	0.0031	2.10E-09	<.2	0.04
Well #41	08/13/18	0.0067	4.50E-09	0.2	0.1
Well #61	08/13/18	<.0003	<2.0E-10	3.0	0.2
Well #63	08/13/18	0.0158	1.10E-08	0.3	0.1
Well #66	08/13/18	0.0213	1.40E-08	0.4	0.1
Well #125	08/13/18	0.0049	3.30E-09	<.2	0.05
Well #129	08/13/18	0.0070	4.70E-09	<.2	0.04
Well #131	08/13/18	0.0039	2.60E-09	<.2	0.05
Well #133	08/13/18	0.0082	5.60E-09	0.2	0.1
Well #134	08/13/18	0.0096	6.50E-09	0.4	0.1
Well #135	08/13/18	0.0152	1.00E-08	0.3	0.1
Well #138	08/13/18	0.0167	1.10E-08	0.4	0.1
Well #140	08/13/18	0.0079	5.40E-09	<.2	0.05
Well #435	08/13/18	0.0074	5.00E-09	<.2	0.05
Well #445	08/13/18	0.0098	6.60E-09	<.2	0.05
Drinking Water Well	08/13/18	0.0065	4.40E-09	<.2	0.05
Stream S-1	08/13/18	0.0041	2.80E-09	<.2	0.03
Stream S-2	08/14/18	0.0040	2.70E-09	<.2	0.04
Stream S-5	08/14/18	0.0048	3.30E-09	<.2	0.03
Stream E-1 & 2 Composite	08/14/18	0.0104	7.00E-09	0.3	0.1
Stream E-5	08/14/18	0.0029	2.00E-09	<.2	0.1
Impoundment I-3	08/14/18	0.0050	3.40E-09	0.3	0.1
Impoundment I-4	08/14/18	0.0018	2.00E-01	0.2	0.1
Impoundment I-5	08/13/18	0.0040	2.70E-09	<.2	0.1
Reporting Limit		0.0003	2.00E-10	0.2	-

ND-Not detected at the reporting limit

CROW BUTTE RESOURCES, INC.

PRIVATE WELL AND SURFACE WATER RADIOLOGICAL MONITORING RESULTS

Fourth Quarter, 2018

SAMPLE ID	DATE SAMPLED	URANIUM mg/l	URANIUM μCi/ml	RADIUM-226 pCi/l	RADIUM-226 precision \pm
Well #8	12/04/18	0.0116	7.90E-09	0.8	0.1
Well #11	12/04/18	0.0071	4.80E-09	0.5	0.1
Well #12	12/04/18	0.0037	2.50E-09	0.4	0.1
Well #26	12/04/18	0.0049	3.30E-09	0.5	0.1
Well #28	12/04/18	0.0055	3.70E-09	0.3	0.1
Well #38	12/04/18	0.0036	2.40E-09	1.3	0.1
Well #41	12/04/18	0.0064	4.30E-09	0.3	0.1
Well #61	12/10/18	<.0003	<2.0E-10	2.8	0.2
Well #63	12/10/18	0.0171	1.16E-08	0.3	0.1
Well #66	12/10/18	0.0175	1.18E-08	0.3	0.1
Well #125	12/05/18	0.0048	3.30E-09	0.2	0.1
Well #129	12/05/18	0.0055	3.70E-09	<.2	0.1
Well #131	12/04/18	0.0041	2.80E-09	0.3	0.1
Well #133	12/05/18	0.0067	4.50E-09	0.4	0.1
Well #134	12/05/18	0.0070	4.70E-09	0.3	0.1
Well #135	12/10/18	0.0162	1.10E-08	0.3	0.1
Well #138	12/04/18	0.0108	7.30E-09	0.4	0.1
Well #140	12/04/18	0.0082	5.60E-09	0.3	0.1
Well #435	12/04/18	0.0062	4.20E-09	0.2	0.1
Well #445	12/04/18	0.0097	6.60E-09	0.3	0.1
Drinking Water Well	12/05/18	0.0062	4.20E-09	0.2	0.1
Stream S-1	12/04/18	0.0038	2.60E-09	0.3	0.1
Stream S-2	12/04/18	0.0033	2.20E-09	0.2	0.1
Stream S-5	12/04/18	0.0038	2.60E-09	<.2	0.1
Stream E-1 & 2 Composite	12/10/18	0.0278	1.88E-08	0.3	0.1
Stream E-5	12/10/18	0.0119	8.10E-09	<.2	0.05
Impoundment I-3	12/05/18	0.0356	2.41E-08	<.2	0.1
Impoundment I-4	12/05/18	0.0290	1.96E-08	<.2	0.04
Impoundment I-5	12/05/18	0.0139	9.40E-09	<.2	0.05
Reporting Limit		0.0003	2.00E-10	0.2	-

ND-Not detected at the reporting limit

Appendix B

Plant Production and Waste Totals

Third and Fourth Quarter, 2018

WASTE VOLUME

Third Quarter 2018

TOTALIZER	PLANT TO PONDS	PLANT TO DDW 1 & 2	RESTORATION TO DDW	CLEAN WATER INTO PLANT	DDW TOTAL INJECTED	TRUCKS TO POND	POND WATER TREATMENT
July	141,720	8,113,162	3,741,509	28,771	11,854,671	0	0
August	253,480	5,943,814	3,207,935	30,576	9,151,749	0	0
September	1,727,440	4,029,120	2,321,270	8,640	6,350,390	0	0
TOTAL GAL. EOQ	2,122,640	18,086,096	9,270,714	67,987	27,356,810	0	0

TOTAL 2nd QTR VOLUME

DISCHARGED TO WASTE PONDS LESS POND WATER TREATMENT GALLONS =	2,122,640 GALLONS
DISCHARGED TO DEEP WELL=	27,356,810 GALLONS
DISCHARGED TO WASTE PONDS + DPWELL =	29,479,450 GALLONS
WF BLEED FROM WELLFIELDS=	29,411,463 GALLONS

COMMERCIAL WELLFIELD BLEED

Third Quarter 2018

MONTH	July	August	September
BLEED	100.0%	100.0%	100.0%

RESTORATION WELLFIELD BLEED

Third Quarter 2018

MONTH	July	August	September
BLEED	14.6%	19.5%	12.7%

PLANT FLOW

Third Quarter 2018

AVERAGE OPERATING FLOW RATE=	162 GPM EOQ
TOTAL GALLONS PRODUCED=	21,421,971 GALLONS EOQ
TOTAL GALLONS INJECTED=	0 GALLONS EOQ

	TOTAL GALS. PRODUCED	TOTAL GALS. INJECTED	HOURS IN MONTH	HOURS IN PRODUCTION	AVERAGE PROD. GPM	AVERAGE COM INJ GPM	AVERAGE REST INJ GPM	HRS. DOWN TIME
Prev. YTD	310,586,074	279,695,869	4,344	4,344	1,192	1,073	267	0
July	8,715,526	0	744	744	195	0	382	0
August	6,329,959	0	744	744	142	0	246	0
September	6,376,486	0	720	720	148	0	220	0
EOQ TOTAL	21,421,971	0	2,208	2,208	162	0	283	0
YTD TOTAL	332,008,045	279,695,869	6,552	6,552	845	711	273	0

	TOTAL MUII GALS PRODUCED	TOTAL MUIII GALS PRODUCED	TOTAL MUIV GALS PRODUCED	TOTAL MUV GALS PRODUCED	TOTAL MUVI GALS PRODUCED	MUII BLEED TO WASTE	MUIII BLEED TO WASTE	MUIV BLEED TO WASTE	MUV BLEED TO WASTE	MUVI BLEED TO WASTE
Prev. YTD	0	1,807,517	13,082,378	19,086,638	54,567,749	0	-671,846	3,154,701	9,442,002	655,771
July	0	0	5,261,956	4,527,103	10,269,114	0	-586,577	97,920	3,090,781	323,705
August	0	307	1,705,910	2,143,504	9,806,151	0	-736,298	540,752	1,685,804	1,174,362
September	0	26,240	282,082	6,822	11,102,838	0	-26,628	116,751	5,181	1,351,014
EOQ TOTAL	0	26,547	7,249,948	6,677,429	31,178,103	0	-1,349,503	755,422	4,781,765	2,849,081
YTD TOTAL	0	1,834,064	20,332,326	25,764,067	85,745,852	0	-2,021,349	3,910,124	14,223,768	3,504,852

	TOTAL BRINE GALS PRODUCED	TOTAL PERM GALS PRODUCED	COMM BLEED TO RO FEED
Prev. YTD	13,260,947	41,034,169	882,612
July	3,741,509	8,697,189	815,681
August	3,207,935	4,508,619	543,316
September	2,321,270	6,173,123	874,952
EOQ TOTAL	9,270,714	19,378,931	2,233,949
YTD TOTAL	22,531,661	60,413,100	3,116,561

WASTE VOLUME

Fourth Quarter 2018

TOTALIZER	PLANT TO PONDS	PLANT TO DDW 1 & 2	RESTORATION TO DDW	CLEAN WATER INTO PLANT	DDW TOTAL INJECTED	TRUCKS TO POND	POND WATER TREATMENT
October	252,500	3,848,367	3,296,665	21,915	7,145,032	0	0
November	328,660	3,996,310	5,140,629	23,586	9,136,939	0	0
December	140,370	6,816,996	5,083,448	8,660	11,900,444	3,325	0
TOTAL GAL. EOQ	721,530	14,661,673	13,520,742	54,161	28,182,415	3,325	0

TOTAL 4th QTR VOLUME

DISCHARGED TO WASTE PONDS LESS POND WATER TREATMENT GALLONS =	724,855 GALLONS
DISCHARGED TO DEEP WELL=	28,182,415 GALLONS
DISCHARGED TO WASTE PONDS + DPWELL =	28,907,270 GALLONS
WF BLEED FROM WELLFIELDS=	28,853,109 GALLONS

COMMERCIAL WELLFIELD BLEED

Fourth Quarter 2018

MONTH	October	November	December
BLEED	100.0%	100.0%	100.0%

RESTORATION WELLFIELD BLEED

Fourth Quarter 2018

MONTH	October	November	December
BLEED	28.0%	18.8%	19.4%

PLANT FLOW

Fourth Quarter 2018

AVERAGE OPERATING FLOW RATE=	139 GPM EOQ
TOTAL GALLONS PRODUCED=	18,353,692 GALLONS EOQ
TOTAL GALLONS INJECTED=	0 GALLONS EOQ

	TOTAL GALS. PRODUCED	TOTAL GALS. INJECTED	HOURS IN MONTH	HOURS IN PRODUCTION	AVERAGE PROD. GPM	AVERAGE COM INJ GPM	AVERAGE REST INJ GPM	HRS. DOWN TIME
Prev. YTD	332,008,045	279,695,869	6,552	6,552	845	711	273	0
October	5,660,140	0.0	744	744	127	0	196	0
November	5,169,180	0.0	720	720	120	0	523	0
December	7,524,372	0.0	744	744	169	0	452	0
EOQ TOTAL	18,353,692	0	2,208	2,208	139	0	389	0
YTD TOTAL	350,361,736	279,695,869	8,760	8,760	667	532	245	0

	TOTAL MUII GALS PRODUCED	TOTAL MUIII GALS PRODUCED	TOTAL MUIV GALS PRODUCED	TOTAL MUV GALS PRODUCED	TOTAL MUVI GALS PRODUCED	TOTAL MUVII GALS PRODUCED	MUII BLEED TO WASTE	MUIII BLEED TO WASTE	MUIV BLEED TO WASTE	MUV BLEED TO WASTE	MUVI BLEED TO WASTE	MUVII BLEED TO WASTE
Prev. YTD	0	1,834,064	20,332,326	25,764,067	85,745,852	0	0	-2,021,349	3,910,124	14,223,768	3,504,852	0
October	0	23,538	64,132	122,689	10,368,331	1,234,658	0	20,276	55,240	105,679	2,209,124	286,171
November	0	29,510	73,905	122,130	9,897,935	17,298,746	0	27,095	67,857	112,137	1,623,984	2,608,698
December	0	29,941	77,518	553,999	8,986,070	16,533,723	0	21,329	55,221	394,648	2,209,877	1,590,449
EOQ TOTAL	0	82,989	215,555	798,818	29,252,336	35,067,127	0	68,699	178,318	612,464	6,042,985	4,463,318
YTD TOTAL	0	1,917,053	20,547,881	26,562,885	114,998,188	35,067,127	0	-1,952,650	4,088,442	14,836,231	9,547,837	4,463,318

