Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 21-H104.1

File/dossier : 6.01.07
Date : 2020-10-27
e-Docs pdf : 6565407

Written submission from Saskatchewan Research Council

Mémoire du Saskatchewan Research Council

In the Matter of

À l'égard de

Application for a licence to abandon the SLOWPOKE-2 reactor facility

Demande d'un permis d'abandon à l'égard de l'installation du réacteur SLOWPOKE-2

Public Hearing - Hearing in writing based on written submissions

Audience Publique - Audience fondée sur des mémoires

July 2021

July 2021

Canada

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October 27, 2020

Mr. Pierre Tanguay
Senior Project Officer, Nuclear Processing Facilities Division
Canadian Nuclear Safety Commission
280 Slater Street
PO Box 1046, Station B
Ottawa, Ontario KIP 5S9

Re: Application for the Licence to Abandon the Saskatchewan Research Council SLOWPOKE-2 Facility (SRCSF).

The Saskatchewan Research Council SLOWPOKE-2 Facility (SRCSF) has a Non-Power Reactor Operating Licence, NPROL-19.01/2023 which is valid until June 30, 2023. The Canadian Nuclear Safety Commission (CNSC) held a hearing September 26, 2019 to consider an application from the Saskatchewan Research Council (SRC) to amend its Non-Power Reactor Operating Licence for its SLOWPOKE-2 non-power reactor and associated facilities. Following the deliberations and decision of the Commission on this matter, the Commission issued a licence amendment to allow for the decommissioning of the SRCSF.

The Decommissioning of SRCSF is now complete. This letter requests that a licence to Abandon the SRCSF be issued and that the NPROL-19.01/2023 in place at that time be revoked on the date the Licence to Abandon the SRCSF becomes effective. The proposed start date for the Licence to Abandon is March 1, 2021. This Application for a Licence to Abandon the SRCSF includes the following attachments:

a) Attachment 1, which shows how each of the requirements of the Nuclear Safety and Control Act and Regulations are addressed in the Application and in the licensing support documents referenced in the Application; and

b) Attachment 2, which, together with the licensing support documents referenced in it, provides the detailed information to address the requirements identified in Attachment 1.

The Decommissioning - End State Report will be submitted to the CNSC by November 6, 2020. If you have any comments or questions with regard to our requests or to the attached documents please do not hesitate to contact us.

Yours sincerely,

Mike Crabtree, President & CEO

Attachments:
1. Application for the Licence to Abandon SRCSF - Attachment 1.

2. Application for the Licence to Abandon SRCSF-Attachment 2.

Attachment 1 to the Letter to
xxx, October 2020
RE: Application for the Licence to Abandon SRCSF

Saskatchewan Research Council
Application for the Licence to Abandon SRCSF – Attachment 1

CNSC Document and associated Requirements	Section of the Application (Attachment 2) addressing the requirement	SRCSF Decommissioning Project Support Document (Note: If edition, date or revision number is not specifically mentioned below, the documents applicable to the SRCSF decommissioning project will at the latest revision issued as "approved for use".)
General Nuclear Safety and Control Regulations		
3. (1) An application for a licence shall contain the following information:		
(a) the applicant's name and business address;	A.1	- N/A
(b) the activity to be licensed and its purpose;	C	- N/A
(c) the name, maximum quantity and form of any nuclear substance to be encompassed by the licence;	B.3	- No nuclear substances beyond exemption levels will be present within the boundaries of the SRCSF as will be confirmed by the results of the final radiological survey presented in Section 7 of the End State Report, 147-01600-ESDR-002.
(d) a description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence;	B.2	- No nuclear facility, prescribed equipment or prescribed information will be present within the boundaries of SRCSF as will be confirmed by the Section 2 of End State Report , 147-01600-ESDR-002 which will provide the facility description including the identification of the materials, equipment and premises released/cleared from regulatory control

CNSC Document and associated Requirements	Section of the Application (Attachment 2) addressing the requirement	SRCSF Decommissioning Project Support Document (Note: If edition, date or revision number is not specifically mentioned below, the documents applicable to the SRCSF decommissioning project will at the latest revision issued as "approved for use".)
(e) the proposed measures to ensure compliance with the *Radiation Protection Regulations*, the *Nuclear Security Regulations and the Packaging and Transport of Nuclear Substances Regulations, 2015;*	E.1 F	- No measures to ensure compliance with Radiation Protection Regulations or Nuclear Security Regulations are required for the purpose of the Licence to Abandon the SRCSF. The radiological condition of the facility will be presented in Section 7 of the End State Report, 147-01600-ESDR-002.
(f) any proposed action level for the purpose of section 6 of the *Radiation Protection Regulations;*	E.1	- None
(g) the proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information;	F	- None
(h) the proposed measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information;	F	- None
(i) a description and the results of any test, analysis or calculation performed to substantiate the information included in the application;	G	- Environmental Impact Statement- Saskatchewan Research Council SLOWPOKE-2 Reactor Decommissioning, Version 3.0, Matrix Solutions document, April 2019. - End-State Decommissioning Report, Candu Energy Document 147-01600-ESDR-002

CNSC Document and associated Requirements	Section of the Application (Attachment 2) addressing the requirement	SRCSF Decommissioning Project Support Document (Note: If edition, date or revision number is not specifically mentioned below, the documents applicable to the SRCSF decommissioning project will at the latest revision issued as "approved for use".)
(j) the name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activity to be licenced, including waste that may be stored, managed, processed or disposed of at the site of the activity to be licenced, and the proposed method for managing and disposing of that waste;	B.4	- All nuclear and hazardous waste has been disposed of, and no waste is stored within the boundaries of SRCSF at this time or at the time of Abandonment. This will be presented in the Section 9 of the End State Report, 147-01600-ESDR-002.
(k) the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the Act and the regulations made under the Act, including the internal allocation of functions, responsibilities and authority;	A.2	- None
(l) a description of any proposed financial guarantee relating to the activity to be licenced	H	- None

CNSC Document and associated Requirements	Section of the Application (Attachment 2) addressing the requirement	SRCSF Decommissioning Project Support Document (Note: If edition, date or revision number is not specifically mentioned below, the documents applicable to the SRCSF decommissioning project will at the latest revision issued as "approved for use".)
(m)any other information required by the Act or the regulations made under the Act for the activity to be licenced and the nuclear substance, nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence; and	None	- None
(n) – Repealed by SOR/2008-119, s.2 (1.1) The Commission or a designated officer authorized under paragraph 37(2)(c) of the act may require any other information that is necessary to enable the Commission or the designated officer to determine whether the applicant (i) is qualified to carry on the activity to be licenced, or (ii) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national	N/A	- N/A

CNSC Document and associated Requirements	Section of the Application (Attachment 2) addressing the requirement	SRCSF Decommissioning Project Support Document (Note: If edition, date or revision number is not specifically mentioned below, the documents applicable to the SRCSF decommissioning project will at the latest revision issued as "approved for use".)
security and measures required to implement international obligations to which Canada has agreed. **(2)** Subsection (1) does not apply in respect of an application for a licence to import or export for which the information requirements are prescribed by the *Nuclear Non-Proliferation Import and Export Control Regulations*, or in respect of an application for a licence to transport while in transit for which the information requirements are prescribed by the *Packaging and Transport of Nuclear Substances Regulations, 2015*. SOR/2008-119, s. 2; SOR/2015-145, s. 43.		

CNSC Document and associated Requirements	Section of the Application (Attachment 2) addressing the requirement	SRCSF Decommissioning Project Support Document (Note: If edition, date or revision number is not specifically mentioned below, the documents applicable to the SRCSF decommissioning project will at the latest revision issued as "approved for use".)
Application for Licence to Abandon		
4 An application for a licence to abandon a nuclear substance, a nuclear facility, prescribed equipment or prescribed information shall contain the following information in addition to the information required by section 3:		
(a) the name and location of the land, buildings, structures, components and equipment that are to be abandoned;	B.1	- End-State Decommissioning Report, Candu Energy Document 147-01600-ESDR-002, Section 2.
(b) the proposed time and location of the abandonment;	B.5	- N/A
(c) the proposed method of and procedure for abandonment; and	C	- N/A
(d) the effects on the environment and the health and safety of persons that may result from the abandonment, and the measures that will be taken to prevent or mitigate those effects.	E.2	- End-State Decommissioning Report, Candu Energy Document 147-01600-ESDR-002, Section 7.

CNSC Document and associated Requirements	Section of the Application (Attachment 2) addressing the requirement	SRCSF Decommissioning Project Support Document (Note: If edition, date or revision number is not specifically mentioned below, the documents applicable to the SRCSF decommissioning project will at the latest revision issued as "approved for use".)
Class 1 Nuclear Facility Regulations		
8 An application for a licence to abandon a Class I nuclear facility shall contain the following information in addition to the information required by sections 3 and 4 of the *General Nuclear Safety and Control Regulations*:		
(a) the results of the decommissioning; and	D	- End-State Decommissioning Report, Candu Energy Document 147-01600-ESDR-002, Sections 3, 5, 7, 9 and 10.
(b) the results of the environmental monitoring programs.	E.3	The radiological condition of the facility will be presented in the Section 7 of the End-State Decommissioning Report, Candu Energy Document 147-01600-ESDR-002. No environmental monitoring activities are necessary for the purposes of Licence to Abandon SRCSF.

Attachment 2 to the Letter to
xth October 2020
RE: Application for the Licence to Abandon SRCSF

SASKATCHEWAN RESEARCH COUNCIL
APPLICATION FOR THE LICENCE TO ABANDON THE SASKATCHEWAN RESEARCH COUNCIL SLOWPOKE-2 FACILITY (SRCSF) – ATTACHMENT 2

OCTOBER 2020

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Attachment 2 to the Letter to
xth October 2020
RE: Application for the Licence to Abandon SRCSF

A. DATA ABOUT THE APPLICANT

A.1 Applicant's Name and Business Address

Applicant's Full Name: The Saskatchewan Research Council

Head Office Address:
125-15 Innovation Boulevard
Saskatoon, Saskatchewan
S7N 2X8

Business Address:
125-15 Innovation Boulevard
Saskatoon, Saskatchewan
S7N 2X8

Saskatchewan Research Council (SRC) SLOWPOKE-2 Physical Location:
SRC Environmental Analytical Laboratories

Address:
102 - 422 Downey Road,
Saskatoon, Saskatchewan S7N 4N1

SRC Facility Manager's Address:
Philip Rees
CSO & Facilities Manager
Saskatchewan Research Council
125 - 15 Innovation Boulevard
Saskatoon, SK, Canada S7N 2X8
Voice: +1.306.385.4024
Philip.Rees@src.sk.ca

A.2 Applicant's Organizational Structure

The end state objective of decommissioning activities is to achieve conditions that will allow the return of areas occupied by the **Saskatchewan Research Council SLOWPOKE-2 Facility** (SRCSF) to unrestricted use, as will be presented in Section 3 of the End State Report (Reference [1]).

At the completion of the decommissioning activities the reactor core and the radioactive hazardous waste have been removed from the SRCSF and no prescribed equipment, prescribed information or nuclear substances beyond clearance levels (Reference [1]) are present within the boundaries of the SRCSF. SRC plans to terminate the long-term lease agreement and return the building possession to SPM (Saskatchewan Property Management) after the completion of the decommissioning work and issuance of the Licence to Abandon by the CNSC, allowing unrestricted use of the space occupied by the facility. There was no change in the foot print of the building during the decommissioning work. The SRC President and CEO, has the responsibility for the oversight of administration of the space occupied by SRCSF.

B. DATA ABOUT THE FACILITY, NUCLEAR SUBSTANCES, NUCLEAR AND HAZARDOUS WASTE, PRESCRIBED EQUIPMENT, AND PRESCRIBED INFORMATION TO BE ABANDONED

B.1 Location of Land, Buildings and Structures

The SRCSF is located in the Innovation Place Research Park in Saskatoon and the building that houses the facility was one of the first buildings constructed in the Research Park in 1980. The Research Park is home to a number of applied research facilities engaged in the development of industrial and agricultural products and processes.

The South Saskatchewan River runs on the west side 0.7km. The Yellow Head Highway (Hwy 16) runs approximately 0.7km on the east and 1.0km on the north side. College Drive (local Hwy 5) runs 1.1km on the south side. There is no residential area within this envelope. The closest residential area is 0.8km on the east side beyond the Hwy 16. The map of the local area is presented in Figure B-1.

The SRC SLOWPOKE-2 reactor resides in the SRC Environmental Analytical Laboratories which is located on 422 Downey Road in the Innovation Place Research Park in Saskatoon, SK. The land at the Innovation Place Research Park is owned by the University of Saskatchewan, it has been leased on long term basis to SOCO (Saskatchewan Opportunities Corporation) and SPM in order to establish a Research Park. The building that houses SRCSF (422 Downey Road) is owned, operated and maintained by SPM and SRC is under a long term leased agreement. The layout of SRC buildings is shown in Figure B-2. The floor plan of the Analytical Laboratories in presented in Figure B-3 which also shows the space occupied by the SRCSF.

B.2 Description of Facility, Components and Equipment

The SRCSF consists of 4 rooms as shown in Figure B-4. The description, room numbers and sizes are:

1. Room143, uranium analysis laboratory (5.85m x 5.85m)
2. Room 144, gamma spectroscopy laboratory (5.85m x 5.85m)
3. Room 145, radioactive storage room (2.25m x 5.85m)
4. Room 146, reactor room (9.6m x 5.85m)

The only entrance to the SRCSF is through the double doors leading from the Radiochemistry Laboratory (Room 139) see Figure B-3, into the Room 143. The entrance to the reactor room (Room 146), in only through the Room 143. All walls of the Room 146 (reactor room) are a minimum of 20 cm masonry construction. The floor is an on-grade concrete slab with no crawl space below. The roof over the Room 146 (reactor room) is a heavy gauge steel. The radioactive samples were stored in the Room 145 and the gamma spectroscopy was performed in the Room 144. The total floor area of SRCSF is 137.5m^2 and the Room 146 (reactor room) occupies 55.7m^2. The ceiling height of Room 146 (reactor room) is 3.4m. There is an additional space between the ceiling tiles and the hard ceiling is an additional 0.6m for a total of 4.0m. The concrete floors are covered with linoleum tiles throughout the facility.

The SRC Analytical building that houses the SRCSF was occupied by 70 staff. The space has been vacated with the relocation of the Environmental Analytical Laboratory. There was one building technician on site in this space during the regular work days. Rooms 140, 141, 142.1 and 142.2 (Figure B-3) have also been vacated.

In an adjoining, but completely separate section of SRC Analytical building, the Potash Corporation of Saskatchewan has a pilot plant operation. It is located on the (west of Rooms 122, 123 and 124, see Figure B-3). North of SRC Analytical (Figure B-2), there is a parking lot and the Innovation Place Atrium building that houses offices and research laboratories for several tenants of the Research Park including some SRC facilities. Immediately south of the building is a roadway (Downey Road). There is a parking lot across the roadway and a building that houses offices and laboratories for tenants of the Research Park.

A detailed description of the SRCSF at the completion of decommissioning activities will be provided in Section 2 of Reference [1].

B.3 Nuclear Substances, Prescribed Equipment and Prescribed Information

No prescribed equipment, prescribed information or nuclear substances beyond clearance levels will be present in the SRCSF at the time of abandonment.

The reactor core and other radioactive and hazardous waste have been removed and sent to other licensed facilities.

The SRCSF will be confirmed to be free of contamination, below the allowable IAEA clearance levels as will be presented in Section 4 of the End State Report (Reference [1]).

A systematic final status survey was performed in the reactor pool, in the exhaust ventilation system, and in the facility rooms affected by decommissioning work to verify that no residual contamination, beyond the clearance levels, is present following the decommissioning activities. The surveys were performed to verify that decommissioning activities have not resulted in radioactive contamination being spread to other areas of the facility, and to ensure that those areas which had originally contained radiological materials were within the accepted release limits. The absence of any contamination within the facility confirmed that the measures taken to decontaminate and survey all items leaving the facility were fully effective in eliminating the spread of radioactive contamination. The results of both surveys will be included in Section 7 of the End State Report (Reference [1]). The results will demonstrate that all the structures, equipment and components remaining within the boundaries of the SRCSF meet the clearance level criteria and that the SRCSF is in a state to be released for unrestricted use.

B.4 Nuclear and Hazardous Waste

The name, quantity, form, origin and the volume of the waste resulting from the decommissioning process, including the final destinations will be presented in Section 9 of the End State Report (Reference [1]).

All waste has been disposed of, and no waste will be stored within the boundaries of the SRCSF at the time of abandonment. Therefore no waste management process is required for the scope of this Licence.

B.5 Proposed Time and Location of Abandonment

The proposed time for the abandonment of the SRCSF and the release of the rooms Room143, Room 144, Room 145, Room 146 in building that houses SRCSF (422 Downey Road) in the SRC Environmental Analytical Laboratories for use of the landlord SPM is March, 2021, subject to CNSC's issuance of the Licence to Abandon.

Figure B-1 Aerial View of the SRC Environmental Analytical Laboratories

Figure B-2 Location of Reactor and SRC Building in the Innovation Park

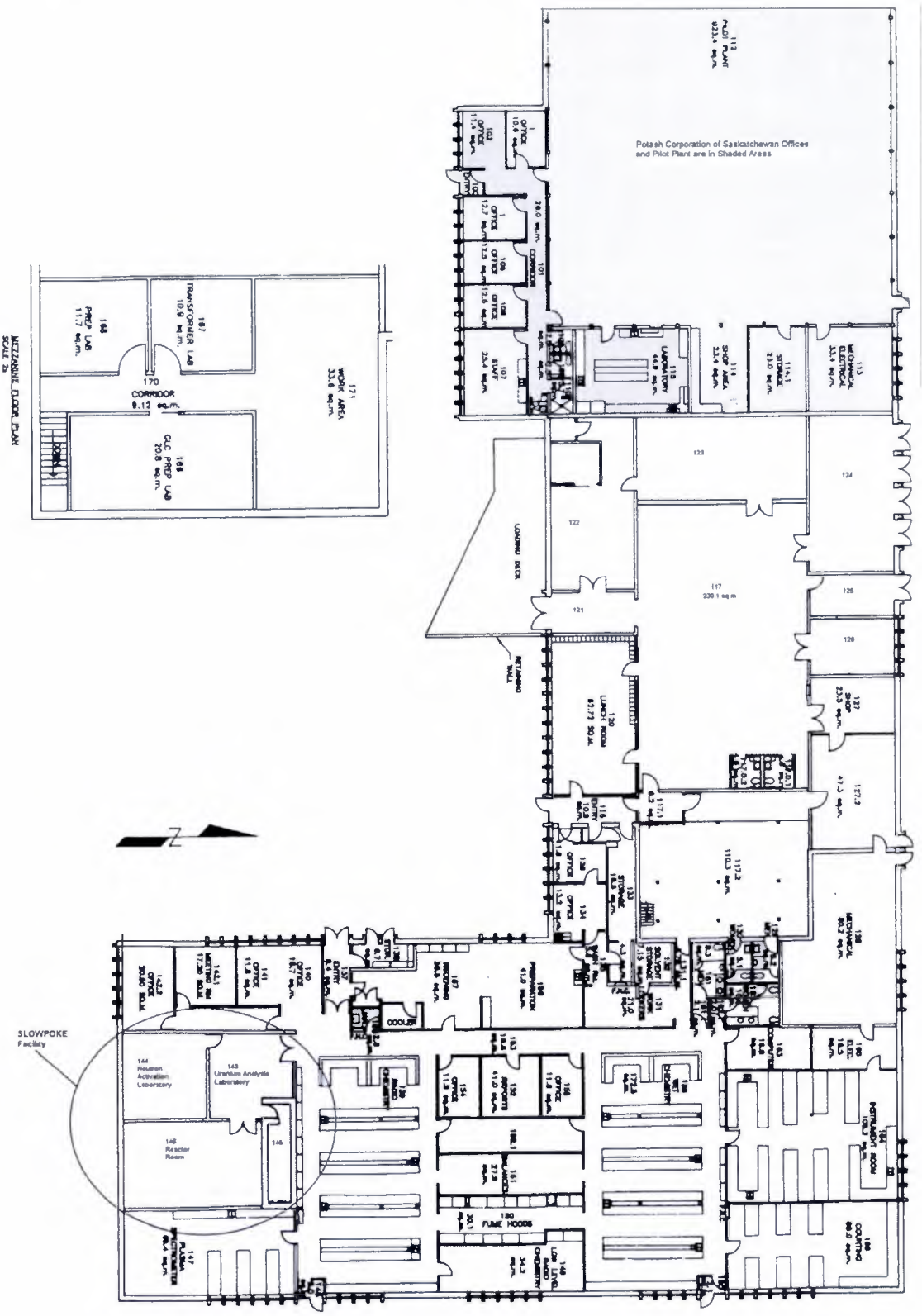

Figure B-3 SRC Analytical Floor Plan

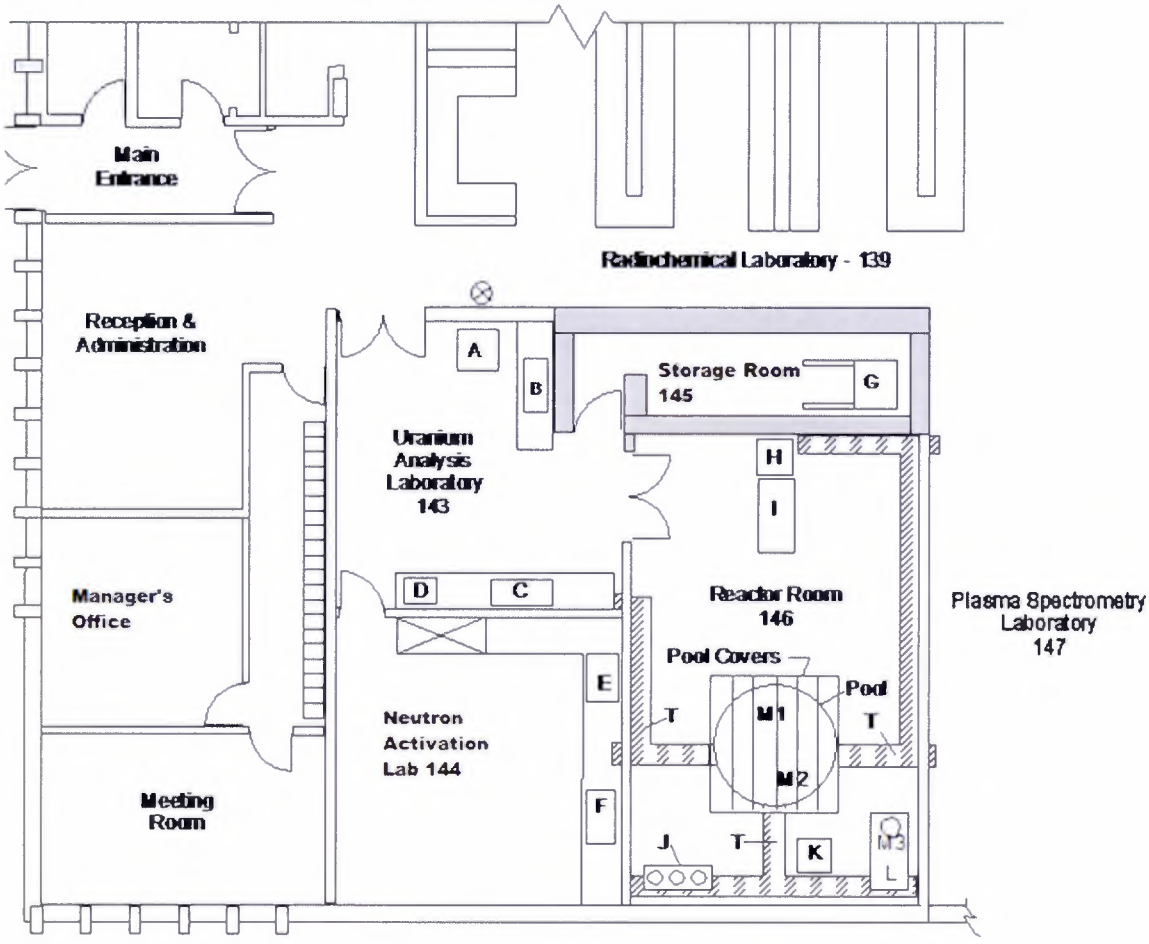

Figure B-4 Layout of SRCSF Reactor Room and Associated Labs

C. ACTIVITIES TO BE LICENCED

This application is for the Licence to Abandon the SRCSF as described in Section 0. At this time the reactor core and the radioactive and the hazardous waste have been removed from the SRCSF and the reactor rooms and the reactor pool has been cleaned and surveyed to ensure that no radioactive products are present above the clearance levels, as will be documented in Section 7 of the End State Report. No licensed activities will be conducted under the license to Abandon the SRCSF.

The proposed effective date for the Licence to Abandon the SRCSF is March 1, 2021.

D. DECOMMISSIONING RESULTS

The results of the decommissioning activities will be presented in the End State Report (Reference [1]), which will be structured as follows:

- Section 1 – will provide an introduction/overview of the report;
- Section 2 – will provide the facility description including the identification of the materials, equipment and premises released/cleared from regulatory control
- Section 3 – will provide the description of the objectives of the decommissioning and the extent to which this objective will have been reached at the completion of the decommissioning activities;
- Section 4 – will provide the radiological criteria used as the basis for the release of equipment, buildings or structures or areas from regulatory control;
- Section 5 – will provide brief descriptions of the major decommissioning activities;
- Section 6 – will identify the institutional controls to remain in place at the facility, if applicable;
- Section 7 – will provide a summary of the final radiological condition of any remaining equipment, structures, or areas, with reference to the final radiological survey report;
- Section 8 – will provide the list of structures, areas, and equipment designated for restricted use, if any, including any requirements for further monitoring, if applicable;
- Section 9 – will provide descriptions of waste quantities and disposition methods;
- Section 10 will provide a summary of the radiological doses received by workers during the decommissioning activities, including a comparison of the actual doses received with the initial estimates;
- Section 11 – will provide a summary of any abnormal events or incidents occurred during the decommissioning process, as applicable; and
- Section 12 – will provide a discussion of the lessons learned during the decommissioning process.

E. RADIATION PROTECTION AND RESULTS OF ENVIRONMENTAL MONITORING PROGRAMS

E.1 Radiation Protection Plan and Action Levels

At this time and at the time of abandonment the reactor core and the radioactive hazardous waste have been removed from the SRCSF and have been sent to other licensed facilities. The reactor rooms and the reactor pool have been cleaned and surveyed as will be documented in the Section 7 of the End State Report (Reference [1]). The radiological doses received by the workers during execution of the decommissioning activities will be reported in the Section 10 of the End State Report.

No other measures to ensure compliance with the *Radiation Protection Regulations* or the *Nuclear Security Regulations* are needed and no action levels, as defined in Section 6 of the *Radiation Protection Regulations*, are required for the purpose of the Licence to Abandon the SRCSF.

E.2 Effects on Environment

An Environment Impact statement (EIS) was produced for the SRCSF Decommissioning (Reference [2]). The following conclusions were made in the Environmental Impact Statement:

- This is a low risk project, as this project drew on experiences gained from other similar projects like University of Alberta and Dalhousie University.
- SRCSF decommissioning, uses the same methodology (as used in University of Alberta and Dalhousie University) for the same type of SLOWPOKE facility.
- This project uses experienced personnel with prior experience decommissioning a similar type of reactor.
- Potential of releases of contaminants to the environment low and no residual adverse effects are expected.
- The decommissioning process has very little impact on surrounding natural and social environment.
- There is no need to modify the surrounding building during decommissioning and no need to change the surrounding natural environment
- Reactor components can be easily removed from the building and directly shipped for disposal.
- The only substantive impact on the environment would be from accidental release of radioactive material during transportation. The risk and impact of such an accident will be reduced by using the appropriate packaging and adhering to applicable transport and security regulations.

Note: As on date of writing this application, the radioactive material have been transported to their final destination safely, without incidents and adhering to the applicable transport and security regulations.

- Adequate provision is being made for protection of workers, the public, and for the protection of the environment. The potential risk to workers, the public, and the environment is assessed taking into consideration normal operating conditions, malfunctions, and the potential for accidents.

Furthermore, as part of CNSC review and Commissions hearing on September 29, 2019 regarding decommissioning of SRCSF the following conclusions were made:

- SRC's environmental protection programs and compliance verification activities (e.g., inspections) continue to meet CNSC regulatory requirements.
- CNSC reviewed the Detailed Decommissioning Plan (DDP) and EIS prepared for the decommissioning of the SRC's SLOWPOKE-2 reactor project and found them to be satisfactory to meet CNSC requirements.
- SRC has and will continue to make adequate provision for the protection of the environment and the health of persons.
- The Commission examined SRC's environmental protection programs at the SRCSF, it concluded that the "The Commission is satisfied that the SRCSF environmental protection programs continue to meet the specifications of REGDOC-2.9.1".

At the completion of the SRCSF decommissioning, the contaminated equipment and other nuclear and non-nuclear components have been removed from the SRCSF. The End State (Reference [1]) of SRCSF will be documented. No nuclear substances beyond the clearance levels as defined in the IAEA safety guide, *Application of the Concepts of Exclusion, Exemption and Clearance*, RS-G-1.7 and the unconditional clearance levels as specified in the Schedule 2 of the CNSC's *Nuclear Substances and Radiation Devices Regulations* are present within the boundaries of SRCSF.

No effects on the environment and on the health and safety of persons are anticipated in regard to the abandonment of the SRCSF. Therefore, no measures need to be taken after the abandonment of the SRCSF.

E.3 Results of the Environmental Monitoring Program

Measurements of indoor air quality and water quality were conducted during the decommissioning. The water released from the SRCSF met the release criteria accepted by the CNSC and the City of Saskatoon, as will be documented in the End Sate Report. The results of the monitoring activities will be provided in Section 7 of the End State Report. No environmental monitoring is required for the purpose of the Licence to Abandon SRCSF.

F. PHYSICAL PROTECTION/SECURITY

For the purposes of the decommissioning activities a site security plan was submitted to the CNSC. After the completion of decommissioning activities, the reactor core and the radioactive and the hazardous waste have been removed from SRCSF. No prescribed equipment, prescribed information or nuclear substances beyond clearance levels are present within the boundaries of SRCSF.

No specific measures to control the access to the site or to prevent the loss or illegal use, possession or removal of nuclear substances, prescribed equipment or prescribed information will be required for the abandonment of SRCSF.

G. ANALYSIS REPORTS/TECHNICAL REPORTS

The technical documents that provide the evaluations and the results of the decommissioning activities and the supporting information regarding the abandonment and the return to unrestricted use of SRCSF:

- Environmental Impact Statement- Saskatchewan Research Council SLOWPOKE-2 Reactor Decommissioning, Version 3.0, Matrix Solutions document, April 2019.
- End-State Decommissioning Report, Candu Energy Document 147-01600-ESDR-002 (to be issued)

The results and conclusions of these technical documents are presented in various sections of this application. References to the relevant sections of these technical reports are made to identify the source of information provided throughout this application.

H. FINANCIAL GUARANTEE

No expenses are anticipated with regard to the abandonment of SRCSF and no financial guarantee is required for the Licence to Abandon the SRCSF.

I. REFERENCES

[1] End-State Decommissioning Report, Candu Energy Document #147-01600-ESDR-002 (to be issued).

[2] Environmental Impact Statement- Saskatchewan Research Council SLOWPOKE-2 Reactor Decommissioning, Version 3.0, Matrix Solutions document, April 2019.

SNC·LAVALIN

Document Number	Revision
147-01600-ESDR-002	0

Nuclear Project Number	Contract Number	Page
655352	255905	1

Customer Document Number	Customer Name
	SASKATCHEWAN RESEARCH COUNCIL (SRC)

Title:

END STATE DECOMMISSIONING REPORT FOR SRC SLOWPOKE-2 FACILITY

Project: **CANDU Services**

655352	255905		APPROVED FOR USE	2020/10/28
FINANCIAL PROJECT NO	CONTRACT NO	CHANGE ORDER	DESCRIPTION	RELEASE DATE

SNC·LAVALIN

Document Number	Revision
147-01600-ESDR-002	0

Nuclear Project Number	Contract Number	Page
655352	255905	2

Customer Document Number	Customer Name
	SASKATCHEWAN RESEARCH COUNCIL (SRC)

Title:

END STATE DECOMMISSIONING REPORT FOR SRC SLOWPOKE-2 FACILITY

Project: **CANDU Services**

Prepared by [redacted]

Reviewed by [redacted]

Approved by [redacted]

SNC·LAVALIN

		Doc#:	147-01600-ESDR-002	Rev:	0
Nuclear Project#:	655352	Contract#:	255095	Page:	3 of 201
Customer Doc#:		Customer:	Saskatchewan Research Council (SRC)		
Title:	END STATE DECOMMISSIONING REPORT FOR SRC SLOWPOKE-2 FACILITY				

Revision History

Ref. Procedure NU-907020-PRO-001

For Release Information, refer to the Document Transmittal Sheet accompanying this document.

Revision History

Revision No	Revision Date (yyyy/mm/dd)	Details of Rev.	Prepared By	Reviewed By	Approved By
D1	2020/10/13	Issued for Internal "Review and Comment"	[redacted]		
D2	2020/10/19	Issued for External "Review and Comment"			
0	2020/10/21	Issued as "Approved for Use"			

TERMS AND ABBREVIATIONS

BV Labs	Bureau Veritas Laboratories
Candu	Candu Energy Inc.
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DDP	Detailed Decommissioning Plan
DI	Decommissioning Instructions
DWP	Decommissioning Work Package
ESDR	End State Decommissioning Report
HEPA	High Efficiency Particulate Air
HEU	High Enriched Uranium
HVAC	Heating Ventilation and Air Conditioning
IAEA	International Atomic Energy Agency
iCAM	Integrated Continuous Air Monitor
ISO	The International Organization for Standardization
LLD	Lessons Learned Document
LRC	Lower Reactor Container
NAA	Neutron Activation Analysis
NEW	Nuclear Energy Worker
NPROL	Non-Power Reactor Operating Licence
NORM	Naturally Occurring Radioactive Material
PPE	Personal Protective Equipment
QAP	Quality Assurance Plan
RAM	Radioactive Material
RMC	Royal Military College
SLOWPOKE	Safe Low Power Kritical Experiment
SPM	Saskatchewan Property Management

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1. INTRODUCTION

This document is the End State Decommissioning Report (ESDR) for the decommissioning of the Saskatchewan Research Council SLOWPOKE-2 Facility (SRCSF) located in Saskatoon, Saskatchewan.

This ESDR is provided as committed in the Quality Assurance Plan (QAP) [1] and Detailed Decommissioning Plan (DDP) [2], which were issued in support of the application for the amendment of the Operating Licence to allow the decommissioning of the SRCSF.

The Canadian Nuclear Safety Commission (CNSC) decommissioning planning document, CNSC Regulatory Guide G-219 Decommissioning Planning for Licensed Activities [3] provides guidelines for the content and structure of ESDRs that are to be submitted to the CNSC for acceptance following the completion of physical decommissioning activities. ESDR is structured to meet the requirements outlined in the CNSC guidelines and meet the requirements of the Canadian Standards Association (CSA) Standards CSA N286-12 [4] and CSA N294-09 [5]. The structure and content of the report are consistent with Annex D of CSA N294-09 [5].

Decommissioning activities have been completed in the SRCSF. Security and other requirements continue to be in place, as required per Security Plan [6].

The ESDR is a supporting document to the Saskatchewan Research Council's application in order to revoke the current Operating Licence and to obtain the License to Abandon the space that is occupied by SRCSF allowing for unrestricted access.

2. FACILITY DESCRIPTION

2.1 Name and Address of the Facility

The name and address of the facility is:

Saskatchewan Research Council SLOWPOKE-2 Facility
422 Downey Road
Saskatchewan Research Council,
Saskatoon, SK S7N 4L8

The holder of Licence is:

M. Crabtree
Saskatchewan Research Council
125-15 Innovation Boulevard,
Saskatoon, SK S7N 2X8

2.2 Site Description, Location and Boundaries of the Facility

The SRCSF is located in the Innovation Place Research Park in Saskatoon and the building that houses the facility was one of the first buildings constructed in the Research Park in 1980. The Research Park is home to a number of applied research facilities engaged in the development of industrial and agricultural products and processes.

The South Saskatchewan River runs 0.7 km on the west side. The Yellow Head Highway (Hwy 16) runs approximately 0.7 km on the east and 1.0 km on the north side. College Drive (local Hwy 5) runs 1.1 km on the south side. There is no residential area within this envelope. The closest residential area is 0.8 km on the east side beyond the Hwy 16. The map of the local area is presented in Figure 1.

The SRC SLOWPOKE-2 reactor resides in the SRC Environmental Analytical Laboratories which is located on 422 Downey Road in the Innovation Place Research Park in Saskatoon, SK. The land at the Innovation Place Research Park is owned by the University of Saskatchewan, it has been leased on long term basis to SOCO (Saskatchewan Opportunities Corporation) and SPM (Saskatchewan Property Management) in order to establish a Research Park. The building that houses SRCSF (422 Downey Road) is owned, operated and maintained by SPM and SRC is under a long term leased agreement. The layout of SRC buildings is shown in Figure 2. The floor plan of the Analytical Laboratories in presented in Figure 3, which also shows the space occupied by the SRCSF.

The SRC plans to terminate the long term lease agreement and return the building possession to SPM after the completion of the decommissioning work and issuance of the Licence to Abandon by the CNSC, allowing unrestricted use of the space occupied by the facility. There were no changes made to the foot print of the building during the decommissioning work.

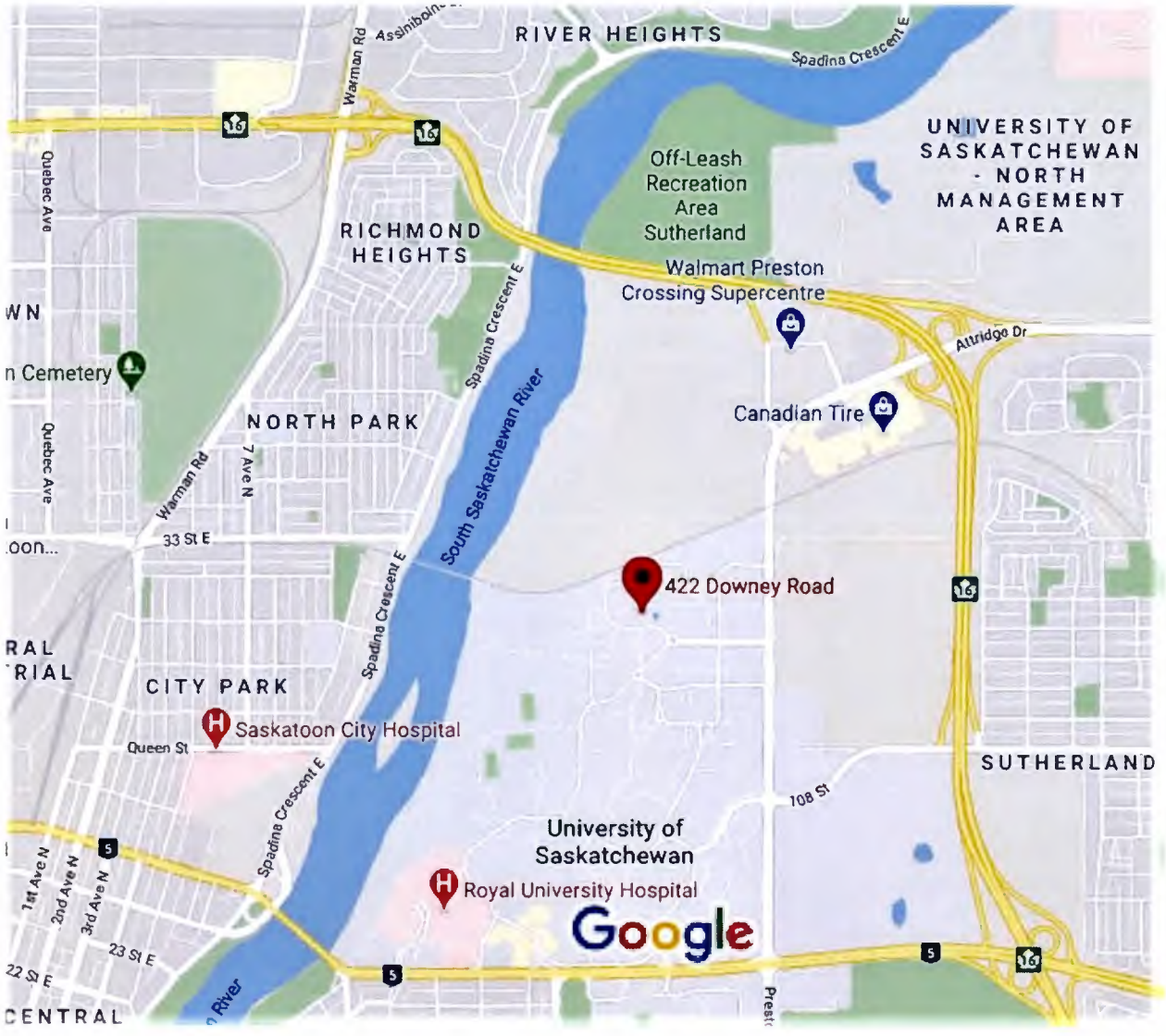

Figure 1 Map of SRC & University of Saskatchewan Located in Saskatoon

Source: http://www.maps.google.com

Figure 2 Innovation Place Layout

Source: SRC

The SRCSF consists of 4 rooms as shown in Figure 4. The description, room numbers and sizes are:

1. Room 143, uranium analysis laboratory (5.85m x 5.85m)
2. Room 144, gamma spectroscopy laboratory (5.85m x 5.85m)
3. Room 145, radioactive storage room (2.25m x 5.85m)
4. Room 146, reactor room (9.6m x 5.85m)

The only entrance to the SRCSF is through the double doors leading from the Radiochemistry Laboratory (Room 139) see Figure 3, into the Room 143. The entrance to the reactor room (Room 146), in only through the Room 143. All walls of the Room 146 (reactor room) are a minimum of 20 cm masonry construction. The floor is an on-grade concrete slab with no crawl space below. The roof over the Room 146 (reactor room) is a heavy gauge steel. The radioactive samples were stored in the Room 145 and the gamma spectroscopy used to be performed in the Room 144.

The total floor area of SRCSF is 137.5m^2 and the Room 146 (reactor room) occupies 55.7m^2. The ceiling height of Room 146 (reactor room) is 3.4m. There is an additional space between the ceiling tiles and the hard ceiling is an additional 0.6m for a total of 4.0m. The concrete floors are covered with linoleum tiles throughout the facility.

Figure 3 SRC Environmental Analytical Laboratory Layout
Source: SRC

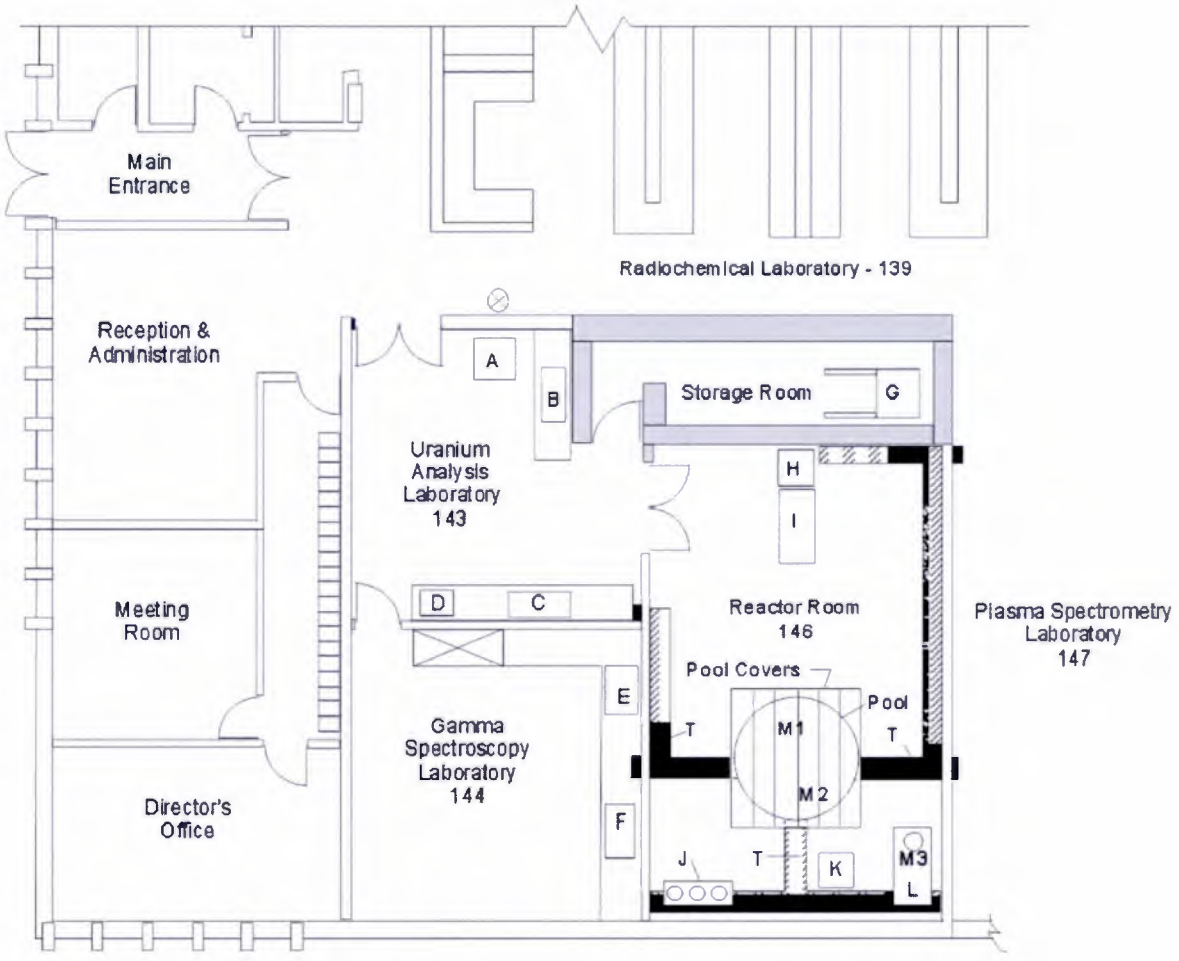

Figure 4 SRCSF and associated rooms
Source: SRC

The SRC Analytical building that houses the SRCSF was occupied by a staff of 70. The space has been vacated with the relocation of the Environmental Analytical Laboratory. There was one building technician on site in this space during the regular work days. Rooms 140, 141, 142.1 and 142.2 (Figure 3) have also been vacated.

