Air Ventilation, Air Surveys and Air Exchange Measurements for Plant Facilities at Crow Butte, NE and Smith Ranch, WY

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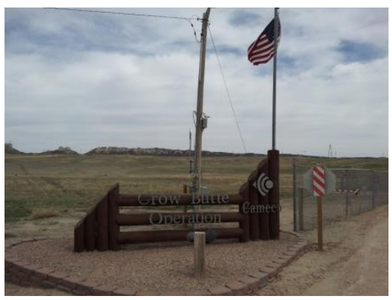

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EXECUTIVE SUMMARY

Airflow measurements were made at Cameco's Crow Butte, NE and the Smith Ranch, WY in-situ leach uranium processing facilities to determine the airflow rate and the air exchange rate for these facilities. Prior to data collection, the facility layouts and configurations were analyzed and a plan was made for conducting physical air measurements and gathering base data to estimate flow rates and air exchange rates for these facilities. These measurements were made at selected points across the openings of the facilities using highly accurate hand-held anemometers, pitot tubes and velometers. Additional flow-rate measurements were calculated using air monitoring instruments and ventilation equipment manufacturer's information. Measurements were based on physical measurements in exhaust vents and stacks. This field data was then reduced and analyzed.

The resulting flow rates for discharges to unrestricted areas and the calculated facility air exchange rates are presented below.

Facility	Flow Rates for Discharges to Unrestricted Areas	Facility Air Exchanges/Hour
Smith Ranch, WY	56,927 cubic feet per minute	5.4
Crow Butte, NE	77,433 cubic feet per minute	4.6

The accuracy of the ventilation numbers reported is estimated at plus-or-minus 15% accuracy. Numerous inputs were considered in this statement of accuracy, such as accuracy of the instruments, accessories and various measuring devices. The range of positioning the garage-style air inlet doors (i.e., were doors open, closed or partially closed) and the resulting effect on air flow was also taken into account.

The multiple exhaust fans at both facilities results in a negative pressure inside each of the facility buildings at Smith Ranch, WY and Crow Butte, NE. In the yellow cake production process, it was noted that areas for potential radon release were enclosed with exhausting ventilation ducting, sheet metal or other material. These enclosures and the negative pressure from the ventilation system design control and mitigate the concentration of radon emissions within each of these facilities.

Airflow, through any openings in vessels or process equipment, is from the process areas into the ventilation systems which maintain the negative pressure, thereby directing any releases from within these facilities to the ventilation exhaust ducting. Any radon emissions within these processes are thereby directed to the ventilation system ducting or fans, which further reduces the radon concentration by the addition of air induced into the ventilation exhaust fans or blowers prior to venting to the atmosphere.

This ventilation design is effective in preventing or mitigating radon releases to the workers and the public.

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1.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) reviewed the gaseous and airborne particulate effluent control systems at the Crow Butte, NE and Smith Ranch, WY facilities. For air particulates related to the vacuum drying of uranium yellow cake, they concluded that Cameco meets all applicable regulatory criteria stated in 10 CFR Parts 20 and 40. With respect to radon, the NRC notes that most of the radon is vented from the process stream via exhaust ventilation that directs the radon to discharge stacks located away from building ventilation intakes. The ventilation system is designed to control worker exposure and to prevent or mitigate releases to the public to prevent or limit radiation exposure. Additional radon releases occurring during operations are infrequent. Thus, the NRC has concluded that Cameco's radon controls are adequate.

Notwithstanding these findings, in the resulting Safety Evaluation Report, the NRC found that Cameco 1) must address the discharge flow rate to the environment and 2) provide information regarding the air flow rate for the redundant exhaust fans and the air exchange rate for each facility. The NRC further noted that 3) Cameco should discuss methods for controlling radon releases. This report details the effort of gathering the requisite data and information to address items 1 through 3 described above.

This report includes measurements of flow rates for discharges to unrestricted areas and the air exchange rate for the facilities, and further describes the method(s) used to control releases to unrestricted areas.

2.0 WORK SCOPE

A portion of this effort included visiting both the Crow Butte and Smith Ranch operations. Additional information was gathered regarding the number of doors and openings to the facilities, the number and configuration of intake and exhaust ducts, the proper placement of air and flow rate measuring instruments in the exhaust stacks and ventilation ducts. Prior to data collection, contacts were made with appropriate Smith Ranch and Crow Butte personnel to more fully define the layout and configuration of these facilities.

A plan was then made for conducting physical air measurements and gathering base data to estimate a range of flow rates and air exchange rates for each of the facilities. These measurements were made at selected points across the openings of the facilities using highly-accurate hand-held anemometers, pitot tubes and velometers.