	TOTAL BRINE GALS PRODUCED	TOTAL PERM GALS PRODUCED	COMM BLEED TO RO FEED
Prev. YTD	22,531,661	60,413,100	3,116,561
October	3,296,665	6,817,860	640,176
November	5,140,629	16,355,623	702,858
December	5,083,448	13,483,960	811,924
EOQ TOTAL	13,520,742	36,657,443	2,154,958
YTD TOTAL	36,052,403	97,070,543	5,271,519

Appendix C

Wellfield Injection Pressures

Third and Fourth Quarter, 2018

WELLFIELD INJECTION PRESSURE - PSI										
Third Quarter 2018										
	WF HOUSE #3		WF HOUSE #4		WF HOUSE #5		WF HOUSE #6		WF HOUSE #7	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	0	4	20	8	25	16	46	29	38
August	0	0	8	24	13	30	21	48	27	38
September	0	0	13	40	18	50	22	46	11	27
AVERAGE	0	0	9	40	13	50	20	48	23	38
	WF HOUSE #8		WF HOUSE #9		WF HOUSE #10		WF HOUSE #11		WF HOUSE #12	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	0	36	45	0	0	26	55	38	54
August	0	0	39	90	0	0	24	36	38	48
September	0	0	18	30	0	0	5	16	13	30
AVERAGE	0	0	31	90	0	0	18	55	30	54
	WF HOUSE #13		WF HOUSE #14		WF HOUSE #15		WF HOUSE #16		WF HOUSE #17	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	36	45	25	57	24	24	55	64	32	40
August	37	47	47	58	24	24	55	65	31	42
September	8	40	30	42	23	46	38	50	15	26
AVERAGE	27	47	34	58	24	46	49	65	26	42
	WF HOUSE #18		WF HOUSE #19		WF HOUSE #20		WF HOUSE #21		WF HOUSE #22	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	3	15	0	0	4	45	57	64	66	75
August	5	20	1	42	43	57	56	66	67	76
September	11	38	2	47	28	38	40	55	50	62
AVERAGE	7	38	1	47	25	57	51	66	61	76
	WF HOUSE #23		WF HOUSE #24		WF HOUSE #25		WF HOUSE #26		WF HOUSE #27	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	62	70	85	92	81	90	73	80	81	88
August	61	70	87	92	80	88	72	82	81	89
September	45	58	69	82	64	76	56	68	65	78
AVERAGE	56	70	80	92	75	90	67	82	76	89
	WF HOUSE #28		WF HOUSE #29		WF HOUSE #30		WF HOUSE #31		WF HOUSE #32	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	0	0	0	0	0	0	2	0	0
August	0	0	0	0	0	0	0	2	0	0
September	0	0	0	0	0	0	0	0	0	0
AVERAGE	0	0	0	0	0	0	0	2	0	0
	WF HOUSE #33		WF HOUSE #34		WF HOUSE #35		WF HOUSE #36		WF HOUSE #37	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	2	0	0	3	90	3	86	0	0
August	0	0	1	46	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0
AVERAGE	0	2	0	46	1	90	1	86	0	0
	WF HOUSE #38		WF HOUSE #39		WF HOUSE #40		WF HOUSE #41		WF HOUSE #42	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	0	0	0	0	0	0	3	0	2
August	0	0	0	0	0	0	0	2	0	2
September	0	0	0	0	0	0	0	3	0	0
AVERAGE	0	0	0	0	0	0	0	3	0	2
	WF HOUSE #43		WF HOUSE #44		WF HOUSE #45		WF HOUSE #46		WF HOUSE #46A	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	0	0	0	0	0	1	4	0	0
August	0	0	0	0	0	0	1	4	0	0
September	0	0	0	0	0	0	0	5	0	0
AVERAGE	0	0	0	0	0	0	0	5	0	0
	WF HOUSE #47		WF HOUSE #47A/65		WF HOUSE #48		WF HOUSE #49		WF HOUSE #50	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	0	0	0	0	0	0	0	0	0
August	0	0	0	0	0	0	0	0	0	5
September	0	0	0	0	0	0	0	0	0	0
AVERAGE	0	0	0	0	0	0	0	0	0	5
	WF HOUSE #51		WF HOUSE #52		WF HOUSE #53		WF HOUSE #54		WF HOUSE #55	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	0	0	2	0	0	0	2	1	4
August	2	68	3	94	0	0	0	0	0	4
September	0	0	0	0	0	0	0	3	0	4
AVERAGE	1	68	1	94	0	0	0	3	0	4
	WF HOUSE #56		WF HOUSE #57							
	AVERAGE	MAXIMUM		AVERAGE	MAXIMUM					
July	0	2	July	1	42					
August	0	2	August	0	0					
September	0	0	September	0	0					
AVERAGE	0	2	AVERAGE	0	42					
	WF HOUSE #60		WF HOUSE #61		WF HOUSE #62		WF HOUSE #63		WF HOUSE #64	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
July	0	2	1	18	0	2	0	9	2	10
August	0	2	0	0	0	2	0	0	1	5
September	0	0	0	0	0	0	0	0	0	4
AVERAGE	0	2	0	18	0	2	0	9	0	10

WELLFIELD INJECTION PRESSURE - PSI										
Fourth Quarter 2018										
	WF HOUSE #3		WF HOUSE #4		WF HOUSE #5		WF HOUSE #6		WF HOUSE #7	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	2	34	8	44	17	66	23	53	9	34
November	0	0	0	6	9	16	23	35	8	36
December	0	6	1	8	11	20	25	40	10	44
AVERAGE	1	34	3	44	12	66	24	53	9	44
	WF HOUSE #8		WF HOUSE #9		WF HOUSE #10		WF HOUSE #11		WF HOUSE #12	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	0	3	13	22	0	0	4	16	11	34
November	0	0	11	17	0	0	2	16	8	32
December	0	0	9	30	0	0	4	16	8	45
AVERAGE	0	3	11	30	0	0	3	16	9	45
	WF HOUSE #13		WF HOUSE #14		WF HOUSE #15		WF HOUSE #16		WF HOUSE #17	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	4	9	22	46	23	44	28	52	5	29
November	5	10	35	49	24	24	20	56	20	33
December	4	8	35	46	24	26	0	6	18	24
AVERAGE	5	10	31	49	24	44	16	56	14	33
	WF HOUSE #18		WF HOUSE #19		WF HOUSE #20		WF HOUSE #21		WF HOUSE #22	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	15	45	0	0	17	40	30	54	42	65
November	16	39	0	0	31	44	45	55	57	67
December	20	51	0	0	31	50	45	66	57	82
AVERAGE	17	51	0	0	26	50	40	66	52	82
	WF HOUSE #23		WF HOUSE #24		WF HOUSE #25		WF HOUSE #26		WF HOUSE #27	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	35	58	60	84	55	78	47	70	57	80
November	49	62	75	86	69	80	62	72	69	80
December	50	83	75	92	67	86	61	68	70	77
AVERAGE	45	83	70	92	64	86	56	72	65	80
	WF HOUSE #28		WF HOUSE #29		WF HOUSE #30		WF HOUSE #31		WF HOUSE #32	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	8	54	3	57	3	53	12	28	5	32
November	44	52	47	54	43	52	19	28	18	31
December	54	60	54	62	53	60	29	52	28	34
AVERAGE	35	60	34	62	33	60	20	52	17	34
	WF HOUSE #33		WF HOUSE #34		WF HOUSE #35		WF HOUSE #36		WF HOUSE #37	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	2	38	0	0	0	0	0	0	0	0
November	28	38	0	0	0	0	0	0	0	0
December	36	45	0	0	0	0	0	0	0	0
AVERAGE	22	45	0	0	0	0	0	0	0	0
	WF HOUSE #38		WF HOUSE #39		WF HOUSE #40		WF HOUSE #41		WF HOUSE #42	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0
AVERAGE	0	0	0	0	0	0	0	0	0	0
	WF HOUSE #43		WF HOUSE #44		WF HOUSE #45		WF HOUSE #46		WF HOUSE #46A	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0
AVERAGE	0	0	0	0	0	0	0	0	0	0
	WF HOUSE #47		WF HOUSE #47A/65		WF HOUSE #48		WF HOUSE #49		WF HOUSE #50	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0
AVERAGE	0	0	0	0	0	0	0	0	0	0
	WF HOUSE #51		WF HOUSE #52		WF HOUSE #53		WF HOUSE #54		WF HOUSE #55	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	0	0	0	0	0	0	0	0	1	5
November	0	0	0	0	0	0	0	0	2	5
December	0	0	0	0	0	0	0	0	0	5
AVERAGE	0	0	0	0	0	0	0	0	1	5
	WF HOUSE #56		WF HOUSE #57							
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM						
October	0	0	0	0						
November	0	0	0	0						
December	0	0	0	0						
AVERAGE	0	0	0	0						
	WF HOUSE #60		WF HOUSE #61		WF HOUSE #62		WF HOUSE #63		WF HOUSE #64	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
October	0	0	0	0	0	0	0	0	0	0
November	1	5	0	0	0	0	0	0	0	0
December	1	6	0	8	0	6	0	6	0	0
AVERAGE	1	6	0	8	0	6	0	6	0	0

Appendix D

Deep Disposal Wells Injection Radiological Data

Third and Fourth Quarter, 2018

Crow Butte Uranium Mine
Deep Disposal Well #1 Injection Radiological Data

Month	Total Gallons Injected	Average Natural Uranium (mg/l)	Total Natural Uranium Injected (mg)	Total Natural Uranium Injected (uCi)	Average Radium- 226 (pCi/l)	Total Radium- 226 Injected (uCi)
July-18	10,986,816	0.34	1.43E+07	9.66E+03	374	1.56E+04
August-18	8,338,048	0.628	1.98E+07	1.34E+04	289	9.12E+03
September-18	5,706,624	0.758	1.64E+07	1.11E+04	312	6.74E+03
October-18	6,259,200	1.16	2.75E+07	1.86E+04	271	6.42E+03
November-18	8,216,256	1.16	3.61E+07	2.44E+04	879	2.73E+04
December-18	10,961,984	2.56	1.06E+08	7.19E+04	576	2.39E+04
Totals	50,468,928		2.20E+08	1.49E+05		8.91E+04

Crow Butte Uranium Mine
Deep Disposal Well #2 Injection Radiological Data

Month	Total Gallons Injected	Average Natural Uranium (mg/l)	Total Natural Uranium Injected (mg)	Total Natural Uranium Injected (uCi)	Average Radium- 226 (pCi/l)	Total Radium- 226 Injected (uCi)
July-18	867,855	0.34	1.13E+06	7.63E+02	374	1.23E+03
August-18	813,701	0.628	1.93E+06	1.31E+03	289	8.90E+02
September-18	643,766	0.758	1.85E+06	1.25E+03	312	7.60E+02
October-18	885,832	1.16	3.89E+06	2.63E+03	271	9.09E+02
November-18	920,683	1.16	4.04E+06	2.74E+03	879	3.06E+03
December-18	1,031,708	2.56	1.00E+07	6.77E+03	576	2.25E+03
Totals	5,163,545		2.28E+07	1.55E+04		9.10E+03

Appendix E

Radon Release Calculations

Third and Fourth Quarter, 2018

Radon Effluent Release Calculation (Production and Startup)

Third Quarter 2018 Radon Release from Leaching Operations:

<i>Curies/M3</i>	<i>Production Flow (liters)</i>	<i>Radon-222 Decay Constant</i>	<i>Operating Days</i>	<i>Operating Factor</i>	<i>M3/liter conversion</i>	<i>Hours/Day Conversion</i>	<i>Minutes/Hour Conversion</i>	<i>Total Radon Release from Leaching</i>
7.04E-04	613	0.72	92	100.0%	0.001	24	60	41

Fourth Quarter 2018 Radon Release from Leaching Operations:

<i>Curies/M3</i>	<i>Production Flow (liters)</i>	<i>Radon-222 Decay Constant</i>	<i>Operating Days</i>	<i>Operating Factor</i>	<i>M3/liter conversion</i>	<i>Hours/Day Conversion</i>	<i>Minutes/Hour Conversion</i>	<i>Total Radon Release from Leaching</i>
7.04E-04	526	0.72	92	100.0%	0.001	24	60	35

Second Half 2018 Radon Release From Startup:

<i>Curies/M3</i>	<i>Total Acres of New Wellfield</i>	<i>Meter2/Acre Conversion</i>	<i>Orebody Thickness (meters)</i>	<i>Porosity</i>	<i>Total Radon Release from Startup</i>
7.04E-04	0.0	4,074	1.52	0.29	0

Total Estimated Radon Release from Production:

76

Radon Effluent Release Calculation (Restoration)

Second Half 2018 Radon Release From Restoration:

<i>Total Restoration Flow (liters)</i>	<i>Microcuries/liter</i>	<i>Curies/Microcurie</i>	<i>Production Potential</i>
418,472,927	0.697	1.00E-06	292

Wellfield Loss (25% of Production Potential):

73

Ion Exchange Loss (10% of Production Potential minus Wellfield Loss):

22

Reverse Osmosis Loss (100% of remaining activity at 0.470 microcuries/liter)

140

<i>Total Reverse Osmosis Flow (liters)</i>	<i>Microcuries/liter</i>	<i>Curies/Microcurie</i>
298,395,797	0.470	1.00E-06

First Half 2018 Radon Release From Startup of New Restoration:

<i>Curies/M3</i>	<i>Total Acres of New Wellfield</i>	<i>Meter2/Acre Conversion</i>	<i>Orebody Thickness (meters)</i>	<i>Porosity</i>	<i>Total Radon Release from Startup</i>
7.04E-04	7.10	4074	1.52	0.29	9

Total Estimated Radon Release from Restoration:

244

Total Estimated Radon Release, Second Half 2018:

321

Appendix F

Main Plant

Track Etch Detectors

Working Level Measurements

Scintillation Cell Measurements

Isotopic Analyses

Second Half, 2018

Calculation of Radon Gas Emissions from the Main Plant

Second Half of 2018

Locations	RnG Concentration (x 10 ⁻⁹ µCi/ml)
01 Blower Pipe (Injection Filters)	2.5
02 Blower Pipe (Between Injection Tanks)	2.1
03 Boxed Fan (PWT West)	4.1
04 Boxed Fan (PWT East)	12.5
05 Pipe Duct (PWT)	5.5
09 Boxed Fan (Behind Acid Scrubber)	0.95
12 Shaker Room Blower/Exhaust	28.3

	Average RnG Concentration (µCi/ml)	Plant Vent Rate (CFM)	Plant Vent Rate (ml/6 months)	RnG Emissions (Ci/6 Months)
Plant Average	8.0E-09	49748	3.7E+14	2.96

Formula Ci/yr = average (µCi/ml) * ventilation (ml/yr) / (1e6 µCi/Ci)

2018 Radon Gas Emissions from the Main Plant

Annual RnG Emissions (Ci/Yr) 4.49

Calculation of Radon Progeny Emissions from the Plant

Second Half of 2018

Exhaust Rate for Building (CFM) 49748
Total Flow from Building (ml/ 6 months) 3.7E+14

Total In Plant Radon Progeny Emissions (Ci/yr) 0.17

Formula Ci/yr = WL * (3e-8 µCi/ml/0.33 WL) * ventilation (ml/6 months) / (1e6 µCi/Ci)

Start Date 7/1/2018 Average 0.0051
End Date 12/31/2018

SITE_CODE	LOCATION_NAME	START_DATE	RNP_VALUE	AREA_SAMPLE CLASS CODE	AREA_SAMP PLE_TYPE CODE
CB	R8 Motor Control Room	7/25/2018 5:46	0.00147827	Dosimetry	R
CB	R7 Between Precip Cells and Raw Water Tank	7/25/2018 5:52	0.00468861	Dosimetry	R
CB	R1 Between IX Columns and Precip Cells	7/25/2018 5:58	0.00387394	Dosimetry	R
CB	R2 Between Precip Cells and Eluent Tanks	7/25/2018 6:04	0.00269078	Dosimetry	R
CB	R12 Down Flow Column Area	7/25/2018 6:10	0.00130152	Dosimetry	R
CB	R13-E Pond Water Treatment Room East	7/25/2018 6:16	0.00717192	Dosimetry	R
CB	R13-M Pond Water Treatment Room Middle	7/25/2018 6:22	0.00688504	Dosimetry	R
CB	R13-W Pond Water Treatment Room West	7/25/2018 6:28	0.00230269	Dosimetry	R
CB	R3 Between IX Columns and Injection Tanks	7/25/2018 6:34	0.00084722	Dosimetry	R
CB	R4 Between IX Columns and Resin Transfer Tanks	7/25/2018 6:40	0.00190495	Dosimetry	R
CB	R5 Between IX Columns and Column Drain Tank	7/25/2018 6:46	0.00367622	Dosimetry	R
CB	R6 Between IX Column Trains	7/25/2018 6:52	0.00283866	Dosimetry	R
CB	R8 Motor Control Room	8/22/2018 6:56	0.00135436	Dosimetry	R
CB	R7 Between Precip Cells and Raw Water Tank	8/22/2018 7:02	0.00165216	Dosimetry	R
CB	R1 Between IX Columns and Precip Cells	8/22/2018 7:08	0.00129063	Dosimetry	R
CB	R2 Between Precip Cells and Eluent Tanks	8/22/2018 7:14	0.00154078	Dosimetry	R
CB	R12 Down Flow Column Area	8/22/2018 7:20	0.00060946	Dosimetry	R
CB	R13-E Pond Water Treatment Room East	8/22/2018 7:26	0.00628508	Dosimetry	R

CB	R13-M Pond Water Treatment Room Middle	8/22/2018 7:32	0.00877626	Dosimetry	R
CB	R13-W Pond WaterTreatment Room West	8/22/2018 7:38	0.00316452	Dosimetry	R
CB	R3 Between IX Columns and Injection Tanks	8/22/2018 7:44	0.00406308	Dosimetry	R
CB	R4 Between IX Columns and Resin Transfer Tanks	8/22/2018 7:50	0.00171411	Dosimetry	R
CB	R5 Between IX Columns and Column Drain Tank	8/22/2018 7:56	0.00236429	Dosimetry	R
CB	R6 Between IX Column Trains	8/22/2018 8:02	0.00228548	Dosimetry	R
CB	R8 Motor Control Room	9/19/2018 4:58	0.00481677	Dosimetry	R
CB	R7 Between Precip Cells and Raw Water Tank	9/19/2018 5:04	0.00470208	Dosimetry	R
CB	R1 Between IX Columns and Precip Cells	9/19/2018 5:10	0.00453994	Dosimetry	R
CB	R2 Between Precip Cells and Eluent Tanks	9/19/2018 5:16	0.00626944	Dosimetry	R
CB	R12 Down Flow Column Area	9/19/2018 5:22	0.00490652	Dosimetry	R
CB	R13-E Pond Water Treatment Room East	9/19/2018 5:28	0.01116744	Dosimetry	R
CB	R13-M Pond Water Treatment Room Middle	9/19/2018 5:34	0.01354199	Dosimetry	R
CB	R13-W Pond WaterTreatment Room West	9/19/2018 5:40	0.00515420	Dosimetry	R
CB	R3 Between IX Columns and Injection Tanks	9/19/2018 5:46	0.00212924	Dosimetry	R
CB	R4 Between IX Columns and Resin Transfer Tanks	9/19/2018 5:52	0.00436011	Dosimetry	R
CB	R5 Between IX Columns and Column Drain Tank	9/19/2018 5:58	0.00247478	Dosimetry	R
CB	R6 Between IX Column Trains	9/19/2018 6:04	0.00454269	Dosimetry	R
CB	R8 Motor Control Room	10/24/2018 5:22	0.00174278	Dosimetry	R
CB	R7 Between Precip Cells and Raw Water Tank	10/24/2018 5:28	0.02653225	Dosimetry	R
CB	R1 Between IX Columns and Precip Cells	10/24/2018 5:34	0.00431799	Dosimetry	R
CB	R2 Between Precip Cells and Eluent Tanks	10/24/2018 5:40	0.00475838	Dosimetry	R
CB	R12 Down Flow Column Area	10/24/2018 5:46	0.00245505	Dosimetry	R
CB	R13-E Pond Water Treatment Room East	10/24/2018 5:52	0.01205786	Dosimetry	R
CB	R13-M Pond Water Treatment Room Middle	10/24/2018 5:58	0.00649360	Dosimetry	R
CB	R13-W Pond WaterTreatment Room West	10/24/2018 6:04	0.00488649	Dosimetry	R
CB	R3 Between IX Columns and Injection Tanks	10/24/2018 6:10	0.00261417	Dosimetry	R
CB	R4 Between IX Columns and Resin Transfer Tanks	10/24/2018 6:16	0.00692993	Dosimetry	R
CB	R5 Between IX Columns and Column Drain Tank	10/24/2018 6:22	0.00693443	Dosimetry	R
CB	R6 Between IX Column Trains	10/24/2018 6:28	0.00693863	Dosimetry	R
CB	R8 Motor Control Room	11/28/2018 5:42	0.00087693	Dosimetry	R
CB	R7 Between Precip Cells and Raw Water Tank	11/28/2018 5:48	0.00425308	Dosimetry	R
CB	R1 Between IX Columns and Precip Cells	11/28/2018 5:54	0.00213849	Dosimetry	R
CB	R2 Between Precip Cells and Eluent Tanks	11/28/2018 6:00	0.00333543	Dosimetry	R
CB	R12 Down Flow Column Area	11/28/2018 6:06	0.00258637	Dosimetry	R
CB	R13-E Pond Water Treatment Room East	11/28/2018 6:12	0.02490118	Dosimetry	R
CB	R13-M Pond Water Treatment Room Middle	11/28/2018 6:18	0.02126430	Dosimetry	R
CB	R13-W Pond WaterTreatment Room West	11/28/2018 6:24	0.00683626	Dosimetry	R

CB	R3 Between IX Columns and Injection Tanks	11/28/2018 6:30	0.00335432	Dosimetry	R
CB	R4 Between IX Columns and Resin Transfer Tanks	11/28/2018 6:36	0.00490131	Dosimetry	R
CB	R5 Between IX Columns and Column Drain Tank	11/28/2018 6:42	0.00444716	Dosimetry	R
CB	R6 Between IX Column Trains	11/28/2018 6:48	0.00480426	Dosimetry	R
CB	R8 Motor Control Room	12/19/2018 5:15	0.00000000	Dosimetry	R
CB	R7 Between Precip Cells and Raw Water Tank	12/19/2018 5:21	0.00276639	Dosimetry	R
CB	R1 Between IX Columns and Precip Cells	12/19/2018 5:27	0.00270053	Dosimetry	R
CB	R2 Between Precip Cells and Eluent Tanks	12/19/2018 5:33	0.00130370	Dosimetry	R
CB	R12 Down Flow Column Area	12/19/2018 5:39	0.00157531	Dosimetry	R
CB	R13-E Pond Water Treatment Room East	12/19/2018 5:45	0.01266949	Dosimetry	R
CB	R13-M Pond Water Treatment Room Middle	12/19/2018 5:51	0.01446710	Dosimetry	R
CB	R13-W Pond Water Treatment Room West	12/19/2018 5:57	0.00416993	Dosimetry	R
CB	R3 Between IX Columns and Injection Tanks	12/19/2018 6:03	0.00240754	Dosimetry	R
CB	R4 Between IX Columns and Resin Transfer Tanks	12/19/2018 6:09	0.00551357	Dosimetry	R
CB	R5 Between IX Columns and Column Drain Tank	12/19/2018 6:15	0.00582301	Dosimetry	R
CB	R6 Between IX Column Trains	12/19/2018 6:21	0.00244444	Dosimetry	R

Calculation of Radon Daughter Emissions from the Plant

Total 2018

Exhaust Rate for Building (CFM)	49748
Total Flow from Building (ml/yr)	7.4E+14

Total In Plant Radon Daughter Emissions (Ci/yr) 0.29

Formula $Ci/yr = WL * (3e-8 \mu Ci/ml / 0.33 WL) * \text{ventilation (ml/yr)} / (1e6 \mu Ci/Ci)$