In an adjoining, but completely separate section of SRC Analytical building, the Potash Corporation of Saskatchewan has a pilot plant in operation. It is located on the west of Rooms 122, 123 and 124 (see Figure 5). North of SRC Analytical (Figure 2), there is a parking lot and the Innovation Place Atrium building that houses offices and research laboratories for several tenants of the Research Park including some SRC facilities. Immediately south of the building is a roadway (Downey Road). There is a parking

lot across the roadway and a building that houses offices and laboratories for tenants of the Research Park.

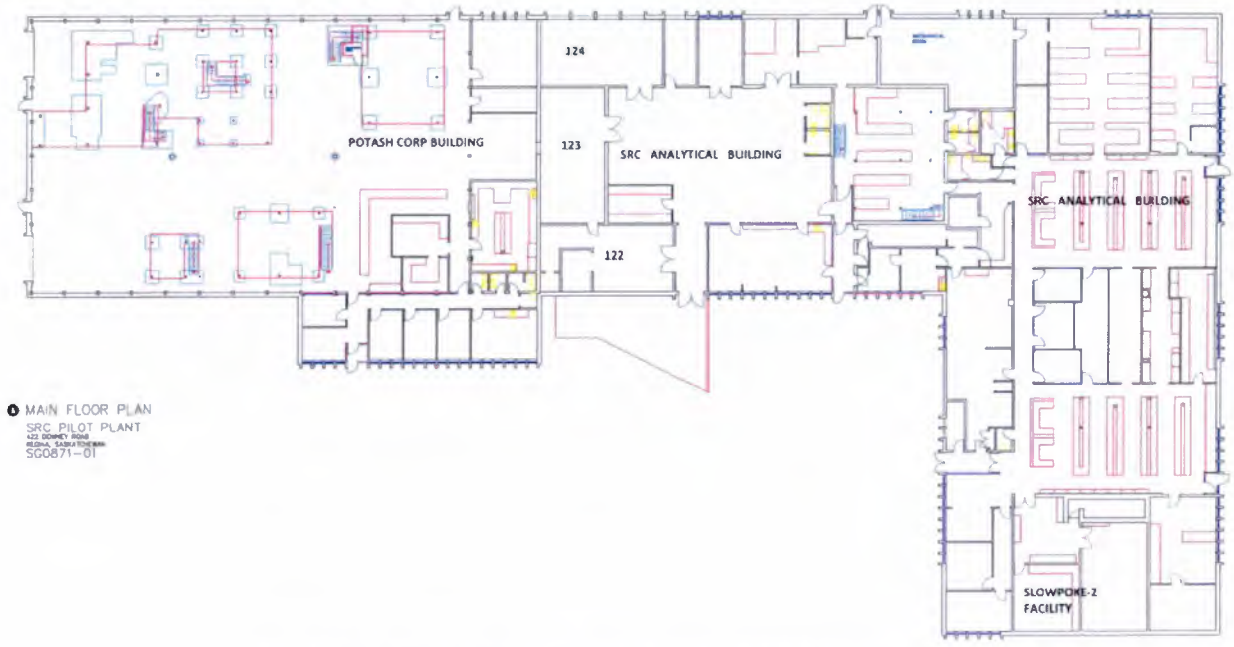

Figure 5 Floor Plan -- Potash Corp and SRC Analytical
Source: SRC

2.3 Type of Facility

The SRCSF was a pool type reactor featuring a highly enriched uranium core surrounded by beryllium reflectors, and cooled by light water via natural convection. Biological shielding was provided by the water filled pool, and moveable concrete shielding blocks which covered the pool. The SRCSF major and auxiliary components were located in Rooms 146, 144, and 143. The radioactive samples were stored in the Room 145.

The SRCSF was established in order to operate purely for scientific purposes. The reactor was used as an analytical tool to analyze for uranium and organic halides. It was used primarily as a neutron source for NAA (Neutron Activation Analysis) and in support of research programs of the Saskatchewan University and other institutions, agencies, and industrial groups in Western Canada. The facility was also helping provide uranium analysis by using the delayed neutron counting technique. More recently, the reactor had been used as a teaching tool in cooperation with the University of Saskatchewan. First criticality of the reactor was achieved on March, 1981 and the reactor was formally transferred to the SRC on March, 1981. The SRC was registered by an operating licence from the CNSC NPROL-19.00/2023 valid through June 2023 [7].

The SRCSF operated under a Non-Power Reactor Operating Licence NPROL – 19.00/2023 [7], until an amendment to the licence was issued. The Record of Decision for this amendment is presented in Appendix A. The SRCSF is currently in the decommissioning process, according to the Non-Power Reactor Licence Amendment (NPROL – 19.01/2023 valid until June 2023), which was issued to Saskatchewan Research Council pursuant to the Nuclear Safety and Control Act, on December 6, 2019.

The Amended Non-Power Reactor Operating Licence includes both: operation and decommissioning activities, which allows the SRC to decommission the SRCSF and meet the regulatory requirements for decommissioning. The amended licence is presented in Appendix B. Over the period that the SRCSF was in service, it was successfully operating with no significant interruptions.

The reactor was licensed to operate at a maximum nominal thermal neutron flux of 1E+12 n/cm^2/s. The primary use of the reactor had been as a neutron source to perform neutron activation analysis (NAA) and to produce radionuclides. At the time of commissioning the reactor the licence allowed a maximum excess reactivity of 3.4mk.

During the initial years of reactor operation, numerous uranium analyses were performed. The demand for the uranium analyses gradually declined; however, the decline had been offset by increased demand for neutron activation analyses. On average, the reactor operates three days a week, five hours a day. As per April 2018, the reactor had been operated for 97,930E+11 flux-hours. Reactor usage prior to the decommissioning was relatively constant over the previous decade at around 3,000E+11 flux-hours per year.

The additional neutron flux seen by the components and fuel during the period leading up to the decommissioning, following the cessation of operation for the purpose of irradiating samples, was predicted to result in a negligible increase in activity relative to the values indicated [8].

2.4 Buildings and Areas Affected by Decommissioning

A radiological baseline survey was performed throughout all the four rooms (143, 144, 145, and 146,) of the facility. The SRCSF layout is presented in Figure 4. This included random direct checks and smears (biased to most probable contaminated locations) to establish an understanding of the contamination levels. No contamination above absolute release criteria and no unexpected radiation fields were found in the baseline survey. The baseline survey data for the facility is presented in Appendix C.

Room 143 was a Uranium Analysis Laboratory. It was equipped with uranium analysis system which was removed from SRCSF before decommissioning work began. The irradiation controllers and a sample irradiation receiver were dismantled. This equipment was checked for contamination and disposed for recycle/reuse. The end state radiological survey was performed to ensure there is no removable or fixed contamination in excess of the established release criteria. No contamination was found in this room exceeding release criteria. The end state radiological survey data of the facility is presented in Appendix D.

Room 144 was equipped with gamma spectroscopy equipment which was removed from the facility before decommissioning work began. The irradiation controllers and irradiation receivers located in room 144 were dismantled. This equipment was checked for contamination and disposed for recycle/reuse within SRC. An initial radiological baseline survey was performed in the Room 144 to ensure there was no removable or fixed contamination in excess of the established release criteria. No contamination was found in this room exceeding release criteria. The end state radiological survey data of the facility is presented in Appendix D.

Room 145 was used as a storage room for radioactive samples. All radioactive material was removed from this room. There was no hazardous material left in the Room 145. Previously used ion exchange columns of the reactor purification system and the previously used beryllium shims were removed from this room, packaged into Type A container and shipped to CNL as a radioactive waste. The radioactive waste data sheets and associated gamma spec reports regarding all radioactive waste shipped to CNL is

presented in the Appendix E. The end state final radiological survey was performed in this room to ensure there was no removable or fixed contamination in excess of established release criteria.

Room 146 was a Reactor Room. The reactor was located inside a pool built into the floor of this room. The only access to the reactor room is through entrance from Room 143. Radiological baseline surveys were performed in this room and the data is presented in Appendix C.

All radioactive and hazardous material was removed. It includes, irradiated fuel, reactor components, auxiliary components, activated concrete, and lead acid batteries.

The end state final systematic survey was performed and the data is presented in Appendix D.

2.5 Materials, Equipment and Premises Released from Regulatory Control

The premises expected to be released from regulatory control, as a result of the decommissioning work, is the space occupied by SRCSF as identified in Figure 3 above, consisting of the rooms and the remaining amenities described in the previous section. As shown in Section 7 of this report, the remaining premises, materials and equipment meet the clearance criteria for unrestricted use stipulated in the Radiation Protection Requirements applicable to the SRCSF Decommissioning Project [9], for surface contamination or in the CNSC "Nuclear Substances and Radiation Devices Regulations", SOR/2000-207 [10] for activity concentrations.

The highly enriched uranium (HEU) fuel was removed from the reactor in the presence of IAEA, CNSC, and US DOE representatives. The HEU fuel was transferred into its dedicated transfer flask (F-257) which was later shipped to the licenced facility (Savannah River Site in US) for final storage. The Bill of Lading and the confirmation of the irradiated fuel received by US DOE are presented in Appendix F.

During the execution of the decommissioning work, all radioactive material which left the SRCSF (excluding the HEU fuel) was packaged into Type A containers and transported to the licensed facility of CNL in Chalk River, Ontario for long term storage.

Numerous samples were collected during decommissioning in order to determine the radionuclide inventory and chemical/biological contaminants prior to their disposal. The list of samples is presented below:

- The reactor water and pool water mixture was run through the reactor water deionizer (ion exchange column) for several days to remove the radionuclides. A sample from the mixed water was obtained and analysed for radionuclides and chemical/biological contaminants. The water sample was analyzed by the SRC for radionuclides and also by an external laboratory BV Labs (Bureau Veritas Laboratories) for other chemical/biological contaminants. The data is presented in Appendix G. The mixed pool water met the release criteria. The reports were sent to the City of Saskatoon and the CNSC. The City of Saskatoon accepted the report and allowed the water to be discharged into the sanitary sewer. The approval from the City of Saskatoon and recommendation from CNSC is presented in Appendix G.
- Gamma spectrometer analysis was performed on several samples of the reactor components. The gamma spec reports of the samples are presented in Appendix E. These reports were sent to CNL for acceptance as radioactive waste.
- Several samples of concrete from the reactor pool floor and wall was drawn in order to assess the extent of activation. All samples were analysed by gamma spectrometry. All concrete and rebar, that did not meet the unconditional release criteria, was removed and packaged. A detailed technical letter was written in support of this activity [11]. This letter will be re-submitted as a

separate document with the Application for the Licence to Abandon. Appendix H presents the sampling plan for concrete in the reactor pool. The details can also be found in the CNSC compliance inspection report [12].

- Part of the removed concrete was packaged and shipped to CNL to be stored as radioactive waste. Remaining part of the concrete is packaged in 6 industrial drums and is currently located in the SRC site. CNL has been contacted to accept this waste. It is planned that this waste will be shipped to CNL in the coming weeks. The site data sheets and gamma spectroscopy reports of this concrete have been provided to CNL for their internal process. A copy of email from SRC to CNSC which includes these reports is presented in Appendix I. A separate letter will be submitted to the CNSC after the concrete has been shipped to CNL waste storage facility.
- All equipment and material that met the unconditional release criteria was released from the SRC site after necessary radiological surveys for fixed and non-fixed contamination. The release forms for all the equipment and material that was released is presented in Appendix J. The majority of the equipment was shipped to local recycling and waste disposal facilities in the Saskatoon area. The other auxiliary reactor components were released to various facilities/organizations as per the Detailed Decommissioning Plan [2].

3. DECOMMISSIONING OBJECTIVES

3.1 Objectives

The end state objective for the decommissioning of the SRCSF is to have the Operating Licence revoked allowing the SRC unrestricted use of the building and services remaining in the space previously occupied by the facility.

At the completion of SRCSF decommissioning process, all contaminated and other equipment associated with the nuclear operation of SRCSF have been removed. The SRCSF has been confirmed as being below approved radioactive contamination criteria, below the allowable IAEA clearance limits as defined in RS-G-1.7 [13], IAEA Safety Standard Series; Application of the Concepts of Exclusion, Exemption and Clearance, August 2004, or below clearance criteria accepted by the CNSC. The unconditional clearance level limits are defined in Schedule 2 of SOR/2000-207 [10].

The ventilation system and other service systems (water, air, electrical) remain in service, and the structures associated with them are confirmed to be below the established unconditional release limits. The ventilation system was surveyed for radiological contamination and no contamination was found above unconditional release limits.

The reactor pool remains in place, and will be filled with grout after the necessary approval from the CNSC is obtained. It was confirmed that the structural materials and inner surface coating satisfy the applicable IAEA clearance limits and that radionuclides concentrations are below the unconditional limits.

The biological shielding blocks, other equipment and systems have been removed from the SRCSF, and have been sent to the appropriate waste management facilities. The unconditional release documentation is presented in Appendix J.

A radiation physics assessment report [8] was written in support of the SRCSF decommissioning. The [8] describes the acceptance criteria in further detail.

The irradiated fuel was sent to the US DOE Savannah River Site (SRS). All other radioactive equipment and radioactive waste was shipped to licensed facilities at CNL as a RAM shipment. The associated documentation is presented in Appendix E.

The results of the radiological surveys and assessments presented in Section 7 of this report confirm that the premises, equipment, and materials located in the space previously occupied by SRCSF meet the clearance criteria for unrestricted use stipulated in the Radiation Protection Requirements applicable to SRCSF [9] for surface contamination, or in the CNSC "Nuclear Substances and Radiation Devices Regulations" SOR/2000-207 [10] for activity concentrations.

All equipment and waste that met the unconditional release criteria was sent to appropriate waste management facilities in the local area or the destinations where they could be reused/recycled.

3.1.1 Objectives of Room 146 (Reactor Room)

The end state objective of this room is for it to be free of all radioactive and hazardous material.

The end state objectives of Room 146 as presented in DDP [2] were:

- Remove irradiated fuel and ship to SRS (Savanah River Site) in F-257 flask.
- Remove all reactor components from the reactor pool and ship to CNL as radioactive waste in Type A containers, this includes upper reactor container, LRC, all irradiated beryllium components, irradiation tubes, thermocouple, flux detector, control rod, and all fasteners etc.
- Remove reactor water purification system will be shipped to CNL as radioactive waste in Type A container.
- Remove pool water purification system and reuse.
- Remove reactor control console and reuse or recycle.
- Remove sump pump to dispose as non-radioactive waste.
- Remove all irradiation controllers and receivers for reuse or recycle.
- Remove all fixed or loose radioactive contamination in excess of regulatory limits.
- Process the reactor pool water (mixed water) through ion exchange columns and dispose the water in the sewer after achieving the free release criteria.
- Remove irradiated part of the reactor pool floor which will include the concrete and the rebar and dispose as radioactive waste.
- Ensure there is no hazardous material left in the room e.g. radioactive samples resulting from irradiation in the reactor, waste materials (gloves, irradiated vials and swipes).
- Fill the reactor pool and the trenches with concrete after necessary inspection and clearance from the CNSC.

The end state objectives for this room were completed and are presented below:

- Irradiated fuel was removed and shipped to SRS site in F-257 flask.
- All reactor components from the reactor pool were removed and shipped to CNL as radioactive waste in Type A containers; this includes upper reactor container, lower reactor container, all irradiated beryllium components, all irradiation tubes, thermocouple, flux detector, control rod, and plastic tubing.
- Reactor water purification system and previously used ion exchange columns were removed and shipped to CNL as radioactive waste in Type A containers.
- Pool water purification system was removed, it was unconditional released, and shipped to Ecole Polytechnique SLOWPOKE-2 facility.

- Reactor control console was removed, unconditional released and shipped to IAEA.
- Sump pump was not removed from the room as there's still a need to remove the water in case of flooding.
- Irradiation controllers were removed and recycled/reused.
- All surfaces were surveyed for fixed and non-fixed contamination. There is no fixed or non-fixed contamination in excess of the regulatory limits present in this room. The end state radiological survey data is presented in Appendix D.
- The reactor pool water (mixed water) was processed through ion exchange column and disposed the water into the sewer after achieving the approvals from the City of Saskatoon, see Appendix G.
- All the irradiated parts of the reactor pool floor and wall was removed. There is no irradiated concrete left in the reactor pool which is above UCL [11]. The reactor pool Areas 48 and 48.5 (as shown in Appendix D) showed elevated counts. This area was treated for further removal of the paint, due to which the count rates were elevated. After removal of the paint, the count rate reduced significantly. The maximum residual fixed/non-fixed activity was 0.24 Bq/cm^2. The details are provided in Reference [12] (Page 30).
- Cadmium capsules were packaged and transported to Environmental and Analytical Laboratory (Atrium Building) for reuse/recycle.
- There is no radioactive or hazardous material left in the room.
- The reactor pool and the trenches have NOT been filled with concrete/grout as yet. The necessary clearance from the CNSC is awaited. SRC will execute this activity and inform/update CNSC after the completion of this end state objective.

3.1.2 Objectives of Room 145

The Room 145 (Radioactive Storage Room) contained radioactive materials. It was used as a storage room for the previously used ion exchange columns of the reactor purification system and the previously used beryllium shims.

The end state objectives of Room 145 as presented in DDP [2] were:

- Remove previously used ion exchange columns and ship to CNL as radioactive waste in Type A container.
- Remove all radioactive beryllium shims and ship to CNL as radioactive waste in Type A container. These will be packaged with the remaining beryllium components removed from the reactor.
- The non-irradiated beryllium shims will be shipped to RMC of Canada for use at their SLOWPOKE-2 facility or returned back to CNL for safe storage.
- Ensure there is no loose or fixed contamination in excess of the regulatory limits.
- Ensure there is no hazardous material left in the room e.g. radioactive samples resulting from irradiation in the reactor, waste materials (gloves, irradiated vials and swipes).

The end state objectives for this room were completed and are presented below:

- Previously used ion exchange columns were removed and shipped to CNL as radioactive waste in Type A container.
- All irradiated beryllium shims were removed and shipped to CNL as radioactive waste in Type A container. These were packaged with the remaining beryllium components removed from the reactor.
- The un-irradiated beryllium shims (that were never used in the reactor) were shipped to RMC for use at their SLOWPOKE-2 facility.
- All surfaces were surveyed for fixed and non-fixed contamination. There is no fixed or non-fixed contamination in excess of the regulatory limits present in this room. The end state radiological survey data is presented in Appendix D.
- There is no radioactive or hazardous material left in the room.

3.1.3 Objectives of Room 144

The Room 144 (Gamma Spectrometry Lab) contained gamma spectroscopy equipment and irradiation controller/receiver.

The end state objectives of Room 144 as presented in DDP [2] were:

- Remove gamma spectroscopy equipment from the room and relocate in SRC for recycle/reuse.
- Perform radiation survey of the removed components.
- Remove all irradiation controllers and receivers for reuse or recycle.
- Dispose the plastic tubing as radioactive waste that connects the auxiliary components to the reactor.
- Ensure there is no loose or fixed contamination in excess of the regulatory limits.
- Ensure there is no hazardous material left in the room e.g. radioactive samples resulting from irradiation in the reactor, waste materials (gloves, irradiated vials and swipes).

The end state objectives for this room were completed and are presented below:

- The gamma spectroscopy equipment was removed from the Room 144 before the decommissioning work began. This equipment is being used by the SRC at a different location.
- Radiation survey of the removed equipment was performed.
- One (1) irradiation controller and one (1) receiver were shipped to IAEA. The remaining irradiation controllers and receivers were shipped to the RMC of Canada SLOWPOKE-2 facility for recycle/reuse.
- The plastic tubing which connected the auxiliary components to the reactor was packaged into Type A containers and shipped to CNL as radioactive waste.
- All surfaces were surveyed for fixed and non-fixed contamination. There is no fixed or non-fixed contamination in excess of the regulatory limits present in this room. The end state radiological survey data is presented in Appendix D.
- There is no radioactive or hazardous material left in the room.

3.1.4 Objectives of Room 143

The Room 143 served as the entrance to the facility and also used as uranium analysis laboratory. It contained the same equipment. The room contained irradiation controllers and a sample irradiation receiver.

The end state objectives of Room 143 as presented in DDP [2] were:

- Perform radiation survey of the removed components.
- The uranium analysis system will be removed from the SRCSF after the planned shutdown of the reactor in April 2019 but before the decommissioning work begins. This system will be reused or recycled.
- Remove all irradiation controllers and receivers for reuse or recycle.
- Dispose the plastic tubing as radioactive waste that connects the auxiliary components to the reactor.
- Ensure there is no loose or fixed contamination in excess of the regulatory limits.
- Ensure there is no hazardous material left in the room e.g. radioactive samples resulting from irradiation in the reactor, waste materials (gloves, irradiated vials and swipes).

The end state objectives for this room were met and completed and are presented below:

- Radiation survey of the all the removed equipment was performed.
- The uranium analysis system was removed from the SRCSF after the planned shutdown of the reactor in April 2019 and transferred to the RMC (Royal Military College) of Canada SLOWPOKE-2 facility for reuse.
- All irradiation controllers and receivers were shipped for future use to the RMC of Canada SLOWPOKE-2 facility.
- The plastic tubing which connected the auxiliary components to the reactor was packaged into Type A containers and shipped to CNL as radioactive waste.
- All surfaces were surveyed for fixed and non-fixed contamination. There is no fixed or non-fixed contamination in excess of the regulatory limits present in this room. The end state radiological survey data is presented in Appendix D.
- There is no radioactive or hazardous material left in the room.

3.2 Decommissioning Strategy

The decommissioning strategy chosen by SRC was a prompt removal of fuel and all radioactive materials; in order to get the operating licence revoked permitting an unrestricted use of the facility.

The decommissioning work started after the NPROL amendment had been issued by the CNSC. The Record of Decision for this amendment is presented in Appendix A. The SRCSF is currently in the decommissioning process, according to the Non-Power Reactor Licence Amendment (NPROL – 19.01/2023 valid until June 2023), which was issued to SRC pursuant to the Nuclear Safety and Control Act, on December 6, 2019.

The decommissioning work included removal of reactor components followed by packaging and transportation to licensed radioactive waste facility in CNL. The decommissioning work also included obtaining concrete core samples from the reactor pool for activation assessment followed by removal of

all activated concrete which was above the unconditional release criteria. End state radiation surveys were performed to ensure no fixed or non-fixed contamination is present above the clearance levels.

CNSC performed a compliance inspection from July 8 to 10, 2020, which included the areas of environmental protection, waste management, and radiation protection. The CNSC compliance inspection report (SRC-2020-01) was issued on September 22, 2020 [12]. The report concluded the following:

- There are no solids present above unconditional clearance levels in the SRC facility.
- There is no liquid present above unconditional clearance levels in the SRC facility.
- The iCAM was in use on continuous basis (24 hours a day) throughout the decommissioning process in order to monitor the quality of air in the reactor room. There was no incident to report for any airborne contamination in the reactor room except due to radon progeny.
- A non-compliance was noted by the CNSC [12], that the gamma characterization of the remaining concrete in the drums was not provided at the time of writing of this inspection report. However, the non-compliance has now been addressed by performing the gamma characterization of the concrete in the drums. A copy of the email from SRC to CNSC and the characterization report is presented in Appendix I. This provides the confirmation that the non-compliance has been addressed.

Further details can be found in the inspection report [12].

4. RELEASE CRITERIA

4.1 Non-Radiological Contaminants

The Hazard Analysis that was carried out in preparation for the decommissioning work in the SRCSF recognized that beryllium and cadmium presented potential non-radiological hazards for the workers. As a result, the decommissioning work instructions included appropriate precautions and requirements for protective equipment and clothing to minimize the risk to the workers. These precautions were adhered throughout the decommissioning process which resulted in an incident free work.

4.2 Radiological Contaminants

The radiological contaminants expected during the decommissioning activities were in liquid, solid, and airborne forms. Estimates of the radiological contaminants were documented in References [9] and [11], which served as bases for irradiated waste management and collective dose assessment in addition to evaluating the radiological hazards.

Information about the types of contaminants encountered during decommissioning and the criteria used for the release of radiological contaminants from the SRCSF is provided in the following sections.

4.2.1 Liquids

The liquid discharge was the water from the reactor pool (approximately 28,000 litres), which was discharged into the City of Saskatoon sanitary sewer system after it had been treated to reduce the activity to be below the release limits accepted by the CNSC and the City of Saskatoon. Appendix G provides the acceptance criteria which were used to support the decision to release the water. Appendix G also provides the detailed results of the analysis of water samples. The analysis results confirm that the release criteria were satisfied and the water was released into the City of Saskatoon sewer system.

4.2.2 Solids

The disposal of radioactive reactor components was performed as described in the Detailed Decommissioning Plan (See Section 10 of [2]). All items were monitored for radioactive contamination before released from SRCSF. The HEU fuel was transferred into its dedicated transfer flask (F-257) which was later shipped to the licenced facility (Savannah River Site in the US) for final storage.

Radioactive and contaminated components for which no re-use has been identified were packaged in Type A containers and sent for storage at a licensed facility in CNL.

Radioactive wastes were characterized as they were packaged. Characterization included monitoring for fixed and removable contamination with bulk radiochemical analysis for significant radionuclides. The analyses (Bq/kg) were combined with the masses of the materials to generate an estimate of the radionuclide inventories in each shipping container. A listing of the inventory of each container was maintained and it was accompanied to the shipment when the wastes were transported from the SRCSF.

A radioactive waste management plan [14] was written as a separate document to full fill the requirements as stipulated in CSA N294-09 [5].

4.2.2.1 Solids Removed

The results of the radiation measurements and the final destination of the reactor components and other waste that was removed are presented in Appendix E, which provides the waste management records for all radioactive solid waste shipped from SRC. The F-257 Flask containing the irradiated fuel was transported to the US DOE, SRS. The bill of lading and the receipt confirmation is presented in Appendix F.

The radioactive concrete waste which was generated during the activated concrete removal process are described in Section 2.5 of this document. Appendix H presents the sampling plan for concrete cores in the reactor pool. The removed concrete was shipped from SRC in the Type A container as a radioactive waste to CNL. The remaining concrete is packaged into 6 steel drums and is planned to be shipped to CNL in the next few weeks. A technical letter will be provided to CNSC to confirm that the shipment has taken place.

4.2.2.2 Solids Retained

Measurement results of the remaining reactor pool shows that there is no concrete remaining in the reactor pool which is above unconditional release limit, see [12] for details.

4.2.3 Airborne Contaminants

The Alpha/Beta Integrated Continuous Air Monitoring (iCAM) was used throughout the project (24 hours a day) to monitor for any potential radioactive airborne contaminants in room 146. No measurable non-NORM in-air radioactivity was detected during decommissioning process.

5. DECOMMISSIONING ACTIVITIES

5.1 Major Decommissioning Activities

The decommissioning of the SRCSF was completed using seven Decommissioning Work Plan/Packages (DWPs).

For each DWP, documentation was prepared to include, as applicable: Radiological Work Plan [15], Decommissioning Instructions (DIs), Decontamination Procedures, Hazard Assessment, Waste Management Data Sheets, Work Permits, StepBack (Pre-Job), Post-job Reviews, and Confined Space Clearances.

The summary of work packages is presented in the following sub-sections.

5.1.1 Defueling Preparations – DWP #1

The work competed under DWP #1, Defueling Preparations:

- Radiological baseline surveys were performed of Rooms 143, 144, 145, and 146 (reactor room), similar to operational surveys performed previously, to confirm radiological status of the facility. The results of the baseline surveys are presented in Appendix C.
- Removal of equipment from Rooms 143, 144, 145, and 146 (reactor room) which were not required for the subsequent operation of the reactor and the decommissioning process, and which were not previously removed as permitted under the Operating Licence. Such items were surveyed to ensure that they met criteria for release.
- Established of a 1m x 1m grid on the walls and floor for systematic square meter baseline radiological survey of Room 146. All transferrable contamination found was removed, and the area resurveyed to confirm release criteria were met, no fixed or non-fixed contamination was left.
- Radiation survey of the concrete blocks (biological shielding) was performed to confirm they met established unconditional release criteria and were subsequently removed from the facility and disposed for landfill.
- Installation of the safety railing around the reactor pool was completed in order to comply the safety guidelines.
- Safety checks were performed to ensure radiation monitoring devices were working properly.
- Safety check were performed to ensure reactor auxiliary systems were working properly.
- Safety check were performed to ensure irradiation systems were working properly.
- Removal of pool water cooling coil and attachments were performed.
- Collected pool water and reactor water samples to establish baseline for radionuclides and chemical contaminants.
- Operated the reactor at low power to verify proper operation of all necessary control equipment and instrumentation.
- Verified existing excess reactivity of the fuel by performing a period measurement.
- Determined the reactivity worth of cadmium capsules.

5.1.2 Core Removal – DWP #2

The work completed under DWP #2, Core Removal:

Removal of the following components, in order to make the reactor sub-critical:

- Small irradiation tubes.
- Large irradiation tube.

- Beryllium shims.
- Shim tray.
- Outlet core water thermocouple and guide tube.
- Neutron flux detector and guide tube.
- Control rod.

Other activities that were completed in order to remove the fuel and prepare for shipment:

- Removed the upper reactor container tie rods.
- Transferred the F-257 Flask to the reactor pool floor.
- Relocated the upper reactor container to the side to allow unrestricted access to the fuel assembly.
- Removed the irradiated fuel from the critical assembly.
- Performed underwater video inspection of the irradiated fuel
- Transferred irradiated fuel into F-257 flask.
- Placed the plug on the F-257 flask.
- Removed F-257 flask from the reactor pool.
- Obtained water samples from the F-257 flask.
- Performed radiation survey of the F-257 flask.
- Installed the fire shield on the F-257 flask and completed shipment preparations.
- Transferred F-257 transport package to the designated temporary storage area in Room 146.
- Transferred F-257 transport package from temporary storage onto the transporter.
- Shipped F-257 transport package to Savannah River Site, US.

Staff from the IAEA, CNSC and US DOE witnessed the loading of the core into the F-257 flask, IAEA staff placed safeguards seal on the F-257 flask after it was raised from the reactor pool.

5.1.3 Reactor Components Removal – DWP #3

The work completed under DWP #3, Reactor Components Removal:

- Removed the control rod motor and drive assembly.
- Sampled pool water and performed a radiological assessment.
- Removed the critical assembly (beryllium assembly) and packed into the beryllium shielding container.
- Removed the shim tray and transferred into the beryllium shielding container.
- Transferred all irradiated beryllium shims into the shim tray in the beryllium shielding container.

The following components were removed from the reactor pool, cut and packed for shipment:

- Upper reactor container.
- Irradiation tubes.
- Outlet core water thermocouple.
- Neutron flux detector.
- Control rod.

Other activities that were completed under DWP-003, Reactor Components Removal:

- Removed of the longitudinal support beams.
- Removed the lower reactor container out from the reactor pool.
- Cut the lower reactor container support bars and packed.
- Transferred the lower reactor container into the shielding container.
- Cut and packed the lower section support rods.
- Removed the reactor radiation monitor.

- Removed and disposed the longitudinal support beams and platform plates.
- Prepared and installed pumping system for the pool water disposal.
- Measured pool water sample for radionuclides and chemicals.
- Disposed pool water.

5.1.4 Auxiliary Components Removal – DWP #4

The work completed under DWP #4, Auxiliary Components Removal:

- Removed the reactor water purification system and packed for shipment.
- Packed previously used purification columns.
- Packed the pool water purification system and associated tubing.
- Removed disposed the sample irradiation system and associated tubing.
- Removed and disposed the radiation monitoring system.
- Removed and disposed the area radiation monitor.
- Removed and packed the gas purge system.
- Removed and disposed the service box.
- Removed and disposed the reactor control console.

5.1.5 Pool Cleanup – DWP #5

The work completed under DWP-005, Pool Cleanup:

- Established confined space clearance after performing initial hazard assessment.
- Established a 1m x 1m grid on the pool wall and floor.
- Performed radiation survey to identify the fixed and non-fixed contamination locations.
- Removed non-fixed and fixed contamination.
- Performed systematic radiation survey of pool walls and floor.
- Removed activated concrete from pool floor and wall.
- Measured the concrete samples for radioactivity due to neutron activation.

5.1.6 Final Survey – DWP #6

The work completed under DWP #6, Final Survey:

- Performed systematic end state radiation survey of Room 146 to ensure decommissioning activities have not resulted in radioactive contamination.
- Performed general end state radiation survey of all the remaining areas including the other rooms in the SRCSF (Rooms 143, 144, and 145).
- Removed of all fixed and non-fixed contamination found during the radiation survey.
- Repeated radiation survey of the recently decontaminated locations.
- Shipped all radioactive waste to the waste management facility of CNL.

A Compliance Inspection was conducted by CNSC during July 10-12, 2020 [12].

5.1.7 Civil Work and Restoration – DWP #7

This work is pending completion under DWP #7, Civil Work and Restoration:

SRC has requested CNSC to perform this activity.

Interior work in Room 146:

- Filling and covering the reactor pool with grout.
- Filling the trenches with grout.

- General cleaning of the room.
- Confirming that the lighting, fire alarm and internal access doors are all operational.
- Ensuring that appropriate signage is in place and locks are installed to the SRC standard for this space.

5.2 Decommissioning Schedule

A schedule showing the start and completion of the major activities comprising the SRCSF decommissioning project is presented in Appendix K.

5.3 Budgeted versus Actual Decommissioning Cost

The project approved budget was $6,665,826.00 (including taxes). The project cost breakdown figures are as listed in the DDP, Section 12 [2]. The actual cost of the project is well within the available budget. The breakdown of cost is presented in Appendix N.

6. REMAINING ENTITIES AND INSTITUTIONAL CONTROLS

The scope of the SRCSF decommissioning project included to obtain the unrestricted use of the building and services remaining in the space currently occupied by the facility.

It is expected that the current operating licence will be revoked by the CNSC. This will confirm that the objective has been achieved.

After obtaining the clearance and revoking the operating licence, provisions will be made, if necessary, to allow for further inspections by IAEA/CNSC personnel reporting to the non-proliferation of nuclear weapons division.

7. FINAL RADIOLOGICAL STATUS

7.1 Final Radiological Condition

Following the dismantling of the SLOWPOKE-2 reactor at Saskatchewan Research Council and the removal of non-radioactive and radioactive waste, a final end state survey was performed in the reactor pool, in the exhaust ventilation system, and in the facility rooms affected by decommissioning work. The surveys were performed to verify that decommissioning activities have not resulted in radioactive contamination being spread to other areas of the facility, and to ensure that those areas which had originally contained radiological materials were within the accepted release limits. The absence of any contamination within the facility confirmed that the measures taken to decontaminate and survey all items leaving the facility were fully effective in eliminating the spread of radioactive contamination.

The surveys performed in the facility consisted of gamma dose rate measurements, surface contamination, and removable contamination measurements (beta/gamma, alpha emitters). The unconditional release criteria used to assess the surface contamination measurements are obtained from Table 7 of [9]. The results of the final release survey are provided in Appendix D and confirm that all surveyed areas of the reactor facility have a level of radiation below the unconditional release criteria.

Concentrations of radionuclides in the reactor pool concrete and reinforcing steel re-bars from the walls and the pool floor were measured and compared with the unconditional release limits from [10]. Reference [11] provides the results of the testing for each of the concrete samples taken from the reactor pool. The results show that the activity concentrations in the remaining pool structure are below unconditional clearance levels.

7.2 Areas Remaining Above the Release Criteria

No areas of the SRCSF remain above the unconditional release criteria as shown in Appendix D and [12].

8. STATE RELEASE

The decommissioning of the SRCSF as authorized by NPROL-19.01/2023 (Revision 2), Appendix B, has been completed as described in this report. The space occupied by the facility is deemed to be suitable for unrestricted use, and it is expected to be confirmed by the CNSC by revoking the current operating licence.

There are no conditions remaining in the SRCSF that are considered to require further monitoring.

9. WASTE QUANTITIES AND DISPOSITION

9.1 Planned versus Actual Quantities

There has been no change between the planned and the actual waste quantities except the activated concrete removed from the reactor pool. Additional amount of concrete was removed from the reactor pool in order to meet the requirements. The [11] provides the details.

9.2 Radioactive Waste, Cleared Materials and Other Special Wastes

Appendix E provides a listing of all radioactive waste that was shipped to the CNL Waste Management Area.

Appendix J provides a listing of all the materials that were cleared for unconditional release, and the destination of those items. As described in Section 2.5, most of the items were segregated for reuse, recycling, or waste disposal.

9.3 Disposition to Storage Sites

Materials and items of equipment with activity below the unconditional release limit were released from SRCSF by the Radiation Safety Officer after they were surveyed for radioactive contamination by the Candu Group 1 Radiation Surveyor. Records of the release of those materials are included in Appendix J.

These releases include hazardous and non-hazardous wastes that were transported to local waste disposal and recycling facilities.

Samples of materials (solids and liquids) which were sent for analysis by outside laboratories were assessed and determined to be below the limits for Exempt Shipments.

Materials, equipment, and wastes which were determined to have activity above the limits for unconditional release, and which were not sent as Exempt Shipments to laboratories for analysis and disposal, were transported from the facility as Radioactive Material (RAM) consignments. These shipments were assessed and released by a certified RAM Shipper.

The RAM consignments departed from Saskatoon on March 6, 2020 following the release by the CNL RAM Shipper. The details of the contents of the Type A containers and the records of the shipment are provided in Appendix E.

9.4 Material Buried on the Site

Surveys of the rooms and equipment remaining in the SRCSF demonstrated that activity was below the unconditional release limits. There is no radioactive material buried or left behind in the SRC site which is above unconditional release limits.

9.5 Airborne or Liquid Waste Emissions

There were no radiological airborne or liquid wastes emissions during the decommissioning process.

The reactor room was maintained under slight negative pressure and the air quality was measured continuously by using iCAM. A sample report is presented in Appendix L. The air monitoring equipment, iCAM, results also show that there were no non-NORM radioactive airborne materials detected during the decommissioning process.

10. PERSONNEL DOSES

The individual and collective worker dose estimates for the decommissioning of the SRCSF are shown in Table 20 of [8]. The measured doses are provided in Appendix M.

The action level was defined to be 1 mSv/person. Only one crew member (Mechanical Technician 1) received whole body dose beyond 0.1 mSv for the whole duration of the decommissioning process. The total reportable dose for the whole crew was 0.16 mSv. This is an exceptionally low dose compared to the previous experiences of UASF and DUSR decommissioning. The dose report is presented in Appendix M.

No recordable dose to the extremities was received to any crew members.

11. ABNORMAL OCCURRENCES AND INCIDENTS

No reportable event occurred during the execution of the decommissioning work of the SRCSF.

Since the SRCSF reactor assembly has been effectively and successfully dismantled, we include recommendations in the Lessons Learned Document, to ensure that future jobs of a similar nature benefit from this experience. Section 12 of this report provides details regarding the associated lessons learned.

12. LESSONS LEARNED

A Lessons Learned Document (LLD) has been prepared for the SRCSF Decommissioning Project and is documented in [16]. Summaries of the lessons learned identified in the LLD are provided below:

- Excellent radiation protection techniques were employed which resulted in the low radiation dose to personnel.
- The daily Step-Back (pre-job) and post-job helped to plan the daily activities and identifying who was performing each task. This resulted in reducing the dose to the workers
- An additional RP resource was employed during the final stages of the project. The RP workload was elevated during the end state surveys. This reduced the site work duration and hence saved unnecessary cost.
- The staff were well trained, coordinated and competent in their work which helped the site work to finish ahead of schedule.
- The SRCSF SLOWPOKE-2 decommissioning Project Team played an active and invaluable role throughout the planning and execution stages of the decommissioning. Involvement by the Project Team contributed significantly to keeping the project focused, avoided situations which might have negatively impacted scheduling and aided in bringing the project within schedule and under budget.
- During the public hearing for the Licence to Decommission, it was noted by the public that concrete slurry which was above UCL, was buried inside the reactor pool prior to filling with grout. This end state report and the associated supporting document [11] shows that no such material above UCL is present in the SRC.

13. REFERENCES

[1] SNC-Lavalin, "SRC Decommissioning Quality Assurance Plan", 147-912020-QAP-004 Revision 1, 2019.

[2] SNC-Lavalin, "SRC Detailed Decommissioning Plan", 147-01600-DDP-002 Revision 1, 2019;

[3] Canadian Nuclear Safety Commission, "Decommissioning Planning for Licensed Activities", Regulatory Guide G-129, 2000.

[4] Canadian Standards Association, "Management System Requirements for Nuclear Facilities", CSA N286-12 (R2017).

[5] Canadian Standards Association, "Decommissioning of Facilities Containing Nuclear Substances", CSA N294-09, 2014.

[6] Saskatchewan Research Council, "Site Security Plan".

[7] Saskatchewan Research Council, "Non-Power Reactor Operating Licence SLOWPOKE-2 Reactor", NPROL-19.00/2023.

[8] SNC-Lavalin, "Radiation Physics Assessment Report", 147-03320-ASD-004 Revision 1, 2019.

[9] SNC-Lavalin, "Action Levels and Radiation Protection Requirements", 147-03400-REPT-002 Revision 1, 2019.

[10] Government of Canada: SOR/2000-207, "Nuclear Substances and Radiation Devices Regulations", Canada Minister Of Justice, June 6, 2016.

[11] SNC Lavalin, "Supporting Evidence for Unconditional Release of SRC SLOWPOKE 2 Reactor Pool Concrete", 147-CECNSC-20-0001, 2020.

[12] CNSC: SRC-2020-01, CNSC Compliance Inspection Report

[13] International Atomic Energy Agency, "Application of the Concepts of Exclusion, Exemption and Clearance", IAEA RS-G-1.7.

[14] SNC-Lavalin, "Action Levels and Radiation Protection Requirements", 147-01622-REPT-002 Revision 0, 2018.

[15] SNC-Lavalin, "Radiological Work Plan for SRC SLOWPOKE-2 Facility", 147-03400-RWP-002 Revision 0, 2018.

[16] SNC-Lavalin, "SRCSF Decommissioning Project – Lessons Learned Report", 147- 904010-LLD-005 Latest Revision.

Appendix A
THE RECORDS OF DECISION FOR ISSUING THE NON-POWER REACTOR LICENCE AMENDMENT

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Record of Decision

DEC 19-H100

In the Matter of

Applicant: Saskatchewan Research Council

Subject: Application to Amend the Non-Power Reactor Licence for the SLOWPOKE-2 Reactor to Authorize Decommissioning

Public Hearing Date: September 26, 2019

Record of Decision Date: December 6, 2019

Canada

16. The *Impact Assessment Act*[4] (IAA) came into force August 28, 2019. Under the IAA and the *Physical Activities Regulations*[5] made under it, impact assessments (IA) will be conducted on projects identified as having the greatest potential for adverse environmental effects in areas of federal jurisdiction. While CEAA 2012 and not the IAA applies to this project, the Commission notes that the decommissioning of an existing reactor is not an activity identified in the regulations for an IA under the IAA.

17. The Commission considered the completeness and adequacy of the environmental protection review under the NSCA and its regulations that CNSC staff conducted for this licence amendment. CNSC staff findings for the proposed SRCSF decommissioning included, but were not limited to:

- Radiation doses to the public resulting from decommissioning activities are estimated to be 0.1 mSv, well below the regulatory dose limit for members of the public of 1.0 mSv;
- Air will be continuously monitored and any radioactive or hazardous substances will be captured using high efficiency particulate air filters to ensure that no airborne contaminants are released into the environment;
- Liquid effluents would be treated using a container water deionizer system to meet the release criteria specified by the CNSC and the City of Saskatoon.

18. The Commission is satisfied that the environmental protection review conducted by CNSC staff was appropriate for this licence amendment and that the NSCA provides a strong regulatory framework for environmental protection.

19. Based on the information provided for this hearing, the Commission concludes that the licence amendment is not a designated project under CEAA 2012 and that an EA under CEAA 2012 is not required prior to its approval. Further, the Commission is satisfied that SRC has made, and will continue to make, adequate provision for the protection of the environment throughout the decommissioning activities to be authorized by this amendment.

4.0 ISSUES AND COMMISSION FINDINGS

20. In making its licensing decision, the Commission considered a number of issues and submissions relating to SRC's qualification to carry out the licensed activities that the amended licence would authorize. The Commission also considered the adequacy of the proposed measures for protecting the environment, the health and safety of persons, national security and international obligations to which Canada has agreed.

21. SRC submitted a licence amendment application for the SRCSF on December 14, 2018. In its consideration of this matter, the Commission examined the completeness of the application and the adequacy of the information submitted by the SRC, as

[4] S.C. 2019, c. 28, s. 1
[5] SOR/2019-285

N. Greencorn	Senior Project Officer, Waste and Decommissiong Division	
B. Thériault	Dosimetry Specialist, Radiation Protection Division	
W. Islam	Project Officer, Canadian Nuclear Laboratories Regulatory Program Division	

Intervenors	
See Appendix A	

Licence: Amended

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1.0 INTRODUCTION

1. The Saskatchewan Research Council (SRC) has applied to the Canadian Nuclear Safety Commission[1] for the amendment of the Non-Power Operating Reactor Licence for its SLOWPOKE-2 reactor facility located at the SRC Environmental Analytical Laboratories complex in Saskatoon, Saskatchewan. The current licence, NPROL-19.00/2023, expires on June 30, 2023. SRC has requested an amendment of the licence to authorize the decommissioning of the SRC SLOWPOKE-2 reactor facility (SRCSF).