Cameco noted that during facility operations, the roll-up doors of the facility may be open or closed, depending on a number of factors. Because the exhaust from the facilities is through vents using air-induced blowers and fans, the facilities each have a negative pressure with respect to the outside atmosphere. As a result, radon is vented from process equipment in these facilities and is routed through the ventilation system for emission to the atmosphere at the exhaust stacks. Accordingly, additional air flow measurements were made in exhaust vents and stacks using air instruments, as appropriate. This field data was then reduced and analyzed.

Based on these measurements, Cameco will be able to provide flow rates for discharges to unrestricted areas and air exchange rates for the facilities. This data coupled with the existing and proposed measurements of emission concentrations will provide a technical basis to determine the radiation dose resulting from releases to unrestricted areas.

3.0 FIELD WORK EXECUTION

The following are highlights of the performed work.

3.1 FIELD INSTRUMENTS UTILIZED

A TSE (Alnor) model 9555-P wind vane anemometer and a model 964 Thermal Anemometer (TA) probe were used to make field air flow measurements. Specifications for each instrument are given below:

Table 1 – Instrument Specifications

Instrument	Range/Resolution	Accuracy	Calibration Date	Notes
TSI (Alnor) model 9555-P wind vane anemometer	50 to 6,000 feet per minute/ -1 feet per minute 0.1 degree Fahrenheit	+/- 1% of reading +/- 4 feet per minute (+/- 0.02 meters per minute)	Aug 2012	Next calibration due Aug 2013
Thermal Anemometer probe model number 964	0 to 9,999 feet per minute	+/- 3% of reading	Aug 2012	Next calibration due Aug 2013

Air measurement instruments were field calibrated for barometric pressure and humidity at the respective facilities, using the facilities' nearest weather station, while cross-referencing with the nearest Accuweather® station. The TSI (Alnor) 9555P, with the wind vane anemometer, was the base instrument used as much as practicable, due to its extraordinary accuracy (+/- 1% of readings).

3.2 FIELD WORK – SMITH RANCH, WY

April 25 -26, 2013:

Arlene Faunce, RSO; Beverly Johnson, Sr. HP tech and Plant Superintendent Erik Heide were extremely helpful in facilitating the process of taking air readings at the facility and also conveying information about the facility ventilation, which was critical in completing this field work. Velocity readings and ancillary measurements were taken at the facility.

All velocity readings were taken with the highly accurate Anemometer, except the truck sump fan inlet, where air readings were taken with the Thermal Anemometer (TA) probe due to physical constraints (see Tables 2 and 3 below). Data was gathered for equipment at inaccessible areas from manufacturer name plate data and plant records, which were plentiful at this facility. Air surveys of the plant wall-installed fan inlets were conducted on all lower wall fans. Area determinations were based on measurements taken with a standard Stanley® metal tape measure. Digital photographs were taken at major sampling locations. These photos are located in Appendix A.

The field readings are summarized in Tables 2 and 3. Total flow rate for discharges to unrestricted areas is 56,927 cubic feet per minute (CFM), which is the sum total of the quantities provided in Tables 2 and 3.

Table 2 - Ventilation & Air Readings - Smith Ranch, WY - 4/26/13

Note: Reference Appendix A for photographs of the items listed below				
Location	**Vane (V) or Thermo Anemometer (TA) Readings (fpm)**	**Area (sq ft)**	**Quantity (cfm)**	**Temperature °F**
#1 Lower Fan	V - 1323, 1313, 1377, 1333 $\overline{V}$ = 1337	5.07	6776	71.0
#2 Upper Fan	Down for Maintenance			
#3 Lower Cooler Fan	V - 508, 482, 490, 577, 445, 439, 548, 486, 548, 522, 490, 513, 359, 432, 501, 573, 570, 573 $\overline{V}$ = 503	32.5" x 53" => 12.0 sq ft	6040	71.0
#4 Upper Fan	Down for Maintenance			
#5 Upper Fan	Down for Maintenance			
#6 Lower Fan	V - 1276, 1292, 1307, 1392 $\overline{V}$ = 1317	5.07	6676	71.4
#7 Lower Fan	V- 1026, 1016, 1099, 992, 865, 964, 934, 1019, 1164 $\overline{V}$ = 1009	44.5" x 44.75" => 13.8 sq ft	13900	71.6
Note: #'s 2, 4 & 5 upper vent fans were down for maintenance.				
Sum of Quantities: 33,392 (cfm)				

Table 3 - Ventilation & Air Readings
Information from Manufacturer's Data & Fan Curves
Smith Ranch, WY - 4/26/13