Tank Vent Effluent (RnP and RnG Emissions from Tank Vents)

Second Half of 2018 Data

Location	Ventilation Blower Flow Rates (cfm)	Ventilation Blower Flow Rates (m³/min)	Ventilation Blower Flow Rates (L/min)	Third Quarter Results						Fourth Quarter Results					
				RnG Filling pCi/l	RnP Filling WL	RnG Draining pCi/l	RnP Draining WL	RnG Steady pCi/l	RnP Steady WL	RnG Filling pCi/l	RnP Filling WL	RnG Draining pCi/l	RnP Draining WL	RnG Steady pCi/l	RnP Steady WL
6 - Pond Water Treat. Fan	4700	133.1	133089.0			4373.5	0.067	16.1	0.030	48.200	0.010	35.340	0.035	25.230	0.042
7 - Chem Mix Demister Fan	4700	133.1	133089.0	2936.680	1.710	54.050	0.006	15.000	0.009	59078.270	1.348	639.830	0.119	8.710	0.006
8 - Waste Tank Blower	1500	42.5	42475.2					83800.200	21.065					9489.700	24.747
10 - Precip Demister Fan	1500	42.5	42475.2	2284.500	0.381	20.400	0.010	12.980	0.023	14169.660	0.423	4.900	0.009	16.230	0.012
11 - Shaker Deck Blower	800	22.7	22653.4	30.910	0.478	2.490	0.000	12.150	0.018	433.680	0.469	109.210	2.234	4.620	0.010
13 - Eluent Tank Blower	1500	42.5	42475.2	2572.310	0.291	858.710	0.369	0.200	0.005	555.790	0.498	146.250	0.184	36.020	0.007
14 - Precip A Blower	185	5.2	5238.6	0.000	0.004			0.000	0.001	19.470	0.009	0.000	0.005	21.450	0.026
15 - East Train Blower	6000	169.9	169900.8	38913.640	8.506	35061.240	6.638	34334.460	10.023	3088.650	8.336	49455.390	7.123	2699.710	8.408
16 - West Train Blower	6000	169.9	169900.8	2597.830	0.595	10023.940	2.314	1015.040	2.164	207.350	0.172	2498.910	0.209	1368.070	0.088
17 - Backwash Tank Blower	800	22.7	22653.4					64552.130	5.331					169.010	0.035

Second Half of 2018 Results

Location	Ventilation Blower Flow Rates (cfm)	Ventilation Blower Flow Rates (m³/min)	Ventilation Blower Flow Rates (L/min)	Average for Second Half of Year						Average RnG (pCi/l)	Average RnG (pCi/mln)	Average RnG Emissions (Ci/6 months)	Average RnP Emissions (Ci/6 months)	Max RnG (pCi/l)	Max RnG (pCi/mln)	Maximum RnG Emissions (Ci/6 months)	Maximum RnP Emissions (Ci/6 months)
				RnG Filling pCi/l	RnP Filling WL	RnG Draining pCi/l	RnP Draining WL	RnG Steady pCi/l	RnP Steady WL								
6 - Pond Water Treat. Fan	4700	133.1	133089.0	48.20	0.0	2204.4	0.1	20.7	0.0	757.8	1.01E+08	26.50	0.1	2204.4	2.93E+08	77.10	0.16
7 - Chem Mix Demister Fan	4700	133.1	133089.0	31007.48	1.5290	346.9	0.1	11.9	0.0	10455.4	1.39E+09	365.69	1.7	31007.5	4.13E+09	1084.51	4.86
8 - Waste Tank Blower	1500	42.5	42475.2					46645.0	22.9	46645.0	1.98E+09	520.67	23.2	46645.0	1.98E+09	520.67	23.24
10 - Precip Demister Fan	1500	42.5	42475.2	8227.08	0.4	12.7	0.0	14.6	0.0	2751.4	1.17E+08	30.71	0.1	8227.1	3.49E+08	91.83	0.41
11 - Shaker Deck Blower	800	22.7	22653.4	232.30	0.5	55.9	1.1	8.4	0.0	98.8	2.24E+06	0.59	0.3	232.3	5.26E+06	1.38	0.60
13 - Eluent Tank Blower	1500	42.5	42475.2	1564.05	0.4	502.5	0.3	18.1	0.0	694.9	2.95E+07	7.8	0.2	1564.1	6.64E+07	17.46	0.40
14 - Precip A Blower	185	5.2	5238.6	9.74	0.0	0.0	0.0	10.7	0.0	6.8	3.57E+04	0.0	0.0	10.7	5.62E+04	0.01	0.00
15 - East Train Blower	6000	169.9	169900.8	21001.15	8.4	42258.3	6.9	18517.1	9.2	27258.8	4.63E+09	1217.1	33.2	42258.3	7.18E+09	1886.83	37.41
16 - West Train Blower	6000	169.9	169900.8	1402.59	0.4	6261.4	1.3	1191.6	1.1	2951.9	5.02E+08	131.8	3.7	6261.4	1.06E+09	279.57	5.12
17 - Backwash Tank Blower	800	22.7	22653.4					32360.6	2.7	32360.6	7.33E+08	192.7	1.5	32360.6	7.33E+08	192.65	1.45

Footnote: Locations numbered per HPC Air Ventilation Study - August 2013 (LRA SUA 1534 November 2014 Appendix C) ML15310A373

Sum	2493.49	64.08
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Second Half 2017 Tank RnP and RnG

4152.03	73.66
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4225.69

Appendix G

Wellfield

Scintillation Cell Measurements

Spill Radon Calculation

Third and Fourth Quarter, 2018

Calculation of Radon Gas Emissions from Venting Wellheads

Second Half of 2018

	RnG (pCi/L)
Average RnG vented from Wellheads - Q3	N/A
Average RnG vented from Wellheads - Q4	N/A

Total Emissions for Second Half

Average RnG (pCi/L)	0.00	
Casing volume (L)	1563.75	(4.5 in diameter, 500 ft depth)
Wellheads bled/Month	0	
Wellheads bled/6 Months	0	
Ci/6 Months	0.00E+00	

Total Radon Gas Emissions from Venting Wellheads for 2018

Ci/12 Months	0.00E+00
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SPILL CALCULATION

Quarter	Volume in Liters	Ci Radon per cubic meter	Total Curies
Q1-Q2		7.04E-04	0.00E+00
Q3-Q4	1556	7.04E-04	1.10E-03

Appendix H

Wellhouses

Track Etch Detectors

Working Level Measurements

Isotopic Analyses

Third and Fourth Quarter, 2018

Calculation of Radon Gas Emissions from Wellhouses

Second Half of 2018

Wellhouses	RnG Concentration (x 10-9 µCi/ml)
Wellhouse 5 (Restoration)	2.1
Wellhouse 8 (Restoration)	3.2
Wellhouse 19 (Restoration)	1.8
Wellhouse 24 (Restoration)	5.6
Wellhouse 30 (Production)	4.5
Wellhouse 36 (Production)	6.3
Wellhouse 43 (Production)	5.4
Wellhouse 50 (Production)	1.1
Wellhouse 9 (Restoration)*	35.8

Total Emissions for Second Half of 2017

	Average RnG Concentration (µCi/ml)	WH Vent Rate (CFM)	WH Vent Rate (ml/6 months)	# WH	RnG Emissions (Ci/6 Months)
WH Avg Concentration (Restoration)	3.18E-09	800	6.0E+12	24	0.45
WH Avg Concentration (Production)	4.33E-09	800	6.0E+12	39	1.00
*WH Not part of Average	3.58E-08	800	6.0E+12	1	0.21
Total Radon Gas Emissions from WH's					1.67

$$\text{Formula Ci/yr} = \text{average } (\mu\text{Ci/ml}) * \text{ventilation (ml/yr)} * \# \text{ WH} / (1\text{e}6 \mu\text{Ci/Ci})$$

2018 Radon Gas Emissions from Wellhouses

WH Avg Concentration (Restoration)
WH Avg Concentration (Production)
*WH Not part of Average
Total Radon Gas Emissions from WH's

RnG Emissions (Ci/Yr)
0.94
2.26
0.43
3.63

$$\text{Formula Ci/yr} = \text{average } (\mu\text{Ci/ml}) * \text{ventilation (ml/yr)} * \# \text{ WH} / (1\text{e}6 \mu\text{Ci/Ci})$$

Calculation of Radon Progeny Emissions from Wellhouses

Second Half of 2018

Wellhouses	WL Q3	Q4	Average
Wellhouse 5 (Restoration)	0.003	0.003	0.003
Wellhouse 8 (Restoration)	0.003	0.003	0.003
Wellhouse 19 (Restoration)	0.002	0.002	0.002
Wellhouse 24 (Restoration)	0.002	0.003	0.003
Wellhouse 30 (Production)	0.003	0	0.002
Wellhouse 36 (Production)	0.002	0.003	0.003
Wellhouse 43 (Production)	0.003	0.002	0.003
Wellhouse 50 (Production)	0.002	0.002	0.002
Wellhouse 9 (Restoration)*	0.032	0.008	0.020

Total Emissions for Second Half of 2017

	Average WL	WH Vent Rate (CFM)	WH Vent Rate (ml/ 6months)	# of WH	Ci/6 Months (RnP)
WH Avg Concentration (Restoration)	0.003	800	6.0E+12	24	0.03
WH Avg Concentration (Production)	0.002	800	6.0E+12	39	0.04
*WH Not part of Average	0.020	800	6.0E+12	1	0.01
Second Half Radon Progeny Emissions from WH					0.09

Formula Ci/yr = WL * (3e-8 µCi/ml/0.33 WL) * ventilation (ml/6 months) * # of WH / (1e6 µC

2018 Radon Progeny Emissions from Wellhouses

WH Avg Concentration (Restoration)
 WH Avg Concentration (Production)
 *WH Not part of Average
Total Radon Progeny Emissions from WH 2017

Ci/Yr (RnP)
0.05
0.09
0.02
0.16

Calculation of Particulate Emissions from the Wellhouses

Second Half of 2018

	Run Time (min)	Flow Rate (LPM)	Total Volume (L)	Lab Result (µCi/ml)				Calculated Result (µCi/ml)	
				Lead 210	Radium 226	Thorium 230	Uranium	Th234	Po-210
Wellhouse 5 (Restoration)	20146	49.4513	996245.9	4.20E-13	3.50E-16	9.70E-15	1.20E-15	5.88E-16	4.20E-13
Wellhouse 8 (Restoration)	20165	49.4607	997375.0	5.40E-14	5.20E-16	6.70E-16	3.40E-16	1.67E-16	5.40E-14
Wellhouse 19 (Restoration)	20142	49.4644	996311.9	1.50E-14	1.40E-16	5.00E-17	2.80E-16	1.37E-16	1.50E-14
Wellhouse 24 (Restoration)	20158	49.5457	998742.2	1.40E-14	3.20E-16	1.50E-15	4.60E-16	2.25E-16	1.40E-14
Wellhouse 30 (Production)	20158	49.6081	1000000.1	1.90E-14	4.80E-16	5.40E-16	1.20E-15	5.88E-16	1.90E-14
Wellhouse 36 (Production)	20150	49.6221	999885.3	2.30E-14	6.00E-16	2.50E-16	9.60E-16	4.70E-16	2.30E-14
Wellhouse 43 (Production)	20158	49.5491	998810.8	2.20E-14	6.90E-16	1.70E-15	1.30E-16	6.37E-17	2.20E-14
Wellhouse 50 (Production)	20144	49.6426	1000000.5	2.90E-14	2.80E-16	3.60E-16	1.40E-16	6.86E-17	2.90E-14
10 CFR 20 Effluent Limit				1.00E-10	3.00E-10	6.00E-12	2.00E-11	3.00E-10	9.00E-13
RL				2.00E-15	1.00E-16	1.00E-16	1.00E-16		

Note: if result was non-detect, 1/2 RL was used

Exhaust Rate for Wellhouse (CFM)	800	
Total Flow from Building (ml/ 6 months)	6.0E+12	(1 ft ³ = 28316.84659 ml)
# Wellhouses	64	