2. The current licence authorizes SRC to operate the SRCSF and to transition the reactor into a safe state, but does not authorize SRC to decommission the reactor. Prior to transitioning into a safe state, the SRCSF provided a source of neutrons for neutron activation analysis and isotope production. It was also used for teaching purposes in conjunction with the University of Saskatchewan.

3. SRC is seeking to decommission its SRCSF at this time because it has been able to replace the reactor's analytical capabilities with alternative technologies at SRC's environmental analytical laboratories. The proposed licence amendment would authorize SRC to decommission the SRCSF to achieve an end-state of unrestricted use. This includes dismantling the reactor, segregating and removing the materials for storage, and restoring the site to its original state.

4. In June 2019, up to $15,000 in funding to participate in this licence amendment process was made available to Indigenous groups, not-for-profit organizations and members of the public through the CNSC's Participant Funding Program (PFP). A Funding Review Committee (FRC) – independent of the CNSC – recommended that up to $14,714 in participant funding be provided to two applicants. These applicants were required, by virtue of being awarded participant funding, to submit a written intervention and/or an oral presentation at the public hearing commenting on SRC's application.

Issues

5. In considering the application, the Commission was required to decide:

   a) what environmental assessment review process to apply in relation to this application;

   b) whether SRC is qualified to carry on the activity that the amended licence would authorize; and

[1] The *Canadian Nuclear Safety Commission* is referred to as the "CNSC" when referring to the organization and its staff in general, and as the "Commission" when referring to the tribunal component.

c) whether, in carrying on that activity, SRC would make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

Public Hearing

6. On June 12, 2019, the Commission issued a notice of public hearing in writing for SRC's licence amendment application. Following its publication, the Commission received a request from the Canadian Environmental Law Association (CELA) on behalf of Northwatch, the Inter-Church Uranium Committee Educational Cooperative (ICUCEC) and the Concerned Citizens of Renfrew County and Area (CCRCA) to allow for oral interventions, a longer intervention submission period, and to offer participant funding in relation to SRC's application. Following the Commission's consideration of this request, the Commission, in recognition of demonstrated public interest in SRC's application, published a revised notice of public hearing on June 27, 2019 for an oral hearing. The revised notice provided for a 30-day period to seek intervenor status as per the *Canadian Nuclear Safety Commission Rules of Procedure*[2] (Rules of Procedure). Intervenors were provided an opportunity to intervene in writing and orally and were offered up to $15,000 in participant funding through the PFP.

7. Pursuant to section 22 of the NSCA, the President established a Panel of the Commission to consider the information presented for a public hearing held on September 26, 2019 in Ottawa, Ontario. The public hearing was conducted in accordance with the Rules of Procedure. During the public hearing, the Commission considered written submissions and heard oral presentations from SRC (CMD 19-H100.1A) and CNSC staff (CMD 19-H100.A). The Commission also considered oral and written submissions from seven intervenors (see Appendix A for a list of interventions). The hearing was audiocast live via the CNSC website, and audio archives are available on the CNSC's website.

2.0 DECISION

8. Based on its consideration of the matter, as described in more detail in the following sections of this *Record of Decision*, the Commission concludes that SRC is qualified to carry on the activity that the amended licence will authorize. The Commission is of the opinion that SRC, in carrying on that activity, will make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. Therefore,

[2] SOR/2000-211.

the Commission, pursuant to section 24 of the *Nuclear Safety and Control Act*, amends the Non-Power Reactor Operating Licence issued to the Saskatchewan Research Council for its SLOWPOKE-2 reactor facility located in Saskatoon, Saskatchewan to authorize SRC to decommission the facility. The amended licence, NPROL-19.01/2023, remains valid until June 30, 2023.

9. The Commission is satisfied that an environmental assessment (EA) under the *Canadian Environmental Assessment Act, 2012*[3] (CEAA 2012) was not required in this matter and considers the environmental protection review that was conducted by CNSC staff to be acceptable and thorough.

10. The Commission amends Part IV a) of SRC's licence as recommended by CNSC staff in CMD 19-H100, to authorize SRC to decommission the SRCSF.

11. The Commission does not amend the licence period as recommended by CNSC staff in CMD 19-H100. The Commission is satisfied that the start date of the licence need not change. The licence period shall remain as "July 1, 2013 to June 30, 2023" with the authorization to decommission taking effect as of the date of this decision.

12. The Commission anticipates that, following its decision in this matter, CNSC staff will update SRC's Licence Conditions Handbook (LCH) to include references to the Detailed Decommission Plan (DDP) and other documents as presented during this hearing. A draft amended LCH was not included in the hearing materials as is usual; CNSC staff will update it following this decision.

13. The Commission would like to note its displeasure that, during the hearing, it did not receive satisfactory information about how the waste would be characterized during the decommissioning of the SRCSF or about the specific radionuclide activities data. Should SRC submit an application to abandon the SRCSF, the detailed waste characterization data and a confirmation of the accuracy of the estimates will be required to be submitted by SRC, and reviewed by CNSC staff.

3.0 ENVIRONMENTAL ASSESSMENT

14. In coming to its decision, the Commission was first required to determine whether an EA was required.

15. SRC's application was made December 14, 2018, at which time CEAA 2012 and its regulations provided the requirements for EA for nuclear projects. The decommissioning of an existing nuclear reactor is not included on the Designated Project list for an EA, as decommissioning is not an activity identified in the *Regulations Designating Physical Activities*.

[3] S.C. 2012, c. 19, s. 52

16. The *Impact Assessment Act*[4] (IAA) came into force August 28, 2019. Under the IAA and the *Physical Activities Regulations*[5] made under it, impact assessments (IA) will be conducted on projects identified as having the greatest potential for adverse environmental effects in areas of federal jurisdiction. While CEAA 2012 and not the IAA applies to this project, the Commission notes that the decommissioning of an existing reactor is not an activity identified in the regulations for an IA under the IAA.

17. The Commission considered the completeness and adequacy of the environmental protection review under the NSCA and its regulations that CNSC staff conducted for this licence amendment. CNSC staff findings for the proposed SRCSF decommissioning included, but were not limited to:

- Radiation doses to the public resulting from decommissioning activities are estimated to be 0.1 mSv, well below the regulatory dose limit for members of the public of 1.0 mSv;
- Air will be continuously monitored and any radioactive or hazardous substances will be captured using high efficiency particulate air filters to ensure that no airborne contaminants are released into the environment;
- Liquid effluents would be treated using a container water deionizer system to meet the release criteria specified by the CNSC and the City of Saskatoon.

18. The Commission is satisfied that the environmental protection review conducted by CNSC staff was appropriate for this licence amendment and that the NSCA provides a strong regulatory framework for environmental protection.

19. Based on the information provided for this hearing, the Commission concludes that the licence amendment is not a designated project under CEAA 2012 and that an EA under CEAA 2012 is not required prior to its approval. Further, the Commission is satisfied that SRC has made, and will continue to make, adequate provision for the protection of the environment throughout the decommissioning activities to be authorized by this amendment.

4.0 ISSUES AND COMMISSION FINDINGS

20. In making its licensing decision, the Commission considered a number of issues and submissions relating to SRC's qualification to carry out the licensed activities that the amended licence would authorize. The Commission also considered the adequacy of the proposed measures for protecting the environment, the health and safety of persons, national security and international obligations to which Canada has agreed.

21. SRC submitted a licence amendment application for the SRCSF on December 14, 2018. In its consideration of this matter, the Commission examined the completeness of the application and the adequacy of the information submitted by the SRC, as

[4] S.C. 2019, c. 28, s. 1
[5] SOR/2019-285

required by the NSCA, the *General Nuclear Safety and Control Regulations*[6] (GNSCR) and other applicable regulations made under the NSCA.

22. In CMD 19-H100.A, CNSC staff provided responses to some of the questions and issues raised by intervenors. This *Record of Decision* reflects the Commission's consideration of matters as discussed during the hearing and as raised in written submissions.

4.1 Human Performance Management

23. The Commission assessed SRC's human performance management programs which encompass activities that enable effective human performance through the development and implementation of processes that ensure that SRC staff are sufficient in number in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties. During the current licence period, CNSC staff rated SRC's performance in this safety and control area (SCA) as "satisfactory."

24. The Commission examined the information submitted by SRC regarding its human performance program. SRC submitted that the SRCSF decommissioning project included work that its personnel did not normally perform and, therefore, the decommissioning work would be contracted to and carried out by Candu Energy Inc. (Candu Energy), which has specific training and experience for these types of projects.

25. The Commission considered the information submitted by SRC about its personnel training programs, noting that SRC's programs met the specifications of REGDOC-2.2.2, *Personnel Training*.[7] SRC submitted information about its decommissioning training program, which applies to all workers and contractors who are required to perform work, as set out in SRC's *Decommissioning Training Plan for SRC SLOWPOKE-2 Facility*.[8]

26. SRC reported that all Candu Energy staff were required to complete basic industrial safety and radiological training and that all personnel in direct operating positions would be trained in accordance with Candu Energy's Systematic Approach to Training (SAT) program, unless their current CNSC certification covered the activities to be performed during decommissioning. SRC further reported that a review of training and qualifications would be conducted for employees assigned to work at the SRC facility, noting that, as part of the SAT process, a Training Needs Analysis was conducted to examine the tasks involved and the qualification of the personnel assigned to perform the tasks. SRC reported that this analysis produced a matrix which showed the

[6] SOR/2000-202.
[7] CNSC Regulatory Document REGDOC-2.2.2, *Personnel Training, 2016*.
[8] SRC, SLOWPOKE-2 Detailed Decommissioning Plan, March 04, 2019

additional training modules or courses were required to fill any gaps in a worker's required knowledge and skills.

27. CNSC staff reviewed the SRC's detailed training plan, including the advanced training schedule, which provides timelines for all tasks requiring training as identified in the job and task analysis. From this review, CNSC staff were satisfied that the decommissioning training and evaluation program met expectations.

28. The Commission enquired as to whether workers assigned to the decommissioning of the SRCSF were also involved during the decommissioning of the University of Alberta (U of A) SLOWPOKE-2 reactor. An SRC representative responded that, although not all of the workers present during the U of A decommissioning project were working on the SRCSF decommissioning, several were.

29. The Commission assessed the SRC's programs for the certification of employees in certain positions at the SRCSF. SRC submitted that, under its operating licence and pursuant to the *Class I Nuclear Facilities Regulations*[9] (Class I Regulations), the positions requiring a valid CNSC certification included: reactor operator, reactor engineer, and reactor technician.

30. CNSC staff submitted that there were three SLOWPOKE-2 reactor operators employed by SRC who were certified by the CNSC, and the reactor engineer and the reactor technician were Candu Energy employees, who were also certified by the CNSC to work on the SRC SLOWPOKE-2 reactor.

31. Based on the information presented during this hearing, the Commission is satisfied that SRC has appropriate training and certification programs in place at the SRCSF for carrying out the decommissioning of the SRCSF. The Commission is also satisfied that SRC's programs meet the objectives of REGDOC-2.2.2.

32. The Commission is satisfied that appropriate programs are in place for contracted Candu Energy workers.

33. Based on its consideration of the information presented on the record for this hearing, the Commission concludes that SRC has appropriate programs in place and that current efforts related to human performance management provide a positive indication of SRC's ability to adequately carry out the proposed decommissioning activities at the SRCSF.

[9] SOR/2000-204

4.2 Radiation Protection

34. As part of its evaluation of the adequacy of the measures for protecting the health and safety of persons, the Commission considered the performance of SRC in the area of radiation protection. The Commission also considered how SRC's radiation protection program specified that radiation doses to persons and contamination would be monitored, controlled and kept as low as reasonably achievable (ALARA), with social and economic factors taken into consideration, during the decommissioning of the SRCSF. Throughout the current licence period thus far, CNSC staff rated SRC's performance in this SCA as "satisfactory."

35. The Commission considered the information provided by SRC and CNSC staff to assess whether the SRC radiation protection program satisfied the requirements of the *Radiation Protection Regulations*.[10] SRC submitted that Candu Energy's Radiation Protection Plan for the decommissioning of the SRCSF was based on Candu Energy's radiation protection program requirements used at CANDU licensed sites and would see to it that doses to workers would remain below regulatory limits during the decommissioning project.

36. SRC submitted that, in order to keep doses ALARA, a radiation protection surveyor would provide oversight throughout the decommissioning work and that workers would perform decommissioning work at a safe distance from the radiation source using cranes and extension tools. SRC further submitted that the use of personal dosimetry in radiological work zones to control the spread of contamination would be utilized.

37. CNSC staff submitted that, throughout the current licence period, SRC had implemented an appropriate and effective radiation program at the SRCSF that satisfied the regulatory requirements set out in the *Radiation Protection Regulations*. CNSC staff also reported that SRC used a licensed dosimetry service to monitor, assess, record and report doses received by workers, noting that the workers in the SRCSF were not designated as nuclear energy workers (NEWs). CNSC staff further submitted that doses to public and the workers during the current licence period were well below the public annual whole-body regulatory dose limit of 1 mSv.[11] CNSC staff noted that the maximum effective dose to an SRC worker during the current licence period was 0.28 mSv, well below the 1 mSv regulatory dose limit.

38. CNSC staff reported that radioactive fields to which workers may be exposed during the decommissioning project were estimated to be between 0.30 µSv/h and 0.37 µSv/h. CNSC staff further submitted that, based on previous decommissioning projects, SRC established action levels[12] for the decommissioning project of 1 mSv effective dose, 50

[10] SOR/2000-203
[11] SOR/2000-203, subsection 13(1)
[12] The *Radiation Protection Regulations* define an "action level" as a specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program and triggers a requirement for specific action to be taken.

mSv for skin dose and 50 mSv for extremities. CNSC staff submitted that there would be real time monitoring of alpha, beta, and gamma radiation using Improved Chemical Agent Monitors (ICAM).

39. The Commission asked for information in regard to a concern raised by the National Council of Women of Canada with respect to the estimated collective dose for the decommissioning of the SRCSF. A Candu Energy representative responded that the total dose received by workers in the three-month duration of the U of A decommissioning was 0.26 mSv and that Candu Energy was anticipating a similar collective dose for the SRCSF decommissioning. The Candu Energy representative added that for the activities that Candu Energy had carried out at SRCSF to date (including the removal and shipment of the fuel from the reactor), the collective dose was 0.165 mSv.

40. The Commission asked SRC to opine on which decommissioning activity was considered the most hazardous from a radiological perspective. A Candu Energy representative responded that the removal of the beryllium annulus was the most hazardous activity with respect to radiation, as the beryllium annulus had to be brought up to the surface of the reactor pool and stored in a shielding container while workers were present.

41. Further on that topic, the Commission asked about what was considered to be the worst case scenario during the SLOWPOKE-2 decommissioning and what controls were in place to prevent such an accident from occurring. The Candu Energy representative responded that the worst case scenario would be a worker standing near the beryllium annulus for an extended duration of approximately four hours which would result in a regulatory dose limit for a member of the public of 1 mSv. The Candu Energy representative added that, in order to prevent this from occurring, radiation detectors to monitor radiation levels, and radiation protection personnel to monitor doses to workers, were in place. The Commission was satisfied with the information provided.

42. Following the concerns about alpha hazards expressed in the intervention from the National Council of Women of Canada, the Commission asked if alpha radiation hazards were anticipated during the decommissioning of the SRCSF and whether SRC's radiation protection program would adequately provide for protection in regard to such hazards. CNSC staff responded that, although there were alpha hazards present in the SRCSF, SRC had provisions in place such as contamination monitoring; real-time monitoring of alpha, beta, and gamma radiation; and the use of personal protective equipment such as respiratory systems and radiation protection coveralls to limit the intake of alpha particles.

43. The Commission asked for information regarding the methodology that was used to determine that five samples from the pool floor would be adequate to ensure that no contamination would be left behind in the SRCSF. A Candu Energy representative responded that the samples were to confirm the computer model prediction that provided the activity on the reactor pool floor. The Candu Energy representative added

that once the results were validated, they would know exactly how much concrete would need to be removed from the reactor pool to ensure that there will be no contamination left behind in the SRCSF.

44. Based on the information considered for this hearing, the Commission is satisfied that the ALARA concept is adequately applied to all SRCSF activities.

45. Based on the information provided on the record for this hearing, the Commission concludes that, given the mitigation measures and safety programs that are in place and will be in place to control radiation hazards, SRC provides for, and will continue to provide for, the adequate protection of the health and safety of persons and the environment throughout the decommissioning of the SRCSF.

46. The Commission is satisfied that SRC's radiation protection program at the SRCSF will continue to meet the requirements of the *Radiation Protection Regulations* during the decommissioning of the facility.

4.3 Environmental Protection

47. The Commission examined SRC's environmental protection programs at the SRCSF, which are intended to identify, control and monitor all releases of radioactive and hazardous substances, and aim to minimize the effects on the environment which may result from the licensed activities. These programs include effluent and emissions control, environmental monitoring and estimated doses to the public. CNSC staff rated SRC's performance in this SCA as "satisfactory" during the current licence period.

48. The Commission considered whether the SRCSF environmental protection programs adequately met the specifications of REGDOC-2.9.1, *Environmental Protection Policies, Programs and Procedures*.[13]

49. CNSC staff reported that SRC's environmental protection program met the requirements of the Class I Regulations and that radiological and non-radiological releases at the SRCSF remained below regulatory limits during the current licence period.

50. The Commission considered SRC's programs to control the release of effluents and emissions from the SRCSF to the environment. In its written submission, SRC submitted that the release of radioactive material was expected to be below the regulatory limits and that airborne emissions would be continuously monitored and filtered using high efficiency particulate air filters prior to being released into the environment during the decommissioning of the SRCSF.

[13] CNSC Regulatory Document REGDOC-2.9.1, *Environmental Protection Policies, Programs and Procedures*, 2013.

51. The Commission assessed SRC's programs to mitigate risk to members of the public from hazardous substances discharged from the SRCSF. CNSC staff submitted that airborne releases from the SRCSF were below regulatory limits and that the dose to the public was estimated to be 0.010 mSv as compared to the regulatory limit for the dose to a member of the public of 1 mSv. SRC submitted that it would have mitigation measures in place to ensure that airborne emissions are minimal and that operating experience had shown no instances where airborne radioactivity was detected.

52. In its written submission, SRC submitted that approximately 28,380 L of contaminated reactor pool water to be disposed of during the decommissioning process will be treated using a container water deionizer system prior to release into the City of Saskatoon sewer system. SRC further submitted that the level of activity in the pool water would be subject to CNSC release criteria as detailed in the *Nuclear Substances and Radiation Devices Regulations*[14] (NSRDR) and City of Saskatoon by-laws for hazardous substances.[15]

53. In consideration of concerns raised by the National Council of Women of Canada regarding the release of liquid waste into the City of Saskatoon sewage system, the Commission asked CNSC staff to elaborate on the type of assessment that was conducted with respect to the cumulative risks to the environment associated with SRC's liquid waste disposal proposal. CNSC staff stated that, when assessing whether liquid waste could be released into the municipal sewage system, it had to be ascertained that the waste was below the clearance levels set out in Appendix R of REGDOC-1.6.1, *Licence Application Guide: Nuclear Substances and Radiation Devices*, Version 2[16], and IAEA-TECDOC-1000, *Clearance of Materials Resulting from the Use of Radionuclides in Medicine, Industry and Research*.[17] CNSC staff further added that these clearance levels were derived to ensure that no member of the public received an annual dose of more than 0.01 mSv.

54. Based on the assessment of the application and the information provided on the record at the hearing, the Commission is satisfied that, given the mitigation measures and safety programs that are in place to control hazards, SRC will provide adequate protection to the health and safety of persons and the environment throughout the decommissioning activities.

55. The Commission is satisfied that the SRCSF environmental protection programs continue to meet the specifications of REGDOC-2.9.1.

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[14] SOR/2000-207

[15] https://www.saskatoon.ca/services-residents/power-water/water-wastewater/sewer-use-bylaw

[16] CNSC Regulatory Document REGDOC-1.6.1, *Licence Application Guide: Nuclear Substances and Radiation Devices*, Version 2

[17] INTERNATIONAL ATOMIC ENERGY AGENCY, Clearance of Materials Resulting from the Use of Radionuclides in Medicine, Industry and Research, IAEA-TECDOC-1000, IAEA, Vienna (1998).

4.4 Waste Management

56. The Commission assessed SRC's site-wide waste management program. During the current licence period, CNSC staff assessed SRC's performance in this SCA, including waste minimization, segregation, characterization, and storage programs, as "satisfactory."

57. SRC submitted that waste generated at the SRCSF could be categorized as radioactive waste, non-radioactive hazardous waste, and non-radioactive and non-hazardous waste. SRC further submitted that it has an effective waste management plan and that all waste generated during the SRCSF's decommissioning would be managed in accordance with licensing requirements.

58. SRC provided the Commission with information regarding its waste minimization strategy reporting that, in order to minimize waste, SRC would decontaminate, segregate, reuse and recycle non-radioactive waste material to the extent possible and that the remaining waste will be shipped to either a landfill disposal site or a licensed waste management facility.

59. SRC submitted that non-radioactive chemical waste would be sent to a licensed hazardous waste management facility and that demolition debris that is determined to be below the release limits would be send to a landfill that is authorized to receive the waste. SRC further submitted that all waste would be transported in accordance with the *Transportation of Dangerous Goods Regulations*.[18]

60. CNSC staff reported that SRC's Decommissioning Waste Management Plan (DWMP) met the specifications of CSA N292.3-08, *Management of low and intermediate-level radioactive waste*,[19] and N292.0-14, *General principles for the management of radioactive waste and irradiated fuel*.[20] CNSC staff submitted that SRC's DWMP and supporting documents were satisfactory and met licensing requirements.

61. SRC reported that the reactor core containing the used highly enriched uranium fuel had been transported from the SRCSF to Savannah River, South Carolina, in accordance with the Canada-US agreement to return highly enriched uranium fuel to the country of origin. SRC further reported that the fuel had been transported in accordance with a CNSC-issued transportation licence in a Type B container, specifically an F-257 flask which had been certified by the CNSC.

62. The Commission enquired as to the volume of non-radioactive hazardous waste that is expected from the proposed decommissioning project. An SRC representative responded that the amount of non-radioactive hazardous waste would be minimal, approximately three car batteries that would be sent for recycling.

[18] SOR/2001-286
[19] N292.3, *Management of low and intermediate-level radioactive waste*, CSA Group, 2008 and 2014.
[20] N292.0-14, *General principles for the management of radioactive waste and irradiated fuel*, CSA Group, 2014.

63. On an issue raised by the Concerned Citizens of Renfrew County and Area (CCRCA), that radioactive waste resulting from the decommissioning of the SRCSF would be transported to the Canadian Nuclear Laboratories (CNL) site in Chalk River, Ontario, the Commission enquired about whether SRC would have any liability in respect of the waste once the title of the waste was transferred to CNL. CNSC staff responded that once the waste has been accepted by CNL, CNL will be the owner of the waste. An SRC representative further added that SRC would not hold any long-term liability in regard to the SRCSF radioactive waste following its transfer to Chalk River Laboratories (CRL). The Commission was satisfied with the information provided.

64. Noting the interventions submitted by CCRCA, Northwatch and the National Council of Women regarding alternative decommissioning options, the Commission asked SRC if the removal of the reactor concrete pool in its entirety had been considered. A Candu Energy representative responded that the general practice in decommissioning SLOWPOKE-2 reactors is to survey and remove concrete wherever there is contamination above unconditional clearance levels as specified in the NSRDR. The Candu Energy representative added that although it was possible to remove the entire reactor pool, it is not the general practice as there is no benefit of removing concrete that is below the clearance levels.

65. On a concern raised by Nuclear Waste Waste + Inter-Church Uranium Committee Educational Cooperative (NWW – ICUCEC), the Commission requested details about Canada's regulatory framework for the decommissioning of nuclear facilities. CNSC staff responded that the high-level requirements are set out in the regulations and the policy for waste management and decommissioning is set out in Natural Resources Canada's (NRCan) *Radioactive Waste Policy Framework*[21] and CNSC regulatory document REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada*.[22] CNSC staff added that there is a Regulatory Guide G-219, *Decommissioning Planning for Licensed Activities*,[23] for decommissioning, and CNSC staff is currently in the process of developing regulatory documents for both waste management and decommissioning.

66. The Commission requested information on the concerns expressed by NWW + ICUCEC, Northwatch and CCRCA that the U of A SLOWPOKE-2 reactor was abandoned without having removed all the radiological hazards. A Candu Energy representative responded that the initial post-decommissioning measurements had shown that radiological hazards were still present and that further decontamination had to be done. CNSC staff confirmed this to be the case and reported that, when CNSC staff carried out the final surveys as part of the end-state inspection, dose rates were below the industry standard clearance level of 0.5 µSv/hour.

[21] Retrieved from https://www.nrcan.gc.ca/energy/energy-sources-distribution/uranium-nuclear-energy/radioactive-waste/radioactive-waste-policy-framework/7725
[22] CNSC Regulatory Document REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada*, 2018.
[23] CNSC Guidance Document G-219, *Decommissioning Planning for Licensed Activities*, 2000.

67. The Commission notes the concerns raised by intervenors with respect to the abandonment of the U of A reactor facility and their uncertainty concerning the unconditional release levels at the time of abandonment of that facility. The Commission authorized the U of A to abandon its facility upon receipt of its application and the evidence that it had met the regulatory requirements. When SRC has completed its decommissioning activities, any licence application it makes to be authorized to abandon will be subjected to the same regulatory requirements. The Commission will require evidence to satisfy itself, before making a decision, of the completion of satisfactory decommissioning. That is not the subject of this application.

68. On an issue raised by Northwatch regarding the terminology used to describe the decommissioning of the SLOWPOKE-2 reactor, the Commission asked staff to clarify whether the proposed decommissioning project could be referred to as "entombment" or "*in situ* waste disposal". CNSC staff responded that, as per international standards that speak to all options of decommissioning, "*in situ*" refers to leaving the reactor in place and that the decommissioning of the SRCSF could not be defined as "*in situ* waste disposal" as there will be no parts of the reactor left behind and the facility will be free of contamination. The Commission is satisfied with this information and does not consider the proposed decommissioning of the SRCSF to be an "*in situ* waste disposal" or "entombment."

69. The Commission enquired as to how SRC would treat the liquid waste in the event that it is still radioactive after passing through the ion exchange column. An SRC representative stated that the radioactivity in the liquid waste has already been brought down to the unconditional release limits. A Candu Energy representative added that SRC had a backup ion exchange column that was always available in the event that the water had to be further processed in order to meet the release limits. The Commission was satisfied with the information provided.

70. Noting the concerns raised by the Nation Council of Women of Canada about the disposal of non-radioactive liquid waste in the City of Saskatoon's landfill and municipal sewage system, the Commission enquired about the consultation that SRC had carried out with the City of Saskatoon in regard to sending non-radioactive waste materials to landfills and the sewage system. An SRC representative responded that SRC maintained an ongoing discussion with the City of Saskatoon on these issues.

71. On a concern raised by Northwatch, the Commission asked for clarification as to the criteria for the classification of radioactive waste as low or intermediate level. CNSC responded that there are a number of considerations that need to be taken into account when characterizing waste, such as the radioisotope and the decay scheme. CNSC staff added that upon reviewing SRC's application to amend, some inconsistencies were found and were taken back to the licensee to address.

72. The Commission expressed concern as to whether processes are in place to ensure that waste is adequately characterized given the presence of hard to measure radionuclides. CNSC staff responded that waste is characterized based on the waste receivers' acceptance criteria and also in accordance with CSA N292.0-14. A Candu Energy representative responded that the presence of radionuclides in waste resulting from the SRCSF decommissioning had been estimated using an industry standard computation code and that the estimates would be validated as measurements were taken during the decommissioning process.

73. Further on that topic, the Candu Energy representative added that, although not all the radionuclides such as Nickel-59, Tritium, and Calcium-41 had been measured, the ones that were measured contributed to approximately 99% of the radionuclides with respect to the unconditional release limit. During the hearing, the Commission did not receive satisfactory confirmation that the waste would be adequately characterized and anticipates that reliable data will be available upon conducting decommissioning activities. Should SRC submit an application to abandon the SRCSF, the detailed waste characterization data and a confirmation of the accuracy of the estimates will be required to be submitted by SRC, and reviewed by CNSC staff.

74. The Commission enquired about the assessment that institutional control for the decommissioned SRCSF would not be required. CNSC staff responded that, because the proposed decommissioning strategy is for complete decommissioning, the SRCSF would be cleaned to below the unconditional release limits and therefore no CNSC regulatory control would be required, if the strategy materializes.

75. Based on the above information and consideration of the hearing materials, the Commission is satisfied that, according to SRC's decommissioning plans, there will be no waste left at the SRCSF and that SRC has appropriate programs in place to safely characterize and manage the waste generated at the SRCSF as part of decommissioning.

4.5 Packaging and Transport

76. The Commission examined SRC's packaging and transport program. Packaging and transport covers the safe packaging and transport of nuclear substances and radiation devices to and from the licensed facility. The licensee must adhere to the *Packaging and Transport of Nuclear Substances Regulations* 2015 (PTNSR, 2015).[24] and Transport Canada's *Transportation of Dangerous Goods Regulations* for all shipments. During the licence period, CNSC staff rated SRC's performance in this SCA as "satisfactory."

[24] SOR/205-145

77. On a concern raised by the Northwatch regarding the education and training for first responders, the Commission asked CNSC staff to comment on the training provided to first responders along the transportation route of radioactive waste, specifically, the rural and remote areas along the route. CNSC staff responded that all first responders in Canada receive HAZMAT training which includes radioactive material emergency management training. CNSC staff added that an emergency number through which any necessary information on the specific material being transported could be obtained in the event of emergency was required to be included in shipping documents. CNSC staff also stated that the CNSC has a duty officer and Transport Canada had the Canadian Transport Emergency Centre (CANUTEC) which are available at all times to provide technical information and guidance in the event of an emergency.

78. Noting that approximately 8 m^3 of radioactive waste would be generated through the decommissioning of the SRCSF, the Commission enquired as to how many shipments of radioactive waste would be sent to CRL. An SRC representative responded that it would be a single shipment of three Type A packages.

79. Based on the information presented on the record for this hearing, the Commission is satisfied that SRC is meeting, and will continue to meet, regulatory requirements regarding packaging and transport of waste generated during the decommissioning of the SRCSF.

4.6 Indigenous Engagement and Public Information

4.6.1 Participant Funding Program

80. The Commission assessed the information provided by CNSC staff regarding public engagement in the licensing process as enhanced by the CNSC's Participant Funding Program (PFP). CNSC staff submitted that, in June 2019, up to $15,000 in funding to participate in this licensing process was made available to Indigenous groups, members of the public and other stakeholders to review SRC'S licence amendment application and associated documents, and to provide the Commission with value-added information through topic-specific interventions.

81. A Funding Review Committee (FRC), independent of the CNSC, recommended that two applicants be provided with up to $15,000 in participant funding. These applicants were required, by virtue of being awarded participant funding, to submit a written intervention and to make an oral presentation at the public hearing on SRC's licence amendment application.

82. Based on the information submitted for this hearing, the Commission is satisfied that Indigenous groups, members of the public and other stakeholders were encouraged to participate in this process.

4.6.2 Indigenous Engagement

83. The common law duty to consult with Indigenous peoples applies when the Crown contemplates action that may adversely affect established or potential Aboriginal and/or treaty rights. The CNSC, as an agent of the Crown and as Canada's nuclear regulator, recognizes and understands the importance of building relationships and engaging with Canada's Indigenous peoples. The CNSC ensures that its licensing decisions under the NSCA uphold the honour of the Crown and consider Indigenous peoples' potential or established rights pursuant to section 35 of the *Constitution Act, 1982*.[25]

84. CNSC staff submitted that, because the proposed decommissioning activities would be conducted within the facility with no adverse impact to the surrounding environment, the duty to consult does not arise with respect to the proposed licence amendment. CNSC staff further submitted that the proposed activities would not have an impact on potential or established Indigenous and/or treaty rights.

85. Noting the concerns expressed about the impacts on Indigenous groups along the transportation route to CRL, the Commission enquired about the duty to consult with Indigenous communities in relation to this activity. CNSC staff submitted that the transportation of radioactive materials is heavily regulated and safety during transport is inherent in the CNSC's packaging and certification process which is based in accordance with the PTNSR, 2015. CNSC staff added that although they are of the opinion that there was no impact to Indigenous community or treaty rights along the route, participant funding had been offered. No request from Indigenous communities for funding had been made.

86. Based on the information provided for this hearing, the Commission is satisfied that Indigenous engagement activities carried out for this licence amendment were adequate.

4.6.3 Public Information

87. The Commission assessed SRC's public information and disclosure program (PIDP) for the SRCSF. A public information program is a regulatory requirement for licence applicants and licensed operators of Class I nuclear facilities. Paragraph 3(j) of the *Class I Nuclear Facilities Regulations*[26] requires that licence applications include

> "the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed."

[25] *Constitution Act, 1982*, Schedule B to the *Canada Act 1982*, 1982, c. 11 (U.K.).
[26] SOR/2000-204.

88. The Commission also assessed how SRC's PIDP met the specifications of RD/GD-99.3, *Public Information and Disclosure*[27]. SRC provided the Commission with information regarding its PIDP including the mechanisms in place to provide the public information related to its operations and a dedicated web page for the decommissioning of the SRCSF. CNSC staff informed the Commission that SRC has undertaken a number of initiatives in support of its PIDP and added that there has been a very low level of public interest regarding the decommissioning of the SRCSF.

89. SRC submitted that it held a public meeting on December 5, 2018 to provide information to the public about its decommissioning plans and answer any questions that may arise. SRC further submitted that the interest from the public was minimal and that it would continue to share information via newsletters and invite members of the public to submit comments or concerns.

90. The Commission requested additional details about the public information forum held at the SRCSF on December 5, 2018, including attendance and the concerns that were raised. An SRC representative responded that approximately seven people came to the information forum, representing various groups and SRC's stakeholders, and that the concerns were similar to the concerns raised by intervenors in this hearing.

91. In consideration of a concern raised by NWW + ICUCEC, the Commission asked CNSC staff if there were lessons learned reports for the previous SLOWPOKE-2 decommissioning projects and if they were publicly available. CNSC staff responded that the lessons learned were a section of the end-state report that the licensee must submit upon the completion of decommissioning and that they were available to the public upon request. CNSC staff added that the end state reports for previous decommissioning projects were available, with the exception of University of Toronto, and that the lessons learnt from the University of Toronto decommissioning project were implemented in other projects such as the increased shielding of the beryllium package. An SRC representative reported that Candu Energy had conducted the decommissioning of the U of A and lessons learned from previous decommissioning projects were incorporated into the work plans developed for the decommissioning of the SRC SLOWPOKE-2 reactor. The Commission was satisfied with the information provided.

92. Based on the information presented for this hearing, the Commission is satisfied that SRC's PIDP has and will continue to communicate to the public, information about the health, safety and security of persons and the environment and other issues. This will continue throughout the decommissioning of the SRCSF.

93. Recognizing that parts of the end-state report may contain commercially sensitive information, and in anticipation of interest, the Commission expects that SRC share the publicly available portions of the end-state report with interested stakeholders if requested upon completion of the decommissioning project.

[27] CNSC Regulatory Guidance Document RD/GD-99.3, *Public Information and Disclosure*, 2012.

4.6.4 Conclusion on Indigenous Engagement and Public Information

94. Based on the information presented, the Commission is satisfied that, overall, SRC's PIDP meets regulatory requirements and is effective in keeping Indigenous groups and the public informed of SRC's operations.

95. Based on the information presented on the record for this hearing, the Commission is satisfied that this licence amendment will not result in changes to SRC's operations that would cause adverse impacts to any potential or established Indigenous and/or treaty rights.

4.7 Decommissioning Plans and Financial Guarantee

96. The Commission requires SRC to have a detailed decommissioning plan for the decommissioning of the SRC SLOWPOKE-2 facility and a long-term management plan for waste produced from the project. In order to ensure that adequate resources are available for safe and secure decommissioning of the SRCSF, the Commission requires that an adequate financial guarantee for realization of the planned activities is put in place and maintained in a form acceptable to the Commission throughout the licence period.

97. As part of the licence amendment application, SRC submitted a Detailed Decommissioning Plan (DDP) which describes the decommissioning process for the SRCSF and the measures in place to ensure that the public and the environment are protected during the decommissioning project. CNSC staff reported that the DDP was assessed against the requirements of CNSC Regulatory Guide G-219, *Decommissioning Planning for Licensed Activities* and CSA N294-09: *Decommissioning of Facilities Containing Nuclear Substances*[28] and CNSC staff found it to be acceptable.

98. CNSC staff submitted that SRC's activities that are authorized under the operating licence included defueling the reactor, maintenance of the reactor, and transport of spent fuel and radioactive waste. CNSC staff further submitted that the defueling of the SLOWPOKE-2 reactor had been subject to a CNSC inspection in which inspectors from the International Atomic Energy Agency (IAEA) participated and found no regulatory non-compliances.

99. The Commission asked for clarification in regard to the financial guarantee that SRC has in place for the decommissioning of the SRCSF. CNSC staff submitted that SRC has in place a financial guarantee in the amount of $5,760,000, which will be used towards decommissioning and that the SRC's Board of Directors had approved expenditures in the amount of up to $7,500,000. An SRC representative responded that the current financial guarantee in place was in the form of a trust fund for the amount of $7,500,000 approved by the SRC Board of Directors and accepted by the CNSC.

[28] N294-09 (R2014), *Decommissioning of facilities containing nuclear substances*, CSA Group, reaffirmed in 2014.

The SRC representative added that the decommissioning work would be funded out of SRC's operating budget of $ 5,760,000 and that the trust fund in place would be released to the SRC upon successful decommissioning and final approval from the Commission.

100. Based on the record, the Commission concludes that the detailed decommissioning plan and related financial guarantee for the SRCSF are acceptable for the purpose of the current application for licence amendment.

5.0 CONCLUSION

101. The Commission has considered the amendment application submitted by the SRC. Based on its consideration of the information submitted, the Commission is satisfied that the application meets the requirements of the NSCA, the GNSCR and other applicable regulations made under the NSCA.

102. The Commission has also considered the information and submissions of the applicant, CNSC staff and all participants as set out in the material available for reference on the record, as well as the oral presentations made by the participants at the hearing.

103. The Commission is satisfied that SRC meets the test set out in subsection 24(4) of the *Nuclear Safety and Control Act*. That is, the Commission is of the opinion that SRC is qualified to carry on the decommissioning activity that the amended licence will authorize and that it will make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

104. Therefore, the Commission, pursuant to section 24 of the *Nuclear Safety and Control Act*, amends the Non-Power Reactor Operating Licence issued to the Saskatchewan Research Council for its facility located in Saskatoon, Saskatchewan. The amended licence, NPROL-19.01/2023, is valid until June 30, 2023.

105. The Commission amends Part IV a) of SRC's licence as recommended by CNSC staff in CMD 19-H100, to authorize it to decommission the SRCSF.

106. The Commission would like to note that this decision does not authorize abandonment. Should SRC apply for a licence to abandon, this will be the subject of a different proceeding.

107. The Commission anticipates that, following its decision in this matter, CNSC staff will update SRC's Licence Conditions Handbook (LCH) to include references to the Detailed Decommission Plan (DDP) and other documents as presented during this hearing.

108. The Commission considers the environmental protection review that was conducted by CNSC staff to be acceptable and thorough. The Commission is satisfied that an EA under CEAA 2012 was not required for the SRCSF licence amendment application and notes that the NSCA provides a strong regulatory framework for environmental protection.

109. The Commission anticipates that, following its decision in this matter, CNSC staff will update SRC's Licence Conditions Handbook (LCH) to include references to the Detailed Decommission Plan (DDP) and other documents as presented during this hearing. A draft amended LCH was not included in the hearing materials following usual practice; CNSC will update it following this decision.

R Velshi Dec 6, 2019

Rumina Velshi Date
President,
Canadian Nuclear Safety Commission

Appendix A – Intervenors

Intervenors – Oral Presentations	Document Number
Concerned Citizens of Renfrew County and Area, represented by O. Hendrickson	CMD 19-H100.5 CMD 19-H100.5A
National Council of Women of Canada, represented by G. Janes	CMD 19-H100.2
Nortwatch, represented by B. Lloyd	CMD 19-H100.6 CMD 19-H100.6A
Nuclear Waste Watch and Inter-Church Uranium Committee Educational Cooperative, represented by J. Karban	CMD 19-H100.8 CMD 19-H100.8A

Intervenors – Written Interventions	Document Number
Elaine Hughes	CMD 19-H100.3
Linda Murphy	CMD 19-H100.4
North American Young Generation in Nuclear	CMD 19-H100.7

Appendix B
THE AMENDED NON-POWER REACTOR OPERATING LICENCE

Canadian Nuclear Safety Commission / Commission canadienne de sûreté nucléaire

Word Ref: e-Doc 5899570
PDF Ref: e-Doc 5905832
File: 2.03

NON-POWER REACTOR OPERATING LICENCE
SLOWPOKE-2 REACTOR

SASKATCHEWAN RESEARCH COUNCIL

I) **LICENCE NUMBER:** **NPROL-19.01/2023**

II) **LICENSEE:** Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to

Saskatchewan Research Council
15 Innovation Boulevard
Saskatoon, Saskatchewan
S7X 0X1

III) **LICENCE PERIOD:** This licence is valid from **July 1, 2013**, to **June 30, 2023**, unless otherwise suspended, amended, revoked, or replaced.

IV) **LICENSED ACTIVITIES:**

This licence authorizes the licensee to:

(a) operate and decommission the Saskatchewan Research Council SLOWPOKE-2 reactor and associated facilities (hereinafter "the facility"), located in the Analytical and Radiochemical Laboratory of the Council in the Innovation Place Research Park, in Saskatoon, Saskatchewan;

(b) produce, possess, transfer, use, package, manage, and store the nuclear substances that are required for, associated with or arise from the activities described in (a); and

(c) possess and use prescribed equipment and prescribed information required for, associated with or arise from the activities described in (a).

V) EXPLANATORY NOTES:

(a) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.

(b) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* (hereinafter "NSCA") and associated regulations.

(c) The Saskatchewan Research Council Licence Conditions Handbook (hereinafter "SRC-LCH") provides

(i) compliance verification criteria in order to meet the conditions set out in this licence;
(ii) information regarding delegation of authority to CNSC staff; and
(iii) applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria.

VI) CONDITIONS:

1. GENERAL

1.1 The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis for the facility, unless otherwise approved in writing by the Commission.

1.2 The licensee shall give written notification of changes made to the licensee documents submitted to support the licence application.

1.3 The licensee shall maintain a preliminary decommissioning plan for the facility, and shall review and revise the plan at such times as the Commission may require and in any event, no later than ten years from previous revision.

1.4 The licensee shall maintain in effect a financial guarantee for decommissioning of facility that is acceptable to the Commission. The licensee shall report annually that the financial guarantee is valid and in effect.

1.5 The licensee shall implement and maintain a public information program including a public disclosure protocol.

1.6 The licensee shall, in the event of any conflict or inconsistency between licence conditions, codes or standards or regulatory documents used as compliance verification criteria in the SRC-LCH, refer the matter to the Commission for resolution.

2. MANAGEMENT SYSTEM

2.1 The licensee shall implement and maintain a management system for activities carried out under this licence.

3. HUMAN PERFORMANCE MANAGEMENT

3.1 The licensee shall ensure that persons appointed to the positions of reactor engineer, reactor technician, or reactor operator hold certifications in accordance with the requirements of the NSCA.

3.2 The licensee shall establish and maintain a training program for certified persons.

4. OPERATING PERFORMANCE

4.1 The licensee shall operate the facility subject to the terms and conditions of this licence and within the limits specified in Appendix A to this licence.

4.2 The licensee shall maintain an accurate inventory of their sealed sources, both in use and in storage, and provide details of this inventory when requested.

4.3 The licensee shall report to the Commission unplanned situations or events at the facility.

4.4 The licensee shall submit annual compliance monitoring and operational performance reports to the Commission.

5. SAFETY ANALYSIS

5.1 The licensee shall conduct and maintain safety analyses that are representative for the current hazards of the facility or process analyzed.

6. PHYSICAL DESIGN

6.1 The licensee shall ensure that the defence-in-depth principle is applied and maintained in the design of the nuclear facility in order to prevent, or if prevention fails, to mitigate the consequences resulting from radioactive releases.

7. FITNESS FOR SERVICE

7.1 The licensee shall develop, implement and maintain documented programs of maintenance, testing, surveillance, and inspection of structures, systems and components important to safety to ensure that their availability, reliability and functionality remain in accordance with the design over the lifetime of the facility.

7.2 The licensee shall develop, implement and maintain an aging management program for the facility to identify all aging mechanisms relevant to structures, systems and components important to safety; to evaluate their possible consequences; and to provide direction for the activities required to maintain the operability and reliability of these structures, systems and components.

8. RADIATION PROTECTION

8.1 The licensee shall implement and maintain a radiation protection program which includes action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

9. CONVENTIONAL HEALTH AND SAFETY

9.1 The licensee shall implement and maintain an occupational health and safety program at the facility.

10. ENVIRONMENTAL PROTECTION

10.1 The licensee shall control, monitor and record releases of radioactive nuclear substances and hazardous substances from the facility.

11. EMERGENCY MANAGEMENT AND FIRE RESPONSE

11.1 The licensee shall implement and maintain an emergency management program to prepare for and respond to emergency events, including fires, initiating at or impacting the facility, and for dealing with the effects of such emergencies both in the facility and outside the facility.