Location	Quantity (cfm)	Temperature °F
Note: Reference Appendix A for photographs of the items listed below		
#8 Upper Fan	3610	68.5
#9 Upper Fan	3610	67.0
A. T106A Fan (HF)	263	71.5
B. T100 Fan (HF)	263	71.0
C. Truck Sump Fan	5000	71.0
D. NE Shaker Fan	5000	72.3
E. SE Shaker Fan	5000	74.3
F. T20 Radon Exhaust Fan	263	71.6
G. T40 Radon Exhaust Fan	263	71.9
H. T21 Radon Exhaust Fan	263	75.3
Sum of Quantities: 23,535 (cfm)		

3.3 FIELD WORK – CROW BUTTE, NE

April 28 -29, 2013:

Meetings were held with Plant Superintendent Bruce Lemmon to facilitate data collection. This ensured the plant was covered adequately. Rhonda Grantham, RSO; Casey Yada, Sr. HP tech, and Plant Superintendent Bruce Lemmon were extremely helpful in facilitating the process of taking air readings at the facility and also conveying information about the facility ventilation, which was critical in completing this field work.

Velocity readings and ancillary physical measurements were taken inside and out of the processing plant at accessible exhaust fans and stacks. Data was gathered at inaccessible areas from manufacturer name plate data and plant records, which were plentiful at this facility.

The TSI (Alnor) 9555P was the base instrument used in these field air measurements with all velocity readings taken with the Vane Anemometer attachment (accuracy +/- 1% of readings). In this plant, there were dozens of manometers (U-tubes) in the vent lines, which were also located and read.

Digital photographs were taken at major sampling locations. These photos are located in Appendix B. The field readings are summarized in Tables 4 and 5 on the following pages. Total flow rate for discharges to unrestricted areas is 77,433 cubic feet per minute (CFM), which is the sum total of the quantities provided in Tables 4 and 5.

Table 4 - Ventilation & Air Readings - Crow Butte, NE - 4/29/13

Note: Reference Appendix B for photographs of the items listed below					
Location	**Vane (V) or Thermo Anemometer (TA) Readings (fpm)**	**Dimensions (inches)**	**Area (sq ft)**	**Quantity (cfm)**	**Temperature °F**
#1 Pipe	V - 2952 (centerline) 3200, 2872, 2876, 3029 $\overline{V}$ = 2994	23.75" diam	3.076	9209	63.2
#2 Pipe	V - 3389 (centerline) 3200, 3595, 3740, 3046 $\overline{V}$ = 3395	22.75" diam	2.83	9610	62.4
#3 Boxed Fan	V - 574, 689, 818, 756, 930, 730, 427, 578, 818, 619, 818, 803, 656, 837, 678, 1027, 788, 780 $\overline{V}$ = 740	36.5" by 36.5" by 11" box	9.25	6845	63.0
#4 Boxed Fan	V- 634, 864, 652, 666, 709, 754, 786, 506, 490, 665, 903, 566, 710, 671, 776, 521, 487, 490 $\overline{V}$ = 658	36.5" by 36.5" by 11" box	9.25	6090	63.0
#5 Duct	V- 3369 (centerline) 3572, 2579, 2830, 3214 $\overline{V}$ = 3049	24.5" diam	3.22	9820	66.5
#9 Box Fan	V- 670, 636, 433, 602, 780, 654, 592, 672, 672, 785, 579, 691, 485, 666, 670, 212, 616, 378, 669, 482 $\overline{V}$ = 597	36.5" by 36.5" by 14" box	9.25	5523	63.9
#12 Shaker Room Blower/Exhaust	V - 3111 (centerline)	12.5" diam 0.85	0.85	2651	49.0
Sum of Quantities: 49,748 (cfm)					

Table 5 - Ventilation & Air Information from Manufacturer's Data
Crow Butte, NE - 4/29/13

Note: Reference Appendix B for photographs of the items listed below		
Location	**Quantity (cfm)**	**Temperature °F**
#6 Centifugal Pond Water Treatment Fan	4700	67.0
#7 Chem Mix Demister Fan	4700	66.1
#8 Waste Tank Blower	1500	66.1
#10 Precip Demister Fan (same unit as #8 above)	1500	62.0
#11 Shaker Deck (west)	800	63.9
#13 Eluent Tank Blower	1500	67.8
#14 Precip A Blower	185	67.8
#15 East Train Blower	6000	71.3
#16 West Tank Blower	6000	72.0
#17 Backwash Tank Demister Blower	800	70.5
Sum of Quantities: 27,685 (cfm)		

4.0 DISCUSSION AND ANALYSIS OF FIELD DATA

There are large roll-up, garage style doors at both the Smith Ranch, WY and Crow Butte, NE plant facilities. Typically, these doors have openings measuring 12' wide by 16' high. During operations at the facilities these roll-up doors may be positioned fully opened, partially opened and sometimes fully closed. On a particular day, this positioning of the doors may change for a number of reasons, like opening/closing doors for retrieval of resin, deliveries, facility temperature control and general personnel/equipment access.