Total Emissions of Each Radionuclide for Second Half of Year

	Emission (Ci/6 Months)
Lead 210	2.84E-05
Radium 226	1.61E-07
Thorium 230	7.03E-07
Uranium	2.24E-07
Th234	1.10E-07
Po-210	2.84E-05
Sum	5.80E-05

Total 2018 Particulate Emissions from the Wellhouses

Total Emissions of Each Radionuclide for Full Year

	Emission (Ci/yr)
Lead 210	3.65E-05
Radium 226	2.20E-07
Thorium 230	8.43E-07
Uranium	3.30E-07
Th234	1.62E-07
Po-210	3.65E-05
Sum	3.81E-05

Calculation of Particulate Emissions from DeepWell Buildings

Second Half of 2018

	Run Time (min)	Flow Rate (LPM)	Total Volume (L)	Lab Result (µCi/ml)				Calculated Result (µCi/ml)	
				Lead 210	Radium 226	Thorium 230	Uranium	Th234	Po-210
DeepWell Building #1	20087	49.5539	995389.2	2.30E-14	1.50E-15	6.50E-16	1.30E-15	6.37E-16	2.30E-14
DeepWell Building #2	20091	47.5894	956118.6	6.90E-14	3.90E-16	3.70E-16	2.30E-16	1.13E-16	6.90E-14
10 CFR 20 Effluent Limit					3.00E-10	6.00E-12	2.00E-11	3.00E-10	9.00E-13
RL				2.00E-15	1.00E-16	1.00E-16	1.00E-16		

Note: if result was non-detect, 1/2 RL was used

	Building 1	Building 2
Exhaust Rate for Wellhouse (CFM)	800	800
Total Flow from Building (ml/ 6 months)	6.0E+12	6.0E+12

(1 ft3 = 28316.84659 ml)

Total Emissions of Each Radionuclide for Second Half of Year

	Emission (Ci/6 Months)	
	Building 1	Building 2
Lead 210	1.37E-07	4.11E-07
Radium 226	8.93E-09	2.32E-09
Thorium 230	3.87E-09	2.20E-09
Uranium	7.74E-09	1.37E-09
Th234	3.79E-09	6.71E-10
Po-210	1.37E-07	4.11E-07
By Building	2.98E-07	8.28E-07
Total	1.13E-06	

2018 Total Particulate Emissions from DeepWell Buildings

Total Emissions of Each Radionuclide for Full Year

	Emission (Ci/yr)
Lead 210	1.00E-06
Radium 226	1.28E-08
Thorium 230	1.10E-08
Uranium	1.34E-08
Th234	6.56E-09
Po-210	1.00E-06
Sum	2.04E-06

Crow Butte Resources

Wellhouse Radon Daughters Summary

C.Yada

WH#	2018 4th Qtr.	Date	2018 3rd Qtr.	Date
	Working Level Concentration		Working Level Concentration	
3	0.002	10/17/2018	0.001	7/12/2018
4	0.000	10/17/2018	0.002	7/12/2018
5	0.003	10/17/2018	0.003	7/12/2018
6	0.003	10/17/2018	0.005	7/12/2018
7	0.003	10/17/2018	0.004	7/12/2018
8	0.003	10/17/2018	0.003	7/12/2018
9	0.008	10/17/2018	0.032	7/12/2018
10	0.019	10/17/2018	0.005	7/12/2018
11	0.002	10/17/2018	0.004	7/13/2018
12	0.001	10/17/2018	0.003	7/13/2018
13	0.000	10/17/2018	0.002	7/13/2018
14	0.006	10/17/2018	0.005	7/13/2018
15	0.000	10/17/2018	0.002	7/13/2018
16	0.000	10/17/2018	0.004	7/13/2018
17	0.000	10/17/2018	0.003	7/13/2018
18	0.001	10/17/2018	0.002	7/13/2018
19	0.002	10/17/2018	0.002	7/13/2018
20	0.002	10/17/2018	0.003	7/13/2018
21	0.001	10/17/2018	0.002	7/13/2018
22	0.002	10/17/2018	0.004	7/13/2018
23	0.000	10/17/2018	0.040	7/13/2018
24	0.003	10/17/2018	0.002	7/13/2018
25	0.002	10/17/2018	0.003	7/13/2018
26	0.001	10/17/2018	0.003	7/13/2018
27	0.001	10/17/2018	0.002	7/13/2018
28	0.002	11/14/2018	0.007	8/14/2018
29	0.002	11/14/2018	0.008	8/14/2018
30	0.000	11/14/2018	0.003	8/14/2018
31	0.001	11/14/2018	0.002	8/14/2018
32	0.002	11/14/2018	0.003	8/14/2018
33	0.004	11/14/2018	0.002	8/14/2018
34	0.003	11/15/2018	0.002	8/14/2018
35	0.002	11/15/2018	0.001	8/14/2018
36	0.003	11/15/2018	0.002	8/14/2018
37	0.005	11/15/2018	0.012	8/14/2018

Crow Butte Resources

Wellhouse Radon Daughters Summary

C.Yada

	2018 4th Qtr.		2018 3rd Qtr.	
	Working Level	Date	Working Level	Date
WH#	Concentration		Concentration	
38	0.007	11/15/2018	0.004	8/14/2018
39	0.004	11/15/2018	0.005	8/14/2018
40	0.002	11/15/2018	0.003	8/14/2018
41	0.004	11/16/2018	0.001	8/15/2018
42	0.004	11/16/2018	0.004	8/15/2018
43	0.002	11/16/2018	0.003	8/15/2018
44	0.003	11/16/2018	0.000	8/15/2018
45	0.002	11/16/2018	0.001	8/15/2018
46	0.003	11/16/2018	0.003	8/15/2018
46A	0.002	11/16/2018	0.003	8/15/2018
47	0.001	11/16/2018	0.002	8/15/2018
47A	0.000	11/16/2018	0.001	8/15/2018
48	0.270	11/16/2018	0.003	8/15/2018
49	0.026	11/16/2018	0.019	8/15/2018
50	0.002	11/16/2018	0.002	8/15/2018
51	0.001	12/17/2018	0.002	9/18/2018
52	0.001	12/17/2018	0.003	9/18/2018
53	0.001	12/17/2018	0.003	9/18/2018
54	0.001	12/17/2018	0.003	9/18/2018
55	0.002	12/17/2018	0.002	9/18/2018
56	0.001	12/17/2018	0.003	9/18/2018
57	0.001	12/17/2018	0.004	9/18/2018
60	0.001	12/17/2018	0.001	9/18/2018
61	0.000	12/17/2018	0.003	9/18/2018
62	0.001	12/17/2018	0.002	9/18/2018
63	0.001	12/17/2018	0.002	9/18/2018
64	0.001	12/17/2018	0.003	9/18/2018
DDW-1	0.001	12/17/2018	0.004	9/18/2018
DDW-2	0.000	12/17/2018	0.001	9/18/2018

Appendix I

Environmental Air Monitoring Results

Third and Fourth Quarter, 2018

Crow Butte Resources, Inc.
Crow Butte Uranium Project

Track Etch Cup Ambient Radon Concentrations

Air
Monitoring
Station No.

Period: June 29, 2018 to January 3, 2019

		Average Radon Concentration (x 10 ⁻⁹ µCi/ml)	Accuracy (x 10 ⁻⁹ µCi/ml)	Percent Effluent Concentration
	Gross Count			
AM-1	47.0	0.24	0.04	2.4%
AM-2	45.0	0.24	0.04	2.4%
AM-3	43.0	0.22	0.03	2.2%
AM-4	57.0	0.30	0.04	3.0%
AM-5	52.0	0.27	0.04	2.7%
AM-6A	43.0	0.22	0.03	2.2%
AM-6B	47.0	0.24	0.04	2.4%
AM-6C	Lab didn't receive			0.0%
AM-6D	45.0	0.24	0.04	2.4%
AM-6E	51.0	0.27	0.04	2.7%
AM-6F	43.0	0.22	0.03	2.2%
AM-8	45.0	0.24	0.04	2.4%
AM-9A	37.0	0.19	0.03	1.9%
AM-9B	42.0	0.22	0.03	2.2%
AM-9C	54.0	0.30	0.04	3.0%
AM-9D	56.0	0.30	0.04	3.0%
AM-9E	44.0	0.24	0.04	2.4%
AM-9F	46.0	0.24	0.04	2.4%

LLD (x 10 ⁻⁹ µCi/ml)	0.2
Effluent Concentration Limit, 10 CFR 20 App B Column 2:	10



Inter-Mountain Labs

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Air Filter Summary Report**Client: Cameco Resources, Crow Butte Operation****Client Sampler ID: AM-1**

Lab ID S1901114-001 Sampled 10/1/18-1/3/19 (2018 4th Qtr)						Sample Air Volume: 6729262 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	19.5	2.2	2.9E-15	3.3E-16	2E-15	6 E-13	Day	0.48
Radium 226	0.7	0.2	9.9E-17	3.0E-17	1E-16	9 E-13	Week	0.011
Thorium 230	0.15	0.2	0.0E+0	3.0E-17	1E-16	3 E-14	Year	0
Uranium	3.7		5.5E-16		1E-16	9 E-14	Year	0.61

Lab ID S1810112-001 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)						Sample Air Volume: 6730722 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	103	4.8	1.5E-14	7.1E-16	2E-15	6 E-13	Day	2.5
Radium 226	1.2	0.2	1.7E-16	3.0E-17	1E-16	9 E-13	Week	0.019
Thorium 230	0.3	0.2	4.9E-17	3.0E-17	1E-16	3 E-14	Year	0.16
Uranium	0.3		3.8E-17		1E-16	9 E-14	Year	0.042

Lab ID S1807064-001 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)						Sample Air Volume: 6583462 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	69.7	5.0	1.1E-14	7.6E-16	2E-15	6 E-13	Day	1.8
Radium 226	0.1	0.1	1.7E-17	1.5E-17	1E-16	9 E-13	Week	0.0019
Thorium 230	0.9	0.3	1.4E-16	4.6E-17	1E-16	3 E-14	Year	0.47
Uranium	0.0		3.7E-18		1E-16	9 E-14	Year	0.0041

Lab ID S1804040-001 Sampled 1/2/18-3/29/18 (2018 1st Qtr)						Sample Air Volume: 6156023 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	82.4	5.3	1.3E-14	8.6E-16	2E-15	6 E-13	Day	2.2
Radium 226	0.4	0.1	6.2E-17	1.6E-17	1E-16	9 E-13	Week	0.0069
Thorium 230	0.1	0.1	0.0E+0	1.6E-17	1E-16	3 E-14	Year	0
Uranium	0.1		1.5E-17		1E-16	9 E-14	Year	0.017

Effluent Limits are from 10 CFR Part 20 Appendix B Table 2

ND - Not Detected at the Reporting Limit



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Air Filter Summary Report**Client: Cameco Resources, Crow Butte Operation****Client Sampler ID: AM-2**

Lab ID S1901114-002 Sampled 10/1/18-1/3/19 (2018 4th Qtr)						Sample Air Volume: 6726837 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	50.2	5.0	7.5E-15	7.4E-16	2E-15	6 E-13	Day	1.2
Radium 226	0.27	0.2	4.1E-17	3.0E-17	1E-16	9 E-13	Week	0.0046
Thorium 230	0.08	0.1	0.0E+0	1.5E-17	1E-16	3 E-14	Year	0
Uranium	3.6		5.3E-16		1E-16	9 E-14	Year	0.59

Lab ID S1810112-002 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)						Sample Air Volume: 6727815 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	97.0	4.7	1.4E-14	7.0E-16	2E-15	6 E-13	Day	2.3
Radium 226	0.5	0.2	7.3E-17	3.0E-17	1E-16	9 E-13	Week	0.0081
Thorium 230	0.4	0.2	5.6E-17	3.0E-17	1E-16	3 E-14	Year	0.19
Uranium	0.2		3.6E-17		1E-16	9 E-14	Year	0.040