12. WASTE MANAGEMENT

12.1 The licensee shall implement and maintain a waste management program documenting handling, processing, transportation, storage and disposal of nuclear wastes, including nuclear wastes mixed with other hazardous substance.

e-Doc 5899570 (Word)
e-Doc 5905832 (PDF)

13. SECURITY

13.1 The licensee shall implement and maintain a nuclear security program to prevent persons from carrying out malevolent actions capable of affecting the safe operation of the facility.

14. SAFEGUARDS AND NON-PROLIFERATION

14.1 The licensee shall implement and maintain safeguards measures required to ensure safeguards implementation at the facility.

15. PACKAGING AND TRANSPORT

15.1 The licensee shall implement and maintain a program for the packaging and transport of nuclear substances.

SIGNED at OTTAWA, this 6th day of December, 2019.

Rumina Velshi, President
on behalf of the Canadian Nuclear Safety Commission

e-Doc 5899570 (Word)
e-Doc 5905832 (PDF)

APPENDIX A

Operating Limits

1. The licensee shall ensure that the total thermal power from the reactor fuel does not exceed 20 kilowatts under steady-state operating conditions.

2. The licensee shall ensure that the maximum excess reactivity of the reactor does not exceed 4.0 mk.

3. The licensee shall not operate the reactor at neutron flux levels exceeding 1.05×10^{12} n cm^{-2} s^{-1}, except that while increasing power under automatic control a peak power of no more than 1.4×10^{12} n cm^{-2} s^{-1} may be permitted for a time of no more than one minute.

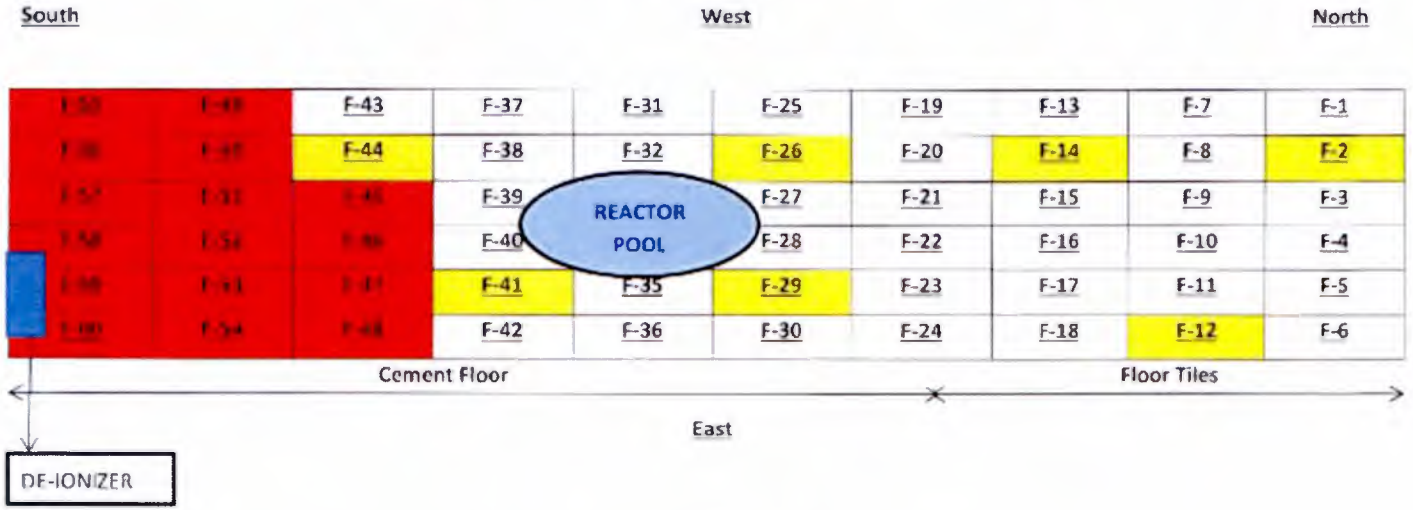
4. The licensee shall not allow the reactor to contain more than 300 finished SLOWPOKE-2 fuel elements except otherwise approved in writing by the Commission. The total amount of uranium-235 in the reactor shall not exceed 0.95 kg. The fuel elements shall consist of only an uranium-aluminum alloy containing 28% by weight uranium and the uranium enriched to no more than 95% by weight uranium-235.

5. The facility may contain sealed sources of uranium-235 for use as testing or calibration devices. The licensee shall ensure that no sealed source contains more than 1.0 grams of uranium-235.

Appendix C
SUMMARY OF BASELINE RADIOLOGICAL SURVEYS

Floor Plan Of Reactor, Rm #146 Baseline Survey 2019-07-22

Squares chosen for baseline survey will be in yellow with results shown below.
Squares are actually 1 metre²



For squares coloured red; De-ionizer increases background counts for floor squares F-45 to F-60.

F-2: Bkgd α 1cpm β 201cpm, D/C α 0cpm β 0cpm, O/S α 0cpm β 0cpm
F-12: Bkgd α 0cpm β 206cpm, D/C α 0cpm β 0cpm, O/S α 0cpm β 0cpm
F-14: Bkgd α 0cpm β 223cpm, D/C α 0cpm β 0cpm, O/S α 0cpm β 0cpm
F-26: Bkgd α 1cpm β 238cpm, D/C α 0cpm β 62cpm, O/S α 0cpm β 0cpm
F-29: Bkgd α 2cpm β 228cpm, D/C α 0cpm β 92cpm, O/S α 0cpm β 0cpm
F-41: Bkgd α 0cpm β 241cpm, D/C α 0cpm β 88cpm, O/S α 0cpm β 0cpm
F-44: Bkgd α 1cpm β 400cpm (affected by de-ionizer gamma), D/C α 0cpm β 27cpm, O/S α 2cpm β 0cpm

Bkgd = Background of 2360 (4393), D/C = Direct Check, O/S = On Swipe. All counts are net counts, (gross counts – Bkgd counts)
Ludlum 2929 Bkgd α = 1cpm β = 55cpm

West Wall Of Reactor Room, Rm #146 Baseline Survey 2019-07-22

Squares chosen for baseline survey will have results printed in the square
Squares are 1 metre^2

South End

North End

			WW-21	WW-18	WW-15	WW-12	WW-9	WW-6 Bkgd α 0cpm β 246cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm	WW-3
			WW-20 Bkgd α 1cpm β 244cpm D/C α 2cpm β 61cpm O/S α 0cpm β 0cpm	WW-17	WW-14	WW-11 Bkgd α 1cpm β 215cpm D/C α 0cpm β 60cpm O/S α 0cpm β 0cpm	WW-8	WW-5	WW-2 Bkgd α 0cpm β 219cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm
			WW-19	WW-16	WW-13	WW-10	WW-7	WW-4	WW-1

Bkgd = Background of 2360 (4393), D/C = Direct Check, O/S = On Swipe
Ludlum 2929 Bkgd α=0cpm, β=65cpm
All counts are net counts, (Gross counts – Bkgd counts)
Squares in red, WW-22 to WW-30, are too close to the de-ionizer where the dose rate pushes up the Bkgd too much.

North Wall Of Reactor Room, Rm #146 Baseline Survey 2019-07-22

Squares chosen for baseline survey will have results printed in the square

Squares are 1 metre^2

West

East

NW-3	NW-6	NW-9	NW-12	NW-15	NW-18
NW-2	NW-5 Bkgd α 0cpm β 191cpm D/C α 1cpm β 28cpm O/S α 0cpm β 0cpm	NW-8	NW-11	NW-14	NW-17
NW-1	NW-4	NW-7	NW-10	NW-13 Bkgd α 1cpm β 209cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm	NW-16

Bkgd = Background of 2360 (4393), D/C = Direct Check, O/S = On Swipe

Ludlum 2929 Bkgd α=0cpm, β=65cpm

All counts are net counts, (Gross counts – Bkgd counts)

East Wall Of Reactor Room, Rm #146 Baseline Survey 2019-07-22

Squares chosen for baseline survey will have results printed in the square

Squares are 1 metre^2

North End

EW-3	EW-6	EW-9	EW-12 Bkgd α 0cpm β 201cpm D/C α 1cpm β 68cpm O/S α 2cpm β 0cpm	EW-15	EW-18	EW-21			
EW-2	EW-5	EW-8 Bkgd α 1cpm β 241cpm D/C α 1cpm β 0cpm O/S α 0cpm β 0cpm	EW-11	EW-14	EW-17	EW-20 Bkgd α 1cpm β 233cpm D/C α 2cpm β 37cpm O/S α 0cpm β 0cpm			
EW-1 Bkgd α 1cpm β 184cpm D/C α 2cpm β 33cpm O/S α 0cpm β 0cpm	EW-4	EW-7	EW-10	EW-13	EW-16	EW-19			

South End

Bkgd = Background of 2360 (4393), D/C = Direct Check, O/S = On Swipe

Ludlum 2929 Bkgd α=0cpm, β=65cpm

All counts are net counts, (Gross counts – Bkgd counts)

Squares in red, EW-22 to EW-30, are too close to the de-ionizer where the dose rate pushes up the Bkgd too much.

Surveyed by Roger Rees 2019-07-24

Internal Radiological Survey Of Fumehood (Rm 144)

Direct Check Using 2360 with 4393 Detector (background β186cpm α 1cpm) Net Counts

- Bottom - α 1cpm, β 0cpm
- Right side - α 1cpm, β 0cpm
- Left side - α 1cpm, β 0cpm
- Back - α 0cpm, β 0cpm
- Top - α 0cpm, β 4cpm
- Vent - α 8cpm, β 47cpm
- Inner glass - α 0cpm, β 0cpm

Indirect Check Counted with Ludlum 2929 (background β 55cpm α 0cpm Net Counts

- Bottom - α 6cpm, β 0cpm
- Right side - α 1cpm, β 0cpm
- Left side - α 2cpm, β 11cpm
- Back - α 2cpm, β 12cpm
- Top - α 2cpm, β 10cpm
- Vent - α 5cpm, β 4cpm
- Inner glass - α 1cpm, β 0cpm

Surveyed by Roger Rees 2019-07-22 to 2019-07-27

Survey of Zones 1 and 2

Zone 1 Rooms 139, 140, 141, 142.1, 142.2, 147 and 147.1

- Bkgd of 4393 α 0cpm β 162cpm, Bkgd of 2929 α 0cpm β 53cpm
- Direct and indirect checks of benches carried out using Ludlum instruments 2360 with 4393 and 2929.
- Random spot direct checks carried out of the floor.
- 5M^2 areas of floor surface indirect checked by Masslinn mop.
- Gamma survey carried out at zone boundaries and throughout zone using Bot P-200 with SM305 probe.

Results

- Direct checks = Nothing noted above background for α or β
- Indirect checks = Nothing noted above background levels for α or βγ
- Masslinn mop of floors = Nothing noted above background levels for α or β
- Random spot checks of floors (direct check) = Nothing above background levels for α or β
- Highest recorded gamma level noted = 0.03mrem/h

Zone 2 Rooms 143,144,145

- Bkgd of 4393 1 0cpm β 197cpm, Bkgd of 2929 α 0cpm β 47cpm
- Direct and indirect checks of benches carried out using Ludlum instruments 2360 with 4393 and 2929.
- Random spot direct checks carried out of the floor.
- 5M^2 areas of floor surface indirect checked by Masslinn mop.
- Gamma survey carried out at zone boundaries and throughout zone using Bot P-200 with SM305 probe

Results

- Direct checks = Nothing noted above background for α or β
- Indirect checks = Nothing noted above background levels for α or βγ
- Masslinn mop of floors = Nothing noted above background levels for α or β
- Random spot checks of floors (direct check) = Nothing above background levels for α or β
- Highest recorded gamma level noted = 0.04mrem/h

Appendix D
SUMMARY OF END STATE RADIOLOGICAL SURVEYS

Final Surveys For SLOWPOKE Reactor at Saskatchewan Research Council, Saskatoon

The following tables are the results of the final release surveys carried out following the decommissioning of the SLOWPOKE reactor situated at: 422 Downey Rd, Saskatoon, SK S7N 4L8, on the campus of the University of Saskatchewan.

Reactor Room (Zone 3)

Surveys were done over a period of 2 weeks, 2020-02-24 to 2020-03-06, and incorporated the Reactor Room (room #146) walls, floor, and the empty reactor pool wall and floor. Walls were gridded out in squares of $1m^2$, as mandated, and the tables are a direct visual representation of each wall, floor etc. and the squares as they are drawn on the wall. The information inside each square is the final release survey results of that individual square. Crane, manlift and vents above as well as the roof vents have been confirmed free of contamination and radiation.

Zone 2 Rooms

The Uranium Analysis Lab (room#143), Gamma Spectroscopy Lab (room#144), and the Sample Storage Room (room#145) were also surveyed for release and the results will be presented in a separate table. These rooms were not mandated to be gridded in the same fashion as Rm #146.

Instruments Used

- **Fixed Contamination:** Ludlum 2360 rate meter using 4293 detector. Detects alpha and beta. Portable hand held instrument.
- **Loose Contamination:** Ludlum 2929 dual scaler with a 43-10-6 detector. Swipes of areas/items that are suspected of being contaminated are placed in the detector and counted.
- **Gamma:** Bot P200 meter using a SM 305 low range detector. This is a hand held instrument.

Survey Sheet Key

Example of one square:

Square Number

Bkgd = Result in counts per minute (cpm) of a 1 minute background count of 4393 fixed contamination instrument.

D/C = Direct Check . Use 4393 to survey square and perform a one minute count on area of with the highest reading. Record net counts (in cpm). Net counts are the counts left after background is subtracted.

O/S = On Swipe. Result of the swipe used on the square after being counted for 1 minute on the Ludlum 2929. Recorded in cpm (net counts) Swipes area = $100cm^2$

γ = Highest gamma reading, 1cm, near contact from surfaces being surveyed. Recorded in millirem per hour (mrem/h).

Uranium Analysis Lab (room#143), Gamma Spectroscopy Lab (room#144), and the Sample Storage Room (room#145) Survey Results

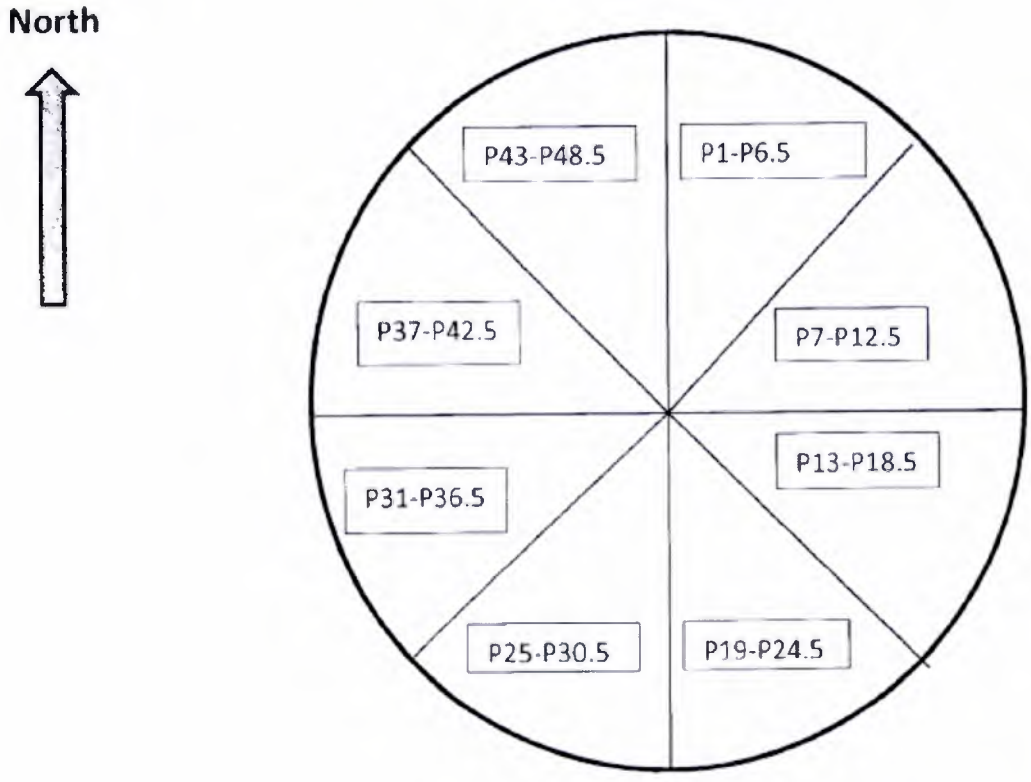
- Swipes (100cm^2) were taken on all surfaces of benches, fumehood (internal and external), cupboards, doors, walls, and floor.
- Direct checks were also performed on these surfaces.
- Gamma, near contact, dose checks were carried out on these surfaces as well as a general field measurement taken.
- Net activity is as follows. Highest D/C = α 2cpm, β 23cpm. Highest swipe counted = α 1cpm, β 9cpm. Highest γ dose rate = 0.02mrem/h. γ general field = background (0.02 to 0.03mrem/h)

Background Levels During Survey and Swipe Counting

Ludlum 2929 - α 0cpm, β 48cpm
Ludlum 4393 - α 1cpm, β 157cpm
Bot P200 - γ 0.00 to 0.04mrem/h

Surveyor Sign Off

[redacted]



Plan View of Reactor Pool Hole:

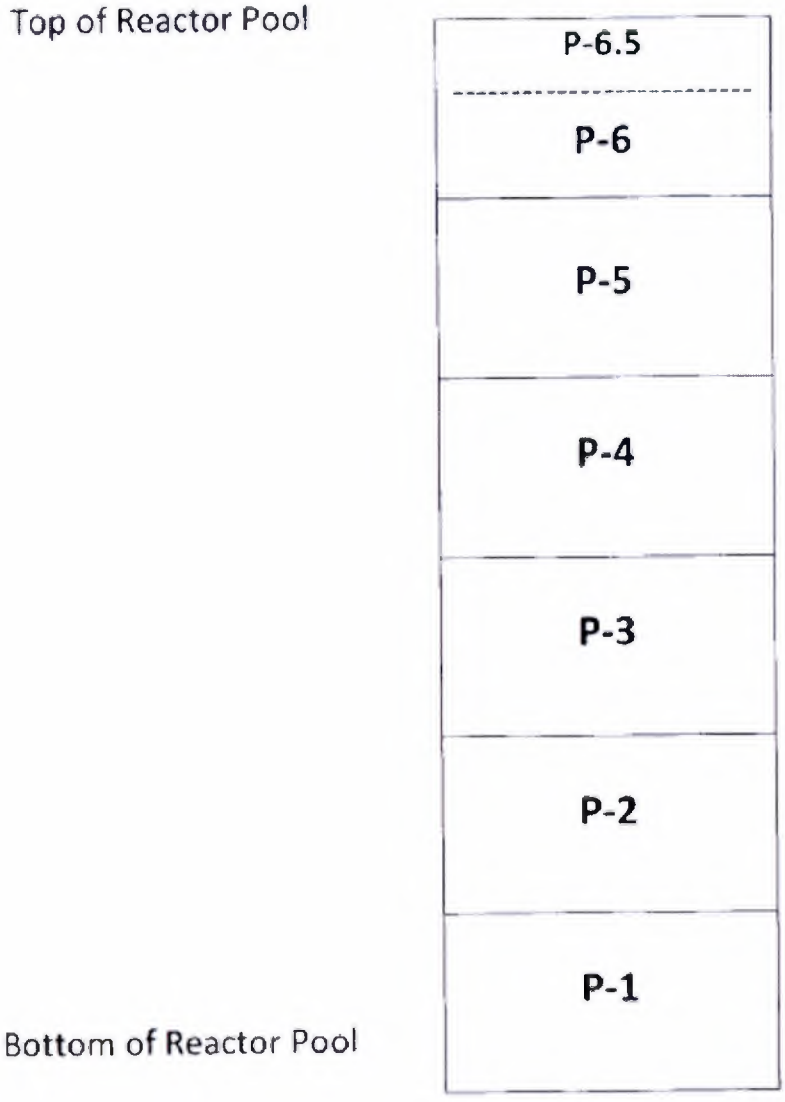
- Segments showing where grid numbers will be located within the Reactor Pool Hole.

LOCATION	Bkgd (4393)cpm		D/C (net)cpm		O/S (net)cpm		Gamma mrem/h
	α	β	α	β	α	β	
P-1	0	165	0	15	0	35	0.00
P-2	0	143	0	9	1	0	0.02
P-3	0	173	0	0	1	21	0.01
P-4	0	169	2	0	0	2	0.04
P-5	1	151	0	12	0	2	0.02
P-6	0	165	2	1	0	0	0.01
P-6.5	1	169	0	8	0	5	0.02
P-7	0	163	0	14	0	10	0.01
P-8	1	157	0	0	0	6	0.01
P-9	0	145	1	0	0	18	0.04
P-10	0	143	1	0	0	10	0.03
P-11	0	154	0	0	1	1	0.03
P-12	0	157	0	0	0	2	0.01
P-12.5	1	157	0	1	0	1	0.03
P-13	0	163	0	0	0	0	0.00
P-14	2	164	0	4	0	0	0.02
P-15	0	159	0	0	0	4	0.02
P-16	0	155	0	0	0	7	0.04
P-17	0	146	0	2	0	14	0.01
P-18	0	137	0	0	1	19	0.02
P-18.5	0	145	1	0	0	0	0.01
P-19	0	167	0	0	0	6	0.03
P-20	1	163	0	0	0	6	0.00
P-21	0	163	2	0	0	25	0.01
P-22	1	149	1	3	0	0	0.01
P-23	2	148	1	0	0	5	0.04
P-24	0	163	0	0	0	11	0.02
P-24.5	0	161	0	2	0	0	0.02
P-25	0	149	0	11	0	0	0.02
P-26	0	144	1	0	0	9	0.04
P-27	1	153	2	16	0	21	0.01
P-28	1	158	2	0	0	0	0.02

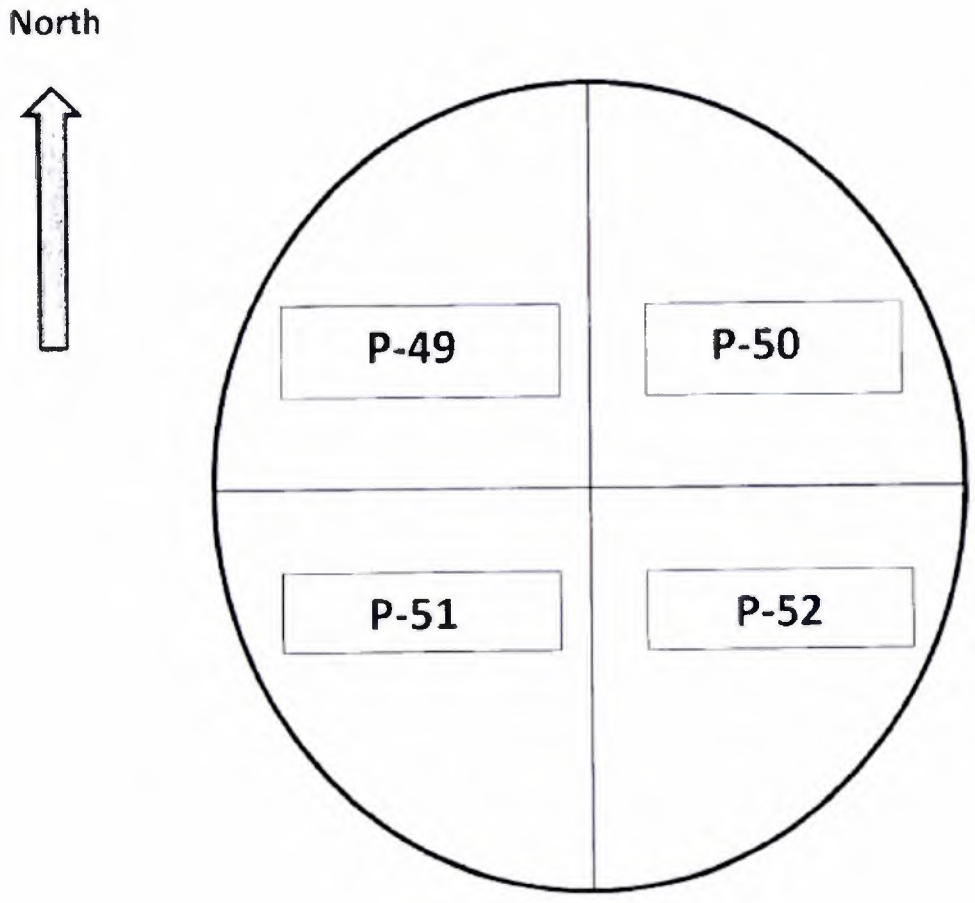
Location	Bkgd (4393)cpm		D/C (net)cpm		O/S (net)cpm		Gamma mrem/h
	α	β	α	β	α	β	
P-29	0	146	1	4	0	20	0.01
P-30	0	156	1	0	0	4	0.01
P-30.5	0	162	2	2	0	0	0.03
P-31	0	163	0	0	0	1	0.02
P-32	0	137	2	12	0	4	0.04
P-33	0	146	2	9	0	21	0.02
P-34	1	144	0	0	0	15	0.00
P-35	1	152	0	0	0	21	0.01
P-36	0	174	0	21	1	22	0.01
P-36.5	0	166	0	7	1	12	0.04
P-37	2	154	0	0	1	6	0.01
P-38	0	132	0	0	0	7	0.04
P-39	0	158	0	0	0	21	0.02
P-40	0	139	0	7	0	20	0.02
P-41	0	132	0	2	0	5	0.03
P-42	0	149	0	3	0	19	0.01
P-42.5	0	158	0	2	0	0	0.02
P-43	0	155	1	0	0	9	0.00
P-44	0	146	0	13	0	3	0.00
P-45	0	163	0	0	1	27	0.02
P-46	0	157	0	0	0	10	0.01
P-47	2	147	0	0	0	13	0.03
P-48	1	165	2	688	0	18	0.02
P-48.5	0	169	0	637	0	0	0.01
P-49	1	167	0	5	0	0	0.00
P-50	1	156	0	1	0	0	0.02
P-51	1	163	0	1	0	0	0.01
P-52	0	146	1	0	0	0	0.04

Background- Swipe Counter = α 1cpm, β 57cpm - Gamma Meter= γ 0.00-0.04mrem/h

Sections P-48 and P48.5 readings listed were after the paint was removed – 44-9 instrument background 100 cpm – readings on the two areas were Beta/Gamma 250 cpm direct check, no loose contamination

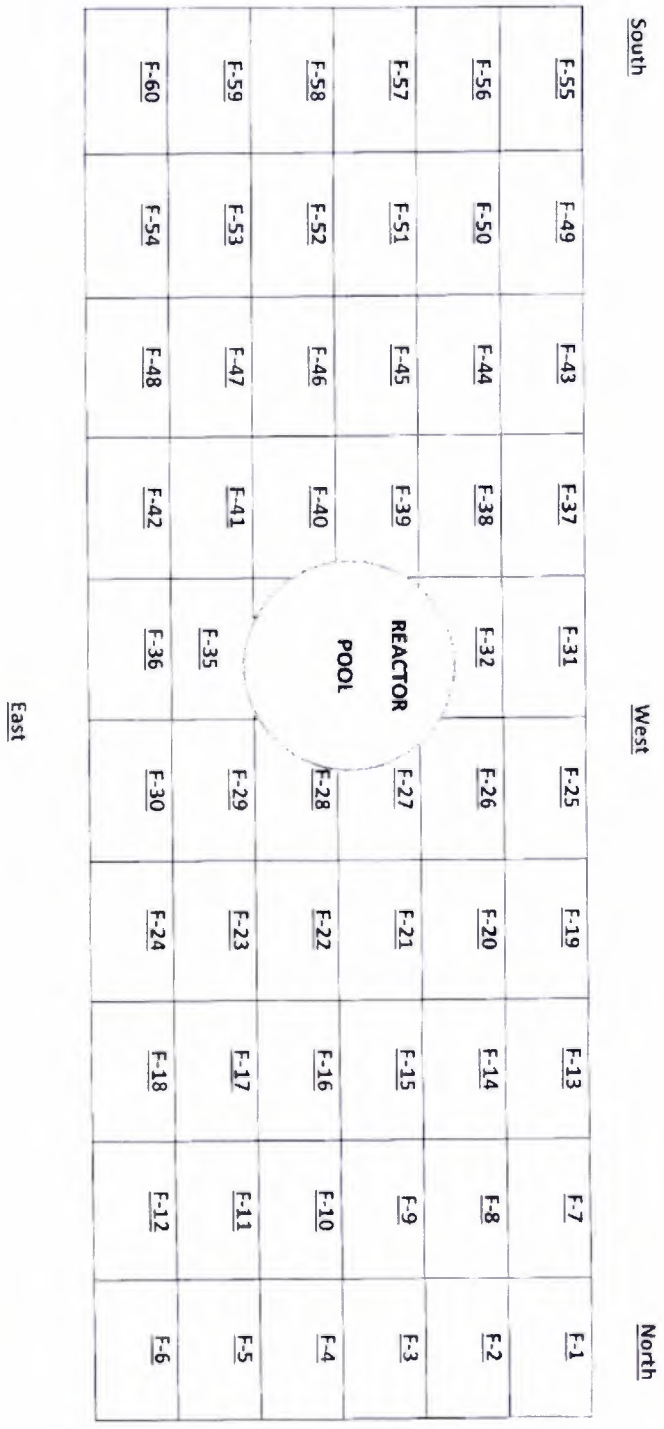


Elevation view of Reactor Pool wall grid pattern



Reactor Room #146 Floor Plan and Final Survey Results

Squares are 1 m^2



Reactor Room #146 Floor Plan and Final Survey Results

Squares are 1 m^2

LOCATION	Bkgd (4393)cpm		D/C (net)cpm		D/S (net)cpm		Gamma (net)mrem/h
	α	β	α	β	α	β	
F-1	0	143	0	2	1	0	0.00
F-2	0	137	0	4	0	2	0.02
F-3	0	153	1	0	1	0	0.00
F-4	0	163	0	0	0	5	0.04
F-5	0	155	0	9	0	0	0.04
F-6	1	167	0	11	0	3	0.03
F-7	0	164	0	4	0	6	0.01
F-8	0	145	0	0	1	14	0.02
F-9	0	149	0	0	1	0	0.02
F-10	0	157	0	0	1	8	0.01
F-11	0	157	2	9	0	0	0.03
F-12	0	149	0	15	2	5	0.00
F-13	0	147	0	3	0	0	0.00
F-14	0	134	0	0	0	2	0.04
F-15	1	144	1	0	0	16	0.01
F-16	1	155	1	0	1	9	0.03
F-17	0	148	0	0	0	0	0.01
F-18	0	166	0	6	2	12	0.01
F-19	0	168	0	1	0	20	0.02
F-20	0	158	2	7	0	0	0.00
F-21	1	153	1	9	0	9	0.04
F-22	0	169	1	0	0	6	0.04
F-23	2	156	0	0	0	0	0.04
F-24	0	152	0	0	1	1	0.01

Reactor Room #146 Floor Plan and Final Survey Results

Squares are 1 m^2

LOCATION	Bkgd (4393)cpm		D/C (net)cpm		D/S (net)cpm		Gamma (net)mrem/h
	α	β	α	β	α	β	
F-25	0	157	2	0	0	4	0.01
F-26	0	147	0	0	0	4	0.04
F-27	0	163	0	0	0	1	0.03
F-28	0	167	0	2	0	0	0.02
F-29	0	159	0	9	0	4	0.02
F-30	0	152	0	17	2	3	0.03
F-31	0	154	1	8	0	2	0.01
F-32	0	151	0	8	0	6	0.01
F-33	Space at top of reactor pool						
F-34	Space at top of reactor pool						
F-35	0	162	0	0	0	0	0.00
F-36	1	142	0	5	0	1	0.01
F-37	1	158	0	0	0	0	0.00
F-38	0	144	0	0	0	0	0.04
F-39	0	148	0	8	1	3	0.00
F-40	0	159	1	5	0	0	0.02
F-41	0	151	1	3	0	0	0.03
F-42	0	155	1	2	1	0	0.01
F-43	1	157	1	6	1	6	0.02
F-44	0	147	0	5	0	0	0.02
F-45	0	149	0	0	0	0	0.01
F-46	0	141	1	0	0	5	0.02
F-47	0	139	1	0	0	1	0.03
F-48	2	149	1	0	2	0	0.00

Reactor Room #146 Floor Plan and Final Survey Results

Squares are 1 m^2

LOCATION	Bkgd (4393)cpm		D/C (net)cpm		O/S (net)cpm		Gamma (net)mrem/h
	α	β	α	β	α	β	
F-49	2	155	0	0	0	0	0.03
F-50	1	161	0	0	0	0	0.03
F-51	0	160	1	8	0	0	0.03
F-52	0	148	0	0	1	7	0.04
F-53	0	152	0	8	0	0	0.01
F-54	0	172	0	3	0	0	0.00
F-55	0	163	3	8	1	17	0.02
F-56	0	157	1	0	0	0	0.03
F-57	0	162	1	0	1	12	0.01
F-58	0	163	1	0	0	0	0.03
F-59	0	158	0	0	0	3	0.02
F-60	0	157	0	0	1	0	0.02

Background

Swipe Counter = α 0cpm, β 49cpm

Gamma Meter= γ 0.02-0.04 mrem/h

Reactor Room #146 North Wall Final Survey Results

Squares are 1 m^2

West East

NW-3 Bkgd α 0cpm β 152cpm D/C α 0cpm β 0cpm O/S α 1cpm β 0cpm γ Dose Rate 0.01mrem/h	**NW-6** Bkgd α 0cpm β 145cpm D/C α 0cpm β 4cpm O/S α 1cpm β 14cpm γ Dose Rate 0.04mrem/h	**NW-9** Bkgd α 1cpm β 157cpm D/C α 1cpm β 0cpm O/S α 0cpm β 26cpm γ Dose Rate 0.02mrem/h	**NW-12** Bkgd α 0cpm β 138cpm D/C α 0cpm β 0cpm O/S α 0cpm β 9cpm γ Dose Rate 0.03mrem/h	**NW-15** Bkgd α 0cpm β 132cpm D/C α 0cpm β 9cpm O/S α 0cpm β 0cpm γ Dose Rate 0.00mrem/h	**NW-18** Bkgd α 0cpm β 146cpm D/C α 0cpm β 0cpm O/S α 2cpm β 16cpm γ Dose Rate 0.00mrem/h
NW-2 Bkgd α 2cpm β 133cpm D/C α 0cpm β 0cpm O/S α 0cpm β 6cpm γ Dose Rate 0.01mrem/h	**NW-5** Bkgd α 1cpm β 158cpm D/C α 0cpm β 17cpm O/S α 0cpm β 23cpm γ Dose Rate 0.02mrem/h	**NW-8** Bkgd α 0cpm β 165cpm D/C α 0cpm β 0cpm O/S α 0cpm β 31cpm γ Dose Rate 0.01mrem/h	**NW-11** Bkgd α 0cpm β 147cpm D/C α 2cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.03mrem/h	**NW-14** Bkgd α 0cpm β 152cpm D/C α 0cpm β 12cpm O/S α 1cpm β 0cpm γ Dose Rate 0.03mrem/h	**NW-17** Bkgd α 0cpm β 149cpm D/C α 0cpm β 0cpm O/S α 0cpm β 9cpm γ Dose Rate 0.04mrem/h
NW-1 Bkgd α 0cpm β 167cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.02mrem/h	**NW-4** Bkgd α 1cpm β 159cpm D/C α 1cpm β 0cpm O/S α 0cpm β 11cpm γ Dose Rate 0.04mrem/h	**NW-7** Bkgd α 0cpm β 151cpm D/C α 0cpm β 21cpm O/S α 0cpm β 12cpm γ Dose Rate 0.03mrem/h	**NW-10** Bkgd α 1cpm β 167cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.00mrem/h	**NW-13** Bkgd α 0cpm β 149cpm D/C α 0cpm β 0cpm O/S α 1cpm β 0cpm γ Dose Rate 0.01mrem/h	**NW-16** Bkgd α 0cpm β 141cpm D/C α 1cpm β 7cpm O/S α 2cpm β 1cpm γ Dose Rate 0.01mrem/h

Background

Swipe Counter = α 1cpm, β 64cpm

Gamma Meter= γ 0.00-0.04 mrem/h

Reactor Room #146 East Wall Final Survey Results

Squares are 1 m^2

North End

South End

EW-3 Bkgd α 0cpm β 167cpm D/C α 0cpm β 15cpm O/S α 0cpm β 0cpm γ Dose Rate 0.00mrem/h	**EW-6** Bkgd α 0cpm β 156cpm D/C α 0cpm β 9cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	**EW-9** Bkgd α 1cpm β 163cpm D/C α 2cpm β 0cpm O/S α 1cpm β 0cpm γ Dose Rate 0.02mrem/h	**EW-12** Bkgd α 0cpm β 146cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.03mrem/h	**EW-15** Bkgd α 0cpm β 144cpm D/C α 0cpm β 12cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	**EW-18** Bkgd α 0cpm β 149cpm D/C α 0cpm β 1cpm O/S α 0cpm β 19cpm γ Dose Rate 0.04mrem/h	**EW-21** Bkgd α 1cpm β 156cpm D/C α 1cpm β 14cpm O/S α 0cpm β 5cpm γ Dose Rate 0.02mrem/h	**EW-24** Bkgd α 0cpm β 165cpm D/C α 0cpm β 0cpm O/S α 0cpm β 4cpm γ Dose Rate 0.03mrem/h	**EW-27** Bkgd α 0cpm β 145cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	**EW-30** Bkgd α 0cpm β 162cpm D/C α 0cpm β 0cpm O/S α 0cpm β 2cpm γ Dose Rate 0.00mrem/h
EW-2 Bkgd α 0cpm β 164cpm D/C α 1cpm β 0cpm O/S α 1cpm β 6cpm γ Dose Rate 0.02mrem/h	**EW-5** Bkgd α 1cpm β 149cpm D/C α 0cpm β 0cpm O/S α 1cpm β 0cpm γ Dose Rate 0.04mrem/h	**EW-8** Bkgd α 1cpm β 139cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.04mrem/h	**EW-11** Bkgd α 0cpm β 147cpm D/C α 0cpm β 4cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	**EW-14** Bkgd α 2cpm β 155cpm D/C α 0cpm β 0cpm O/S α 0cpm β 8cpm γ Dose Rate 0.01mrem/h	**EW-17** Bkgd α 0cpm β 159cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.00mrem/h	**EW-20** Bkgd α 1cpm β 149cpm D/C α 1cpm β 2cpm O/S α 0cpm β 0cpm γ Dose Rate 0.04mrem/h	**EW-23** Bkgd α 1cpm β 146cpm D/C α 1cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.03mrem/h	**EW-26** Bkgd α 0cpm β 164cpm D/C α 1cpm β 0cpm O/S α 0cpm β 7cpm γ Dose Rate 0.01mrem/h	**EW-29** Bkgd α 0cpm β 158cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.00mrem/h
EW-1 Bkgd α 1cpm β 157cpm D/C α 0cpm β 3cpm O/S α 1cpm β 12cpm γ Dose Rate 0.01mrem/h	**EW-4** Bkgd α 0cpm β 158cpm D/C α 0cpm β 6cpm O/S α 0cpm β 0cpm γ Dose Rate 0.03mrem/h	**EW-7** Bkgd α 0cpm β 148cpm D/C α 1cpm β 12cpm O/S α 0cpm β 0cpm γ Dose Rate 0.00mrem/h	**EW-10** Bkgd α 0cpm β 162cpm D/C α 1cpm β 16cpm O/S α 0cpm β 11cpm γ Dose Rate 0.00mrem/h	**EW-13** Bkgd α 0cpm β 158cpm D/C α 1cpm β 4cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	**EW-16** Bkgd α 0cpm β 152cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	**EW-19** Bkgd α 1cpm β 161cpm D/C α 0cpm β 0cpm O/S α 1cpm β 0cpm γ Dose Rate 0.02mrem/h	**EW-22** Bkgd α 0cpm β 151cpm D/C α 0cpm β 8cpm O/S α 0cpm β 0cpm γ Dose Rate 0.04mrem/h	**EW-25** Bkgd α 0cpm β 157cpm D/C α 0cpm β 5cpm O/S α 0cpm β 16cpm γ Dose Rate 0.03mrem/h	**EW-28** Bkgd α 0cpm β 167cpm D/C α 0cpm β 5cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h

Background

Swipe Counter = α 0cpm, β 64cpm

Gamma Meter= γ 0.00-0.04mrem/h

Reactor Room #146 South Wall Final Survey Results

Squares are $1m^2$

East West

SW-18	SW-15	SW-12	SW-9	SW-6	SW-3
Bkgd α 0cpm β 163cpm D/C α 0cpm β 2cpm O/S α 1cpm β 3cpm γ Dose Rate 0.02mrem/h	Bkgd α 0cpm β 137cpm D/C α 0cpm β 0cpm O/S α 1cpm β 10cpm γ Dose Rate 0.03mrem/h	Bkgd α 2cpm β 146cpm D/C α 0cpm β 7cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	Bkgd α 0cpm β 144cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.02mrem/h	Bkgd α 0cpm β 152cpm D/C α 0cpm β 12cpm O/S α 1cpm β 7cpm γ Dose Rate 0.04mrem/h	Bkgd α 0cpm β 174cpm D/C α 1cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h
SW-17	**SW-14**	**SW-11**	**SW-8**	**SW-5**	**SW-2**
Bkgd α 1cpm β 154cpm D/C α 1cpm β 9cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	Bkgd α 0cpm β 132cpm D/C α 0cpm β 22cpm O/S α 1cpm β 0cpm γ Dose Rate 0.03mrem/h	Bkgd α 1cpm β 158cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.04mrem/h	Bkgd α 0cpm β 139cpm D/C α 1cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.00mrem/h	Bkgd α 0cpm β 132cpm D/C α 0cpm β 16cpm O/S α 0cpm β 2cpm γ Dose Rate 0.03mrem/h	Bkgd α 1cpm β 149cpm D/C α 0cpm β 14cpm O/S α 1cpm β 0cpm γ Dose Rate 0.02mrem/h
SW-16	**SW-13**	**SW-10**	**SW-7**	**SW-4**	**SW-1**
Bkgd α 0cpm β 155cpm D/C α 2cpm β 12cpm O/S α 1cpm β 0cpm γ Dose Rate 0.00mrem/h	Bkgd α 0cpm β 146cpm D/C α 0cpm β 0cpm O/S α 0cpm β 16cpm γ Dose Rate 0.04mrem/h	Bkgd α 0cpm β 163cpm D/C α 0cpm β 0cpm O/S α 1cpm β 9cpm γ Dose Rate 0.01mrem/h	Bkgd α 2cpm β 157cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	Bkgd α 0cpm β 147cpm D/C α 0cpm β 8cpm O/S α 0cpm β 0cpm γ Dose Rate 0.01mrem/h	Bkgd α 0cpm β 165cpm D/C α 0cpm β 0cpm O/S α 0cpm β 0cpm γ Dose Rate 0.04mrem/h

Background

Swipe Counter = α 0cpm, β 64cpm

Gamma Meter= γ 0.00-0.04mrem/h

Reactor Room #146 West Wall Final Survey Results

Squares are 1 m^2

South End

WW-30	**WW-27**	**WW-24**	**WW-21**	**WW-18**	**WW-15**	**WW-12**	**WW-9**	**WW-6**	**WW-3**
Bkgd α 2cpm	**Bkgd** α 0cpm	**Bkgd** α 1cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 1cpm	**Bkgd** α 0cpm	**Bkgd** α 1cpm	**Bkgd** α 2cpm
β 165cpm	β 143cpm	β 173cpm	β 169cpm	β 151cpm	β 165cpm	β 163cpm	β 157cpm	β 145cpm	β 143cpm
D/C α 1cpm	**D/C** α 0cpm	**D/C** α 1cpm	**D/C** α 0cpm	**D/C** α 1cpm	**D/C** α 2cpm	**D/C** α 0cpm	**D/C** α 1cpm	**D/C** α 1cpm	**D/C** α 0cpm
β 14cpm	β 0cpm	β 0cpm	β 0cpm	β 17cpm	β 0cpm	β 0cpm	β 2cpm	β 0cpm	β 23cpm
O/S α 2cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm
β 0cpm	β 0cpm	β 0cpm	β 0cpm	β 4cpm	β 0cpm	β 16cpm	β 0cpm	β 0cpm	β 0cpm
γ Dose Rate	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**
0.01mrem/h	0.00mrem/h	0.01mrem/h	0.31mrem/h	0.01mrem/h	0.03mrem/h	0.00mrem/h	0.01mrem/h	0.04mrem/h	0.02mrem/h
WW-29	**WW-26**	**WW-23**	**WW-20**	**WW-17**	**WW-14**	**WW-11**	**WW-8**	**WW-5**	**WW-2**
Bkgd α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 1cpm	**Bkgd** α 1cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 1cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm
β 154cpm	β 157cpm	β 163cpm	β 164cpm	β 159cpm	β 155cpm	β 146cpm	β 137cpm	β 167cpm	β 163cpm
D/C α 1cpm	**D/C** α 1cpm	**D/C** α 1cpm	**D/C** α 1cpm	**D/C** α 0cpm	**D/C** α 0cpm	**D/C** α 0cpm	**D/C** α 1cpm	**D/C** α 1cpm	**D/C** α 1cpm
β 12cpm	β 3cpm	β 14cpm	β 14cpm	β 0cpm	β 0cpm	β 9cpm	β 11cpm	β 0cpm	β 14cpm
O/S α 2cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm
β 11cpm	β 0cpm	β 0cpm	β 0cpm	β 0cpm	β 0cpm	β 0cpm	β 0cpm	β 0cpm	β 0cpm
γ Dose Rate	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**
0.02mrem/h	0.02mrem/h	0.02mrem/h	0.00mrem/h	0.01mrem/h	0.01mrem/h	0.01mrem/h	0.04mrem/h	0.01mrem/h	0.03mrem/h
WW-28	**WW-25**	**WW-22**	**WW-19**	**WW-16**	**WW-13**	**WW-10**	**WW-7**	**WW-4**	**WW-1**
Bkgd α 2cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 1cpm	**Bkgd** α 2cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm	**Bkgd** α 0cpm
β 163cpm	β 149cpm	β 148cpm	β 163cpm	β 149cpm	β 144cpm	β 153cpm	β 158cpm	β 146cpm	β 156cpm
D/C α 0cpm	**D/C** α 0cpm	**D/C** α 0cpm	**D/C** α 0cpm	**D/C** α 1cpm	**D/C** α 0cpm	**D/C** α 1cpm	**D/C** α 0cpm	**D/C** α 0cpm	**D/C** α 0cpm
β 0cpm	β 1cpm	β 17cpm	β 8cpm	β 6cpm	β 13cpm	β 4cpm	β 1cpm	β 16cpm	β 4cpm
O/S α 1cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 0cpm	**O/S** α 1cpm
β 5cpm	β 0cpm	β 1cpm	β 0cpm	β 26cpm	β 0cpm	β 0cpm	β 4cpm	β 9cpm	β 10cpm
γ Dose Rate	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**	**γ Dose Rate**
0.02mrem/h	0.01mrem/h	0.03mrem/h	0.02mrem/h	0.02mrem/h	0.04mrem/h	0.03mrem/h	0.01mrem/h	0.02mrem/h	0.02mrem/h

North End

Background

Swipe Counter = α 1cpm, β 71cpm

Gamma Meter= γ 0.00-0.04mrem/h

Appendix E
RADIOACTIVE WASTE DATA SHEETS

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

Be Container

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM)

OFFICIAL USE ONLY

Page 1 of 3

900-508520-FM-001 REV 0

Reference: 900-508520-STD-001

File No. | Doc. Collection ID | Subject Index | Doc. Code | Serial No.