Field air velocity measurements were taken at both plant facilities to determine the effect of air flow with the opening and closing of the garage style roll-up doors. As the doors were moved to various positions, it was noted that air velocity (and also air flow) measurements did not vary more than approximately 10%, which is comparable to typical variations in air flow operation over the course of time. This field data shows that when the roll-up doors were closed there were alternate and adequately-sized openings for air flow to continue. These openings include louvers, vents, doors and other openings that allowed air flow.

Field air measurements confirmed that the facilities have an effective ventilation design and control system consisting of parallel installations of multiple blowers and fans that exhaust air from the facilities. The configuration of intake and exhaust ducts is adequate with respect to their opening size and location. The air intakes of the facilities are located such that the intake ducts intake fresh air, well away from the plant air exhausts, so air recirculation was not an issue.

The multiple exhaust fans at both facilities results in a negative pressure inside each of the facility buildings at Smith Ranch, WY and Crow Butte, NE. Airflow, through any openings in vessels or process equipment, is from the process areas into the ventilation systems, which maintains negative pressure, positive flow and control of releases. Negative pressure vacuum dryers are used to contain and control radon emissions, which are then reduced in concentration by the induced air flow within the ventilation exhaust system and vented to the atmosphere. These vacuum dryers are much more effective in radon control compared with the former hearth style of dryer design. At each of these two facility buildings, there were 17 blowers or exhaust fans which exhaust air from facility process areas. The ventilation systems at both of these facilities exhaust to outside the facility buildings and draw in fresh air from a location at a sufficient distance from the exhaust locations. This design minimizes recirculation of the fresh air ventilation system and help control potential releases. The field data and measurements of these 34 blowers or exhaust fans are shown in Section 3.0 of this report.

This negative pressure present in the facilities is a control feature for radon emissions. In the yellow cake production process, it was noted that points for potential radon release were enclosed with exhaust ventilation ducting, sheet metal or other items to contain and direct radon emissions to the exhaust ventilation system where possible. Accordingly, radon emissions are controlled where possible within these facilities and their concentrations are reduced by the induced air flow from the ventilation exhaust fans or blowers, and vented to the atmosphere.

Based on the physical measurements taken in the field, the air exchange rates for the two facilities are presented in the following table:

Table 6 – Facility Air Exchanges

Facility	Air Exchanges / Day	Air Exchanges / Hour
Smith Ranch, WY	129	5.4
Crow Butte, NE	111	4.6

An additional objective of the field work was to provide flow rates for discharges to unrestricted areas. These flow rates, for the Smith Ranch, WY and Crow Butte, NE plant facilities are presented in the following table:

Table 7 - Flow Rates for Discharges to Unrestricted Areas

Facility	Flow Rates for Discharges to Unrestricted Areas	Facility Volume
Smith Ranch, WY	56,927 cubic feet per minute	632,050 cubic feet
Crow Butte, NE	77,433 cubic feet per minute	1,000,565 cubic feet

5.0 CONCLUSIONS

Field air measurements and data were taken and air volumes calculated for the Smith Ranch, WY and Crow Butte, NE plant facilities. The discharge flow rate to the environment at the two Cameco facilities was calculated utilizing direct field measurements and data taken at the facility.

Facility	Flow Rates for Discharges to Unrestricted Areas	Facility Volume
Smith Ranch, WY	56,927 cubic feet per minute	632,050 cubic feet
Crow Butte, NE	77,433 cubic feet per minute	1,000,565 cubic feet

The air exchange rate for the facility was calculated utilizing field data review and analysis.

Facility	Air Exchanges / Day	Air Exchanges / Hour
Smith Ranch, WY	129	5.4
Crow Butte, NE	111	4.6

The accuracy of the ventilation numbers reported is estimated plus-or-minus 15% accuracy. Numerous inputs were considered in this estimated range, such as accuracy of the instruments, accessories and various measuring devices. Also the range of positioning of the garage-style air inlet doors (i.e., if the doors were open, closed or partially closed) and its effect on air flow was also taken into account to estimate the accuracy of the presented ventilation numbers.

The multiple exhaust fans at both facilities results in a negative pressure inside each of the facility buildings at Smith Ranch, WY and Crow Butte, NE. In the yellow cake production process, it was noted that points for potential radon release were enclosed with exhausting ventilation ducting, sheet metal or other material. Radon emissions were contained and their concentrations were reduced. Airflow, through any openings in vessels or process equipment, is from the process areas into the ventilation systems thus maintaining negative pressure and positive flow inside the ventilation system and controlling releases. Radon emissions are typically controlled and their concentrations are reduced by the induced air flow from ventilation exhaust fans or blowers, and vented to the atmosphere. This general design was found to be effective in preventing or mitigating radon releases to the public.