Lab ID S1807064-002 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)						Sample Air Volume: 6577710 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	63.3	4.8	9.6E-15	7.3E-16	2E-15	6 E-13	Day	1.6
Radium 226	0.3	0.1	4.4E-17	1.5E-17	1E-16	9 E-13	Week	0.0049
Thorium 230	1.8	0.5	2.7E-16	7.6E-17	1E-16	3 E-14	Year	0.90
Uranium	0.1		8.3E-18		1E-16	9 E-14	Year	0.0092

Lab ID S1804040-002 Sampled 1/2/18-3/29/18 (2018 1st Qtr)						Sample Air Volume: 6074908 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	84.7	3.8	1.4E-14	6.3E-16	2E-15	6 E-13	Day	2.3
Radium 226	0.3	0.1	5.1E-17	1.6E-17	1E-16	9 E-13	Week	0.0057
Thorium 230	0.6	0.3	9.2E-17	4.9E-17	1E-16	3 E-14	Year	0.31
Uranium	0.1		1.8E-17		1E-16	9 E-14	Year	0.020

Effluent Limits are from 10 CFR Part 20 Appendix B Table 2

ND - Not Detected at the Reporting Limit



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Air Filter Summary Report**Client: Cameco Resources, Crow Butte Operation****Client Sampler ID: AM-3**

Lab ID S1901114-003 Sampled 10/1/18-1/3/19 (2018 4th Qtr)					Sample Air Volume: 6732418 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	30.4	2.6	4.5E-15	3.9E-16	2E-15	6 E-13	Day	0.75
Radium 226	0.27	0.1	4.1E-17	1.5E-17	1E-16	9 E-13	Week	0.0046
Thorium 230	0.6	0.3	9.2E-17	4.5E-17	1E-16	3 E-14	Year	0.31
Uranium	3.4		5.0E-16		1E-16	9 E-14	Year	0.56

Lab ID S1810112-003 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)					Sample Air Volume: 6730865 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	102	5.0	1.5E-14	7.4E-16	2E-15	6 E-13	Day	2.5
Radium 226	0.4	0.1	5.5E-17	1.5E-17	1E-16	9 E-13	Week	0.0061
Thorium 230	0.6	0.3	9.2E-17	4.5E-17	1E-16	3 E-14	Year	0.31
Uranium	0.4		5.2E-17		1E-16	9 E-14	Year	0.058

Lab ID S1807064-003 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)					Sample Air Volume: 6584676 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	72.8	4.9	1.1E-14	7.4E-16	2E-15	6 E-13	Day	1.8
Radium 226	0.4	0.1	5.9E-17	1.5E-17	1E-16	9 E-13	Week	0.0066
Thorium 230	1.1	0.4	1.6E-16	6.1E-17	1E-16	3 E-14	Year	0.53
Uranium	0.2		2.3E-17		1E-16	9 E-14	Year	0.026

Lab ID S1804040-003 Sampled 1/2/18-3/29/18 (2018 1st Qtr)					Sample Air Volume: 6157995 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	93.3	4.0	1.5E-14	6.5E-16	2E-15	6 E-13	Day	2.5
Radium 226	0.3	0.1	5.1E-17	1.6E-17	1E-16	9 E-13	Week	0.0057
Thorium 230	0.2	0.2	3.9E-17	3.2E-17	1E-16	3 E-14	Year	0.13
Uranium	0.1		1.7E-17		1E-16	9 E-14	Year	0.019

Effluent Limits are from 10 CFR Part 20 Appendix B Table 2!

ND - Not Detected at the Reporting Limit



Inter-Mountain Labs

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Air Filter Summary Report**Client: Cameco Resources, Crow Butte Operation****Client Sampler ID: AM-4**

Lab ID S1901114-004 Sampled 10/1/18-1/3/19 (2018 4th Qtr)					Sample Air Volume: 6729349 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	72.1	3.7	1.1E-14	5.5E-16	2E-15	6 E-13	Day	1.8
Radium 226	0.3	0.2	5.2E-17	3.0E-17	1E-16	9 E-13	Week	0.0058
Thorium 230	0.3	0.2	5.1E-17	3.0E-17	1E-16	3 E-14	Year	0.17
Uranium	3.2		4.8E-16		1E-16	9 E-14	Year	0.53

Lab ID S1810112-004 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)					Sample Air Volume: 6729584 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	97.6	4.7	1.4E-14	7.0E-16	2E-15	6 E-13	Day	2.3
Radium 226	0.19	0.1	2.9E-17	1.5E-17	1E-16	9 E-13	Week	0.0032
Thorium 230	0.4	0.2	5.9E-17	3.0E-17	1E-16	3 E-14	Year	0.20
Uranium	0.3		4.7E-17		1E-16	9 E-14	Year	0.052

Lab ID S1807064-004 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)					Sample Air Volume: 6583338 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	66.4	4.8	1.0E-14	7.3E-16	2E-15	6 E-13	Day	1.7
Radium 226	0.3	0.1	5.1E-17	1.5E-17	1E-16	9 E-13	Week	0.0057
Thorium 230	0.4	0.3	6.6E-17	4.6E-17	1E-16	3 E-14	Year	0.22
Uranium	0.1		1.2E-17		1E-16	9 E-14	Year	0.013

Lab ID S1804040-004 Sampled 1/2/18-3/29/18 (2018 1st Qtr)					Sample Air Volume: 6164348 Liters			
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	99.2	4.2	1.6E-14	6.8E-16	2E-15	6 E-13	Day	2.7
Radium 226	0.2	0.1	3.7E-17	1.6E-17	1E-16	9 E-13	Week	0.0041
Thorium 230	0.6	0.4	9.0E-17	6.5E-17	1E-16	3 E-14	Year	0.30
Uranium	0.3		4.2E-17		1E-16	9 E-14	Year	0.047

Effluent Limits are from 10 CFR Part 20 Appendix B Table 2

ND - Not Detected at the Reporting Limit



Inter-Mountain Labs

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Air Filter Summary Report**Client: Cameco Resources, Crow Butte Operation****Client Sampler ID: AM-5**

Lab ID S1901114-005 Sampled 10/1/18-1/3/19 (2018 4th Qtr)						Sample Air Volume: 6729001 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	57.2	3.3	8.5E-15	4.9E-16	2E-15	6 E-13	Day	1.4
Radium 226	0.19	0.1	3.0E-17	1.5E-17	1E-16	9 E-13	Week	0.0033
Thorium 230	0.25	0.2	3.8E-17	3.0E-17	1E-16	3 E-14	Year	0.13
Uranium	3.3		4.9E-16		1E-16	9 E-14	Year	0.54

Lab ID S1810112-005 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)						Sample Air Volume: 6727864 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	116	5.1	1.7E-14	7.6E-16	2E-15	6 E-13	Day	2.8
Radium 226	0.24	0.1	3.7E-17	1.5E-17	1E-16	9 E-13	Week	0.0041
Thorium 230	0.3	0.2	5.1E-17	3.0E-17	1E-16	3 E-14	Year	0.17
Uranium	0.2		3.7E-17		1E-16	9 E-14	Year	0.041

Lab ID S1807064-005 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)						Sample Air Volume: 6583579 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	72.9	5.0	1.1E-14	7.6E-16	2E-15	6 E-13	Day	1.8
Radium 226	0.4	0.1	6.5E-17	1.5E-17	1E-16	9 E-13	Week	0.0072
Thorium 230	0.8	0.3	1.3E-16	4.6E-17	1E-16	3 E-14	Year	0.43
Uranium	0.0		5.5E-18		1E-16	9 E-14	Year	0.0061

Lab ID S1804040-005 Sampled 1/2/18-3/29/18 (2018 1st Qtr)						Sample Air Volume: 6160888 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	11.8	1.8	1.9E-15	2.9E-16	2E-15	6 E-13	Day	0.32
Radium 226	0.4	0.1	7.1E-17	1.6E-17	1E-16	9 E-13	Week	0.0079
Thorium 230	0.3	0.2	4.8E-17	3.2E-17	1E-16	3 E-14	Year	0.16
Uranium	0.3		5.3E-17		1E-16	9 E-14	Year	0.059

Effluent Limits are from 10 CFR Part 20 Appendix B Table 2

ND - Not Detected at the Reporting Limit



Inter-Mountain Labs

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Air Filter Summary Report**Client:** Cameco Resources, Crow Butte Operation**Client Sampler ID:** AM-6

Lab ID S1901114-006 Sampled 10/1/18-1/3/19 (2018 4th Qtr)						Sample Air Volume: 6726107 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	112	5.2	1.7E-14	7.7E-16	2E-15	6 E-13	Day	2.8
Radium 226	0.5	0.2	7.8E-17	3.0E-17	1E-16	9 E-13	Week	0.0087
Thorium 230	0.08	0.1	0.0E+0	1.5E-17	1E-16	3 E-14	Year	0
Uranium	3.2		4.8E-16		1E-16	9 E-14	Year	0.53

Lab ID S1810112-006 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)						Sample Air Volume: 6731045 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	111	5.0	1.6E-14	7.4E-16	2E-15	6 E-13	Day	2.7
Radium 226	0.27	0.1	4.1E-17	1.5E-17	1E-16	9 E-13	Week	0.0046
Thorium 230	0.5	0.3	7.5E-17	4.5E-17	1E-16	3 E-14	Year	0.25
Uranium	1.0		1.5E-16		1E-16	9 E-14	Year	0.17

Lab ID S1807064-006 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)						Sample Air Volume: 6576395 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	79.5	5.2	1.2E-14	7.9E-16	2E-15	6 E-13	Day	2.0
Radium 226	0.17	0.1	2.6E-17	1.5E-17	1E-16	9 E-13	Week	0.0029
Thorium 230	0.3	0.2	5.2E-17	3.0E-17	1E-16	3 E-14	Year	0.17
Uranium	0.0		4.8E-18		1E-16	9 E-14	Year	0.0053

Lab ID S1804040-006 Sampled 1/2/18-3/29/18 (2018 1st Qtr)						Sample Air Volume: 6154512 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	101	4.2	1.6E-14	6.8E-16	2E-15	6 E-13	Day	2.7
Radium 226	0.3	0.1	4.7E-17	1.6E-17	1E-16	9 E-13	Week	0.0052
Thorium 230	0.1	0.2	0.0E+0	3.2E-17	1E-16	3 E-14	Year	0
Uranium	0.5		7.5E-17		1E-16	9 E-14	Year	0.083

Effluent Limits are from 10 CFR Part 20 Appendix B Table 2

ND - Not Detected at the Reporting Limit



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Air Filter Summary Report**Client:** Cameco Resources, Crow Butte Operation**Client Sampler ID:** AM-8

Lab ID S1901114-007 Sampled 10/1/18-1/3/19 (2018 4th Qtr)						Sample Air Volume: 6733124 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	68.6	5.1	1.0E-14	7.6E-16	2E-15	6 E-13	Day	1.7
Radium 226	0.4	0.2	6.1E-17	3.0E-17	1E-16	9 E-13	Week	0.0068
Thorium 230	0.4	0.3	6.2E-17	4.5E-17	1E-16	3 E-14	Year	0.21
Uranium	3.5		5.2E-16		1E-16	9 E-14	Year	0.58

Lab ID S1810112-007 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)						Sample Air Volume: 6726101 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	108	5.0	1.6E-14	7.4E-16	2E-15	6 E-13	Day	2.7
Radium 226	2.3	0.3	3.4E-16	4.5E-17	1E-16	9 E-13	Week	0.038
Thorium 230	0.8	0.3	1.2E-16	4.5E-17	1E-16	3 E-14	Year	0.40
Uranium	0.4		6.3E-17		1E-16	9 E-14	Year	0.070

Lab ID S1807064-007 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)						Sample Air Volume: 6583608 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	82.4	18.6	1.3E-14	2.8E-15	2E-15	6 E-13	Day	2.2
Radium 226	0.1	0.1	1.9E-17	1.5E-17	1E-16	9 E-13	Week	0.0021
Thorium 230	0.4	0.2	6.2E-17	3.0E-17	1E-16	3 E-14	Year	0.21
Uranium	0.0		4.2E-18		1E-16	9 E-14	Year	0.0047

Lab ID S1804040-007 Sampled 1/2/18-3/29/18 (2018 1st Qtr)						Sample Air Volume: 6156905 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	101	4.3	1.6E-14	7.0E-16	2E-15	6 E-13	Day	2.7
Radium 226	0.3	0.1	4.9E-17	1.6E-17	1E-16	9 E-13	Week	0.0054
Thorium 230	0.6	1.3	1.0E-16	2.1E-16	1E-16	3 E-14	Year	0.33
Uranium	0.2		3.1E-17		1E-16	9 E-14	Year	0.034