Office Use Only ICD # . Notification Given ☐ CNL Ref # .

This form is to be submitted to the site CNL RAM Shipper.

PART 1: SHIPMENT DETAILS

Proposed shipment date: ☐ Unknown – details to follow later via email ☒ Known -provide date: 2020 02 22

Description of item(s)/ Package contents: SRC SLOWPOKE-2 Reactor Components – Type-A (B-25) Serial # 16592

Tritium shipment: ☒ No ☐ Yes - provide tritium transfer reference number:

Reason for shipment: ☐ Material to be analyzed ☒ Waste disposal ☐ Commercial project ☐ Calibration ☐ Other provide reason:

International shipment: ☒ No ☐ Yes "NO" - leave this section blank. "YES" – fill out this section

Value in Canadian dollars: $

USA shipment: ☐ No ☐ Yes - provide federal ID#

The country of origin of the item(s): ☐ Unknown - details to follow later via email ☐ Known - provide country

Is this CNL property: ☒ No ☐ Yes Will the material be returned to CNL: ☐ No ☐ Yes

Will the shipment be: ☐ Collect ☒ Prepaid

Special handling instructions: ☒ None ☐ Fragile ☐ Do not freeze ☐ Other – provide instructions:

☐ Other dangerous goods – provide description:

Example: Flammable, Corrosive

PART 2: CONSIGNEE INFORMATION (SHIPPING TO)

Company name	SNC-Lavalin Inc.
Company address	2251 Speakman Drive, Mississauga, ON, L5K 1B2

Provide as much information as possible

	Radioactive Material (Class 7) Shipper	Technical Contact (if applicable)
Name		
Telephone number		
Fax number		
E-mail address		

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) Be Container
900-508520-FM-001 REV 0

OFFICIAL USE ONLY.
Page 2 of 3

PART 3: PACKAGE INFORMATION/ DELIVERY INFORMATION

Package description: Type-A (B-25) Serial # 16592 ☐ Unknown	Package dimensions: 75" X 50" X 51" (LxWxH) ☐ Unknown
Package quantity: ☐ Unknown	Method of transport: ☒ Road ☐ Rail ☐ Air ☐ Marine ☐ Unknown
Package gross weight: 2,100 kg ☐ Unknown	Carrier name: ☐ Unknown
Package/item Location: Building: Room:	

PART 4: MATERIAL INFORMATION

Fissile material: ☒ No ☐ Yes Irradiated: ☐ No ☒ Yes Physical form: ☒ Solid ☐ Liquid ☐ Gas

Chemical form: Beryllium metal inside a shielding container made from steel and lead, soft waste bags, Tray, Lead + Control Rod
Elemental (e.g. I-125, Xe-133) Oxide (e.g. UO_2, U_3O_8) Other (e.g. $(NH_4)_2MoO_4$)

OFFICE USE ONLY – RAM SHIPPER COMMENTS

Radionuclide Inventory: the radionuclide(s) and its activity (Bq or Bq/g) shall be identified prior to shipping.
Check one of the following OPTIONS

1. 3 or less radionuclide identified ☐ Complete Table 1
2. More than 3 radionuclides identified ☒ Attach a radionuclide inventory list/gamma spec including activities (Leave Table 1 blank)

Unknown radionuclide(s) and activity: A gamma spec shall be completed to identify radionuclide(s) and activity. Decide to either:

I. Wait for the results and then choose Option 1 or 2 depending on results
II. Submit the 434-form and ensure the results are sent to the Shipper ☐ (Leave Table 1 blank)

TABLE 1

Radionuclide(s)	Activity – provide either "Bq" or "Bq/g"				
SEE ATTACHMENT	SEE ATTACHMENT	Bq			Bq/g
See gamma spec report		Bq			Bq/g
		Bq			Bq/g
	Total activity	Bq	Total activity		Bq/g

If the radionuclide(s) are either uranium, thorium or plutonium you must fill in the section below:

☐ Natural uranium	kg	☐ Depleted uranium	kg		
☐ Natural thorium	kg	☐ Plutonium	g		
☐ Enriched uranium	g	Wt% U	Wt% U-235 in U		g U-235

PART 5: INITI[redacted]

[redacted]

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) Be Container OFFICIAL USE ONLY
900-508520-FM-001 REV 0 Page 3 of 3

PART 6: RADIOLOGICAL SURVEY COMPLETED BY GROUP 1 RADIATION SURVEYOR

Note: background for measurements not to exceed beta/gamma 300 cpm and alpha 3 cpm.

INNER CONTAINERS OR SHIPPING CONTAINERS CHECKED BY SURVEYOR:

Contamination Levels on:

☑ Material ☐ Material in inner container (not shipping container) ☐ Shipping container

Number of containers:

Type	Reading (gross)	Units	Instrument model and serial number
Total beta/gamma (if applicable)	SEE ATTACHMENT	cpm	
Total alpha		cpm	
Removable beta/gamma		cpm/300cm^2 on swipe	
Removable alpha		cpm/300cm^2 on swipe	

Dose rates on:

☐ Material ☐ Material in inner container (not shipping container) ☑ Shipping container

	Near Contact			At 1 Meter	
Beta	Background	rem/h	Beta	Background	rem/h
Gamma	15 20	mrem/h	Gamma	3.50	mrem/h
Neutron	Background	mrem/h	Neutron	Background	mrem/h

Additional radiological survey results may be attached to this form under the direction of a Health Physicist.

Comments: The Gamma Spec. report is attached for the most significant radionuclides.

Group 1 Radiation Surveyor [redacted]

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

HEU Source

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM)

OFFICIAL USE ONLY
Page 1 of 3

900-508520-FM-001 REV 0

Reference: 900-508520-STD-001

File No.:

Doc. Collection ID	Subject Index	Doc. Code	Serial No.

Office Use Only ICD # Notification Given ☐ CNL Ref #

This form is to be submitted to the site CNL RAM Shipper.

PART 1: SHIPMENT DETAILS

Proposed shipment date: ☐ Unknown - details to follow later via email ☒ Known - provide date 2020-02-22

Description of item(s)/ Package contents: SRC HEU Source

Tritium shipment: ☒ No ☐ Yes - provide tritium transfer reference number:

Reason for shipment: ☐ Material to be analyzed ☐ Waste disposal ☐ Commercial project
☐ Calibration ☒ Other - provide reason: Inventory Change from SRC to CNL

International shipment: ☒ No ☐ Yes "NO" - leave this section blank. "YES" – fill out this section

Value in Canadian dollars: $

USA shipment: ☐ No ☐ Yes - provide federal ID#

The country of origin of the item(s): ☐ Unknown - details to follow later via email
☐ Known - provide country:

Is this CNL property: ☒ No ☐ Yes Will the material be returned to CNL: ☐ No ☐ Yes

Will the shipment be: ☐ Collect ☒ Prepaid

Special handling instructions: ☒ None ☐ Fragile ☐ Do not freeze ☐ Other – provide instructions:

☐ Other dangerous goods – provide description:

Example: Flammable, Corrosive

PART 2: CONSIGNEE INFORMATION (SHIPPING TO)

Company name	SNC-Lavalin Inc.
Company address	2251 Speakman Drive, Mississauga, ON, L5K 1B2

Provide as much information as possible

	Radioactive Material (Class 7) Shipper	Technical Contact (if applicable)
Name		
Telephone number		
Fax number		
E-mail address		

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) WFD Source OFFICIAL USE ONLY
900-508520-FM 001 REV 0 Page 2 of 3

PART 3: PACKAGE INFORMATION/ DELIVERY INFORMATION

Package description: 5 Gal Pail	Package dimensions:
☐ Unknown	☐ Unknown
Package quantity:	Method of transport: ☒ Road ☐ Rail ☐ Air ☐ Marine
☐ Unknown	☐ Unknown
Package gross weight: 2 kg	Carrier name:
☐ Unknown	☐ Unknown
Package/Item Location: Building:	Room:

PART 4: MATERIAL INFORMATION

Fissile material: ☐ No ☒ Yes Irradiated: ☐ No ☒ Yes Physical form: ☒ Solid ☐ Liquid ☐ Gas

Chemical form: U-235 Metal
Elemental (e.g I-125, Xe-133) Oxide (e.g. UO_2, U_3O_8) Other (e.g $(NH4)_2MoO_4$)

OFFICE USE ONLY – RAM SHIPPER COMMENTS

Radionuclide Inventory: the radionuclide(s) and its activity (Bq or Bq/g) shall be identified prior to shipping.
Check one of the following OPTIONS:

1. 3 or less radionuclide identified ☐ Complete Table 1
2. More than 3 radionuclides identified ☐ Attach a radionuclide inventory list/gamma spec including activities (Leave Table 1 blank)

Unknown radionuclide(s) and activity: A gamma spec shall be completed to identify radionuclide(s) and activity. Decide to either:

i. Wait for the results and then choose Option 1 or 2 depending on results
ii. Submit the 434-form and ensure the results are sent to the Shipper ☐ (Leave Table 1 blank)

TABLE 1

Radionuclide(s)	Activity – provide either "Bq" or "Bq/g"					
			Bq			Bq/g
			Bq			Bq/g
			Bq			Bq/g
	Total activity		Bq	Total activity		Bq/g

If the radionuclide(s) are either uranium, thorium or plutonium you must fill in the section below:

☐ Natural uranium	kg		☐ Depleted uranium	kg	
☐ Natural thorium	kg		☐ Plutonium	g	
☒ Enriched uranium	0.01 g	Wt% U		Wt% U-235 in U	g U-235

PART 5: INITIATOR INFORMATION

[redacted]

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) HEU Source OFFICIAL USE ONLY
900-508520-FM-001 REV 0 Page 3 of 3

PART 6: RADIOLOGICAL SURVEY COMPLETED BY GROUP 1 RADIATION SURVEYOR

Note: background for measurements not to exceed beta/gamma 300 cpm and alpha 3 cpm

INNER CONTAINERS OR SHIPPING CONTAINERS CHECKED BY SURVEYOR:

Contamination Levels on:

☒ Material ☐ Material in inner container (not shipping container) ☐ Shipping container

Number of containers: _____

Type	Reading (gross)	Units	Instrument model and serial number
Total beta/gamma (if applicable)	Background	cpm	
Total alpha	Zero	cpm	
Removable beta/gamma	Zero	cpm/300cm^2 on swipe	
Removable alpha	Zero	cpm/300cm^2 on swipe	

Dose rates on:

☐ Material ☐ Material in inner container (not shipping container) ☒ Shipping container

Near Contact			At 1 Meter		
Beta	Background	rem/h	Beta	Background	rem/h
Gamma	Background	mrem/h	Gamma	Background	mrem/h
Neutron	Background	mrem/h	Neutron	Background	mrem/h

Additional radiological survey results may be attached to this form under the direction of a Health Physicist.

Comments: The Gamma Spec. report is attached for the most significant radionuclides.

Group 1 Radiation Surveyor [redacted]

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

URC site Soft waste Concrete

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM)

OFFICIAL USE ONLY
Page 1 of 3
Reference: 900-508520-STD-001

900-508520-FM-001 REV 0

File No.:				
	Doc. Collection ID	Subject Index	Doc. Code	Serial No.

Office Use Only ICD # Notification Given ☐ CNL Ref #

This form is to be submitted to the site CNL RAM Shipper.

PART 1: SHIPMENT DETAILS

Proposed shipment date: ☐ Unknown – details to follow later via email ☒ Known - provide date: 2020-02-22

Description of item(s)/ Package contents: SRC SLOWPOKE-2 Reactor Components – Type-A (B-25) Serial # 16594

Tritium shipment: ☒ No ☐ Yes - provide tritium transfer reference number:

Reason for shipment: ☐ Material to be analyzed ☒ Waste disposal ☐ Commercial project ☐ Calibration ☐ Other-provide reason:

International shipment: ☒ No ☐ Yes "NO" - leave this section blank. "YES" - fill out this section

Value in Canadian dollars: $

USA shipment: ☐ No ☐ Yes provide federal ID#

The country of origin of the item(s): ☐ Unknown - details to follow later via email ☐ Known - provide country:

Is this CNL property: ☒ No ☐ Yes Will the material be returned to CNL: ☐ No ☐ Yes

Will the shipment be: ☐ Collect ☒ Prepaid

Special handling instructions: ☒ None ☐ Fragile ☐ Do not freeze ☐ Other - provide instructions:

☐ Other dangerous goods – provide description:

Example: Flammable, Corrosive

PART 2: CONSIGNEE INFORMATION (SHIPPING TO)

Company name	SNC-Lavalin Inc.
Company address	2251 Speakman Drive, Mississauga, ON, L5K 1B2

Provide as much information as possible

	Radioactive Material (Class 7) Shipper	Technical Contact (if applicable)
Name		
Telephone number		
Fax number		
E-mail address		

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) URC + etc. OFFICIAL USE ONLY
900-508520-FM-001 REV 0 Soft waste + Concrete Page 2 of 3

PART 3: PACKAGE INFORMATION/ DELIVERY INFORMATION

Package description: Type-A (B-25) Serial # 16594 ☐ Unknown	Package dimensions: 75" X 50" X 51" (1.9M x 1.3M x 1.3M) ☐ Unknown
Package quantity: ☐ Unknown	Method of transport: ☒ Road ☐ Rail ☐ Air ☐ Marine ☐ Unknown
Package gross weight: 2,100 kg ☐ Unknown	Carrier name: ☐ Unknown
Package/item Location: Building Room:	

PART 4: MATERIAL INFORMATION

Fissile material: ☒ No ☐ Yes Irradiated: ☐ No ☒ Yes Physical form: ☒ Solid ☐ Liquid ☐ Gas

Chemical form: Aluminum, Plastic, Rubber, Steel
Elemental (e.g. I-125, Xe-133) Oxide (e.g. UO_2, U_3O_8) Other (e.g. $(NH_4)_2MoO_4$)

OFFICE USE ONLY – RAM SHIPPER COMMENTS

Radionuclide inventory: the radionuclide(s) and its activity (Bq or Bq/g) shall be identified prior to shipping.
Check one of the following OPTIONS:

1. 3 or less radionuclide identified ☐ Complete Table 1
2. More than 3 radionuclides identified ☒ Attach a radionuclide inventory list/gamma spec including activities (Leave Table 1 blank)

Unknown radionuclide(s) and activity: A gamma spec shall be completed to identify radionuclide(s) and activity. Decide to either:

I. Wait for the results and then choose Option 1 or 2 depending on results
II. Submit this 434 form and ensure the results are sent to the Shipper ☐ (Leave Table 1 blank)

TABLE 1

Radionuclide(s)	Activity – provide either "Bq" or "Bq/g"				
SEE ATTACHMENT	SEE ATTACHMENT	Bq			Bq/g
		Bq			Bq/g
		Bq			Bq/g
	Total activity	Bq	Total activity		Bq/g

If the radionuclide(s) are either uranium, thorium or plutonium you must fill in the section below:

☐ Natural uranium	kg	☐ Depleted uranium	kg		
☐ Natural thorium	kg	☐ Plutonium	g		
☐ Enriched uranium	g	Wt% U	Wt% U-235 in U	g U-235	

PART 5: INITIA[redacted]

[redacted] Branch code:

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) URC + etc. Soft waste Concrete.
900-508520-FM-001 REV 0

OFFICIAL USE ONLY
Page 3 of 3

PART 6: RADIOLOGICAL SURVEY COMPLETED BY GROUP 1 RADIATION SURVEYOR

Note: background for measurements not to exceed beta/gamma 300 cpm and alpha 3 cpm.

INNER CONTAINERS OR SHIPPING CONTAINERS CHECKED BY SURVEYOR:

Contamination Levels on:

☒ Material ☐ Material in inner container (not shipping container) ☐ Shipping container

Number of containers: _____

Type	Reading (gross)	Units	Instrument model and serial number
Total beta/gamma (if applicable)	SEE ATTACHMENT	cpm	
Total alpha		cpm	
Removable beta/gamma		cpm/300cm^2 on swipe	
Removable alpha		cpm/300cm^2 on swipe	

Dose rates on:

☐ Material ☐ Material in inner container (not shipping container) ☒ Shipping container

	Near Contact			At 1 Meter	
Beta	Background	rem/h	Beta	Background	rem/h
Gamma	0.16	mrem/h	Gamma	0.04	mrem/h
Neutron	Background	mrem/h	Neutron	Background	mrem/h

Additional radiological survey results may be attached to this form under the direction of a Health Physicist.

Comments: The Gamma Spec. report is attached for the most significant radionuclides.

Group 1 Radiation [redacted]

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

LRC + IR tubes + Flux + Phecmo

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM)

OFFICIAL USE ONLY

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Reference: 900-508520-STD-001

File No.: | Doc. Collection ID | Subject Index | Doc. Code | Serial No. |

Office Use Only ICD # . Notification Given ☐ CNL Ref # .

This form is to be submitted to the site CNL RAM Shipper.

PART 1: SHIPMENT DETAILS

Proposed shipment date: ☐ Unknown – details to follow later via email ☒ Known -provide date: 2020-02-22

Description of item(s)/ Package contents: SRC SLOWPOKE-2 Reactor Components – Type-A (B-25) Serial # 16593

Tritium shipment: ☒ No ☐ Yes - provide tritium transfer reference number:

Reason for shipment: ☐ Material to be analyzed ☒ Waste disposal ☐ Commercial project ☐ Calibration ☐ Other -provide reason:

International shipment: ☒ No ☐ Yes "NO" - leave this section blank. "YES" – fill out this section

Value in Canadian dollars: $

USA shipment: ☐ No ☐ Yes - provide federal ID#

The country of origin of the item(s): ☐ Unknown - details to follow later via email ☐ Known - provide country:

Is this CNL property: ☒ No ☐ Yes Will the material be returned to CNL: ☐ No ☐ Yes

Will the shipment be ☐ Collect ☒ Prepaid

Special handling instructions: ☒ None ☐ Fragile ☐ Do not freeze ☐ Other - provide instructions:

☐ Other dangerous goods – provide description:

Example: Flammable, Corrosive

PART 2: CONSIGNEE INFORMATION (SHIPPING TO)

Company name	SNC-Lavalin Inc.
Company address	2251 Speakman Drive, Mississauga, ON, L5K 1B2

Provide as much information as possible

	Radioactive Material (Class 7) Shipper	Technical Contact (if applicable)
Name		
Telephone number		
Fax number		
E-mail address		

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) LRC + IR Tubes + Filter + Thermo
900-508570-FM-001 REV 0

OFFICIAL USE ONLY
Page 2 of 3

PART 3: PACKAGE INFORMATION/ DELIVERY INFORMATION

Package description: Type-A (B-25) Serial # 16593	Package dimensions: 75" X 50" X 51" (LxWxH)
☐ Unknown	☐ Unknown
Package quantity:	Method of transport: ☒ Road ☐ Rail ☐ Air ☐ Marine
☐ Unknown	☐ Unknown
Package gross weight: 2,600 kg	Carrier name:
☐ Unknown	☐ Unknown
Package/item Location: Building:	Room:

PART 4: MATERIAL INFORMATION

Fissile material: ☒ No ☐ Yes Irradiated: ☐ No ☒ Yes Physical form: ☒ Solid ☐ Liquid ☐ Gas

Chemical form: Aluminum, Plastic, Rubber, Resin
Elemental (e.g I-125, Xe-133) Oxide (e.g UO_2, U_3O_8) Other (e.g $(NH4)_2MoO_4$)

OFFICE USE ONLY – RAM SHIPPER COMMENTS

Radionuclide Inventory: the radionuclide(s) and its activity (Bq or Bq/g) shall be identified prior to shipping.
Check one of the following OPTIONS.

1. 3 or less radionuclide identified ☐ Complete Table 1
2. More than 3 radionuclides identified ☒ Attach a radionuclide inventory list/gamma spec including activities (Leave Table 1 blank)

Unknown radionuclide(s) and activity: A gamma spec shall be completed to identify radionuclide(s) and activity. Decide to either:

I. Wait for the results and then choose Option 1 or 2 depending on results
II. Submit the 434-form and ensure the results are sent to the Shipper ☐ (Leave Table 1 blank)

TABLE 1

Radionuclide(s)	Activity – provide either "Bq" or "Bq/g"				
SEE ATTACHMENT	SEE ATTACHMENT	Bq			Bq/g
See gamma Spec reports		Bq			Bq/g
		Bq			Bq/g
	Total activity	Bq	Total activity		Bq/g

If the radionuclide(s) are either uranium, thorium or plutonium you must fill in the section below:

☐ Natural Uranium	kg		☐ Depleted uranium	kg	
☐ Natural thorium	kg		☐ Plutonium	g	
☐ Enriched uranium	g	Wt% U		Wt% U-235 in U	g U-235

PART 5: INITIATOR INFORMATION

W[redacted] Branch code:

[redacted]

Name - print Signature Extension Date

REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL FORM (434 FORM) LRC + IR tubes Flux + Thimble
900 508520-FM-001 REV 0 OFFICIAL USE ONLY
Page 3 of 3

PART 6: RADIOLOGICAL SURVEY COMPLETED BY GROUP 1 RADIATION SURVEYOR

Note: background for measurements not to exceed beta/gamma 300 cpm and alpha 3 cpm

INNER CONTAINERS OR SHIPPING CONTAINERS CHECKED BY SURVEYOR:

Contamination Levels on:

☒ Material ☐ Material in inner container (not shipping container) ☐ Shipping container

Number of containers:

Type	Reading (gross)	Units	Instrument model and serial number
Total beta/gamma (if applicable)	SEE ATTACHMENT	cpm	
Total alpha		cpm	
Removable beta/gamma		cpm/300cm^2 on swipe	
Removable alpha		cpm/300cm^2 on swipe	

Dose rates on:

☐ Material ☐ Material in inner container (not shipping container) ☒ Shipping container

	Near Contact			At 1 Meter	
Beta	Background	rem/h	Beta	Background	rem/h
Gamma	19.28	mrem/h	Gamma	0.44	mrem/h
Neutron	Background	mrem/h	Neutron	Background	mrem/h

Additional radiological survey results may be attached to this form under the direction of a Health Physicist.

Comments: The Gamma Spec. report is attached for the most significant radionuclides.

Group 1 Rad [redacted]

[redacted]

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-1119

Feb 03, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Jan-29-2020 Client P.O.:

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 4 authorized by Vicky Snook, Supervisor

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  * Environment Canada
  * US EPA
  * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SRC SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
143-111 Research Drive, Saskatchewan, SK, Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-1119

Feb 03, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Jan-29-2020

Client P.O.:

5758 01/29/2020 SHIM "SOLIDS"

Analyte	Units	5758
Lab Section 4		
Europium-152	Bq/g	9.7
Europium-154	Bq/g	0.8
Scandium-46	Bq/g	<0.2
Cesium-134	Bq/g	<0.09
Cobalt-60	Bq/g	450
Iron-59	Bq/g	<0.4
Manganese-54	Bq/g	<0.1
Zinc-65	Bq/g	2.2
Potassium-40	Bq/g	<0.3

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

The temperature of the cooler was 21.9 °C upon receipt.

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-694

Jan 28, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Jan-20-2020 Client P.O.:

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 4 authorized by Vicky Snook, Supervisor

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  * Environment Canada
  * US EPA
  * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
www.src.sk.ca/analytical
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

SRC Group # 2020-694

Jan 28, 2020

Date Samples Received: Jan-20-2020 Client P.O.:

4352 01/18/2020 EXTENTION ROD *SOLIDS*

Analyte	Units	4352
Lab Section 4		
Europium-152	Bq/g	3.2
Europium-154	Bq/g	0.4
Scandium-46	Bq/g	3.4
Cesium-134	Bq/g	<0.1
Cobalt-60	Bq/g	240
Iron-59	Bq/g	1.1
Manganese-54	Bq/g	5.4
Zinc-65	Bq/g	7
Potassium-40	Bq/g	<0.5

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

The temperature of the cooler was 24.2 °C upon receipt.

SRC SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-483

Jan 21, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Jan-14-2020 Client P.O.:

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 4 authorized by Vicky Snook, Supervisor

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  * Environment Canada
  * US EPA
  * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-483

Jan 21, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Sample #: 2020003534
Date Sampled: Jan 10, 2020
Sample Matrix: METAL
Description: 01/10/2020 IRRADIATION TUBE

Client PO #:
Date Received: Jan 14, 2020

Analyte	Units	Result	DL
Lab Section 4			
Europium-152	Bq/g	0.04	0.01
Europium-154	Bq/g	0.03	0.009
Scandium-46	Bq/g	0.06	0.02
Cesium-134	Bq/g	<0.01	0.01
Cobalt-60	Bq/g	2.8	0.009
Iron-59	Bq/g	<0.03	0.03
Manganese-54	Bq/g	0.11	0.02
Zinc-65	Bq/g	10	0.04
Potassium-40	Bq/g	0.09	0.05

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Gamma spectroscopy detection limits are influenced by several factors.
"Less than" values reported above represent the lowest detection limits achievable for the sample.

The temperature of the cooler was 21.4 °C upon receipt.

SRC SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2

T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca

www.src.sk.ca/analytical

RUSH

SRC Group # 2020-1703

Feb 13, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Feb-12-2020 Client P.O.:

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 4 authorized by Vicky Snook, Supervisor

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  * Environment Canada
  * US EPA
  * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SRC SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

RUSH

SRC Group # 2020-1703

Feb 13, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Feb-12-2020 Client P.O.:

8221 02/12/2020 CHIPS OF C3 REACTOR POOL *CONCRETE*
8222 02/12/2020 RESIN FROM RM 145 *RESIN*

Analyte	Units	8221	8222
Lab Section 4			
Europium-152	Bq/g	0.64	<0.02
Europium-154	Bq/g	<0.008	0.05
Scandium-46	Bq/g	0.04	<0.009
Cesium-134	Bq/g	0.04	<0.007
Cesium-137	Bq/g	0.02	70
Cobalt-60	Bq/g	0.43	0.02
Iron-59	Bq/g	<0.02	<0.01
Manganese-54	Bq/g	0.09	<0.007
Zinc-65	Bq/g	<0.03	<0.01
Potassium-40	Bq/g	0.5	<0.04

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

WASTE CONTAINER INVENTORY FORM

900-508600-FM-005 REV 1

OFFICIAL USE ONLY
Page 1 of 2
Reference: Reference: 900-508600-FID-003

File No.: 508600 (Subject Index) 016 (Dir. Code) 005 (Serial No.) — Doc. Collection ID

SECTION 1 – CONTAINER DETAILS

Waste Profile ID: N/A	Waste Management Plan: See Waste Package Data Form	Generator Representative Name: Rick Mills/Shahzad Alim	Phone: 42279
Waste Package ID	Container Type: B-25	Container Weight Empty: ~~~~ kg 475	Max Fill Weight: ~~~~ kg 4545 *Obtain from Container Catalogue
	Container ID: 16534	Container Weight Full: 2,100 kg	Percent Filled: %

SECTION 2 – INVENTORY LIST / **SECTION 3 – RADIATION PROTECTION**

	Waste Description	Est. Weight (kg)	Area of Origin	Photo Attached	Emp. Number	Date (yyyy/mm/dd)	Initials	N/C β (rem/h)	N/C γ (mrem/h)	Fixed β/γ (cpm)	Fixed α (cpm)	Loose β/γ (cpm)	Loose α (cpm)	Emp. Number	Date (yyyy/mm/dd)	Initials
1	Upper reactor container	840		☐	5591	2022/01/30	DJ		0.6	10,000	Ø	411	2	N/A	2022/01/30	JZ
2	Outer irradiation tubes	50		☐	"	"	DJ		20			Ø	Ø	N/A.	"	JZ
3	Plastic tubing	30		☐	"	"	DJ									
4	PPE&C	90		☐	"	"	DJ									
5	Concrete	400		☐	"	"	DJ									
6	Rubber Hoses	40		☐	"	"	DJ									
7	Tie Rods	20		☐	"	"	DJ									
8	Support Bars	60		☐	"	"	DJ									
9	Reactor Purification System Components.	90		☐	"	"	DJ									
10				☐												

900-511300-TMP-011 REV 3

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

WASTE CONTAINER INVENTORY FORM — **OFFICIAL USE ONLY**

900-508600-FM-005 REV 1 — Page 1 of 2 — Reference: Reference: 900-508600 FID 003

File No.	File Collection ID	Subject Index	Doc Code	Serial No
		508600	016	035

SECTION 1 – CONTAINER DETAILS

Waste Profile ID: N/A	Waste Management Plan: See Waste Package Data Form	Generator Representative Name: Rick Milk/Shahzad Alam	4595 Phone: 42279
Waste Package ID:	Container Type: B-25	Container Weight Empty: ~~350 kg~~ 475	Max Fill Weight: ~~2,312 kg~~ *Obtain from Container Catalogue
	Container ID: 16393	Container Weight Full: 2 600 Kg	Percent Filled: %

SECTION 2 – INVENTORY LIST / **SECTION 3 – RADIATION PROTECTION**

	Waste Description	Est. Weight (kg)	Area of Origin	Photo Attached	Emp. Number	Date (yyyy/mm/dd)	Initials	N/C β (Rem/h)	N/C γ (mrem/h)	Fixed β/γ (cpm)	Fixed α (cpm)	Loose β/γ (cpm)	Loose α (cpm)	Emp. Number	Date (yyyy/mm/dd)	Initials
1	Ion Exchange from water purification system	40		☐	55891	2020/01/30	DJ		35			∅	∅	N/A	2020/01/20	TR
2.	Cylinder #2	40		☐	"	"	DJ		35			45	3	N/A	"	TR
3.	Cylinder #3	40		☐	"	"	DJ		3			35	4	N/A	"	TR
4	Filled shielded container	1800		☐	"	"	DJ		9			∅	∅	N/A	"	TR
5.	Irradiation tubes	30		☐	"	"	DJ		55			4000	3	N/A	"	TR
6	Metal arms	20		☐	"	"	DJ		1.3			232	∅	N/A	"	TR
7	Cobalt 60 source	0.01		☐	"	"	DJ		2			100	50	N/A	"	TR
8	Resin	20		☐	"	"	DJ		4			32	2	N/A	"	TR
9				☐												
10				☐												

900-511300-TMP-011 REV 3

Canadian Nuclear Safety Commission / Commission canadienne de sûreté nucléaire

Directorate of Security and Safeguards
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, Ontario K1P 5S9

Fax: (613) 995-5086
safeguards.generalinfo@cnsc-ccsn.gc.ca

INVENTORY CHANGE DOCUMENT (ICD)

Report Type: ○ Internal ● Domestic ○ Import ○ Export ○ Retransfer ○ From Holding Account

Licensee Reference No:

Shipper		Internal/Receiver		Batch	
Shipped Date [412]:		Internal/Received Date [412]:		Entry Status [209]:	
Batch Name [447]:	Ref Source	Batch Name [448]:		Correction [1021]:	
MBA [370]:	CN-U	MBA [372]:	CNA1	Safeguards Status [1020]:	● 1A ○ 2 ○ Exempt U ○ Exempt Q
Country Code [370]:	C	Country Code [372]:	CN	Tracking Identifier:	
Holding Account Code [2005]:		Holding Account Code [2005]:		Licence [2001,2002]:	
Facility Code [370]:	CNU	Facility Code [372]:		Material Description Code [430]:	QSOF
IC Type [411]:	SD	IC Type [411]:		Chemical and Physical Description [436]:	10 mg of U-235 metal
P-KMP (for LOFs):		P-KMP (for LOFs):			
LOC id:		LOC id:			
F-KMP [407]:	2	F-KMP [407]:			
Measurement Basis [459]:	N	Measurement Basis [459]:		Remarks [1004]:	

Shipper Company [1027]		Internal/Receiver Company [1028]	
Company Name:	Saskatchewan Research Council	Company Name:	Canadian Nuclear Laboratories
Contact Name (First):	David	Contact Name (First):	David
Contact Name (Last):	Chorney	Contact Name (Last):	Koopman
Apt. #:	143	Apt. #:	
Civic #:	111	Civic #:	286
PO Box:		PO Box:	
Dept:	Environmental Analytical Labs	Dept:	Chalk River Laboratories
Building:		Building:	
Street:	Research Drive	Street:	Plant Road
City:	Saskatoon	City:	Chalk River Laboratories
Province:	SK	Province:	ON
Country:	Canada	Country:	Canada
Postal Code:	S7N 3R2	Postal Code:	K0J 1J0

Nuclear Material Description

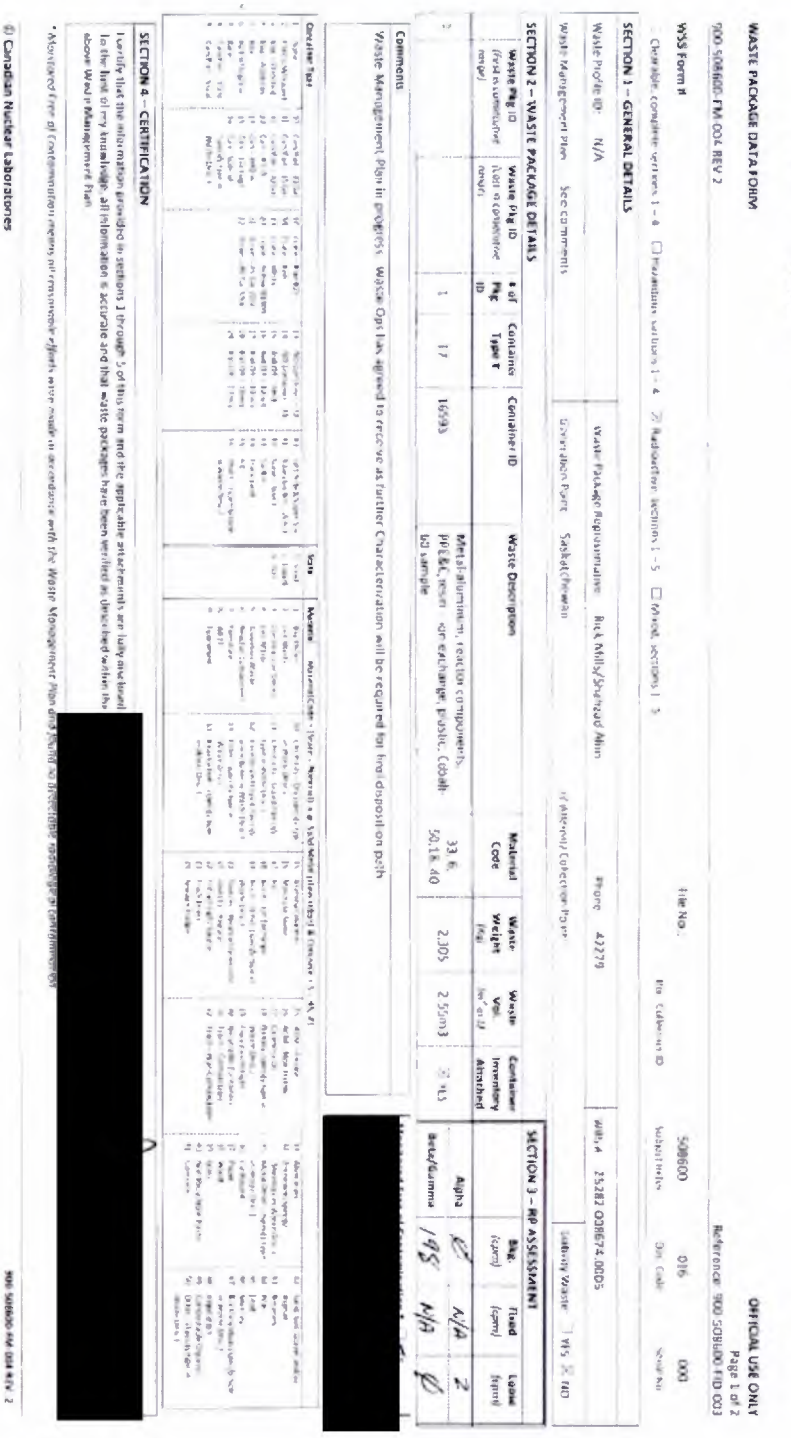
Number of Items	Element Code	Element Weight	Units (kg/g)	Isotope Code	Isotope Weight (Units g)	Unique Identifier (Batch of Items)	Country of Origin Code	Obligated Material		
[470]	[1006]	[600-630, 700,800,1032, 1634]	[1023]	[1024]	[640,660,670]	[1025]	[2003]	Country Code [2004]	Element Weight (Units kg/g) [2006]	Isotope Weight (Units g) [2007]
1	E	0.010000	g	G	0.010000	Source	U	U	0.010000	0.010000

Signature (if required): [signature] **Date:** Jan 29/20

Form must be submitted in Excel version 2003 only (CNSC cannot accept .xlsx files)

PROTECTED B (when completed)

Canada



Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiennes

WASTE PACKAGE DATA FORM

OFFICIAL USE ONLY

WSS Form H

SECTION 1 – GENERAL DETAILS

SECTION 2 – WASTE PACKAGE DETAILS

SECTION 3 – RP ASSESSMENT

Comments

Waste Management Plan in progress. Waste Ops has agreed to receive as further characterization will be required for final disposition path

SECTION 4 – CERTIFICATION

WASTE PACKAGE DATA FORM **OFFICIAL USE ONLY**

900-508600-FM-C04 REV 2 Page 2 of 2

SECTION 5 – RADIOLOGICAL OR MIXED WASTE CONSTITUENTS

Section 5 – Radiological Or Mixed Waste Constituents, describes the following Waste Package's hazards and must be completed for all Radioactive and Mixed Waste. Section 5 is not required for Clearable or Hazardous Waste.

Multiple versions of Section 5 may be required to complete the Waste Package Data Form.

SECTION 5.1 – WASTE PACKAGE(S)

List associated Waste Pkg ID(s):

SECTION 5.2 – RADIATION PROTECTION SURVEY

BETA		GAMMA	
Near Contact (Rem/h)	At 1 Meter (Rem/h)	Near Contact (mrem/h)	At 1 Meter (mrem/h)
N/A	N/A	19.25	1.44

[redacted]

SECTION 5.3 – RADIOACTIVE CONSTITUENTS

Does the waste contain Fissionable Material? ☒ NO ☐ YES, if **above** Safeguard Exception levels then provide either:

a. Nuclear Materials Transfer Document # e.g. T-12345

b. Safeguard Exception Memo reference: e.g. E-12345 Attach Exception Memo ☐ Attached

List all radionuclide constituents present in the waste package.
(If Fissionable Material present, include FM gram/pkg weight along with the nuclide Activity in the Activity column)

Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)
Eu-152							
Eu-154							
Sc-46							
Co-60							
Mn-54							
Zn-65							
K-40							

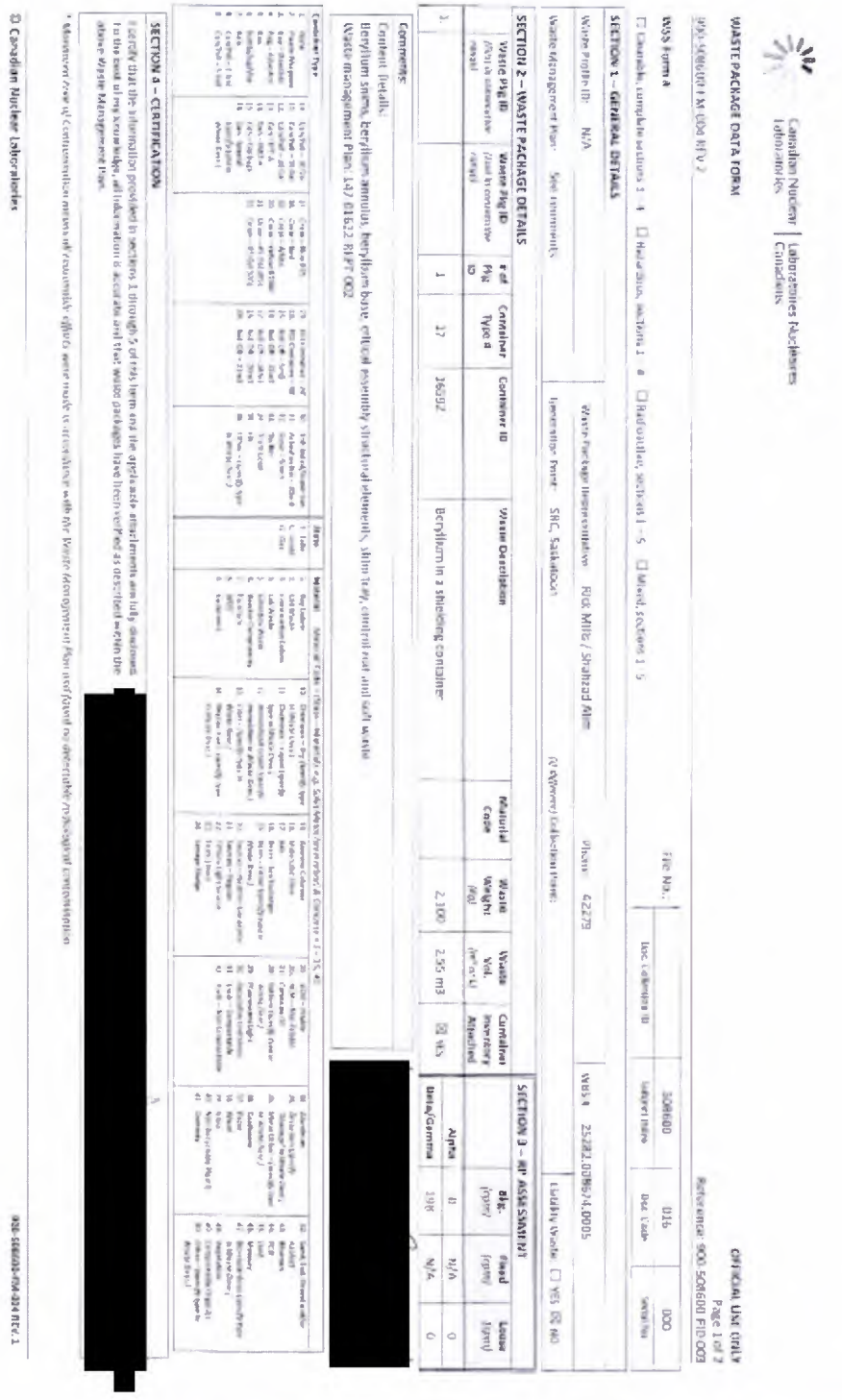
Total Activity: Bq/pkg

SECTION 5.4 – HAZARDOUS CONSTITUENTS

List all hazardous constituents present in the waste package.

If hazardous constituent is an Underlying Hazardous Constituent indicate UHC in the HW Reg Number

HW Reg Number	Hazardous Constituent	Concentration (specify units)



WASTE PACKAGE DATA FORM

OFFICIAL USE ONLY

WSS Form A

SECTION 1 – GENERAL DETAILS

SECTION 2 – WASTE PACKAGE DETAILS

SECTION 3 – RP ASSESSMENT

Comments:

Content Details:

Beryllium shims, beryllium annulus, beryllium base, reflector assembly structural elements, shim tray, control rod and soft waste

Waste Management Plan: LAV 81622 RWP 002

SECTION 4 – CERTIFICATION

WASTE PACKAGE DATA FORM — OFFICIAL USE ONLY

903-508500-FM-004 REV 2 — Page 2 of 2

SECTION 5 – RADIOLOGICAL OR MIXED WASTE CONSTITUENTS

Section 5 – Radiological Or Mixed Waste Constituents, describes the following Waste Package's hazards and must be completed for all Radioactive and Mixed Waste. Section 5 is not required for Cleanable or Hazardous Waste.

Multiple versions of Section 5 may be required to complete the Waste Package Data Form.