Effluent Limits are from 10 CFR Part 20 Appendix B Table 2

ND - Not Detected at the Reporting Limit



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Air Filter Summary Report**Client: Cameco Resources, Crow Butte Operation****Client Sampler ID: AM-9**

Lab ID S1901114-008 Sampled 10/1/18-1/3/19 (2018 4th Qtr)						Sample Air Volume: 6705096 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	107	5.2	1.6E-14	7.8E-16	2E-15	6 E-13	Day	2.7
Radium 226	0.3	0.2	5.1E-17	3.0E-17	1E-16	9 E-13	Week	0.0057
Thorium 230	0.18	0.2	0.0E+0	3.0E-17	1E-16	3 E-14	Year	0
Uranium	3.3		4.9E-16		1E-16	9 E-14	Year	0.54

Lab ID S1810112-008 Sampled 6/29/18-10/1/18 (2018 3rd Qtr)						Sample Air Volume: 6721150 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	123	5.2	1.8E-14	7.7E-16	2E-15	6 E-13	Day	3.0
Radium 226	1.9	0.3	2.8E-16	4.5E-17	1E-16	9 E-13	Week	0.031
Thorium 230	0.18	0.1	0.0E+0	1.5E-17	1E-16	3 E-14	Year	0
Uranium	0.4		5.3E-17		1E-16	9 E-14	Year	0.059

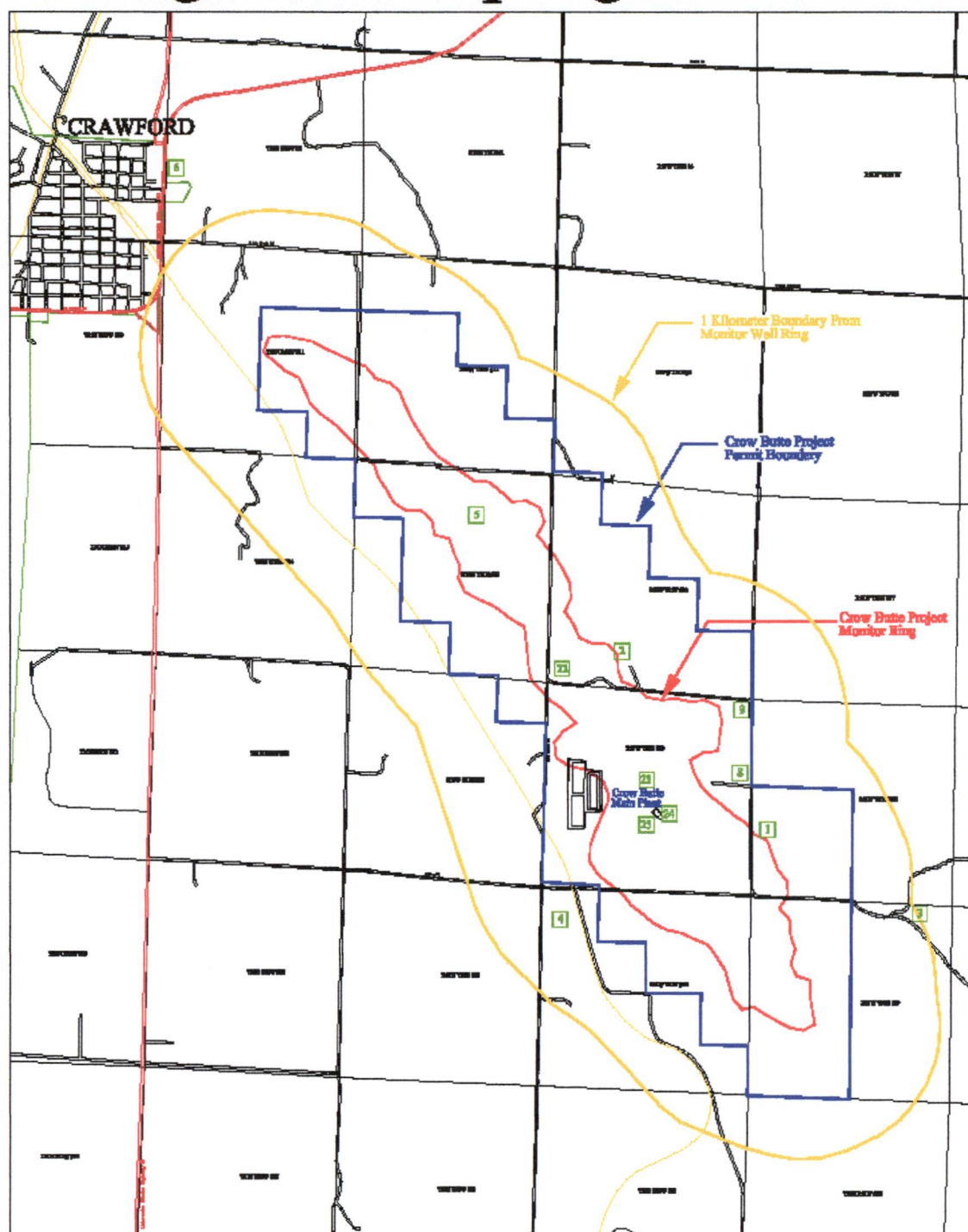
Lab ID S1807064-008 Sampled 4/5/18-6/29/18 (2nd Qtr 2018)						Sample Air Volume: 6585630 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	64.6	4.5	9.8E-15	6.8E-16	2E-15	6 E-13	Day	1.6
Radium 226	0.4	0.1	5.4E-17	1.5E-17	1E-16	9 E-13	Week	0.0060
Thorium 230	2.1	0.5	3.2E-16	7.6E-17	1E-16	3 E-14	Year	1.1
Uranium	0.1		9.8E-18		1E-16	9 E-14	Year	0.011

Lab ID S1804040-008 Sampled 1/2/18-3/29/18 (2018 1st Qtr)						Sample Air Volume: 5957273 Liters		
Analyte	Result pCi/filter	Precision ± pCi/filter	Result µCi/ml	Precision ± µCi/ml	RL	10 CFR Pt 20 Effluent Limit	Effluent Class	% Effluent Conc.
Lead 210	98.4	4.3	1.7E-14	7.2E-16	2E-15	6 E-13	Day	2.8
Radium 226	0.3	0.1	4.5E-17	1.7E-17	1E-16	9 E-13	Week	0.0050
Thorium 230	0.5	0.4	7.9E-17	6.7E-17	1E-16	3 E-14	Year	0.26
Uranium	0.1		1.7E-17		1E-16	9 E-14	Year	0.019

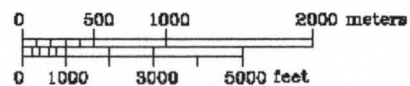
Effluent Limits are from 10 CFR Part 20 Appendix B Table 2

ND - Not Detected at the Reporting Limit

Regional Sampling Locations



6 Air Monitoring Station, Rainfall, Soil, Direct Radiation



Appendix J

Environmental OSL Monitoring Results

Third and Fourth Quarter, 2018

Crow Butte Resources
Crow Butte Uranium Project
Perimeter Air Monitoring Stations

Gamma Exposure Results

Location	Exposure of Dosimeter		Net Cumulative Totals		
	(mrems ambient dose equivalent)				
	Gross	Net	Calendar Quarter	Year to Date	Permanent
07/01/2018 - 09/30/2018					
Transient Control	--	0.0	Q3	2018	--
Deploy Control	23.3	0.0	--	--	--
AM-1	31.2	7.9	7.9	29.2	338.7
AM-2	38.5	15.2	15.2	43.3	375.6
AM-3	36.4	13.1	13.1	36.1	401.1
AM-4	34.4	11.0	11.0	29.8	306.9
AM-5	37.0	13.6	13.6	48.5	401.7
AM-6	35.5	12.1	12.1	39.4	356.9
AM-8	35.7	12.4	12.4	44.5	473.4
AM-9	38.6	15.3	15.3		

mrem – millirems

AM-1 air sampling locations

Minimum Detectable Dose = 0.1 mrems ambient dose equivalent

Crow Butte Resources
Crow Butte Uranium Project
Perimeter Air Monitoring Stations

Gamma Exposure Results

Location	Exposure of Dosimeter		Net Cumulative Totals		
	(mrems ambient dose equivalent)				
	Gross	Net	Calendar Quarter	Year to Date	Permanent
10/01/2018 - 12/31/2018					
Transient Control	--	0.0	Q4	2018	--
Deploy Control	25.6	0.0	--	--	--
AM-1	38.2	12.7	12.7	41.8	351.4
AM-2	34.8	9.2	9.2	52.5	384.8
AM-3	40.0	14.4	14.4	50.5	415.5
AM-4	35.3	9.8	9.8	39.5	316.6
AM-5	38.6	13.0	13.0	61.5	414.7
AM-6	37.5	12.0	12.0	51.3	368.9
AM-8	38.8	13.3	13.3	57.8	486.7
AM-9	39.4	13.9			

mrem – millirems

AM-1 air sampling locations

Minimum Detectable Dose = 0.1 mrems ambient dose equivalent

Appendix K

Air Particulate Stations

Operational Soil Sampling Results

2018



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8245

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 189
Crawford, NE 68339

Date Reported 1/28/2019
Report ID S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-001
ClientSample ID: Soil AM-1
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/16/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Lead 210	2.4	pCi/g	B	0.2	OTW01	12/24/2018 941	WN
Lead 210 Precision (±)	0.3	pCi/g	B		OTW01	12/24/2018 941	WN
Radium 226	0.9	pCi/g		0.2	EPA 901.1 Mod.	12/08/2018 818	WN
Radium 226 Precision (±)	0.3	pCi/g			EPA 901.1 Mod.	12/08/2018 818	WN
Metals - Total							
Uranium	0.3	pCi/g		0.2	EPA 200.8	11/21/2018 1653	MS



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8245

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 189
Crawford, NE 68339

Date Reported 1/28/2019
Report ID S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-002
ClientSample ID: Soil AM-2
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/16/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Lead 210	2.1	pCi/g	B	0.2	OTW01	12/24/2018 941	WN
Lead 210 Precision (±)	0.3	pCi/g	B		OTW01	12/24/2018 941	WN
Radium 226	0.9	pCi/g		0.2	EPA 901.1 Mod.	12/08/2018 850	WN
Radium 226 Precision (±)	0.3	pCi/g			EPA 901.1 Mod.	12/08/2018 850	WN
Metals - Total							
Uranium	0.3	pCi/g		0.2	EPA 200.8	11/21/2018 1716	MS



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported 1/28/2019
Report ID S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-003
ClientSample ID: Soil AM-3
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/18/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Lead 210	2.6	pCi/g	B	0.2	OTW01	12/24/2018 941	WN
Lead 210 Precision (±)	0.3	pCi/g	B		OTW01	12/24/2018 941	WN
Radium 226	1.0	pCi/g		0.2	EPA 901.1 Mod.	12/06/2018 922	WN
Radium 226 Precision (±)	0.3	pCi/g			EPA 901.1 Mod.	12/06/2018 922	WN
Metals - Total							
Uranium	0.5	pCi/g		0.2	EPA 200.8	11/21/2018 1722	MS



Inter-Mountain Labs

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported 1/28/2019
Report ID S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-004
ClientSample ID: Soil AM-4
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/18/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Lead 210	2.3	pCi/g	B	0.2	OTW01	12/24/2018 941	WN
Lead 210 Precision (±)	0.3	pCi/g	B		OTW01	12/24/2018 941	WN
Radium 226	1.0	pCi/g		0.2	EPA 901.1 Mod.	12/06/2018 954	WN
Radium 226 Precision (±)	0.4	pCi/g			EPA 901.1 Mod.	12/06/2018 954	WN
Metals - Total							
Uranium	0.6	pCi/g		0.2	EPA 200.8	11/21/2018 1728	MS