SECTION 5.1 – WASTE PACKAGE(S)

List associated Waste Pkg ID(s):

SECTION 5.2 – RADIATION PROTECTION SURVEY

BETA		GAMMA		[redacted]
Near Contact (Bem/h)	At 1 Meter (Bem/h)	Near Contact (mrem/h)	At 1 Meter (mrem/h)	
Background	Background	15.20	3.50	

SECTION 5.3 – RADIOACTIVE CONSTITUENTS

Does the waste contain Fissionable Material? ☒ NO ☐ YES, if above Safeguard Exception levels then provide either:

a. Nuclear Materials Transfer Document #: e.g. T-12345

b. Safeguard Exception Memo reference: e.g. E-12345 Attach Exception Memo: ☐ Attached

List all radionuclide constituents present in the waste package.
(If Fissionable Material present, include FM gram/pkg weight along with the nuclide Activity in the Activity column)

Nuclide	Activity (Bq/kg)	Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)
See Attachment							

Total Activity: Bq/pkg

SECTION 5.4 – HAZARDOUS CONSTITUENTS

List all hazardous constituents present in the waste package:

If hazardous constituent is an Underlying Hazardous Constituent indicate UHC as the HW Reg Number

HW Reg Number	Hazardous Constituent	Concentration (specify units)

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

WASTE PACKAGE DATA FORM

OFFICIAL USE ONLY
Page 1 of 2

900-508600-FM-004 REV 2

Reference: 900-508600-FID-003

WSS Form #

File No: 508600 / 016 / 000 (Doc Collection ID / Subject Index / Doc Code / Serial No)

☐ Clearable, complete sections 1 - 4 ☐ Hazardous, sections 1 - 4 ☒ Radioactive, sections 1 - 5 ☐ Mixed, sections 1 - 5

SECTION 1 – GENERAL DETAILS

Waste Profile ID: N/A	Waste Package Representative: Rick Mills / Shahzad Alim	Phone: 42279	WBS #: 25282.008674.0006
Waste Management Plan: SLWPK6 50860 WMP-001	Generation Point: Saskatchewan	(Maintenance) Collection Point:	Liability Waste: ☐ YES ☒ NO

SECTION 2 – WASTE PACKAGE DETAILS

	Waste Pkg ID (First in consecutive range)	Waste Pkg ID (Last in consecutive range)	# of Pkg ID	Container Type #	Container ID	Waste Description	Material Code	Waste Weight (Kg)	Waste Vol. (m³ or L)	Container Inventory Attached
1	C565998		1	9		U 235 Source	21	1	0.037	☒ YES

SECTION 3 – RP ASSESSMENT

	Bkg. (cpm)	Fixed (cpm)	Loose (cpm)
Alpha	0	Bkgd	0
Beta/Gamma	100	Bkgd	0

[redacted]

Comments:
Slowpoke

Container Type / State / Material code legend: [illegible]

SECTION 4 – CERTIFICATION

I certify that the information provided in sections 1 through 5 of this form and the applicable attachments are fully disclosed. To the best of my knowledge, all information is accurate and that waste packages have been verified as described within the above Waste Management Plan.

Shahzad Alim
WASTE PACKAGE REPRESENTATIVE
(Print name)

[redacted]

* Monitored Free of Contamination means all reasonable efforts were made in accordance with the Waste Management Plan and found no detectable radiological contamination.

900-508600-FM-004 REV 2

WASTE PACKAGE DATA FORM **OFFICIAL USE ONLY**

900-508600-FM-004 REV 2 Page 2 of 2

SECTION S – RADIOLOGICAL OR MIXED WASTE CONSTITUENTS

Section S – Radiological Or Mixed Waste Constituents, describes the following Waste Package's hazards and must be completed for all Radioactive and Mixed Waste. Section S is not required for Clearable or Hazardous Waste.

Multiple versions of Section S may be required to complete the Waste Package Data Form.

SECTION S.1 – WASTE PACKAGE(S)

List associated Waste Pkg ID(s):

SECTION S.2 – RADIATION PROTECTION SURVEY

BETA		GAMMA	
Near Contact (Rem/h)	At 1 Meter (Rem/h)	Near Contact (mrem/h)	At 1 Meter (mrem/h)
<0.01(bkgd))	<0.01	<0.1 (bkgd)	<0.1

[redacted]

SECTION S.3 – RADIOACTIVE CONSTITUENTS

Does the waste contain Fissionable Material? ☐ NO ☒ YES, if above Safeguard Exception levels then provide either

a. Nuclear Materials Transfer Document # e.g. T-12345

b. Safeguard Exception Memo reference e.g. E-12345 Attach Exception Memo ☐ Attached

List all radionuclide constituents present in the waste package.
If Fissionable Material present, include FM gram/pkg weight along with the nuclide Activity in the Activity column)

Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)	Nuclide	Activity (Bq/pkg)
U-235	0.01 g						
U-235	799.66 Bq						
EnrU	0.01 g						

Total Activity: Bq/pkg

SECTION S.4 – HAZARDOUS CONSTITUENTS

List all hazardous constituents present in the waste package.

- *If hazardous constituent is an Underlying Hazardous Constituent, indicate UHC as the HW Reg Number.*

HW Reg Number	Hazardous Constituent	Concentration (specify units)

Appendix F
IRRADIATED FUEL BILL OF LADING AND RECEIPT OF DELIVERY

From: [redacted]
To:
Subject:
Date:

[redacted]

All –

Official confirmation of receipt of the spent fuel by DOE.

[redacted]

CAUTION: This email is from an external source. Do not click links or open attachments unless you recognize the sender and know the content is safe.

[redacted]

I know you already heard, but I just wanted to send you the official confirmation that your core arrived at SRS safely.

It was great working with you and your team and I'm really happy this went as smoothly as it did.

Excellent work and congratulations.

[redacted]

Office of Nuclear Material Removal
National Nuclear Security Administration
P.O. Box A
Aiken, SC 29802-0900
(803) 952-7639 ofc
(240) 388-5438 cell

0289448 763/CX010

STS
Secured Transportation Services

STRAIGHT BILL OF LADING

ORIGINAL - NOT NEGOTIABLE

Shipper No: SRC-1901

Comp No: 0289448

Date: [redacted]

TRI STATE MOTOR TRANSIT (TSMT) (SCAC)
(Name of Carrier)

To: Consignee: U.S. DOE Savannah River Site Jackson Gate Aiken, SC 29803 Attn: Michael Dunsmuir 803-761-2744	From: Shipper: Saskatchewan Research Council SLOWPOKE Facility 125-15 Innovation Blvd Saskatoon, SK, S7N 2X8 Attn: Philip Rees 306-385-4024
Street:	Street:
City, State, Zip Code:	City, State, Zip Code: 24 hr. Emergency Contact Tel. No.: 1-803-725-3333

Route: TSMT Direct — NRC Approved Route #253 — Vehicle Number:

No. of Units & Container Type	HM	BASIC DESCRIPTION	WEIGHT	RATE	CHARGES
1	RQ	UN3328, RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE, FISSILE, CLASS 7 EXCLUSIVE USE SHIPMENT Per 49CFR173 457(c) Radionuclides Pr-144, Ba-137m, Ce-144, Rh-106, Sr-90, Y-90, Cs-137, Nb-95 Physical Form Solid Transport Form Normal Chemical Form Solid Metal Oxide as U-Al Alloy Activity 10 73 TBq (290 Ci) Labels Radioactive Yellow II and Fissile Transport Index 0 1 Criticality Safety Index 100 Net Weight 5.05 Kg, 1 SLOWPOKE Reactor Core Supplemental Information Package F-257-02 USA/0561/B(U)F, Rev 3 (DOT) CDN/2048/B(U)F, Rev 9 (CNSC) Container TID's 000355, 000356, 000357 Emergency Contact SRSOC 803-725-3333	3161.1 Kg (6954.6 lbs)		

RED ROCK GRP TRI STATE MOTOR TRANSIT
21GZ 650401

PLACARDS TENDERED: N/A YES ☐ NO ☐

REMIT COD TO ADDRESS

COD Amt $ COD Fee PREPAID ☐ COLLECT ☐

Total Charges $

Freight Charges

Freight PREPAID
Except when box at right is checked ☐

SHIPPER [redacted]

CARRIER TSMT

Eric Tucker [redacted]

Appendix G
POOL WATER SAMPLE DATA & APPROVALS

City of Saskatoon

Community Standards/Community Services
222 Third Ave N
Saskatoon SK S7K 0J5
www.saskatoon.ca
tel (306) 657.8766

[redacted]

Saskatchewan Research Council
422 Downey Rd
Saskatoon SK S7N 2X8

[redacted]

Re: Saskatchewan Research Council – Special Discharge Permit Application

I acknowledge receipt of your Special Discharge Permit Application received on January 10, 2020. Having reviewed the information provided, we have determined to issue a conditional permit to discharge into the City sanitary system.

In addition to the terms and conditions attached to this letter, conditions of the permit are as follows:

- Discharge into the sanitary system should be discontinued in the event any radionuclide in the reactor pool water is above the limit permitted by SRC's Canadian Nuclear Safety Commission amended licence.
- SRC is responsible for making sure that the sanitary system inside the University of Saskatchewan is able to handle the proposed flow rate indicated in their application.

Please be advised that a permit to discharge is hereby granted until February 28, 2020.

Sincerely,

[redacted]

cc: Trent Schmidt, Water & Sewer Manager
Terry Freimark, Operations Superintendent
Terry Enns, Claims and Technical Operations Supervisor
Mike Sadowski, Acting Plant Manager
Sudhir Pandey, Environmental Laboratory Coordinator

City of Saskatoon

Terms and Conditions Related to the Application

1. The applicant agrees to provide such additional information the City may require to consider this permit application.
2. The applicant must obtain written right-of-way permission to cross all private land and access private infrastructure.
3. The applicant must obtain site specific traffic control authorization to cross any City owned street with hoses or to temporarily block traffic.
4. Without limiting any other right, remedy or enforcement power under Sewer Use Bylaw No. 9466, if the applicant makes any false, misleading or inaccurate representations in this application, as determined by the General Manager, the General Manager may reject this application or cancel or terminate any Permit or Agreement arising from this application. It is an offence to make any false, misleading or inaccurate representations in this application.

Conditions Which Attach to All Permits

5. The applicant must agree to accept and abide by the Terms and Conditions identified in the permit and the permit approval letter;
6. The applicant must agree to assume all responsibility and liability whatsoever in respect to any fees, interest, costs, expenses, damage or loss, arising directly or indirectly from the issuance of this permit.
7. The applicant must at all times, retain a copy of the permit at the location specified in the address indicated in this application.
8. Issuance of a permit is specific to the conditions listed and shall in no way be construed or be deemed to be a broad approval, authorization or acceptance of any discharge to the City's sanitary sewage system.
9. The applicant understands authorization to discharge to the City's sanitary sewer system shall occur and take effect only to the extent stated in a fully and validly executed permit.
10. The applicant is responsible for ensuring discharge into the sanitary sewer system will not cause an adverse effect.
11. The applicant must notify the City immediately of any spill, breach of condition, or expansion or alteration to process which may impact the conditions stated within the permit.
12. The applicant must not add, cause or permit the addition of any matter to sewage for the purpose of dilution to achieve compliance with any limits specified by the City.
13. The applicant is responsible for ensuring the discharge pursuant to issuance of a permit meets all applicable legislation and the operation is conducted in a safe manner. Issuance of a permit does not relieve duties to comply with any other law, including public health legislation, environmental protection legislation, and any other bylaw of the City.
14. An Environmental Protection Officer or other personnel authorized under the Sanitary Sewer Bylaw No. 9466 may inspect any property for the purpose of ensuring compliance with the Conditions associated with an issued permit.

Canadian Nuclear Safety Commission / Commission canadienne de sûreté nucléaire

Directorate of Nuclear Cycle and Facilities Regulation

File No.: 4.03.02
e-Doc: 6097275

Telephone: 613-992-3870
E-mail: ismail.erdebil@canada.ca

January 20, 2020

Mr. Philip Rees
Facilities Manager & CSO, Organizational Effectiveness
Saskatchewan Research Council
125-15 Innovation Blvd,
Saskatchewan, Saskatoon SK S7N 2X8

Subject: Saskatchewan Research Council (SRC) Pool Water Analyses

Dear Mr. Rees,

Canadian Nuclear Safety Commission (CNSC) staff reviewed [1] Saskatchewan Research Council's (SRC) analyses of radionuclides in the SRC SLOWPOKE-2 Reactor pool (SRC pool) water [2 & 3], and compared them against the conditional clearance levels in appendix R of CNSC REGDOC-1.6.1 [4], as well as the exposure-based release limit derived using the methodology in CSA N288.1-14 [5]. Furthermore, assuming that the activity of the radionuclide is equal to the detection limit, the activities would still be below the conservative conditional clearance levels.

CNSC staff also reviewed the results of the hazardous substances and compared them against the limits in schedule "B" of the City of Saskatoon's sewer use bylaw [6].

CNSC staff conclude that releasing the pool water to the sewer does not present unreasonable risk and can be discharged to the sewer. CNSC staff note that SRC would still need to obtain the required permissions from the City of Saskatoon.

280 Slater Street, Post Office Box 1046, Station B
Ottawa, Ontario K1P 5S9 Canada
Fax: 613-995-5086 nuclearsafety.gc.ca

Canada

280 rue Slater, Case postale 1046, Succursale B
Ottawa (Ontario) K1P 5S9 Canada
Télécopieur : 613-995-5086suretenucleaire.gc.ca

Should you require further information or clarification, please do not hesitate to contact the undersigned.

Sincerely,

Ismail Erdebil
Senior Project Officer
Canadian Nuclear Safety Commission
Nuclear Processing Facilities Division

c.c.: D. Chorney (SRC)
A. Shahzad (CANDU Energy)
C. Ducros, P. Tanguay, S. Eaton, J. Lam, K. Sauvé (CNSC)

References:

1. Memo, J. Lam to P. Tanguay, *HSECD memo on the results of the SRC Pool Water Analysis.* January 16, 2020. (e-Doc: 6096576)

2. Saskatchewan Research Council (SRC). SRC Pool Water Analysis results – Performed by an Independent Lab. (e-Doc: 6091871)

3. Saskatchewan Research Council (SRC), SRC Pool Water Analysis results – Performed by SRC's lab (e-Doc: 6093584)

4. Canadian Nuclear Safety Commission (CNSC). REGDOC-1.6.1: *Licence Application Guide: Nuclear Substances and Radiation Devices* (https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc1-6-1/index.cfm)

5. CSA Group. CSA N288.1-14 Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities

6. City of Saskatoon. Bylaw No. 9466 The Sewer Use Bylaw, 2017 (https://www.saskatoon.ca/sites/default/files/documents/city-clerk/bylaws/9466.pdf)

Your Project #: 11526
Your C.O.C. #: M081665

Attention: KEITH GIPMAN

Saskatchewan Research Council
143 - 111 Research Drive
Saskatoon, SK
CANADA S7N 3R2

Report Date: 2020/01/07
Report #: R2831227
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9A8342
Received: 2019/12/17, 14:08

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Biochemical Oxygen Demand	1	2019/12/19	2019/12/24	AB SOP-00017	SM 23 5210B m
Cadmium - low level CCME (Total)	1	N/A	2019/12/20		Auto Calc
Chloride/Sulphate by Auto Colourimetry	1	N/A	2019/12/24	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
COD by Colorimeter	1	N/A	2019/12/21	AB SOP-00016	SM 23 5220D m
Sulphide (as H2S)	1	N/A	2019/12/23		Auto Calc
Mercury (Total) by CV (1)	1	2019/12/23	2019/12/23	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Elements by ICP - Total	1	2019/12/19	2019/12/20	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS - Total	1	2019/12/19	2019/12/19	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Oil and Grease by IR	1	2019/12/19	2019/12/20	CAL SOP-00096	SM 23 5520C m
Benzo[a]pyrene Equivalency (4)	1	N/A	2019/12/20		Auto Calc
PAH in Water by GC/MS	1	2019/12/19	2019/12/20	AB SOP-00037 / AB SOP-00008	EPA 3510C/3270E m
Total LMW, HMW, Total PAH Calc	1	N/A	2019/12/20		Auto Calc
Phenols (4-AAP)	1	N/A	2019/12/23	AB SOP-00008	EPA 9066 R0 m
Total Sulphide	1	N/A	2019/12/23	AB SOP-00050	SM 23 4500 S2-A D Fm
Cyanide (Total) Low level	1	2019/12/19	2019/12/19	CAL SOP-00270	SM 23 4500-CN m
Total Trihalomethanes Calculation	1	N/A	2019/12/23		Auto Calc
Total Kjeldahl Nitrogen	1	2019/12/27	2019/12/27	AB SOP-00006	EPA 351.1 R1978 m
Total Phosphorus	1	2019/12/27	2019/12/27	AB SOP-00024	SM 23 4500-P A,B,F m
Hydrocarbon by IR (Mineral oil & grease)	1	2019/12/19	2019/12/20	CAL SOP-00096	SM 23 5520C,F m
Total Suspended Solids (NFR)	1	2019/12/24	2019/12/24	AB SOP-00061	SM 23 2540 D m
VOCs in Water by HS GC/MS (Std List)	1	N/A	2019/12/21	AB SOP-00056	EPA 5021a/8260d m
Total Nonylphenol in Liquids by HPLC (2)	1	2019/12/27	2019/12/28	CAM SOP-00313	In-house Method
Nonylphenol Ethoxylates in Liquids: HPLC (2)	1	2019/12/27	2019/12/28	CAM SOP-00313	Maxxam Method
Artificial Isotope Group Analysis (3)	1	N/A	2019/12/27	BQL SOP-00007	Gamma Spectrometry
NORM Group Analysis (3)	1	N/A	2020/01/01	BQL SOP-00007	Gamma Spectrometry

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your Project #: 11526
Your C.O.C. #: M081665

Attention: KEITH GIPMAN

Saskatchewan Research Council
143 - 111 Research Drive
Saskatoon, SK
CANADA S7N 3R2

Report Date: 2020/01/07
Report #: R2831227
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9B8142
Received: 2019/12/17, 14:08

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by BV Labs Vancouver
(2) This test was performed by BV Labs Ontario (From Calgary)
(3) This test was performed by BV Labs Kitimat (From Calgary)
(4) B(a)P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas Laboratories
07 Jan 2020 11:32:22

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bvlabs.com
Phone# (403) 291-3077

This report has been generated and distributed using a secure automated process.
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Total Cover Pages : 2
Page 1 of 23

Bureau Veritas Laboratories Calgary [illegible]

BV Labs Job #: B9A0342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

PAH IN WATER BY GC/MS (WATER)

BV Labs ID		XD4197		
Sampling Date		2019/12/17		
COC Number		M081665		
	UNITS	SLOWPOKE POOL	RDL	QC Batch
Polycyclic Aromatics				
Low Molecular Weight PAH's	ug/L	<0.20	0.20	9714116
High Molecular Weight PAH's	ug/L	<0.050	0.050	9714116
Total PAH	ug/L	<0.20	0.20	9714116
B(a)P TPE Total Potency Equivalents	ug/L	<0.010	0.010	9713881
Acenaphthene	ug/L	<0.10	0.10	9714646
Acenaphthylene	ug/L	<0.10	0.10	9714646
Acridine	ug/L	<0.040	0.040	9714646
Anthracene	ug/L	<0.010	0.010	9714646
Benzo(a)anthracene	ug/L	<0.0085	0.0085	9714646
Benzo(b&j)fluoranthene	ug/L	<0.0085	0.0085	9714646
Benzo(k)fluoranthene	ug/L	<0.0085	0.0085	9714646
Benzo(g,h,i)perylene	ug/L	<0.0085	0.0085	9714646
Benzo(c)phenanthrene	ug/L	<0.050	0.050	9714646
Benzo(a)pyrene	ug/L	<0.0075	0.0075	9714646
Benzo(e)pyrene	ug/L	<0.050	0.050	9714646
Chrysene	ug/L	<0.0085	0.0085	9714646
Dibenz[a,h]anthracene	ug/L	<0.0075	0.0075	9714646
Fluoranthene	ug/L	<0.010	0.010	9714646
Fluorene	ug/L	<0.050	0.050	9714646
Indeno(1,2,3-cd)pyrene	ug/L	<0.0085	0.0085	9714646
1-Methylnaphthalene	ug/L	<0.10	0.10	9714646
2-Methylnaphthalene	ug/L	<0.10	0.10	9714646
Naphthalene	ug/L	<0.10	0.10	9714646
Phenanthrene	ug/L	<0.050	0.050	9714646
Perylene	ug/L	<0.050	0.050	9714646
Pyrene	ug/L	<0.020	0.020	9714646
Quinoline	ug/L	<0.20	0.20	9714646
Surrogate Recovery (%)				
D10-ANTHRACENE (sur.)	%	101		9714646
D8-ACENAPHTHYLENE (sur.)	%	97		9714646
D8-NAPHTHALENE (sur.)	%	82		9714646
TERPHENYL-D14 (sur.)	%	123		9714646
RDL = Reportable Detection Limit				

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BV Labs Job #: B9A0342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		XD4197		
Sampling Date		2019/12/17		
COC Number		M001665		
	UNITS	SLOWPOKE POOL	RDL	QC Batch
Low Level Elements				
Total Cadmium (Cd)	ug/L	<0.020	0.020	9712092
Elements				
Total Aluminum (Al)	mg/L	0.0049	0.0030	9713053
Total Antimony (Sb)	mg/L	<0.00060	0.00060	9713053
Total Arsenic (As)	mg/L	<0.00020	0.00020	9713053
Total Barium (Ba)	mg/L	<0.010	0.010	9713060
Total Beryllium (Be)	mg/L	<0.0010	0.0010	9713053
Total Boron (B)	mg/L	<0.020	0.020	9713060
Total Calcium (Ca)	mg/L	<0.30	0.30	9713060
Total Chromium (Cr)	mg/L	<0.0010	0.0010	9713053
Total Cobalt (Co)	mg/L	<0.00030	0.00030	9713053
Total Copper (Cu)	mg/L	<0.00020	0.00020	9713053
Total Iron (Fe)	mg/L	<0.060	0.060	9713060
Total Lead (Pb)	mg/L	0.00031	0.00020	9713053
Total Lithium (Li)	mg/L	<0.020	0.020	9713060
Total Magnesium (Mg)	mg/L	<0.20	0.20	9713060
Total Manganese (Mn)	mg/L	<0.0040	0.0040	9713060
Total Molybdenum (Mo)	mg/L	<0.00020	0.00020	9713053
Total Nickel (Ni)	mg/L	<0.00050	0.00050	9713053
Total Phosphorus (P)	mg/L	<0.10	0.10	9713060
Total Potassium (K)	mg/L	<0.30	0.30	9713060
Total Selenium (Se)	mg/L	0.00083	0.00020	9713053
Total Silicon (Si)	mg/L	<0.10	0.10	9713060
Total Silver (Ag)	mg/L	0.00012	0.00010	9713053
Total Sodium (Na)	mg/L	<0.50	0.50	9713060
Total Strontium (Sr)	mg/L	<0.020	0.020	9713060
Total Sulphur (S)	mg/L	0.43	0.20	9713060
Total Thallium (Tl)	mg/L	<0.00020	0.00020	9713053
Total Tin (Sn)	mg/L	<0.0010	0.0010	9713053
Total Titanium (Ti)	mg/L	<0.0010	0.0010	9713053
Total Uranium (U)	mg/L	<0.00010	0.00010	9713053
Total Vanadium (V)	mg/L	<0.0010	0.0010	9713053
Total Zinc (Zn)	mg/L	<0.0030	0.0030	9713053
RDL = Reportable Detection Limit				

BV Labs Job #: B9A8342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		XD4197		
Sampling Date		2019/12/17		
COC Number		MD81665		
	UNITS	SLOWPOKE POOL	RDL	QC Batch
Calculated Parameters				
Sulphide (as H2S)	mg/L	<0.0020	0.0020	9713020
Demand Parameters				
Biochemical Oxygen Demand	mg/L	<2.0 (1)	2.0	9714648
Chemical Oxygen Demand	mg/L	<10	10	9717834
Misc. Inorganics				
Strong Acid Dissoc. Cyanide (CN)	mg/L	<0.0020	0.0020	9708137
Total Suspended Solids	mg/L	<1.0	1.0	9719561
Anions				
Total Sulphide	mg/L	<0.0010	0.0010	9719621
Dissolved Sulphate (SO4)	mg/L	<1.0	1.0	9719690
Nutrients				
Total Phosphorus (P)	mg/L	<0.0030	0.0030	9721399
Total Total Kjeldahl Nitrogen	mg/L	<0.050	0.050	9721299
Misc. Organics				
Oil and grease	mg/L	<2.0	2.0	9712328
Phenols	mg/L	<0.0015	0.0015	9716458
Total Petroleum Hydrocarbon	mg/L	<2.0	2.0	9713998
RADIONUCLIDE				
Cesium-134	Bq/l	<1	1	9727685
Cesium-137	Bq/l	<1	1	9727685
Cobalt-60	Bq/l	<1	1	9727685
Iodine-131	Bq/l	<1	1	9727685
Manganese-54	Bq/l	<1	1	9727685
Radium 226	Bq/l	<1.0	1.0	9727686
Uranium-235	Bq/l	<0.50	0.50	9727686
Zinc-65	Bq/l	<1	1	9727685

RDL = Reportable Detection Limit
(1) Spike exceeds method criteria of 85-115% with value of 128.3%. Unable to reanalyze due to hold time & incubation requirements.

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BV Labs Job #: B9A0342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

NONYL PHENOL AND NONYL PHENOL ETHOXYLATE (WATER)

BV Labs ID		XD4197		
Sampling Date		2019/12/17		
COC Number		M081665		
	UNITS	SLOWPOKE POOL	RDL	QC Batch
MISCELLANEOUS				
Nonylphenol Ethoxylate (Total)	mg/L	<0.025	0.025	9723115
Phenols				
Nonylphenol (Total)	mg/L	<0.0010	0.0010	9723114
RDL = Reportable Detection Limit				

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BV Labs Job #: B9A8342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

MERCURY BY COLD VAPOR (WATER)

BV Labs ID		XD4197		
Sampling Date		2019/12/17		
COC Number		M0S1665		
	UNITS	SLOWPOKE POOL	RDL	QC Batch
Elements				
Total Mercury (Hg)	ug/L	<0.0020	0.0020	9718156
RDL = Reportable Detection Limit				

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BV Labs Job #: B9A0342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

VOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		XD4197		
Sampling Date		2019/12/17		
COC Number		M081665		
	UNITS	SLOWPOKE POOL	RDL	QC Batch
Volatiles				
Total Trihalomethanes	ug/L	<1.3	1.3	9714011
Benzene	ug/L	<0.40	0.40	9716741
Bromodichloromethane	ug/L	<0.50	0.50	9716741
Bromoform	ug/L	<0.50	0.50	9716741
Bromomethane	ug/L	<2.0	2.0	9716741
Carbon tetrachloride	ug/L	<0.50	0.50	9716741
Chlorobenzene	ug/L	<0.50	0.50	9716741
Chlorodibromomethane	ug/L	<1.0	1.0	9716741
Chloroethane	ug/L	<1.0	1.0	9716741
Chloroform	ug/L	<0.50	0.50	9716741
Chloromethane	ug/L	<2.0	2.0	9716741
1,2-dibromoethane	ug/L	<0.20	0.20	9716741
1,2-dichlorobenzene	ug/L	<0.50	0.50	9716741
1,3-dichlorobenzene	ug/L	<0.50	0.50	9716741
1,4-dichlorobenzene	ug/L	<0.50	0.50	9716741
1,1-dichloroethane	ug/L	<0.50	0.50	9716741
1,2-dichloroethane	ug/L	<0.50	0.50	9716741
1,1-dichloroethene	ug/L	<0.50	0.50	9716741
cis-1,2-dichloroethene	ug/L	<0.50	0.50	9716741
trans-1,2-dichloroethene	ug/L	<0.50	0.50	9716741
Dichloromethane	ug/L	<2.0	2.0	9716741
1,2-dichloropropane	ug/L	<0.50	0.50	9716741
cis-1,3-dichloropropene	ug/L	<0.50	0.50	9716741
trans-1,3-dichloropropene	ug/L	<0.50	0.50	9716741
Ethylbenzene	ug/L	<0.40	0.40	9716741
Methyl methacrylate	ug/L	<0.50	0.50	9716741
Methyl-tert-butylether (MTBE)	ug/L	<0.50	0.50	9716741
Styrene	ug/L	<0.50	0.50	9716741
1,1,1,2-tetrachloroethane	ug/L	<1.0	1.0	9716741
1,1,2,2-tetrachloroethane	ug/L	<2.0	2.0	9716741
Tetrachloroethene	ug/L	<0.50	0.50	9716741
Toluene	ug/L	<0.40	0.40	9716741
1,2,3-trichlorobenzene	ug/L	<1.0	1.0	9716741
RDL = Reportable Detection Limit				

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B9A8342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

VOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		XD4197		
Sampling Date		2019/12/17		
COC Number		M081665		
	UNITS	SLOWPOKE POOL	RDL	QC Batch
1,2,4-trichlorobenzene	ug/L	<1.0	1.0	9716741
1,3,5-trichlorobenzene	ug/L	<0.50	0.50	9716741
1,1,1-trichloroethane	ug/L	<0.50	0.50	9716741
1,1,2-trichloroethane	ug/L	<0.50	0.50	9716741
Trichloroethene	ug/L	<0.50	0.50	9716741
Trichlorofluoromethane	ug/L	<0.50	0.50	9716741
1,2,4-trimethylbenzene	ug/L	<0.50	0.50	9716741
1,3,5-trimethylbenzene	ug/L	<0.50	0.50	9716741
Vinyl chloride	ug/L	<0.50	0.50	9716741
Xylenes (Total)	ug/L	<0.60	0.60	9716741
m & p-Xylene	ug/L	<0.60	0.60	9716741
o-Xylene	ug/L	<0.40	0.40	9716741
Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	98		9716741
4-Bromofluorobenzene (sur.)	%	98		9716741
D4-1,2-Dichloroethane (sur.)	%	100		9716741
RDL = Reportable Detection Limit				

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BV Labs Job #: B9A0342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	17.0°C

Results relate only to the items tested.

BV Labs Job #: B9A8342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9708137	TMU	Matrix Spike	Strong Acid Dissoc. Cyanide (CN)	2019/12/19		NC	%	80 - 120
9708137	TMU	Spiked Blank	Strong Acid Dissoc. Cyanide (CN)	2019/12/19		101	%	80 - 120
9708137	TMU	Method Blank	Strong Acid Dissoc. Cyanide (CN)	2019/12/19	<0.0010		mg/L	
9708137	TMU	RPD	Strong Acid Dissoc. Cyanide (CN)	2019/12/19	16		%	20
9712328	LLO	Matrix Spike [XD4197-19]	Oil and grease	2019/12/20		97	%	70 - 130
9712328	LLO	Spiked Blank	Oil and grease	2019/12/20		96	%	70 - 130
9712328	LLO	Method Blank	Oil and grease	2019/12/20	<2.0		mg/L	
9713833	PCS	Matrix Spike	Total Aluminum (Al)	2019/12/19		105	%	80 - 120
			Total Antimony (Sb)	2019/12/19		120	%	80 - 120
			Total Arsenic (As)	2019/12/19		101	%	80 - 120
			Total Beryllium (Be)	2019/12/19		90	%	80 - 120
			Total Chromium (Cr)	2019/12/19		104	%	80 - 120
			Total Cobalt (Co)	2019/12/19		105	%	80 - 120
			Total Copper (Cu)	2019/12/19		NC	%	80 - 120
			Total Lead (Pb)	2019/12/19		107	%	80 - 120
			Total Molybdenum (Mo)	2019/12/19		109	%	80 - 120
			Total Nickel (Ni)	2019/12/19		102	%	80 - 120
			Total Selenium (Se)	2019/12/19		100	%	80 - 120
			Total Silver (Ag)	2019/12/19		104	%	80 - 120
			Total Thallium (Tl)	2019/12/19		108	%	80 - 120
			Total Tin (Sn)	2019/12/19		113	%	80 - 120
			Total Titanium (Ti)	2019/12/19		101	%	80 - 120
			Total Uranium (U)	2019/12/19		105	%	80 - 120
			Total Vanadium (V)	2019/12/19		106	%	80 - 120
			Total Zinc (Zn)	2019/12/19		113	%	80 - 120
9713833	PCS	Spiked Blank	Total Aluminum (Al)	2019/12/19		109	%	80 - 120
			Total Antimony (Sb)	2019/12/19		126 (1)	%	80 - 120
			Total Arsenic (As)	2019/12/19		110	%	80 - 120
			Total Beryllium (Be)	2019/12/19		92	%	80 - 120
			Total Chromium (Cr)	2019/12/19		109	%	80 - 120
			Total Cobalt (Co)	2019/12/19		110	%	80 - 120
			Total Copper (Cu)	2019/12/19		110	%	80 - 120
			Total Lead (Pb)	2019/12/19		113	%	80 - 120
			Total Molybdenum (Mo)	2019/12/19		113	%	80 - 120
			Total Nickel (Ni)	2019/12/19		108	%	80 - 120
			Total Selenium (Se)	2019/12/19		108	%	80 - 120
			Total Silver (Ag)	2019/12/19		111	%	80 - 120
			Total Thallium (Tl)	2019/12/19		114	%	80 - 120
			Total Tin (Sn)	2019/12/19		119	%	80 - 120
			Total Titanium (Ti)	2019/12/19		109	%	80 - 120
			Total Uranium (U)	2019/12/19		107	%	80 - 120
			Total Vanadium (V)	2019/12/19		113	%	80 - 120
			Total Zinc (Zn)	2019/12/19		108	%	80 - 120
9713833	PCS	Method Blank	Total Aluminum (Al)	2019/12/20	<0.0030		mg/L	
			Total Antimony (Sb)	2019/12/20	<0.00060		mg/L	
			Total Arsenic (As)	2019/12/20	<0.00020		mg/L	
			Total Beryllium (Be)	2019/12/20	<0.0010		mg/L	
			Total Chromium (Cr)	2019/12/20	<0.0010		mg/L	
			Total Cobalt (Co)	2019/12/20	<0.00030		mg/L	
			Total Copper (Cu)	2019/12/20	<0.00020		mg/L	
			Total Lead (Pb)	2019/12/20	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/12/20	<0.00020		mg/L	
			Total Nickel (Ni)	2019/12/20	<0.00050		mg/L	
			Total Selenium (Se)	2019/12/20	<0.00020		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silver (Ag)	2019/12/20	<0.00010		mg/L	
			Total Thallium (Tl)	2019/12/20	<0.00020		mg/L	
			Total Tin (Sn)	2019/12/20	<0.0010		mg/L	
			Total Titanium (Ti)	2019/12/20	<0.0010		mg/L	
			Total Uranium (U)	2019/12/20	<0.00010		mg/L	
			Total Vanadium (V)	2019/12/20	<0.0010		mg/L	
			Total Zinc (Zn)	2019/12/20	<0.0030		mg/L	
9713855	PCP	RPD	Total Aluminum (Al)	2019/12/19	NC		%	20
			Total Antimony (Sb)	2019/12/19	17		%	20
			Total Arsenic (As)	2019/12/19	6.4		%	20
			Total Beryllium (Be)	2019/12/19	NC		%	20
			Total Chromium (Cr)	2019/12/19	NC		%	20
			Total Cobalt (Co)	2019/12/19	NC		%	20
			Total Copper (Cu)	2019/12/19	0.66		%	20
			Total Lead (Pb)	2019/12/19	NC		%	20
			Total Molybdenum (Mo)	2019/12/19	12		%	20
			Total Nickel (Ni)	2019/12/19	15		%	20
			Total Selenium (Se)	2019/12/19	3.8		%	20
			Total Silver (Ag)	2019/12/19	4.6		%	20
			Total Thallium (Tl)	2019/12/19	NC		%	20
			Total Tin (Sn)	2019/12/19	NC		%	20
			Total Titanium (Ti)	2019/12/19	NC		%	20
			Total Uranium (U)	2019/12/19	6.0		%	20
			Total Vanadium (V)	2019/12/19	NC		%	20
			Total Zinc (Zn)	2019/12/19	1.9		%	20
9713860	MAP	Matrix Spike	Total Barium (Ba)	2019/12/20		95	%	80 - 120
			Total Boron (B)	2019/12/20		95	%	80 - 120
			Total Calcium (Ca)	2019/12/20		NC	%	80 - 120
			Total Iron (Fe)	2019/12/20		101	%	80 - 120
			Total Lithium (Li)	2019/12/20		95	%	80 - 120
			Total Magnesium (Mg)	2019/12/20		101	%	80 - 120
			Total Manganese (Mn)	2019/12/20		95	%	80 - 120
			Total Phosphorus (P)	2019/12/20		98	%	80 - 120
			Total Potassium (K)	2019/12/20		96	%	80 - 120
			Total Silicon (Si)	2019/12/20		105	%	80 - 120
			Total Sodium (Na)	2019/12/20		NC	%	80 - 120
			Total Strontium (Sr)	2019/12/20		94	%	80 - 120
			Total Sulphur (S)	2019/12/20		94	%	80 - 120
9713860	MAP	Spiked Blank	Total Barium (Ba)	2019/12/20		99	%	80 - 120
			Total Boron (B)	2019/12/20		97	%	80 - 120
			Total Calcium (Ca)	2019/12/20		102	%	80 - 120
			Total Iron (Fe)	2019/12/20		104	%	80 - 120
			Total Lithium (Li)	2019/12/20		97	%	80 - 120
			Total Magnesium (Mg)	2019/12/20		103	%	80 - 120
			Total Manganese (Mn)	2019/12/20		98	%	80 - 120
			Total Phosphorus (P)	2019/12/20		98	%	80 - 120
			Total Potassium (K)	2019/12/20		97	%	80 - 120
			Total Silicon (Si)	2019/12/20		109	%	80 - 120
			Total Sodium (Na)	2019/12/20		99	%	80 - 120
			Total Strontium (Sr)	2019/12/20		97	%	80 - 120
			Total Sulphur (S)	2019/12/20		96	%	80 - 120
9713860	MAP	Method Blank	Total Barium (Ba)	2019/12/20	<0.010		mg/L	
			Total Boron (B)	2019/12/20	<0.020		mg/L	
			Total Calcium (Ca)	2019/12/20	<0.30		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Iron (Fe)	2019/12/20	<0.060		mg/L	
			Total Lithium (Li)	2019/12/20	<0.020		mg/L	
			Total Magnesium (Mg)	2019/12/20	<0.20		mg/L	
			Total Manganese (Mn)	2019/12/20	<0.0040		mg/L	
			Total Phosphorus (P)	2019/12/20	<0.10		mg/L	
			Total Potassium (K)	2019/12/20	<0.30		mg/L	
			Total Silicon (Si)	2019/12/20	<0.10		mg/L	
			Total Sodium (Na)	2019/12/20	<0.50		mg/L	
			Total Strontium (Sr)	2019/12/20	<0.020		mg/L	
			Total Sulphur (S)	2019/12/20	<0.20		mg/L	
9713860	MAP	RPD	Total Barium (Ba)	2019/12/20	1.9		%	20
			Total Boron (B)	2019/12/20	1.3		%	20
			Total Calcium (Ca)	2019/12/20	1.5		%	20
			Total Iron (Fe)	2019/12/20	NC		%	20
			Total Lithium (Li)	2019/12/20	0.32		%	20
			Total Magnesium (Mg)	2019/12/20	1.9		%	20
			Total Manganese (Mn)	2019/12/20	NC		%	20
			Total Phosphorus (P)	2019/12/20	NC		%	20
			Total Potassium (K)	2019/12/20	2.2		%	20
			Total Silicon (Si)	2019/12/20	1.6		%	20
			Total Sodium (Na)	2019/12/20	1.1		%	20
			Total Strontium (Sr)	2019/12/20	1.8		%	20
			Total Sulphur (S)	2019/12/20	1.6		%	20
9713958	LLO	Matrix Spike [XD4157-12]	Total Petroleum Hydrocarbon	2019/12/20		96	%	70 - 130
9713958	LLO	Spiked Blank	Total Petroleum Hydrocarbon	2019/12/20		96	%	70 - 130
9713958	LLO	Method Blank	Total Petroleum Hydrocarbon	2019/12/20	<2.0		mg/L	
9714646	NK3	Matrix Spike	D10-ANTHRACENE (sur.)	2019/12/19		105	%	30 - 130
			DB-ACENAPHTHYLENE (sur.)	2019/12/19		100	%	30 - 130
			DB-NAPHTHALENE (sur.)	2019/12/19		84	%	30 - 130
			TERPHENYL-D14 (sur.)	2019/12/19		126	%	30 - 130
			Acenaphthene	2019/12/19		88	%	30 - 130
			Acenaphthylene	2019/12/19		89	%	30 - 130
			Acridine	2019/12/19		88	%	30 - 130
			Anthracene	2019/12/19		88	%	30 - 130
			Benzo[a]anthracene	2019/12/19		101	%	30 - 130
			Benzo[b&j]fluoranthene	2019/12/19		90	%	30 - 130
			Benzo[k]fluoranthene	2019/12/19		103	%	30 - 130
			Benzo[g,h,i]perylene	2019/12/19		93	%	30 - 130
			Benzo[c]phenanthrene	2019/12/19		110	%	30 - 130
			Benzo[a]pyrene	2019/12/19		98	%	30 - 130
			Benzo[e]pyrene	2019/12/19		96	%	30 - 130
			Chrysene	2019/12/19		100	%	30 - 130
			Dibenz[a,h]anthracene	2019/12/19		92	%	30 - 130
			Fluoranthene	2019/12/19		109	%	30 - 130
			Fluorene	2019/12/19		88	%	30 - 130
			Indeno[1,2,3-cd]pyrene	2019/12/19		88	%	30 - 130
			1-Methylnaphthalene	2019/12/19		86	%	30 - 130
			2-Methylnaphthalene	2019/12/19		80	%	30 - 130
			Naphthalene	2019/12/19		90	%	30 - 130
			Phenanthrene	2019/12/19		97	%	30 - 130
			Perylene	2019/12/19		90	%	30 - 130
			Pyrene	2019/12/19		106	%	30 - 130
			Quinoline	2019/12/19		101	%	30 - 130
9714646	NK3	Spiked Blank	D10-ANTHRACENE (sur.)	2019/12/19		105	%	30 - 130

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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			DB-ACENAPHTHYLENE (sur.)	2019/12/19		99	%	50 - 130
			DB-NAPHTHALENE (sur.)	2019/12/19		80	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/12/19		127	%	50 - 130
			Acenaphthene	2019/12/19		90	%	50 - 130
			Acenaphthylene	2019/12/19		91	%	50 - 130
			Acridine	2019/12/19		92	%	50 - 130
			Anthracene	2019/12/19		87	%	50 - 130
			Benzo[a]anthracene	2019/12/19		103	%	50 - 130
			Benzo[b&j]fluoranthene	2019/12/19		91	%	50 - 130
			Benzo[k]fluoranthene	2019/12/19		105	%	50 - 130
			Benzo[g,h,i]perylene	2019/12/19		94	%	50 - 130
			Benzo[c]phenanthrene	2019/12/19		110	%	50 - 130
			Benzo[a]pyrene	2019/12/19		99	%	50 - 130
			Benzo[e]pyrene	2019/12/19		98	%	50 - 130
			Chrysene	2019/12/19		104	%	50 - 130
			Dibenz[a,h]anthracene	2019/12/19		92	%	50 - 130
			Fluoranthene	2019/12/19		109	%	50 - 130
			Fluorene	2019/12/19		88	%	50 - 130
			Indeno[1,2,3-cd]pyrene	2019/12/19		85	%	50 - 130
			1-Methylnaphthalene	2019/12/19		84	%	50 - 130
			2-Methylnaphthalene	2019/12/19		77	%	50 - 130
			Naphthalene	2019/12/19		87	%	50 - 130
			Phenanthrene	2019/12/19		97	%	50 - 130
			Perylene	2019/12/19		96	%	50 - 130
			Pyrene	2019/12/19		105	%	50 - 130
			Quinoline	2019/12/19		101	%	50 - 130
8714645	NK3	Method Blank	D10-ANTHRACENE (sur.)	2019/12/20		112	%	50 - 130
			DB-ACENAPHTHYLENE (sur.)	2019/12/20		108	%	50 - 130
			DB-NAPHTHALENE (sur.)	2019/12/20		84	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/12/20		150 (1)	%	50 - 130
			Acenaphthene	2019/12/20	<0.10		ug/L	
			Acenaphthylene	2019/12/20	<0.10		ug/L	
			Acridine	2019/12/20	<0.040		ug/L	
			Anthracene	2019/12/20	<0.010		ug/L	
			Benzo[a]anthracene	2019/12/20	<0.0085		ug/L	
			Benzo[b&j]fluoranthene	2019/12/20	<0.0085		ug/L	
			Benzo[k]fluoranthene	2019/12/20	<0.0085		ug/L	
			Benzo[g,h,i]perylene	2019/12/20	<0.0085		ug/L	
			Benzo[c]phenanthrene	2019/12/20	<0.050		ug/L	
			Benzo[a]pyrene	2019/12/20	<0.0075		ug/L	
			Benzo[e]pyrene	2019/12/20	<0.050		ug/L	
			Chrysene	2019/12/20	<0.0085		ug/L	
			Dibenz[a,h]anthracene	2019/12/20	<0.0075		ug/L	
			Fluoranthene	2019/12/20	<0.010		ug/L	
			Fluorene	2019/12/20	<0.050		ug/L	
			Indeno[1,2,3-cd]pyrene	2019/12/20	<0.0085		ug/L	
			1-Methylnaphthalene	2019/12/20	<0.10		ug/L	
			2-Methylnaphthalene	2019/12/20	<0.10		ug/L	
			Naphthalene	2019/12/20	<0.10		ug/L	
			Phenanthrene	2019/12/20	<0.050		ug/L	
			Perylene	2019/12/20	<0.050		ug/L	
			Pyrene	2019/12/20	<0.020		ug/L	
			Quinoline	2019/12/20	<0.20		ug/L	
8714645	NK3	RPD	Acenaphthene	2019/12/20	NC		%	50