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported: 1/28/2019
Report ID: S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-005
ClientSample ID: Soil AM-5
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/16/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	2.3	pCi/g	B	0.2	OTW01	01/15/2019 1215 TWP
Lead 210 Precision (±)	0.4	pCi/g	B		OTW01	01/15/2019 1215 TWP
Radium 226	1.5	pCi/g		0.2	EPA 901.1 Mod.	12/08/2018 1026 WN
Radium 226 Precision (±)	0.3	pCi/g			EPA 901.1 Mod.	12/08/2018 1026 WN
Metals - Total						
Uranium	0.7	pCi/g		0.2	EPA 200.8	11/21/2018 1734 MS



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported: 1/28/2019
Report ID: S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-006
ClientSample ID: Soil AM-6
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/16/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	4.7	pCi/g	B	0.2	OTW01	01/15/2019 1215 TWP
Lead 210 Precision (±)	1.0	pCi/g	B		OTW01	01/15/2019 1215 TWP
Radium 226	0.8	pCi/g		0.2	EPA 901.1 Mod.	12/08/2018 1058 WN
Radium 226 Precision (±)	0.3	pCi/g			EPA 901.1 Mod.	12/08/2018 1058 WN
Metals - Total						
Uranium	0.4	pCi/g		0.2	EPA 200.8	11/21/2018 1752 MS



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 189
Crawford, NE 69339

Date Reported: 1/28/2019
Report ID: S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-007
ClientSample ID: Soil AM-8
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/16/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Lead 210	3.7	pCi/g	B	0.2	OTW01	12/24/2018 941	WN
Lead 210 Precision (±)	0.5	pCi/g	B		OTW01	12/24/2018 941	WN
Radium 226	1.0	pCi/g		0.2	EPA 901.1 Mod.	12/08/2018 1130	WN
Radium 226 Precision (±)	0.3	pCi/g			EPA 901.1 Mod.	12/08/2018 1130	WN
Metals - Total							
Uranium	0.4	pCi/g		0.2	EPA 200.8	11/21/2018 1758	MS



Inter-Mountain Labs

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 189
Crawford, NE 69339

Date Reported: 1/28/2019
Report ID: S1811148001

ProjectName: Crow Butte Annual Soil Samples
Lab ID: S1811148-008
ClientSample ID: Soil AM-9
COC: WEB
PWS ID:

WorkOrder: S1811148
CollectionDate: 10/16/2018
DateReceived: 11/9/2018 12:11:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init	
Radionuclides - Total							
Lead 210	1.5	pCi/g	B	0.2	OTW01	01/15/2019 1215	TWP
Lead 210 Precision (±)	0.4	pCi/g	B		OTW01	01/15/2019 1215	TWP
Radium 226	1.1	pCi/g		0.2	EPA 901.1 Mod.	12/08/2018 1201	WN
Radium 226 Precision (±)	0.4	pCi/g			EPA 901.1 Mod.	12/08/2018 1201	WN
Metals - Total							
Uranium	0.4	pCi/g		0.2	EPA 200.8	11/21/2018 1804	MS

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits
X Matrix Effect

C Calculated Value
G Analyzed at IML Gillette laboratory
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
U Analysis reported under the reporting limit

Appendix L
Sediment Monitoring Results
2018



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-5245

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported 11/8/2018
Report ID S1808308001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808308-001
ClientSample ID: Stream S-1
COC: WEB
PWS ID:

WorkOrder: S1808308
CollectionDate: 8/13/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	1.3E-8	µCi/g		2.0E-7	OTW01	09/23/2018 1805 MB
Lead 210 Precision (±)	5.0E-7	µCi/g			OTW01	09/23/2018 1805 MB
Radium 226	8.0E-7	µCi/g		2.0E-7	EPA 901.1 Mod.	09/12/2018 1408 WN
Radium 226 Precision (±)	3.0E-7	µCi/g			EPA 901.1 Mod.	09/12/2018 1408 WN
Thorium 230	4.0E-7	µCi/g		2.0E-7	ACW01	10/17/2018 1132 WN
Thorium230 Precision (±)	4.0E-7	µCi/g			ACW01	10/17/2018 1132 WN
Metals - Total						
Uranium	5.0E-7	µCi/g		2.0E-7	EPA 200.8	09/31/2018 1848 MS



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-5245

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported 11/8/2018
Report ID S1808308001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808308-002
ClientSample ID: Impoundment I5
COC: WEB
PWS ID:

WorkOrder: S1808308
CollectionDate: 8/14/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	1.7E-8	µCi/g		2.0E-7	OTW01	09/23/2018 1805 MB
Lead 210 Precision (±)	6.0E-7	µCi/g			OTW01	09/23/2018 1805 MB
Radium 226	6.0E-7	µCi/g		2.0E-7	EPA 901.1 Mod.	09/12/2018 1440 WN
Radium 226 Precision (±)	4.0E-7	µCi/g			EPA 901.1 Mod.	09/12/2018 1440 WN
Thorium 230	1.3E-7	µCi/g		2.0E-7	ACW01	10/17/2018 1132 WN
Thorium230 Precision (±)	2.0E-7	µCi/g			ACW01	10/17/2018 1132 WN
Metals - Total						
Uranium	1.6E-8	µCi/g		2.0E-7	EPA 200.8	09/31/2018 1854 MS



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-5245

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 189
Crawford, NE 69339

Date Reported 11/6/2018
Report ID S1808306001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808306-003
ClientSample ID: Stream S2
COC: WEB
PWS ID:

WorkOrder: S1808306
CollectionDate: 8/14/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	1.5E-6	µCi/g		2.0E-7	OTW01	09/23/2018 1805 MB
Lead 210 Precision (±)	6.0E-7	µCi/g			OTW01	09/23/2018 1805 MB
Radium 226	6.0E-7	µCi/g		2.0E-7	EPA 901.1 Mod.	09/12/2018 1540 WN
Radium 226 Precision (±)	2.0E-7	µCi/g			EPA 901.1 Mod.	09/12/2018 1540 WN
Thorium 230	5.0E-7	µCi/g		2.0E-7	ACW01	11/02/2018 813 WN
Thorium230 Precision (±)	2.0E-7	µCi/g			ACW01	11/02/2018 813 WN
Metals - Total						
Uranium	4.0E-7	µCi/g		2.0E-7	EPA 200.8	08/31/2018 1900 MS



Inter-Mountain Labs

Your Environmental Monitoring Partner

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-5245

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 189
Crawford, NE 69339

Date Reported 11/6/2018
Report ID S1808306001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808306-004
ClientSample ID: Stream E1
COC: WEB
PWS ID:

WorkOrder: S1808306
CollectionDate: 8/14/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	1.4E-6	µCi/g		2.0E-7	OTW01	09/23/2018 2013 MB
Lead 210 Precision (±)	6.0E-7	µCi/g			OTW01	09/23/2018 2013 MB
Radium 226	1.1E-6	µCi/g		2.0E-7	EPA 901.1 Mod.	09/12/2018 1817 WN
Radium 226 Precision (±)	4.0E-7	µCi/g			EPA 901.1 Mod.	09/12/2018 1817 WN
Thorium 230	6.0E-7	µCi/g		2.0E-7	ACW01	10/17/2018 1132 WN
Thorium230 Precision (±)	2.0E-7	µCi/g			ACW01	10/17/2018 1132 WN
Metals - Total						
Uranium	1.5E-6	µCi/g		2.0E-7	EPA 200.8	08/31/2018 1906 MS



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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-5945

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported: 11/6/2018
Report ID: S1808306001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808306-005
ClientSample ID: Impoundment 14
COC: WEB
PWS ID:

WorkOrder: S1808306
CollectionDate: 8/14/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	3.3E-8	µCi/g		2.0E-7	OTW01	02/23/2018 2013 MB
Lead 210 Precision (±)	7.0E-7	µCi/g			OTW01	02/23/2018 2013 MB
Radium 226	9.0E-7	µCi/g		2.0E-7	EPA 901.1 Mod.	09/12/2018 1653 WN
Radium 226 Precision (±)	4.0E-7	µCi/g			EPA 901.1 Mod.	02/12/2018 1653 WN
Thorium 230	8.0E-7	µCi/g		2.0E-7	ACW01	10/17/2018 1132 WN
Thorium230 Precision (±)	3.0E-7	µCi/g			ACW01	10/17/2018 1132 WN
Metals - Total						
Uranium	1.6E-6	µCi/g		2.0E-7	EPA 200.8	09/31/2018 1912 MS



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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-5945

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 69339

Date Reported: 11/6/2018
Report ID: S1808306001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808306-006
ClientSample ID: Impoundment 13
COC: WEB
PWS ID:

WorkOrder: S1808306
CollectionDate: 8/14/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	2.9E-8	µCi/g		2.0E-7	OTW01	02/23/2018 2013 MB
Lead 210 Precision (±)	7.0E-7	µCi/g			OTW01	02/23/2018 2013 MB
Radium 226	1.2E-6	µCi/g		2.0E-7	EPA 901.1 Mod.	09/13/2018 809 WN
Radium 226 Precision (±)	3.0E-7	µCi/g			EPA 901.1 Mod.	09/13/2018 809 WN
Thorium 230	3.0E-7	µCi/g		2.0E-7	ACW01	10/17/2018 1132 WN
Thorium230 Precision (±)	2.0E-7	µCi/g			ACW01	10/17/2018 1132 WN
Metals - Total						
Uranium	2.9E-6	µCi/g		2.0E-7	EPA 200.8	09/31/2018 1930 MS



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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 872-5945

Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 68339

Date Reported: 11/6/2018
Report ID: S1808306001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808306-007
ClientSample ID: Stream S5
COC: WEB
PWS ID:

WorkOrder: S1808306
CollectionDate: 8/14/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	7.0E-7	µCi/g		2.0E-7	OTW01	09/23/2018 2013 MB
Lead 210 Precision (±)	8.0E-7	µCi/g			OTW01	09/23/2018 2013 MB
Radium 226	8.0E-7	µCi/g		2.0E-7	EPA 901.1 Mod.	09/13/2018 201 WN
Radium 226 Precision (±)	2.0E-7	µCi/g			EPA 901.1 Mod.	09/13/2018 201 WN
Thorium 230	8.0E-7	µCi/g		2.0E-7	ACW01	10/17/2018 1132 WN
Thorium230 Precision (±)	2.0E-7	µCi/g			ACW01	10/17/2018 1132 WN
Metals - Total						
Uranium	5.0E-7	µCi/g		2.0E-7	EPA 200.8	09/31/2018 1936 MS



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Sample Analysis Report

Company: Cameco Resources, Crow Butte Operation
PO Box 169
Crawford, NE 68339

Date Reported: 11/6/2018
Report ID: S1808306001

ProjectName: Crow Butte Annual Sediment Samples
Lab ID: S1808306-008
ClientSample ID: Stream E-5
COC: WEB
PWS ID:

WorkOrder: S1808306
CollectionDate: 8/14/2018
DateReceived: 8/17/2018 12:55:00 PM
FieldSampler:
Matrix: Sediment

Comments

Analyses	Result	Units	Qual	RL	Method	Date Analyzed/Init
Radionuclides - Total						
Lead 210	2.5E-6	µCi/g		2.0E-7	OTW01	09/23/2018 2013 MB
Lead 210 Precision (±)	8.0E-7	µCi/g			OTW01	09/23/2018 2013 MB
Radium 226	1.4E-6	µCi/g		2.0E-7	EPA 901.1 Mod.	09/13/2018 1019 WN
Radium 226 Precision (±)	3.0E-7	µCi/g			EPA 901.1 Mod.	09/13/2018 1019 WN
Thorium 230	8.0E-7	µCi/g		2.0E-7	ACW01	10/17/2018 1132 WN
Thorium230 Precision (±)	3.0E-7	µCi/g			ACW01	10/17/2018 1132 WN
Metals - Total						
Uranium	7.0E-7	µCi/g		2.0E-7	EPA 200.8	09/31/2018 1942 MS

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers: B Analyte detected in the associated Method Blank
E Value above quantitation range
H Holding times for preparation or analysis exceeded
L Analyzed by another laboratory
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits
X Matrix Effect

C Calculated Value
G Analyzed at IML Gillette laboratory
J Analyte detected below quantitation limits
M Value exceeds Monthly Ave or MCL or is less than LCL
O Outside the Range of Dilutions
U Analysis reported under the reporting limit