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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acenaphthylene	2019/12/20	NC		%	50
			Acridine	2019/12/20	NC		%	50
			Anthracene	2019/12/20	NC		%	50
			Benzo[a]anthracene	2019/12/20	NC		%	50
			Benzo[b&j]fluoranthene	2019/12/20	NC		%	50
			Benzo[k]fluoranthene	2019/12/20	NC		%	50
			Benzo[g,h,i]perylene	2019/12/20	NC		%	50
			Benzo[c]phenanthrene	2019/12/20	NC		%	50
			Benzo[a]pyrene	2019/12/20	NC		%	50
			Benzo[e]pyrene	2019/12/20	NC		%	50
			Chrysene	2019/12/20	NC		%	50
			Dibenz[a,h]anthracene	2019/12/20	NC		%	50
			Fluoranthene	2019/12/20	NC		%	50
			Fluorene	2019/12/20	NC		%	50
			Indeno[1,2,3-cd]pyrene	2019/12/20	NC		%	50
			1-Methylnaphthalene	2019/12/20	NC		%	50
			2-Methylnaphthalene	2019/12/20	NC		%	50
			Naphthalene	2019/12/20	NC		%	50
			Phenanthrene	2019/12/20	NC		%	50
			Perylene	2019/12/20	NC		%	50
			Pyrene	2019/12/20	NC		%	50
			Quinoline	2019/12/20	NC		%	50
9714648	PKB	Spiked Blank	Biochemical Oxygen Demand	2019/12/24		128 (1)	%	85 - 115
9714648	PKB	Method Blank	Biochemical Oxygen Demand	2019/12/24	<2.0		mg/L	
9714648	PKB	RPD	Biochemical Oxygen Demand	2019/12/24	3.1		%	20
9716438	TMU	Matrix Spike	Phenols	2019/12/25		93	%	80 - 120
9716438	TMU	Spiked Blank	Phenols	2019/12/25		94	%	80 - 120
9716438	TMU	Method Blank	Phenols	2019/12/25	<0.0015		mg/L	
9716438	TMU	RPD	Phenols	2019/12/25	NC		%	20
9716741	MZ	Matrix Spike	1,4-Difluorobenzene (sur.)	2019/12/21		99	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/12/21		95	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/12/21		115	%	50 - 140
			Benzene	2019/12/21		NC	%	50 - 140
			Bromodichloromethane	2019/12/21		96	%	50 - 140
			Bromoform	2019/12/21		95	%	50 - 140
			Bromomethane	2019/12/21		89	%	50 - 140
			Carbon tetrachloride	2019/12/21		89	%	50 - 140
			Chlorobenzene	2019/12/21		93	%	50 - 140
			Chlorodibromomethane	2019/12/21		93	%	50 - 140
			Chloroethane	2019/12/21		93	%	50 - 140
			Chloroform	2019/12/21		92	%	50 - 140
			Chloromethane	2019/12/21		99	%	50 - 140
			1,2-dibromoethane	2019/12/21		93	%	50 - 140
			1,2-dichlorobenzene	2019/12/21		91	%	50 - 140
			1,3-dichlorobenzene	2019/12/21		92	%	50 - 140
			1,4-dichlorobenzene	2019/12/21		91	%	50 - 140
			1,1-dichloroethane	2019/12/21		87	%	50 - 140
			1,2-dichloroethane	2019/12/21		92	%	50 - 140
			1,1-dichloroethene	2019/12/21		84	%	50 - 140
			cis-1,2-dichloroethene	2019/12/21		89	%	50 - 140
			trans-1,2-dichloroethene	2019/12/21		78	%	50 - 140
			Dichloromethane	2019/12/21		83	%	50 - 140
			1,2-dichloropropane	2019/12/21		97	%	50 - 140
			cis-1,3-dichloropropene	2019/12/21		104	%	50 - 140

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			trans-1,3-dichloropropene	2019/12/21		135	%	50 - 140
			Ethylbenzene	2019/12/21		NC	%	50 - 140
			Methyl methacrylate	2019/12/21		101	%	50 - 140
			Methyl-tert-butylether (MTBE)	2019/12/21		88	%	50 - 140
			Styrene	2019/12/21		95	%	50 - 140
			1,1,1,2-tetrachloroethane	2019/12/21		88	%	50 - 140
			1,1,2,2-tetrachloroethane	2019/12/21		103	%	50 - 140
			Tetrachloroethene	2019/12/21		78	%	50 - 140
			Toluene	2019/12/21		NC	%	50 - 140
			1,2,3-trichlorobenzene	2019/12/21		110	%	50 - 140
			1,2,4-trichlorobenzene	2019/12/21		107	%	50 - 140
			1,3,5-trichlorobenzene	2019/12/21		100	%	50 - 140
			1,1,1-trichloroethane	2019/12/21		94	%	50 - 140
			1,1,2-trichloroethane	2019/12/21		138	%	50 - 140
			Trichloroethene	2019/12/21		93	%	50 - 140
			Trichlorofluoromethane	2019/12/21		84	%	50 - 140
			1,2,4-trimethylbenzene	2019/12/21		NC	%	50 - 140
			1,3,5-trimethylbenzene	2019/12/21		NC	%	50 - 140
			Vinyl chloride	2019/12/21		87	%	50 - 140
			m & p-Xylene	2019/12/21		NC	%	50 - 140
			o-Xylene	2019/12/21		NC	%	50 - 140
9716741	MZ	Spiked Blank	1,4-Difluorobenzene (sur.)	2019/12/21		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/12/21		105	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/12/21		86	%	50 - 140
			Benzene	2019/12/21		90	%	60 - 130
			Bromodichloromethane	2019/12/21		99	%	60 - 130
			Bromoform	2019/12/21		101	%	60 - 130
			Bromomethane	2019/12/21		95	%	60 - 130
			Carbon tetrachloride	2019/12/21		95	%	60 - 130
			Chlorobenzene	2019/12/21		93	%	60 - 130
			Chlorodibromomethane	2019/12/21		101	%	60 - 130
			Chloroethane	2019/12/21		92	%	60 - 130
			Chloroform	2019/12/21		87	%	60 - 130
			Chloromethane	2019/12/21		104	%	60 - 130
			1,2-dibromoethane	2019/12/21		96	%	60 - 130
			1,2-dichlorobenzene	2019/12/21		101	%	60 - 130
			1,3-dichlorobenzene	2019/12/21		97	%	60 - 130
			1,4-dichlorobenzene	2019/12/21		94	%	60 - 130
			1,1-dichloroethane	2019/12/21		95	%	60 - 130
			1,2-dichloroethane	2019/12/21		91	%	60 - 130
			1,1-dichloroethene	2019/12/21		90	%	60 - 130
			cis-1,2-dichloroethene	2019/12/21		94	%	60 - 130
			trans-1,2-dichloroethene	2019/12/21		84	%	60 - 130
			Dichloromethane	2019/12/21		85	%	60 - 130
			1,2-dichloropropane	2019/12/21		103	%	60 - 130
			cis-1,3-dichloropropene	2019/12/21		110	%	60 - 130
			trans-1,3-dichloropropene	2019/12/21		113	%	60 - 130
			Ethylbenzene	2019/12/21		94	%	60 - 130
			Methyl methacrylate	2019/12/21		107	%	60 - 130
			Methyl-tert-butylether (MTBE)	2019/12/21		98	%	60 - 130
			Styrene	2019/12/21		102	%	60 - 130
			1,1,1,2-tetrachloroethane	2019/12/21		96	%	60 - 130
			1,1,2,2-tetrachloroethane	2019/12/21		99	%	60 - 130
			Tetrachloroethene	2019/12/21		88	%	60 - 130

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BV Labs Job #: B8A8342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analysed	Value	Recovery	UNITS	QC Limits
			Toluene	2019/12/21		99	%	60 - 130
			1,2,3-trichlorobenzene	2019/12/21		93	%	60 - 130
			1,2,4-trichlorobenzene	2019/12/21		90	%	60 - 130
			1,3,5-trichlorobenzene	2019/12/21		89	%	60 - 130
			1,1,1-trichloroethane	2019/12/21		99	%	60 - 130
			1,1,2-trichloroethane	2019/12/21		99	%	60 - 130
			Trichloroethene	2019/12/21		99	%	60 - 130
			Trichlorofluoromethane	2019/12/21		90	%	60 - 130
			1,2,4-trimethylbenzene	2019/12/21		103	%	60 - 130
			1,3,5-trimethylbenzene	2019/12/21		105	%	60 - 130
			Vinyl chloride	2019/12/21		92	%	60 - 130
			m & p-Xylene	2019/12/21		94	%	60 - 130
			o-Xylene	2019/12/21		89	%	60 - 130
9715741	MB	Method Blank	1,4-Difluorobenzene (sur.)	2019/12/21		98	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/12/21		97	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/12/21		98	%	50 - 140
			Benzene	2019/12/21	<0.40		ug/L	
			Bromodichloromethane	2019/12/21	<0.50		ug/L	
			Bromoform	2019/12/21	<0.50		ug/L	
			Bromomethane	2019/12/21	<2.0		ug/L	
			Carbon tetrachloride	2019/12/21	<0.50		ug/L	
			Chlorobenzene	2019/12/21	<0.50		ug/L	
			Chlorodibromomethane	2019/12/21	<1.0		ug/L	
			Chloroethane	2019/12/21	<1.0		ug/L	
			Chloroform	2019/12/21	<0.50		ug/L	
			Chloromethane	2019/12/21	<2.0		ug/L	
			1,2-dibromoethane	2019/12/21	<0.20		ug/L	
			1,2-dichlorobenzene	2019/12/21	<0.50		ug/L	
			1,3-dichlorobenzene	2019/12/21	<0.50		ug/L	
			1,4-dichlorobenzene	2019/12/21	<0.50		ug/L	
			1,1-dichloroethane	2019/12/21	<0.50		ug/L	
			1,2-dichloroethane	2019/12/21	<0.50		ug/L	
			1,1-dichloroethene	2019/12/21	<0.50		ug/L	
			cis-1,2-dichloroethene	2019/12/21	<0.50		ug/L	
			trans-1,2-dichloroethene	2019/12/21	<0.50		ug/L	
			Dichloromethane	2019/12/21	<2.0		ug/L	
			1,2-dichloropropane	2019/12/21	<0.50		ug/L	
			cis-1,3-dichloropropene	2019/12/21	<0.50		ug/L	
			trans-1,3-dichloropropene	2019/12/21	<0.50		ug/L	
			Ethylbenzene	2019/12/21	<0.40		ug/L	
			Methyl methacrylate	2019/12/21	<0.50		ug/L	
			Methyl-tert-butylether (MTBE)	2019/12/21	<0.50		ug/L	
			Styrene	2019/12/21	<0.50		ug/L	
			1,1,1,2-tetrachloroethane	2019/12/21	<1.0		ug/L	
			1,1,2,2-tetrachloroethane	2019/12/21	<2.0		ug/L	
			Tetrachloroethene	2019/12/21	<0.50		ug/L	
			Toluene	2019/12/21	<0.40		ug/L	
			1,2,3-trichlorobenzene	2019/12/21	<1.0		ug/L	
			1,2,4-trichlorobenzene	2019/12/21	<1.0		ug/L	
			1,3,5-trichlorobenzene	2019/12/21	<0.50		ug/L	
			1,1,1-trichloroethane	2019/12/21	<0.50		ug/L	
			1,1,2-trichloroethane	2019/12/21	<0.50		ug/L	
			Trichloroethene	2019/12/21	<0.50		ug/L	
			Trichlorofluoromethane	2019/12/21	<0.50		ug/L	

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BV Labs Job #: B8A8342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2,4-trimethylbenzene	2019/12/21	<0.50		ug/L	
			1,3,5-trimethylbenzene	2019/12/21	<0.50		ug/L	
			Vinyl chloride	2019/12/21	<0.50		ug/L	
			Xylenes (Total)	2019/12/21	<0.60		ug/L	
			m & p-Xylene	2019/12/21	<0.60		ug/L	
			o-Xylene	2019/12/21	<0.40		ug/L	
9716741	MZ	RPD	Bromodichloromethane	2019/12/21	NC		%	30
			Bromoform	2019/12/21	NC		%	30
			Bromomethane	2019/12/21	NC		%	30
			Carbon tetrachloride	2019/12/21	NC		%	30
			Chlorobenzene	2019/12/21	NC		%	30
			Chlorodibromomethane	2019/12/21	NC		%	30
			Chloroethane	2019/12/21	NC		%	30
			Chloroform	2019/12/21	NC		%	30
			Chloromethane	2019/12/21	0.26		%	30
			1,2-dibromoethane	2019/12/21	NC		%	30
			1,2-dichlorobenzene	2019/12/21	NC		%	30
			1,3-dichlorobenzene	2019/12/21	NC		%	30
			1,4-dichlorobenzene	2019/12/21	NC		%	30
			1,1-dichloroethane	2019/12/21	NC		%	30
			1,2-dichloroethane	2019/12/21	NC		%	30
			1,1-dichloroethene	2019/12/21	NC		%	30
			cis-1,3-dichloroethene	2019/12/21	NC		%	30
			trans-1,2-dichloroethene	2019/12/21	NC		%	30
			Dichloromethane	2019/12/21	NC		%	30
			1,2-dichloropropane	2019/12/21	NC		%	30
			cis-1,3-dichloropropene	2019/12/21	NC		%	30
			trans-1,3-dichloropropene	2019/12/21	NC		%	30
			Methyl methacrylate	2019/12/21	NC		%	30
			Methyl tert-butyl ether (MTBE)	2019/12/21	NC		%	30
			Styrene	2019/12/21	NC		%	30
			1,1,1,2-tetrachloroethane	2019/12/21	NC		%	30
			1,1,2,2-tetrachloroethane	2019/12/21	NC		%	30
			Tetrachloroethene	2019/12/21	NC		%	30
			1,2,3-trichlorobenzene	2019/12/21	NC		%	30
			1,2,4-trichlorobenzene	2019/12/21	NC		%	30
			1,3,5-trichlorobenzene	2019/12/21	NC		%	30
			1,1,1-trichloroethane	2019/12/21	NC		%	30
			1,1,2-trichloroethane	2019/12/21	NC		%	30
			Trichloroethene	2019/12/21	NC		%	30
			Trichlorofluoromethane	2019/12/21	NC		%	30
			1,2,4-trimethylbenzene	2019/12/21	3.4		%	30
			1,3,5-trimethylbenzene	2019/12/21	2.4		%	30
			Vinyl chloride	2019/12/21	NC		%	30
9717834	PRE	Matrix Spike [KD4197-05]	Chemical Oxygen Demand	2019/12/21		104	%	80 - 120
9717834	PRE	Spiked Blank	Chemical Oxygen Demand	2019/12/21		98	%	80 - 120
9717834	PRE	Method Blank	Chemical Oxygen Demand	2019/12/21	<10		mg/L	
9717834	PRE	RPD [KD4197-05]	Chemical Oxygen Demand	2019/12/21	NC		%	20
9718185	CJY	Matrix Spike	Total Mercury (Hg)	2019/12/23		82	%	80 - 120
9718185	CJY	Spiked Blank	Total Mercury (Hg)	2019/12/23		100	%	80 - 120
9718185	CJY	Method Blank	Total Mercury (Hg)	2019/12/23	<0.0020		ug/L	
9718185	CJY	RPD	Total Mercury (Hg)	2019/12/23	NC		%	20
9718621	PKB	Matrix Spike	Total Sulphide	2019/12/23		NC	%	80 - 120
9718621	PKB	Spiked Blank	Total Sulphide	2019/12/23		95	%	80 - 120

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BV Labs Job #: B9A8342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9718621	PKB	Method Blank	Total Sulphide	2019/12/23	<0.0018		mg/L	
9718621	PKB	RPD	Total Sulphide	2019/12/23	12		%	20
9719361	EH2	Matrix Spike	Total Suspended Solids	2019/12/24		87	%	80 - 120
9719361	EH2	Spiked Blank	Total Suspended Solids	2019/12/24		92	%	80 - 120
9719361	EH2	Method Blank	Total Suspended Solids	2019/12/24	<1.0		mg/L	
9719361	EH2	RPD	Total Suspended Solids	2019/12/24	19		%	20
9719690	ZI	Matrix Spike	Dissolved Sulphate (SO4)	2019/12/24		103	%	80 - 120
9719690	ZI	Spiked Blank	Dissolved Sulphate (SO4)	2019/12/24		99	%	80 - 120
9719690	ZI	Method Blank	Dissolved Sulphate (SO4)	2019/12/24	<1.0		mg/L	
9719690	ZI	RPD	Dissolved Sulphate (SO4)	2019/12/24	NC		%	20
9721259	JLD	Matrix Spike [KD4197-05]	Total Total Kjeldahl Nitrogen	2019/12/27		102	%	80 - 120
9721259	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2019/12/27		94	%	80 - 120
9721259	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2019/12/27		95	%	80 - 120
9721259	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2019/12/27	<0.050		mg/L	
9721259	JLD	RPD [KD4197-05]	Total Total Kjeldahl Nitrogen	2019/12/27	NC		%	20
9721399	JLD	Matrix Spike	Total Phosphorus (P)	2019/12/30		NC	%	80 - 120
9721399	JLD	QC Standard	Total Phosphorus (P)	2019/12/27		96	%	80 - 120
9721399	JLD	Spiked Blank	Total Phosphorus (P)	2019/12/27		98	%	80 - 120
9721399	JLD	Method Blank	Total Phosphorus (P)	2019/12/27	<0.0030		mg/L	
9721399	JLD	RPD	Total Phosphorus (P)	2019/12/30	6.1 (1)		%	20
9723114	TJC	Matrix Spike	Nonylphenol (Total)	2019/12/27		114	%	50 - 130
9723114	TJC	Spiked Blank	Nonylphenol (Total)	2019/12/27		108	%	50 - 130
9723114	TJC	Method Blank	Nonylphenol (Total)	2019/12/27	<0.0010		mg/L	
9723115	TJC	Matrix Spike	Nonylphenol Ethoxylate (Total)	2019/12/27		94	%	50 - 130
9723115	TJC	Spiked Blank	Nonylphenol Ethoxylate (Total)	2019/12/27		98	%	50 - 130
9723115	TJC	Method Blank	Nonylphenol Ethoxylate (Total)	2019/12/27	<0.025		mg/L	
9723115	TJC	RPD [KD4197-14]	Nonylphenol Ethoxylate (Total)	2019/12/28	NC		%	40
9727685	ÉFK	QC Standard	Cesium-134	2019/12/27		103	%	N/A
			Cesium-137	2019/12/27		107	%	N/A
			Cobalt-60	2019/12/27		102	%	N/A
			Iodine-131	2019/12/27		85	%	N/A
9727685	ÉFK	Method Blank	Cesium-134	2019/12/30	<1		Bq/l	
			Cesium-137	2019/12/30	<1		Bq/l	
			Cobalt-60	2019/12/30	<1		Bq/l	
			Iodine-131	2019/12/30	<1		Bq/l	
			Manganese-54	2019/12/30	<1		Bq/l	
			Zinc-65	2019/12/30	<1		Bq/l	
9727685	ÉFK	QC Standard	Radium 226	2019/12/24		94	%	74 - 125
			Uranium-235	2019/12/24		101	%	74 - 125
9727685	ÉFK	Method Blank	Radium 226	2019/12/25	<1.0		Bq/l	

BV Labs Job #: B9A0342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Uranium-235	2019/12/26	<0.30		Bq/l	

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: B9A0342
Report Date: 2020/01/07

Saskatchewan Research Council
Client Project #: 11526
Sampler Initials: DC

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

[redacted]

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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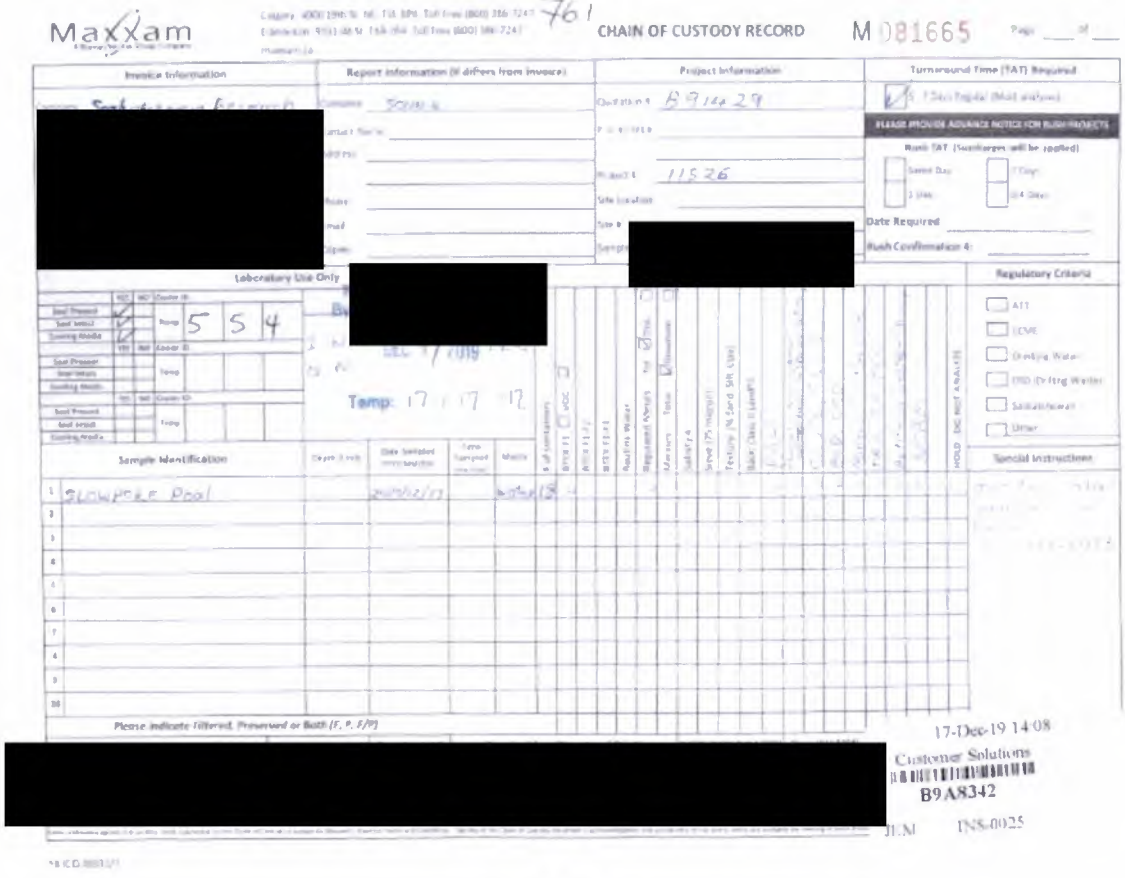

Maxxam

761

CHAIN OF CUSTODY RECORD M081665

Invoice Information

Report Information (if differs from invoice)

Project Information

Turnaround Time (TAT) Required

Laboratory Use Only

Regulatory Criteria

Special Instructions

Sample Identification

1 SLOWPOKE Pool

Please indicate Filtered, Preserved or Both (F, P, F/P)

17-Dec-19 14:08

Customer Solutions

B9A8342

INS-0025

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REACTOR POOL 19-12-17.Rpt

ORTEC g v - i (1215) Env32 G53W4.25 1/10/2020 11:58:39 AM Page 1
Spectrum name: REACTOR POOL 19-12-17.An1

Sample description

Spectrum Filename: C:\User\Reactor Samples\REACTOR POOL 19-12-17.An1

Acquisition information
Start time: 12/17/2019 2:36:30 PM
Live time: 9293
Real time: 10184
Dead time: 8.74 %
Detector ID: 1

Detector system
GAMMASPEC MCB 129 det 1

Calibration
Filename: DET 1 MARN 2008-43-6 19-12-23.Clb
DET 1 2019 DEC MARN

Energy Calibration
Created: 12/23/2019 11:59:27 AM
Zero offset: 0.201 keV
Gain: 0.250 keV/channel
Quadratic: -4.328E-09 keV/channel^2

Efficiency Calibration
Created: 12/23/2019 11:59:52 AM
Knee Energy: 383.75 keV
Above the Knee: Quadratic Uncertainty = 1.87 %
Log(Eff): 1.043489E+01 + (-3.502056E+00*Log(E)) + (1.893361E-01*Log(E)^2)
Below the Knee: Quadratic Uncertainty = 1.88 %
Log(Eff): -1.219382E+01 + (4.101557E+00*Log(E)) + (-4.493891E-01*Log(E)^2)

Library Files
Main analysis library: reactor water.Lib
Library Match Width: 0.500
Peak stripping: Library based

Analysis parameters
Analysis engine: Env32 G53W4.25
Start channel: 50 (12.68keV)
Stop channel: 8000 (1996.35keV)
Peak rejection level: 100.000%
Peak search sensitivity: 2
Sample Size: 5.0000E-01
Activity scaling factor: 1.0000E+00/(1.0000E+00* 5.0000E-01) = 2.0000E+00
Detection limit method: Reg. Guide 4.16 Method

ORTEC g v - i (1215) Env32 G53W4.25 1/10/2020 11:58:39 AM Page 2
Spectrum name: REACTOR POOL 19-12-17.An1

Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).

Half lives decay limit: 12.000

Page 1

REACTOR POOL 19-12-17.Rpt

Activity range factor: 2.000
Min. step backg. energy 0.000
Multiplet shift channel 2.000

Corrections	Status	Comments
Decay correct to date:	YES	12/17/2019 11:50:00 AM
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	Det 1 Nat Bkg 19-10-11.Pbc 10/15/2019 11:30:43 AM
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	NO	

total peaks alloc. 47 cutoff: 2.00E+01 %
Energy Calibration
Normalized diff: 1.0000

***** SUMMARY OF PEAKS IN RANGE *****

Peak Energy	Area	Uncert	FWHM	Corrctn Factor	Nuclide Energy	Brnch. Ratio	Act. Bq/L	Nuc
13.28	87.	17.27	0.80	1.013E-02	13.38	50.000	3.646E+00	SR85
					13.85	1.430	1.206E+02	BA140
16.24	75.	23.47	0.80	1.423E-02	15.80	8.700	1.362E+01	Y88
					16.60	67.530	2.691E+00	MO90
36.12	24.	57.93	0.82	3.795E-02	35.80	1.650	PBC<MDA	XE133
					36.40	1.040	1.298E+01	CS137
					36.03	4.800	2.839E+00	CE144
					35.55	2.500	5.516E+00	CE144
					35.46	5.800	2.382E+00	SB125
46.65	84.	20.20	1.19	4.649E-02	46.60	2.100	1.853E+01	EU152
61.20	16.	87.87	0.85	5.360E-02	61.14	13.000	PBC<MDA	W187
63.45	85.	25.58	1.15	5.437E-02				
67.29	29.	44.83	0.53	5.549E-02	66.91	12.500	9.070E-01	CS136
75.11	63.	27.14	0.86	5.715E-02				
77.07	59.	30.70	0.86	5.746E-02				
81.60	29.	50.66	0.75	5.803E-02	81.00	37.100	2.935E-01	XE133
					81.80	1.000	1.063E+01	SB125
89.65	16.	80.04	0.62	5.860E-02	89.96	1.500	PBC<MDA	U235
143.98	21.	91.72	0.27	5.455E-02	143.76	10.500	PBC<MDA	U235
163.44	45.	37.85	0.68	5.168E-02	163.35	4.700	3.957E+00	U235
					162.93	5.991	5.148E+00	MO90
					163.93	1.960	9.569E+00	XE131M
					163.89	4.630	4.048E+00	CS136
185.58	49.	28.68	0.97	4.825E-02	185.72	54.000	4.006E-01	U235
					185.99	3.280	PBC<MDA	RA226
254.60	11.	63.49	0.25	3.826E-02				
295.59	71.	22.14	0.61	3.323E-02				
351.92	101.	12.79	1.22	2.747E-02				
479.54	20.	42.10	0.25	1.890E-02	479.57	23.400	PBC<MDA	W187
661.57	72.	19.32	0.73	1.325E-02	661.62	84.620	1.391E+00	CS137
684.24	19.	22.94	0.28	1.277E-02	685.74	29.200	1.238E+00	W187
864.34	28.	27.55	0.44	1.017E-02				
1460.50	2.	24.02	0.81	6.535E-03	1460.75	10.700	PBC<MDA	K40

********** UNIDENTIFIED PEAK SUMMARY **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	Suspected Nuclide
52.40	13.28	91.	94.	0.010	41.59	0.551	TH-234 s
64.27	16.24	126.	66.	0.007	62.87	0.740	Y-91M

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Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
186.13	46.65	68.	84.	0.009	40.41	1.192	EU-152	S
253.43	63.45	121.	85.	0.009	51.15	1.154	PA-234	SM
269.09	67.29	74.	28.	0.003	94.13	0.852	TA-182	D
300.16	75.06	116.	63.	0.007	54.29	0.860	PB-214	D
308.04	77.03	133.	59.	0.006	61.41	0.862	PB-214	D
654.11	163.44	72.	45.	0.005	75.69	0.680	U-235	SM
1019.43	254.60	19.	11.	0.001	126.98	0.250	SN-113	S
1183.71	295.59	48.	71.	0.008	44.27	0.606	PB-214	S
1409.45	351.92	22.	101.	0.011	25.59	1.224	PB-214	S
3462.94	864.34	7.	28.	0.003	55.10	0.437	-	SM

S - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.
M - Peak is close to a library peak.

This section based on library: reactor water.Lib

********** IDENTIFIED PEAK SUMMARY **********

Nuclide	Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 2 Sigma %	FWHM keV	
XE-133	142.65	35.80	86.	24.	0.003	115.86	0.821D	
CS-137	0.00	36.40	0.	0.	0.000	0.00	0.000	
W-187	244.19	61.14	93.	16.	0.002	175.74	0.846D	
XE-133	326.19	81.60	68.	29.	0.003	101.32	0.746	
U-235	358.43	89.65	65.	16.	0.002	160.07	0.624S	
U-235	0.00	93.35	0.	0.	0.000	0.00	0.000	
U-235	0.00	105.00	0.	0.	0.000	0.00	0.000	
U-235	576.14	143.98	105.	21.	0.002	183.44	0.272S	
U-235	0.00	163.35	0.	0.	0.000	0.00	0.000	
U-235	743.41	185.72	85.	49.	0.005	57.35	0.966D	
U-235	0.00	205.31	0.	0.	0.000	0.00	0.000	
W-187	1920.84	479.54	13.	20.	0.002	84.20	0.250S	
W-187	0.00	618.28	0.	0.	0.000	0.00	0.000	
W-187	0.00	625.54	0.	0.	0.000	0.00	0.000	
CS-137	2650.34	661.57	22.	72.	0.008	38.65	0.733S	
W-187	2741.17	684.24	0.	19.	0.002	45.88	0.281S	
AR-41	0.00	1293.60	0.	0.	0.000	0.00	0.000	

S - Peak fails shape tests.
D - Peak area deconvoluted.
A Derived peak area.

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Spectrum name: REACTOR POOL 19-12-17.An1

***** SUMMARY OF LIBRARY PEAK USAGE *****

- Nuclide - Name	Code	Average Activity Bq/L	Peak Energy keV	Activity Bq/L	Code	MDA Value Bq/L		COMMENTS
AR-41		0.0000E+00						
			1293.60	0.000E+00		1.696E+00	0.00E+00	G
XE-131M		0.0000E+00						
			29.78	0.000E+00	%	1.308E+00	1.00E+03	G
			29.46	0.000E+00	%	1.918E+00	1.00E+03	G
			33.60	0.000E+00	%	2.847E+00	1.00E+03	G
			163.93	0.000E+00	&	7.425E+00	1.00E+03	G
			34.40	0.000E+00	%	1.555E+01	1.00E+03	G

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XE-133	6.4276E-01						
		81.00	2.935E-01	&(	4.222E-01	5.07E+01	G
		30.97	1.199E-01	}	1.258E+00	2.01E+02	G
		30.63	0.000E+00	}	2.062E+00	1.09E+03	G
		35.00	0.000E+00	%	3.564E+00	1.81E+02	G
		35.80	8.495E+00	(	1.614E+01	5.79E+01	G
XE-133M	0.0000E+00						
		29.78	0.000E+00	%	1.286E+00	1.00E+03	G
		29.46	0.000E+00	%	1.959E+00	1.00E+03	G
		233.20	0.000E+00	%	1.173E+00	1.00E+03	G
		33.60	0.000E+00	%	2.948E+00	1.00E+03	G
		34.40	0.000E+00	%	1.497E+01	1.00E+03	G
XE-135	0.0000E+00						
		249.79	0.000E+00	%	1.938E-01	1.00E+03	G
		608.18	0.000E+00	%	1.414E+01	1.00E+03	G
		30.97	0.000E+00	%	1.897E+01	1.00E+03	G
		30.63	0.000E+00	%	2.679E+01	1.00E+03	G
NA-24	0.0000E+00						
		1368.55	0.000E+00	%	3.534E-01	1.00E+03	G
		2754.10	0.000E+00	=	0.000E+00	0.00E+00	G
BE-7	0.0000E+00						
		477.56	0.000E+00	%	1.657E+00	1.00E+03	G
CR-51	0.0000E+00						
		320.07	0.000E+00	%	2.203E+00	1.00E+03	G

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Nuclide	Ave activity	Energy			Activity	Code	Peak MDA	Comments
W-187	1.1676E+00							
		685.74	1.238E+00	&(	4.801E-01	2.29E+01	G	
		479.57	1.080E+00	?(	1.083E+00	4.21E+01	G	
		61.14	5.637E-01	-	1.660E+00	8.79E+01	G	
		72.00	0.000E+00	%	1.649E+00	1.93E+02	G	
		134.25	0.000E+00	%	1.757E+00	1.95E+02	G	
		59.72	0.000E+00	%	2.335E+00	2.31E+02	G	
		618.28	0.000E+00		1.877E+00	0.00E+00	G	
		551.52	0.000E+00	%	2.037E+00	1.00E+03	G	
		69.20	0.000E+00	%	4.863E+00	4.56E+02	G	
		772.91	0.000E+00	%	3.586E+00	1.00E+03	G	
		625.54	0.000E+00		1.088E+01	0.00E+00	G	
		71.20	0.000E+00	%	2.026E+01	4.56E+02	G	
MN-54	0.0000E+00							
		834.81	0.000E+00	%	4.128E-01	1.00E+03	G	
MO-99	0.0000E+00							
		140.51	0.000E+00	%	2.584E-01	1.00E+03	G	
		739.47	0.000E+00	%	1.759E+00	1.00E+03	G	
		18.30	0.000E+00	%	3.387E+00	1.00E+03	G	
		181.09	0.000E+00	%	3.965E+00	1.00E+03	G	
		777.88	0.000E+00	%	4.253E+00	1.00E+03	G	
		20.60	0.000E+00	&	2.330E+01	1.00E+03	G	
		366.44	0.000E+00	%	1.812E+01	1.00E+03	G	
		40.58	0.000E+00	&	1.966E+01	1.00E+03	G	
TC-99M	0.0000E+00							
		140.51	0.000E+00	%	4.061E-01	1.00E+03	G	
		18.35	0.000E+00	%	1.020E+01	1.00E+03	G	
		20.60	0.000E+00	&	6.144E+01	1.00E+03	G	
FE-59	0.0000E+00							

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		1099.22	0.000E+00	%	6.112E-01	1.00E+03	G
		1291.56	0.000E+00	&	7.492E-01	1.00E+03	G
		192.34	0.000E+00	%	3.678E+00	1.00E+03	G
		142.65	0.000E+00	%	9.773E+00	1.00E+03	G
CO-57	0.0000E+00						
		122.07	0.000E+00	%	2.158E-01	1.00E+03	G
		136.43	0.000E+00	%	1.352E+00	1.00E+03	G
		14.41	0.000E+00	%	8.561E+00	1.00E+03	G
CO-58	0.0000E+00						
		810.75	0.000E+00	&	4.507E-01	1.00E+03	G

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Spectrum name: REACTOR POOL 19-12-17.An1

Nuclide	Ave activity	Energy	Activity		Code	Peak	MDA	Comments
CO-60	0.0000E+00							
		1332.51	0.000E+00	%		2.264E-01	1.00E+03	G
		1173.23	0.000E+00	%		2.994E-01	1.00E+03	G
ZN-65	0.0000E+00							
		1115.52	0.000E+00	%		9.142E-01	1.00E+03	G
		8.13	0.000E+00	=		0.000E+00	0.00E+00	G
NB-94	0.0000E+00							
		871.10	0.000E+00	%		2.800E-01	1.00E+03	G
		702.50	0.000E+00	%		2.078E-01	1.00E+03	G
ZR-95	0.0000E+00							
		756.72	0.000E+00	%		4.466E-01	1.00E+03	G
		724.18	0.000E+00	&		5.700E-01	1.00E+03	G
NB-95	0.0000E+00							
		765.82	0.000E+00	&		4.491E-01	1.00E+03	G
I-131	0.0000E+00							
		364.48	0.000E+00	&		3.008E-01	1.00E+03	G
		636.97	0.000E+00	%		2.622E+00	1.00E+03	G
		284.29	0.000E+00	%		1.822E+00	1.00E+03	G
		80.18	0.000E+00	%		4.843E+00	1.00E+03	G
		29.78	0.000E+00	%		1.461E+01	1.00E+03	G
		722.89	0.000E+00	%		9.306E+00	1.00E+03	G
		29.46	0.000E+00	%		2.219E+01	1.00E+03	G
I-132	0.0000E+00							
		667.69	0.000E+00	%		4.032E-01	1.00E+03	G
		772.61	0.000E+00	%		1.160E+00	1.00E+03	G
		954.55	0.000E+00	%		3.111E+00	1.00E+03	G
		522.65	0.000E+00	%		3.375E+00	1.00E+03	G
		630.22	0.000E+00	%		4.462E+00	1.00E+03	G
		1398.57	0.000E+00	%		1.090E+01	1.00E+03	G
		812.20	0.000E+00	%		1.412E+01	1.00E+03	G
		671.60	0.000E+00	&		2.618E+01	1.00E+03	G
		669.80	0.000E+00	%		1.168E+01	1.00E+03	G
		505.90	0.000E+00	%		1.267E+01	1.00E+03	G
		727.20	0.000E+00	%		1.712E+01	1.00E+03	G
		1136.03	0.000E+00	%		2.184E+01	1.00E+03	G
		809.80	0.000E+00	&		5.079E+01	1.00E+03	G
		650.60	0.000E+00	%		2.556E+01	1.00E+03	G
		1372.07	0.000E+00	%		3.050E+01	1.00E+03	G
		728.10	0.000E+00	%		5.055E+01	1.00E+03	G
		727.00	0.000E+00	%		2.490E+01	1.00E+03	G
		1295.30	0.000E+00	&		1.027E+02	1.00E+03	G

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Spectrum name: REACTOR POOL 19-12-17.An1
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Nuclide	Ave activity	Energy	Activity	Code	Peak	MDA	Comments
		621.20	0.000E+00	%	3.372E+01	1.00E+03	G
		262.70	0.000E+00	%	4.306E+01	1.00E+03	G
		1442.56	0.000E+00	%	5.577E+01	1.00E+03	G
		1143.40	0.000E+00	%	9.019E+01	1.00E+03	G
		547.10	0.000E+00	%	9.691E+01	1.00E+03	G
		780.20	0.000E+00	%	4.778E+01	1.00E+03	G
		1921.08	0.000E+00	%	8.186E+01	1.00E+03	G
		1290.70	0.000E+00	&	8.048E+01	1.00E+03	G
		2002.30	0.000E+00	=	0.000E+00	0.00E+00	G
		1173.20	0.000E+00	%	8.951E+01	1.00E+03	G
		876.80	0.000E+00	&	7.871E+01	1.00E+03	G
I-133	0.0000E+00						
		529.50	0.000E+00	%	2.374E-01	1.00E+03	G
		875.30	0.000E+00	%	4.002E+00	1.00E+03	G
		1298.90	0.000E+00	%	1.169E+01	1.00E+03	G
		1237.50	0.000E+00	%	1.972E+01	1.00E+03	G
		707.40	0.000E+00	%	1.185E+01	1.00E+03	G
		510.40	0.000E+00	%	6.238E+01	1.00E+03	G
		856.10	0.000E+00	%	4.330E+01	1.00E+03	G
I-135	0.0000E+00						
		1260.41	0.000E+00	&	3.658E+00	1.00E+03	G
		1131.51	0.000E+00	%	1.362E+00	1.00E+03	G
		526.56	0.000E+00	%	3.138E+00	1.00E+03	G
		1678.03	0.000E+00	%	4.351E+00	1.00E+03	G
		1457.56	0.000E+00	%	8.850E+00	1.00E+03	G
		1038.76	0.000E+00	%	8.514E+00	1.00E+03	G
		1791.20	0.000E+00	%	5.630E+00	1.00E+03	G
		546.56	0.000E+00	%	4.788E+00	1.00E+03	G
		836.80	0.000E+00	%	3.510E+00	1.00E+03	G
		1706.46	0.000E+00	%	1.025E+01	1.00E+03	G
		1124.00	0.000E+00	%	2.450E+01	1.00E+03	G
		417.63	0.000E+00	%	6.381E+00	1.00E+03	G
		288.45	0.000E+00	&	1.388E+01	1.00E+03	G
		220.50	0.000E+00	&	2.003E+01	1.00E+03	G
		1101.58	0.000E+00	%	1.871E+01	1.00E+03	G
		1566.41	0.000E+00	%	3.068E+01	1.00E+03	G
		972.61	0.000E+00	&	3.988E+01	1.00E+03	G
		1502.79	0.000E+00	%	3.574E+01	1.00E+03	G
SR-91	0.0000E+00						
		555.57	0.000E+00	%	6.020E-01	1.00E+03	G
		1024.30	0.000E+00	&	2.033E+00	1.00E+03	G
		749.80	0.000E+00	%	2.679E+00	1.00E+03	G
		652.90	0.000E+00	%	2.096E+00	1.00E+03	G
		925.80	0.000E+00	%	7.197E+00	1.00E+03	G
		652.30	0.000E+00	%	1.560E+01	1.00E+03	G

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Spectrum name: REACTOR POOL 19-12-17.An1

Nuclide	Ave activity	Energy	Activity	Code	Peak	MDA	Comments
		620.10	0.000E+00	%	1.430E+01	1.00E+03	G
		14.90	0.000E+00	%	5.150E+01	1.00E+03	G
		274.70	0.000E+00	%	2.727E+01	1.00E+03	G
Y-88	0.0000E+00						
		1836.01	0.000E+00	%	2.868E-01	1.00E+03	G
		898.02	0.000E+00	%	1.721E-01	1.00E+03	G
		14.15	0.000E+00	&	2.395E+00	1.00E+03	G
		15.80	0.000E+00	%	1.224E+01	1.00E+03	G
Y-91M	0.0000E+00						
		557.57	0.000E+00	&	8.073E+00	1.00E+03	G
		14.90	0.000E+00	%	6.356E+02	1.00E+03	G

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RU-103	0.0000E+00						
		497.08	0.000E+00	%	2.401E-01	1.00E+03	G
		610.33	0.000E+00	%	4.918E+00	1.00E+03	G
CS-134	0.0000E+00						
		604.66	0.000E+00	%	1.631E-01	1.00E+03	G
		795.76	0.000E+00	%	2.130E-01	1.00E+03	G
		569.29	0.000E+00	%	1.078E+00	1.00E+03	G
		801.84	0.000E+00	%	3.395E+00	1.00E+03	G
		563.26	0.000E+00	%	3.575E+00	1.00E+03	G
		1365.13	0.000E+00	%	7.586E+00	1.00E+03	G
		1167.86	0.000E+00	%	1.427E+01	1.00E+03	G
		475.35	0.000E+00	%	2.212E+01	1.00E+03	G
		1038.50	0.000E+00	%	1.843E+01	1.00E+03	G
CS-136	0.0000E+00						
		818.50	0.000E+00	%	3.375E-01	1.00E+03	G
		1048.07	0.000E+00	%	2.336E-01	1.00E+03	G
		340.57	0.000E+00	%	3.725E-01	1.00E+03	G
		1235.34	0.000E+00	%	1.585E+00	1.00E+03	G
		176.56	0.000E+00	&	1.588E+00	1.00E+03	G
		273.65	0.000E+00	&	1.789E+00	1.00E+03	G
		66.91	0.000E+00	%	1.007E+00	1.00E+03	G
		153.22	0.000E+00	%	1.335E+00	1.00E+03	G
		86.29	0.000E+00	%	1.496E+00	1.00E+03	G
		163.89	0.000E+00	&	3.141E+00	1.00E+03	G
		32.19	0.000E+00	%	9.629E+00	1.00E+03	G
		31.82	0.000E+00	%	1.873E+01	1.00E+03	G
CS-137	1.3912E+00						
		661.62	1.391E+00	@(	4.762E-01	1.93E+01	G
		32.19	4.384E-01	}	7.425E+00	2.87E+02	G
		31.82	3.089E-01	}	1.452E+01	1.07E+03	G
		36.40	0.000E+00		3.961E+00	0.00E+00	G

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Spectrum name: REACTOR POOL 19-12-17.An1

Nuclide	Ave activity	Energy	Activity	Code	Peak	MDA	Comments
BA-140	0.0000E+00						
		537.38	0.000E+00	&	1.906E+00	1.00E+03	G
		29.96	0.000E+00	&	2.608E+00	1.00E+03	G
		162.64	0.000E+00	&	4.272E+00	1.00E+03	G
		304.82	0.000E+00	%	6.387E+00	1.00E+03	G
		423.69	0.000E+00	%	6.752E+00	1.00E+03	G
		437.55	0.000E+00	%	9.973E+00	1.00E+03	G
		13.85	0.000E+00	%	6.614E+01	1.00E+03	G
		33.44	0.000E+00	%	1.800E+01	1.00E+03	G
LA-140	0.0000E+00						
		1596.20	0.000E+00	%	5.946E-01	1.00E+03	G
		487.03	0.000E+00	%	5.652E-01	1.00E+03	G
		815.80	0.000E+00	%	8.971E-01	1.00E+03	G
		328.75	0.000E+00	%	1.401E+00	1.00E+03	G
		925.25	0.000E+00	%	3.257E+00	1.00E+03	G
		867.86	0.000E+00	%	3.962E+00	1.00E+03	G
		751.79	0.000E+00	%	3.496E+00	1.00E+03	G
		2521.83	0.000E+00	=	0.000E+00	0.00E+00	G
		432.55	0.000E+00	&	8.743E+00	1.00E+03	G
		919.60	0.000E+00	%	6.805E+00	1.00E+03	G
CE-144	0.0000E+00						
		133.53	0.000E+00	%	2.263E+00	1.00E+03	G
		36.03	0.000E+00	%	6.775E+00	1.00E+03	G
		35.55	0.000E+00	%	1.312E+01	1.00E+03	G
		80.12	0.000E+00	%	7.817E+00	1.00E+03	G
		40.70	0.000E+00	&	1.569E+01	1.00E+03	G

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CD-109	0.0000E+00						
		22.10	0.000E+00	%	3.047E-01	1.00E+03	G
		24.95	0.000E+00	%	3.828E+00	1.00E+03	G
		88.04	0.000E+00	&	5.071E+00	1.00E+03	G
		25.50	0.000E+00	%	1.354E+01	1.00E+03	G
CE-139	0.0000E+00						
		165.85	0.000E+00	%	1.289E-01	1.00E+03	G
		33.44	0.000E+00	%	5.528E-01	1.00E+03	G
		33.03	0.000E+00	%	7.603E-01	1.00E+03	G
		37.80	0.000E+00	%	9.222E-01	1.00E+03	G
		38.70	0.000E+00	%	6.034E+00	1.00E+03	G
HG-203	0.0000E+00						
		279.17	0.000E+00	%	2.365E-01	1.00E+03	G
		72.87	0.000E+00	%	3.422E+00	1.00E+03	G
		10.27	0.000E+00	=	0.000E+00	0.00E+00	G
		70.83	0.000E+00	&	5.020E+00	1.00E+03	G

1

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Spectrum name: REACTOR POOL 19-12-17.An1

Nuclide	Ave activity	Energy	Activity	Code	Peak	MDA	Comments
		82.50	0.000E+00	%	4.384E+00	1.00E+03	G
K-40	0.0000E+00						
		1460.75	0.000E+00	% P	8.948E+00	2.40E+01	G
SB-124	0.0000E+00						
		602.71	0.000E+00	%	3.762E-01	1.00E+03	G
		1691.04	0.000E+00	%	5.397E-01	1.00E+03	G
		722.78	0.000E+00	%	1.403E+00	1.00E+03	G
		645.84	0.000E+00	%	3.820E+00	1.00E+03	G
		2091.20	0.000E+00	=	0.000E+00	0.00E+00	G
		1368.21	0.000E+00	%	9.071E+00	1.00E+03	G
		713.82	0.000E+00	%	1.057E+01	1.00E+03	G
		1045.12	0.000E+00	%	9.921E+00	1.00E+03	G
		968.22	0.000E+00	%	1.661E+01	1.00E+03	G
		1325.53	0.000E+00	%	1.525E+01	1.00E+03	G
		709.34	0.000E+00	%	1.955E+01	1.00E+03	G
		1436.60	0.000E+00	%	2.804E+01	1.00E+03	G
SB-125	0.0000E+00						
		427.95	0.000E+00	&	1.324E+00	1.00E+03	G
		600.77	0.000E+00	%	5.872E-01	1.00E+03	G
		636.15	0.000E+00	%	1.025E+00	1.00E+03	G
		463.51	0.000E+00	%	1.436E+00	1.00E+03	G
		176.29	0.000E+00	&	3.308E+00	1.00E+03	G
		35.46	0.000E+00	%	5.507E+00	1.00E+03	G
		606.82	0.000E+00	%	3.428E+00	1.00E+03	G
		671.66	0.000E+00	%	2.296E+01	1.00E+03	G
		380.51	0.000E+00	%	1.736E+01	1.00E+03	G
		81.80	0.000E+00	%	1.802E+01	1.00E+03	G
SE-75	0.0000E+00						
		264.65	0.000E+00	%	3.237E-01	1.00E+03	G
		136.00	0.000E+00	%	2.556E-01	1.00E+03	G
		10.53	0.000E+00	=	0.000E+00	0.00E+00	G
		279.53	0.000E+00	&	7.797E-01	1.00E+03	G
		121.12	0.000E+00	%	1.387E+00	1.00E+03	G
		400.65	0.000E+00	%	1.662E+00	1.00E+03	G
		11.70	0.000E+00	=	0.000E+00	0.00E+00	G
		96.73	0.000E+00	%	2.848E+00	1.00E+03	G
		198.60	0.000E+00	%	1.722E+01	1.00E+03	G
		303.92	0.000E+00	%	9.753E+00	1.00E+03	G
EU-152	0.0000E+00						
		40.12	0.000E+00	&	1.021E+00	1.00E+03	G
		121.78	0.000E+00	&	7.786E-01	1.00E+03	G

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344.30	0.000E+00	%	4.495E-01	1.00E+03	G
1408.08	0.000E+00	%	2.272E+00	1.00E+03	G

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Spectrum name: REACTOR POOL 19-12-17.An1

Nuclide	Ave activity	Energy	Activity	Code	Peak	MDA	Comments
		39.52	0.000E+00	%	1.661E+00	1.00E+03	G
		964.00	0.000E+00	%	3.520E+00	1.00E+03	G
		1112.07	0.000E+00	&	3.547E+00	1.00E+03	G
		778.90	0.000E+00	%	1.590E+00	1.00E+03	G
		1085.80	0.000E+00	&	3.038E+00	1.00E+03	G
		45.40	0.000E+00	%	1.177E+00	1.00E+03	G
		244.67	0.000E+00	&	3.055E+00	1.00E+03	G
		867.39	0.000E+00	%	9.588E+00	1.00E+03	G
		444.00	0.000E+00	%	1.064E+01	1.00E+03	G
		411.09	0.000E+00	%	7.600E+00	1.00E+03	G
		46.60	0.000E+00	%	1.327E+01	1.00E+03	G
		1089.82	0.000E+00	%	1.117E+01	1.00E+03	G
		1299.19	0.000E+00	%	1.301E+01	1.00E+03	G
		1212.89	0.000E+00	%	3.129E+01	1.00E+03	G
RA-226	0.0000E+00						
							Derived Ave Activity
		185.99	0.000E+00	} P	8.638E+00	1.00E+03	G
U-235	1.1699E+00						
		185.72	4.006E-01	}	3.781E-01	2.87E+01	G
		143.76	7.891E-01	?(	1.896E+00	9.17E+01	G
		205.31	0.000E+00		7.457E-01	0.00E+00	G
		163.35	0.000E+00		6.529E-01	0.00E+00	G
		93.35	0.000E+00		1.081E+00	0.00E+00	G
		109.14	0.000E+00	%	1.099E+01	1.46E+02	G
		89.96	3.835E+00	?(	9.885E+00	8.00E+01	G
		202.12	0.000E+00	%	1.267E+01	2.52E+02	G
		105.00	0.000E+00		2.711E+00	0.00E+00	G
TE-132	0.0000E+00						
		228.16	0.000E+00	&	2.188E-01	1.00E+03	G
		28.50	0.000E+00	%	3.488E-01	1.00E+03	G
		49.72	0.000E+00	&	1.372E+00	1.00E+03	G
		32.30	0.000E+00	%	2.097E+00	1.00E+03	G
		116.30	0.000E+00	%	7.075E+00	1.00E+03	G
		111.76	0.000E+00	%	1.034E+01	1.00E+03	G
MO-90	0.0000E+00						
		257.34	0.000E+00	&	5.088E-01	1.00E+03	G
		16.60	0.000E+00	%	2.417E+00	1.00E+03	G
		122.37	0.000E+00	%	4.492E-01	1.00E+03	G
		18.60	0.000E+00	&	9.615E+00	1.00E+03	G
		203.13	0.000E+00	%	2.144E+00	1.00E+03	G
		323.20	0.000E+00	%	6.102E+00	1.00E+03	G
		445.37	0.000E+00	%	4.827E+00	1.00E+03	G
		162.93	0.000E+00	&	6.122E+00	1.00E+03	G
		941.50	0.000E+00	%	5.076E+00	1.00E+03	G

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Spectrum name: REACTOR POOL 19-12-17.An1

Nuclide	Ave activity	Energy	Activity	Code	Peak	MDA	Comments
		1271.30	0.000E+00	%	1.285E+01	1.00E+03	G
		42.70	0.000E+00	&	1.595E+01	1.00E+03	G
		1454.60	0.000E+00	%	2.152E+01	1.00E+03	G
		1387.40	0.000E+00	%	2.077E+01	1.00E+03	G
		472.24	0.000E+00	%	4.196E+01	1.00E+03	G
		990.20	0.000E+00	%	2.902E+01	1.00E+03	G
ZR-97	0.0000E+00						

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                                REACTOR POOL 19-12-17.Rpt
                              743.36 0.000E+00 %   2.062E-01 1.00E+03 G
                              507.63 0.000E+00 %   4.726E+00 1.00E+03 G
                             1147.95 0.000E+00 &   2.414E+01 1.00E+03 G
                              355.39 0.000E+00 %   1.613E+01 1.00E+03 G
                             1021.30 0.000E+00 %   1.945E+01 1.00E+03 G
                              602.41 0.000E+00 %   2.082E+01 1.00E+03 G
                             1750.46 0.000E+00 %   2.428E+01 1.00E+03 G
                             1362.66 0.000E+00 %   2.026E+01 1.00E+03 G
                              254.15 0.000E+00 %   1.091E+01 1.00E+03 G
                             1276.09 0.000E+00 &   4.981E+01 1.00E+03 G

NB-97          0.0000E+00
                              657.92 0.000E+00 &   3.598E+00 1.00E+03 G
                             1024.53 0.000E+00 &   4.301E+02 1.00E+03 G

SR-85          0.0000E+00
                              513.99 0.000E+00 %   2.655E-01 1.00E+03 G
                               13.38 0.000E+00 %   2.774E+00 1.00E+03 G
                               15.00 0.000E+00 %   6.522E+00 1.00E+03 G

RH-106         0.0000E+00
                              621.80 0.000E+00 %   2.037E+00 1.00E+03 G
                             1050.10 0.000E+00 %   3.583E+01 1.00E+03 G

SN-113         0.0000E+00
                              391.71 0.000E+00 &   4.046E-01 1.00E+03 G
                               24.21 0.000E+00 %   1.347E+00 1.00E+03 G
                               24.00 0.000E+00 %   2.867E+00 1.00E+03 G
                               27.30 0.000E+00 %   3.097E+00 1.00E+03 G
                               27.90 0.000E+00 &   1.583E+01 1.00E+03 G
                              255.04 0.000E+00 %   5.653E+00 1.00E+03 G

Cd-113M  I     0.0000E+00
                              263.70 0.000E+00 &   8.573E+04 1.00E+03 G
   ( - This peak used in the nuclide activity average.

   ^ - Peak is too wide, but only one peak in library.
   ! - Peak is part of a multiplet and this area went
       negative during deconvolution.
^L

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                                Spectrum name: REACTOR POOL 19-12-17.An1

   ? - Peak is too narrow.
   @ - Peak is too wide at FW25M, but ok at FWHM.
   % - Peak fails sensitivity test.
   $ - Peak identified, but first peak of this nuclide
       failed one or more qualification tests.
   + - Peak activity higher than counting uncertainty range.
   - - Peak activity lower than counting uncertainty range.
   = - Peak outside analysis energy range.
   & - Calculated peak centroid is not close enough to the
       library energy centroid for positive identification.
   P - Peakbackground subtraction
   } - Peak is too close to another for the activity
       to be found directly.

   Nuclide Codes:                    Peak Codes:
   T - Thermal Neutron Activation    G - Gamma Ray
   F - Fast Neutron Activation       X - X-Ray
   I - Fission Product               P - Positron Decay
   N - Naturally Occurring Isotope   S - Single-Escape
   P - Photon Reaction               D - Double-Escape
   C - Charged Particle Reaction     K - Key Line
   M - No MDA Calculation            A - Not in Average
   R - Coincidence Corrected         C - Coincidence Peak
   H - Halflife limit exceeded

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                                      Page 10
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***** SUMMARY OF NUCLIDES IN SAMPLE *****

Nuclide		Time of Count Activity Bq/L	Time Corrected Activity Bq/L	Uncertainty Counting Bq/L	2 Sigma Total Bq/L	MDA
AR-41	<	5.9297E-01	1.6963E+00			
XE-131M	<	1.2995E+00	1.3083E+00			
XE-133		6.3310E-01	6.4276E-01	4.9465E-01	4.9645E-01	4.222E-01
XE-133M	<	1.2409E+00	1.2857E+00			
XE-135	<	1.5683E-01	1.9382E-01			
NA-24	<	3.1098E-01	3.5344E-01			
BE-7	<	1.6540E+00	1.6565E+00			
CR-51	<	2.1964E+00	2.2028E+00			
W-187		1.0773E+00	1.1676E+00	5.3574E-01	5.4097E-01	4.801E-01
MN-54	<	4.1272E-01	4.1283E-01			
MO-99	<	2.5104E-01	2.5844E-01			
TC-99M	<	2.9502E-01	4.0608E-01			
FE-59	<	6.1016E-01	6.1124E-01			
CO-57	<	2.1571E-01	2.1578E-01			
CO-58	<	4.5017E-01	4.5068E-01			
CO-60	<	2.2637E-01	2.2638E-01			
ZN-65	<	9.1392E-01	9.1422E-01			
NB-94	<	2.7998E-01	2.7998E-01			
ZR-95	<	4.4601E-01	4.4657E-01			
NB-95	<	4.4808E-01	4.4910E-01			
I-131	<	2.9780E-01	3.0078E-01			

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Spectrum name: REACTOR POOL 19-12-17.An1

I-132	<	1.7968E-01	4.0317E-01			
I-133	<	2.1595E-01	2.3741E-01			
I-135	<	2.7342E+00	3.6577E+00			
SR-91	<	4.9340E-01	6.0198E-01			
Y-88	<	2.8662E-01	2.8684E-01			
Y-91M	<	7.9209E-01	8.0733E+00			
RU-103	<	2.3961E-01	2.4010E-01			
CS-134	<	1.6305E-01	1.6307E-01			
CS-136	<	3.3544E-01	3.3752E-01			
CS-137	#	1.3912E+00	1.3912E+00	5.3764E-01	5.4496E-01	4.762E-01
BA-140	<	1.8940E+00	1.9060E+00			
LA-140	<	5.6682E-01	5.9455E-01			
CE-144	<	2.2627E+00	2.2634E+00			
CD-109	<	3.0469E-01	3.0474E-01			
CE-139	<	1.2880E-01	1.2888E-01			
HG-203	<	2.3613E-01	2.3654E-01			
K-40	<	8.9477E+00	8.9477E+00			
SB-124	<	3.7572E-01	3.7622E-01			
SB-125	<	1.3239E+00	1.3240E+00			
SE-75	<	3.2345E-01	3.2366E-01			
EU-152	<	1.0211E+00	1.0211E+00			
RA-226	<	8.6385E+00	8.6385E+00			
U-235	A	1.1699E+00	1.1699E+00	1.4241E+00	1.4268E+00	1.896E+00
TE-132	<	2.1344E-01	2.1877E-01			
MO-90	<	3.6239E-01	5.0876E-01			
ZR-97	<	1.8388E-01	2.0618E-01			
NB-97	<	7.5599E-01	3.5976E+00			
SR-85	<	2.6515E-01	2.6547E-01			
RH-106	<	2.0365E+00	2.0369E+00			
SN-113	<	4.0429E-01	4.0457E-01			
Cd-113M	<	8.5727E+04	8.5729E+04			

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.

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C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

---------- S U M M A R Y ----------

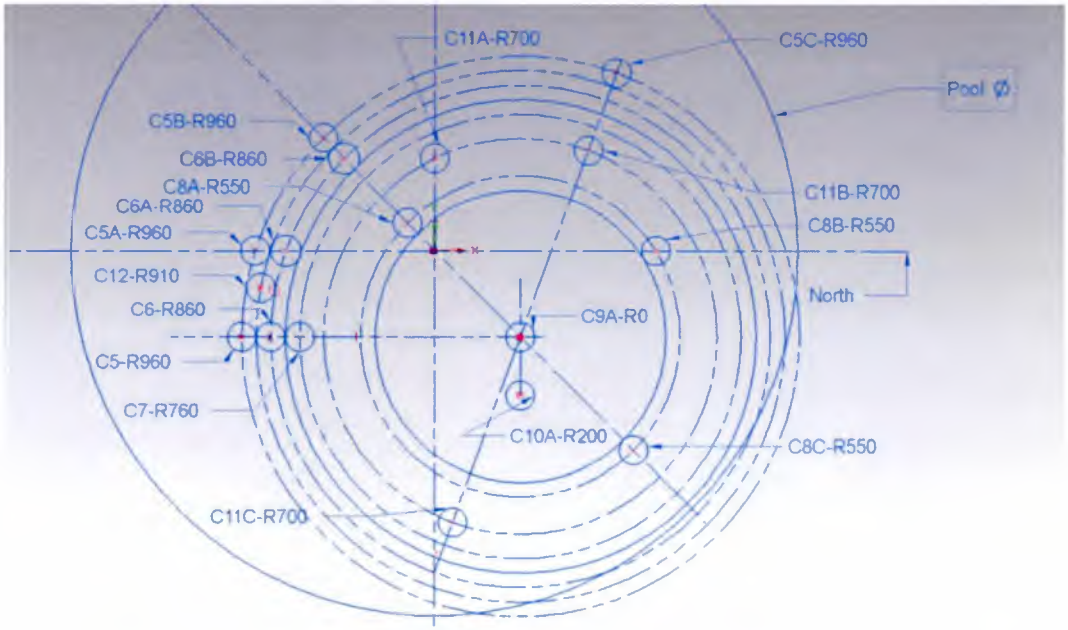
Total Activity (202.1 to 1996.4 keV) 4.272E+00 Bq/L
Total Decayed Activity (202.1 to 1996.4 keV) 4.3714867E+00 Bq/L

Analyzed by: _____ DC

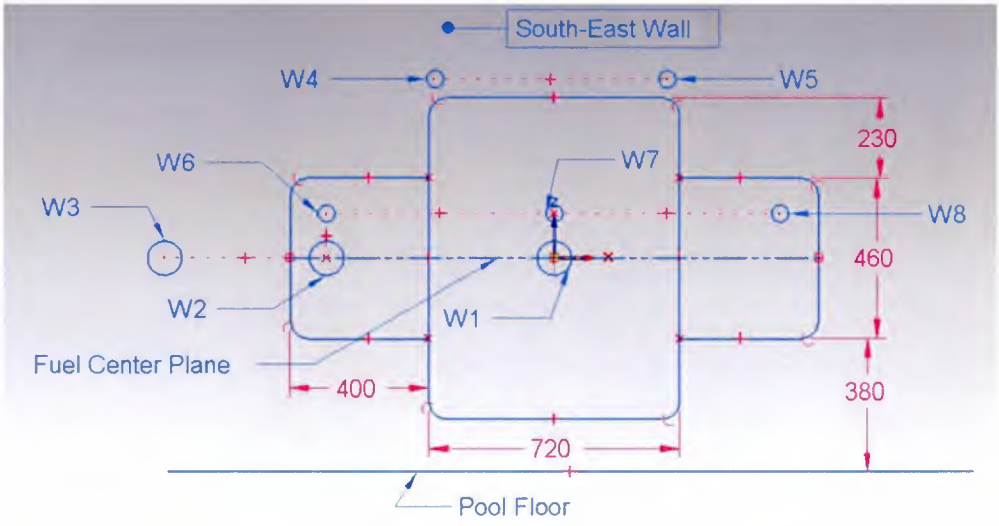
Reviewed by: _____ Supervisor

Laboratory:

Appendix H
REACTOR POOL SAMPLING PLAN



Pool Floor Sampling Plan



Pool Wall Sampling Plan

Appendix I
IRRADIATED CONCRETE IN DRUMS – GAMMA SPEC

From: Rees, Philip
To: Tanguay, Pierre (CNSC/CCSN); Erdebil, Ismail (CNSC/CCSN)
Cc: Alim, Shahzad; Chorney, Dave
Subject: RE: Decommissioning Inspection of the SRC SLOWPOKE-2 Facility Held July 8-10, 2020
Date: Thursday, October 1, 2020 10:36:49 AM
Attachments: Concrete Waste Barrels - Revised Report 2020-9657.pdf

Good Morning Pierre & Ismail –

Related to the non-compliance noted in the decommissioning inspection report, SRC did characterize and measure the concrete waste in the barrels in anticipation of disposal through CNL. The table below provides the readings of the barrels on contact and at a distance of 1 meter.

		RP Readings (mrem/hr)	
	Weight (kg)	Near Contact	@ 1m
Drum 1	325	0.01	0.01
Drum 2	325	0.01	0.01
Drum 3	325	0.01	0.01
Drum 4	325	0.02	0.00
Drum 5	325	0.01	0.01
Drum 6	325	0.02	0.01

In addition, samples were taken from the concrete waste and analyzed via gamma spectroscopy, and these results indicate the various radionuclides present in the waste. The report is attached for reference.
The waste is being prepared for shipment and disposal with CNL, with an anticipated ship date no later than 30 OCT 2020.
Once the shipment has been approved and completed, a final email will be sent indicating the completion of remediation activities related to the non-compliance.

Kind regards,

Philip

From: Holbrook, Allan (CNSC/CCSN) <allan.holbrook@canada.ca>
Sent: Tuesday, September 22, 2020 2:25 PM

To: Chorney, Dave <Dave.Chorney@src.sk.ca>
Cc: Ducros, Caroline (CNSC/CCSN) <caroline.ducros@canada.ca>; Tanguay, Pierre (CNSC/CCSN) <pierre.tanguay@canada.ca>; Erdebil, Ismail (CNSC/CCSN) <ismail.erdebil@canada.ca>; Alim, Shahzad <Shahzad.Alim@snclavalin.com>; Rees, Philip <Philip.Rees@src.sk.ca>
Subject: Decommissioning Inspection of the SRC SLOWPOKE-2 Facility Held July 8-10, 2020

2020-09-22

Subject: Decommissioning Inspection of the SRC SLOWPOKE-2 Facility Held July 8-10, 2020

Dear Mr. Chorney,

Please find attached a letter and report from Mr. Erdebil (CNSC) concerning the subject line above. Kindly note that no paper copy will follow.

Thank you,

Ailan Holbrook
Administrative Assistant | Adjointe administrative
Nuclear Processing Facilities Division | Division des installations de traitement nucléaires
Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire
ailan.holbrook@canada.ca

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Revised

SRC Group # 2020-9657

Oct 05, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Aug-19-2020 Client P.O.:

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 4 authorized by Vicky Snook, Supervisor

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* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  * Environment Canada
  * US EPA
  * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SRC SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

Revised

SRC Group # 2020-9657

Oct 05, 2020

Analytical, SRC
143-111 Research Drive
Saskatoon, SK S7N 3R2
Attn: Dave Chorney, 11526

Date Samples Received: Aug-19-2020 Client P.O.:

40037	08/19/2020 BARREL 5 CONCRETE #1 *CONCRETE*
40038	08/19/2020 BARREL 5 CONCRETE #2 *CONCRETE*
40039	08/19/2020 BARREL 5 CONCRETE #3 *CONCRETE*

Analyte	Units	40037	40038	40039
Lab Section 4				
Europium-152	Bq/g	0.019	0.27	0.10
Europium-154	Bq/g	0.003	0.03	0.011
Scandium-46	Bq/g	0.003	0.005	0.005
Cesium-134	Bq/g	<0.0009	0.009	0.004
Cesium-137	Bq/g	0.004	0.003	0.022
Cobalt-60	Bq/g	0.015	0.17	0.068
Iron-59	Bq/g	<0.002	0.006	0.003
Manganese-54	Bq/g	0.002	<0.003	0.014
Zinc-65	Bq/g	<0.003	<0.005	<0.003
Potassium-40	Bq/g	0.46	0.62	0.61

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 40039
Revised report to correct the Europium 152 result. Sept 1/20 VS

The temperature of the cooler was 24.4 °C upon receipt.

Results are reported on an as received basis.
Gamma spectroscopy detection limits are influenced by several factors.
"Less than" values reported above represent the lowest detection limits achievable for the sample.

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Revised

SRC Group # 2020-9657
Oct 05, 2020

Analytical, SRC

40040 08/19/2020 BARREL 1 CONCRETE SLURRY #6 *CONCRETE*

Analyte	Units	40040
Lab Section 4		
Europium-152	Bq/g	0.095
Europium-154	Bq/g	0.01
Scandium-46	Bq/g	<0.002
Cesium-134	Bq/g	0.004
Cesium-137	Bq/g	0.048
Cobalt-60	Bq/g	0.071
Iron-59	Bq/g	<0.004
Manganese-54	Bq/g	0.012
Zinc-65	Bq/g	<0.002
Potassium-40	Bq/g	0.47

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Note for Sample # 40040
Revised sample description. 10/5/20 TG

The temperature of the cooler was 24.4 °C upon receipt.

Results are reported on an as received basis.
Gamma spectroscopy detection limits are influenced by several factors.
"Less than" values reported above represent the lowest detection limits achievable for the sample.

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Revised

SRC Group # 2020-9657
Oct 05, 2020

Analytical, SRC

Analyte Methods

Name	Units	Method
Cobalt-60	Bq/g	Rad-300
Cesium-134	Bq/g	Rad-300
Cesium-137	Bq/g	Rad-300
Europium-152	Bq/g	Rad-300
Europium-154	Bq/g	Rad-300
Iron-59	Bq/g	Rad-300
Potassium-40	Bq/g	Rad-300
Manganese-54	Bq/g	Rad-300
Scandium-46	Bq/g	Rad-300
Zinc-65	Bq/g	Rad-300

Appendix J
UNCONDITIONAL RELEASED ITEMS

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Unconditional Release Form

NU-910011-FM-001 Rev 4

Ref. Procedure NU-910011-PRO-009

File No: NU-910011-035-000

Section A: Validity Information

1. Description of Equipment or Material: 2 CAPSULE RECEIVERS, 2 IRRADIATION CONTROLLERS
Identification Number (crate or tool): N/A — 1 SERVICE BOX

2. Reason for Request: IRRADIATION CONTROLLER & CAPSULE RECEIVER FOR RMCC - IRRADIATION CONTROLLER & CAPSULE RECEIVER FOR IAEA - 1 SERVICE BOX FOR RECYCLE/LANDFILL

4. Last Known Location of Equipment or Material (brief history): SRC SLOWPOKE FACILITY

[redacted]

Section B: Radiological Assessment

To the best of your knowledge, has the equipment or material at any time been:

Contaminated?	☐ Yes	☒ No
Used or stored in a contaminated area?	☒ Yes	☐ No
Been through a decontamination process?	☐ Yes	☒ No

Loose Contamination	Survey Instrument	Background (cpm)	Large Area Masslinn Contamination above background?	If Yes, 100 cm² sample: Survey Instrument	Net Counts = Gross-Background (cpm)
β/γ emitters	2929	88	☐ Yes ☒ No	-	Ø
α emitters	2929	Ø	☐ Yes ☒ No	-	Ø

Fixed	Survey Instrument	Background (cpm)	NET Counts = Gross-Background (cpm)
β/γ emitters	4393	228	50
α emitters	4393	Ø	2

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Unconditional Release Form

NU-910011-FM-001 Rev 4

Ref Procedure NU-910011-PRO-009

Section C: Radiological Details

Was any additional monitoring required such as tritium samples, gamma spectroscopy or liquid scintillation counting?	☐ Yes ☒ No
If Yes, give details or attach results of analyses.	
Were all of the exterior and interior surfaces monitored?	☐ Yes ☒ No
If No, provide details:	All accessible areas checked - not inside capsule receiver or parts of irradiation controller - some internal parts of service box not accessible
For items fit in the Small Article Monitor (SAM)	
For item(s) placed in SAM, did it "Clear" the SAM? ☐ Yes ☒ No	If No, provide details: n/a (no SAM on site)
For items do not fit in the Small Article Monitor (SAM)	
Did large area Masslinn(s) cleared the SAM? ☐ Yes ☒ No	If No, provide details: n/a (no SAM on site)
Was the gamma dose rate measured below background? ☒ Yes ☐ No	If No, provide details:
Group 1 Radiation Protection Surveyor: [redacted]	
Once surveys are completed by Radiation Protection Surveyor, equipment or material must be removed from Radiation Area immediately after the item(s) have been approved for removal	Date:

Section D: Health Physicist and Radiation Protection Program Authority Approval

Table 1: Maximum Surveyed Values for Unrestricted Use

Radionuclide	Surface Activity (Bq/cm²)	
β/γ emitters	Total	0.063
	Removable	ϕ
α emitters	Total	0.002
	Removable	ϕ

Table 2: Maximum Values for Unrestricted Use

Radionuclide	Maximum Value (Bq/cm²)	
	Total	Removable
β/γ emitters	3.0	0.3
α emitters	0.3	0.03

Are the results from Table 1 Less than the values given in Table 2?	☐ Yes	Removal of item is approved
	☐ No	Removal of item is rejected, notify owner from Section A
Candu Health Physicist or SRC Radiation Safety Officer	[redacted]	
Radiation Protection Program Authority		

Section E: Facility Manager Approval

Facility Manager: [redacted]

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Unconditional Release Form

NU-910011-FM-001 Rev. 4

Ref. Procedure NU-910011-PRO-029

File No.: NU-910011-035-000

Section A: Validity Information

1. Description of Equipment or Material: SRC SLOWPOKE cooling coil + control rod motor cover

Identification Number (crate or tool): N/A

2. Reason for Request: for disposal of items

3. Last Known Location of Equipment or Material (brief history):
Cooling coil sat in clean side of reactor pool.
Control rod motor cover sat over control rod motor.

4. Transfer Requested by: [redacted]

Section B: Radiological Assessment

To the best of your knowledge, has the equipment or material at any time been:

Contaminated? ☐ Yes ☒ No

Used or stored in a contaminated area? ☐ Yes ☒ No

Been through a decontamination process? ☒ Yes ☐ No Items wiped down with Fantastic spray

Loose Contamination	Survey Instrument	Background (cpm)	Large Area Masslinn Contamination above background?	If Yes, 300 cm² sample: Survey Instrument	Net Counts = Gross-Background (cpm)
β/γ emitters	M12 + 44-9	60	☐ Yes ☒ No		0
α emitters	M12 + 44-9	0	☐ Yes ☒ No		0

Fixed	Survey Instrument	Background (cpm)	NET Counts = Gross-Background (cpm)
β/γ emitters	M12 + 44-9	60	0
α emitters	M12 + 44-9	0	0

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Section C: Radiological Details

Was any additional monitoring required such as tritium samples, gamma spectroscopy or liquid scintillation counting? ☐ Yes ☒ No

If Yes, give details or attach results of analyses: n/a

Were all of the exterior and interior surfaces monitored? ☒ Yes ☐ No

If No, provide details: n/a

For items fit in the Small Article Monitor (SAM)

For item(s) placed in SAM, did it "Clear" the SAM? ☐ Yes ☐ No If No, provide details: n/a (no SAM on site)

For items do not fit in the Small Article Monitor (SAM)

Did large area Massinn(s) cleared the SAM? ☐ Yes ☐ No If No, provide details: n/a (no SAM on site)

Was the gamma dose rate measured below background? ☒ Yes ☐ No If No, provide details:

Group 1 Radiation Protection Surveyor: [redacted]

Once surveys are completed by Radiation Protection Surveyor, Equipment or Material must be removed from Radiation Area immediately after the item(s) have been approved for removal. Date:

Section D: Health Physicist and Radiation Protection Program Authority Approval

Table 1: Maximum Surveyed Values for Unrestricted Use

Radionuclide	Surface Activity (Bq/cm²)	
β/γ emitters	Total	0
	Removable	0
α emitters	Total	0
	Removable	0

Table 2: Maximum Values for Unrestricted Use

Radionuclide	Maximum Value (Bq/cm²)	
	Total	Removable
β/γ emitters	3.0	0.3
α emitters	0.3	0.03

Are the results from Table 1 less than the values given in Table 2? ☒ Yes Removal of item is approved ☐ No Removal of Item is rejected: notify owner from Section A

Candu Health Physicist or SRC Radiation Safety Officer

Radiation Protection Program Authority [redacted]

Section E: Facility Manager Approval

Facility Manager: [redacted]

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Unconditional Release Form

NU-910011-FM-001 Rev. 4

Ref. Procedure NU-910011-PRO-009

File No.:	NU-910011-035-000

Section A: Validity Information

1. Description of Equipment or Material:
2 metal brackets, frame of water purification system,pipe with box and separate box from water purification system, radiation detector and attached readout unit with cables, support brackets, 4 tier rack, wood and wooden stand

Identification Number (crate or tool) :N/A

2. Reason for Request: Recycle/landfill

3. Last Known Location of Equipment or Material (brief history): SRC SlowPoke Facility

4. Transfer Requested by: [redacted]

Section B: Radiological

To the best of your knowledge, has the equipment or material at any time been:

Contaminated? ☐ Yes ☒ No

Used or stored in a contaminated area? ☒ Yes ☐ No

Been through a decontamination process? ☐ Yes ☒ No

Loose Contamination	Survey Instrument	Background (cpm)	Large Area Masslinn Contamination above background?	If Yes, 100 cm² sample: Survey Instrument	Net Counts = Gross-Background (cpm)
β/γ emitters	2929	80	☐ Yes ☒ No	–	Ø
α emitters	2929	0	☐ Yes ☒ No	–	Ø

Fixed	Survey Instrument	Background (cpm)	NET Counts = Gross-Background (cpm)
β/γ emitters	4393	230	0
α emitters	4393	0	0

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NU-910011-FM-001 Rev 4

Section C: Radiological Details

Was any additional monitoring required such as tritium samples, gamma spectroscopy or liquid scintillation counting?	☐ Yes	☒ No	
If Yes, give details or attach results of analyses:			
Were all of the exterior and interior surfaces monitored?	☐ Yes	☒ No	
If No, provide details: All accessible surfaces			
For items fit in the Small Article Monitor (SAM)			
For item(s) placed in SAM, did it "Clear" the SAM?	☐ Yes	☐ No	If No, provide details: n/a (no SAM on site)
For items do not fit in the Small Article Monitor (SAM)			
Did large area Masshm(s) cleared the SAM?	☐ Yes	☐ No	If No, provide details: n/a (no SAM on site)
Was the gamma dose rate measured below background?	☒ Yes	☐ No	If No, provide details:
Group 1 Radiation Protection Surveyor: [redacted]			
Once surveys are completed by Radiation Protection Surveyor, Equipment or Material must be removed from Radiation Area immediately after the item(s) have been approved for removal.			Date:

Section D: Health Physicist and Radiation Protection Program Authority Approval

Table 1: Maximum Surveyed Values for Unrestricted Use

Radionuclide	Surface Activity (Bq/cm²)	
β/γ emitters	Total	ø
	Removable	ø
α emitters	Total	ø
	Removable	ø

Table 2: Maximum Values for Unrestricted Use

Radionuclide	Maximum Value (Bq/cm²)	
	Total	Removable
β/γ emitters	3.0	0.3
α emitters	0.3	0.03

Are the results from Table 1 Less than the values given in Table 2?	☒ Yes	Removal of item is approved
	☐ No	Removal of item is rejected: notify owner from Section A
Candu Health Physicist or SRC Radiation Safety Officer: [redacted]		
Radiation Protection Program Authority		

Section E: Facility Manager Approval

Facility Manager: [redacted]

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NU-910011-FM-091 Rev. 4

Page 1 of 2

Ref. Procedure NU-910011-PRO-009

File No.: NU-910011-035-000

Section A: Validity Information

1. Description of Equipment or Material: Six (6) 9000 lbs concrete shielding blocks plus two (2) wheeled side attachments and handles — Identification Number (crate or tool): N/A

2. Reason for Request: Remove blocks from site in order to decommission the SRC SLOWPOKE 2 reactor

3. Last Known Location of Equipment or Material (brief history): Zone 1 - awaiting removal from SRC building. The concrete blocks, side attachments, and handles were previously in room 146 (used as cover for the reactor).

4. Transfer Requested by: Name [redacted]

Section B: Radiological Assessment

To the best of your knowledge, has the equipment or material at any time been:

Contaminated? ☐ Yes ☒ No

Used or stored in a contaminated area? ☐ Yes ☒ No

Been through a decontamination process? ☐ Yes ☒ No

Loose Contamination	Survey Instrument	Background (cpm)	Large Area Massive Contamination above background?	If Yes, 100 cm² sample: Survey Instrument	Net Counts = Gross-Background (cpm)
β/γ emitters	Ludlum 2360 with 43-93 detector	201	☐ Yes ☒ No		0
α emitters	Ludlum 2360 with 43-93 detector	0	☐ Yes ☒ No		0

Fixed	Survey Instrument	Background (cpm)	NET Counts = Gross-Background (cpm)
β/γ emitters	Ludlum 2360 with 43-93 detector	201	40
α emitters	Ludlum 2360 with 43-93 detector	0	3

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NU-910011-FM-001 Rev. 4

Ref. Procedure NU-910011-PRO-009

Section C: Radiological Details

Was any additional monitoring required such as tritium samples, gamma spectroscopy or liquid scintillation counting? ☐ Yes ☒ No

If Yes, give details or attach results of analyses: n/a

Were all of the exterior and interior surfaces monitored? ☒ Yes ☐ No

If No, provide details: n/a

For Items fit in the Small Article Monitor (SAM)

For item(s) placed in SAM, did it "Clear" the SAM? ☐ Yes ☐ No — If No, provide details: n/a (Items are too large for SAM)

For Items do not fit in the Small Article Monitor (SAM)

Did large area Massman(s) cleared the SAM? ☐ Yes ☒ No — If No, provide details: n/a (no SAM on site)

Was the gamma dose rate measured below background? ☒ Yes ☐ No — If No, provide details:

Group 1 Radiation Protection Surveyor: [redacted]

Once surveys are completed by Radiation Protection Surveyor, Equipment or Material must be removed from Radiation Area immediately after the item(s) have been approved for removal. Date:

Section D: Health Physicist and Radiation Protection Program Authority Approval

Table 1: Maximum Surveyed Values for Unrestricted Use

Radionuclide	Surface Activity (Bq/cm²)	
β/γ emitters	Total	0.051
	Removable	0
α emitters	Total	0.003
	Removable	0

Table 2: Maximum Values for Unrestricted Use

Radionuclide	Maximum Value (Bq/cm²)	
	Total	Removable
β/γ emitters	3.0	0.3
α emitters	0.3	0.03

Are the results from Table 1 Less than the values given in Table 2?

☒ Yes Removal of item is approved

☐ No Removal of item is rejected; notify owner from Section A

Candu Health Physicist or SRC Radiation Safety Officer / Radiation Protection Program Authority: [redacted]

Section E: Facility Manager Approval

Facility Manager: [redacted]

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Unconditional Release Form

NU-910011-FM 001 Rev 4

Ref. Procedure NU-910011-PRO-009

File No.: NU-910011-035-000

Section A: Validity Information

1. Description of Equipment or Material: MISC. ITEMS, 2 RADIATION WALL MOUNT DETECTORS, CIGENTEC ELECTRICAL BOX, DESK, CABLE TRAYS (8), MONITOR, VALVES, RML-200 DETECTOR — Identification Number (crate or tool): N/A

2. Reason for Request: RECYCLE / LANDFILL

3. Last Known Location of Equipment or Material (brief history): SRC SLOWPOKE FACILITY

4. Transfer Requested by: Nam [redacted]

Section B: Radiological Assessment

To the best of your knowledge, has the equipment or material at any time been:

- Contaminated? ☐ Yes ☒ No
- Used or stored in a contaminated area? ☒ Yes ☐ No
- Been through a decontamination process? ☐ Yes ☒ No

Loose Contamination	Survey Instrument	Background (cpm)	Large Area Massinn Contamination above background?	If Yes, 100 cm² sample: Survey Instrument	Net Counts = Gross-Background (cpm)
β/γ emitters	2929	88	☐ Yes ☒ No	-	ϕ
α emitters	2929	Ø	☐ Yes ☒ No	-	ϕ

Fixed	Survey Instrument	Background (cpm)	NET Counts = Gross-Background (cpm)
β/γ emitters	4393	228	56
α emitters	4393	Ø	2

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NU-910011-FM-001 Rev 4

Ref. Procedure NU-910011-PRO-009

Section C: Radiological Details

Was any additional monitoring required such as tritium samples, gamma spectroscopy or liquid scintillation counting?	☐ Yes	☒ No
If Yes, give details or attach results of analyses:		

Were all of the exterior and interior surfaces monitored?	☐ Yes	☒ No
If No, provide details: All accessible areas checked, NOT INSIDE valve		

For items fit in the Small Article Monitor (SAM)			
For item(s) placed in SAM, did it "Clear" the SAM?	☐ Yes	☒ No	If No, provide details: n/a (no SAM on site)
For items do not fit in the Small Article Monitor (SAM)			
Did large area Masslinn(s) clear the SAM?	☐ Yes	☒ No	If No, provide details: n/a (no SAM on site)
Was the gamma dose rate measured below background?	☒ Yes	☐ No	If No, provide details

Group 1 Radiation Protection Surveyor:	[redacted]
Once surveys are completed by Radiation Protection Surveyor, Equipment or Material must be removed from Radiation Area immediately after the item[s] have been approved for removal	Date:

Section D: Health Physicist and Radiation Protection Program Authority Approval

Table 1: Maximum Surveyed Values for Unrestricted Use

Radionuclide	Surface Activity (Bq/cm²)	
β/γ emitters	Total	0.063
	Removable	∅
α emitters	Total	0.002
	Removable	∅

Table 2: Maximum Values for Unrestricted Use

Radionuclide	Maximum Value (Bq/cm²)	
	Total	Removable
β/γ emitters	3.0	0.3
α emitters	0.3	0.03

Are the results from Table 1 **Less** than the values given in **Table 2**?	☐ Yes	Removal of item is approved
	☐ No	Removal of item is rejected, notify owner from Section A

Candu Health Physicist or SRC Radiation Safety Officer	[redacted]
Radiation Protection Program Authority	

Section E: Facility Manager Approval

Facility Manager:	[redacted]

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Unconditional Release Form

NU-910011-FM-03 Rev. 4

Page 1 of 2

Ref. Procedure NU-910011-PRO-009

File No.: NU-910011-035-000

Section A: Validity Information

1. Description of Equipment or Material: Identification Number (crate or tool): N/A

Pool water purification System.

2. Reason for Request: To be transferred to RMC SlowPoke Facility

3. Last Known Location of Equipment or Material (brief history): SRC SlowPoke Facility.

4. Transfer Requested by: Name: [redacted]

Section B: Radiological Assessment

To the best of your knowledge, has the equipment or material at any time been:

Contaminated? ☐ Yes ☒ No

Used or stored in a contaminated area? ☒ Yes ☐ No

Been through a decontamination process? ☒ Yes ☐ No

Loose Contamination	Survey Instrument	Background (cpm)	Large Area Masslinn Contamination above background?	If Yes, 100 cm² sample: Survey Instrument	Net Counts = Gross-Background (cpm)
β/γ emitters	4393	143	☐ Yes ☒ No	-	ϕ
α emitters	4393	3	☐ Yes ☒ No	-	ϕ

Fixed	Survey Instrument	Background (cpm)	NET Counts = Gross-Background (cpm)
β/γ emitters	4393	143	0
α emitters	4393	3	0

Unconditional Release Form

Section C: Radiological Details

Was any additional monitoring required such as tritium samples, gamma spectroscopy or liquid scintillation counting?	☐ Yes ☒ No
If Yes, give details or attach results of analyses	
Were all of the exterior and interior surfaces monitored?	☐ Yes ☒ No
If No, provide details: INTERIOR OF PIPES, PUMPS & FILTRATION TANKS NOT ACCESSIBLE	

For Items fit in the Small Article Monitor (SAM)			
For Item(s) placed in SAM, did it "Clear" the SAM?	☐ Yes	☒ No	If No, provide details: n/a (no SAM on site)
For Items do not fit in the Small Article Monitor (SAM)			
Did large area Masslinn(s) cleared the SAM?	☐ Yes	☒ No	If No, provide details: n/a (no SAM on site)
Was the gamma dose rate measured below background?	☒ Yes	☐ No	If No, provide details:

Group 1 Radiation Protection Surveyor:	[redacted]
Once surveys are completed by Radiation Protection Surveyor, Equipment or Material must be removed from Radiation Area immediately after the item(s) have been approved for removal.	Date:

Section D: Health Physicist and Radiation Protection Program Authority Approval

Table 1: Maximum Surveyed Values for Unrestricted Use

Radionuclide	Surface Activity (Bq/cm²)	
β/γ emitters	Total	∅
	Removable	∅
α emitters	Total	∅
	Removable	∅

Table 2: Maximum Values for Unrestricted Use

Radionuclide	Maximum Value (Bq/cm²)	
	Total	Removable
β/γ emitters	3.0	0.3
α emitters	0.3	0.03

Are the results from Table 1 Less than the values given in Table 2?	☐ Yes	Removal of item is approved
	☐ No	Removal of item is rejected; notify owner from Section A

Candu Health Physicist or SRC Radiation Safety Officer	[redacted]
Radiation Protection Program Authority	

Section E: Facility Manager Approval

Facility Manager:	[redacted]

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Unconditional Release Form

NU-910011-FM-001 Rev. 4

Ref. Procedure NU-910011-PRO-009

File No.	NU-910011-035-000

Section A: Validity Information

1. Description of Equipment or Material: 3 metal plates, 2-I beams from reactor room — Identification Number (crate or tool): N/A

2. Reason for Request: Recycle

3. Last Known Location of Equipment or Material (brief history): Plates and I beams were used to retrieve reactor components and for loading of bins

4. Transfer Requested by: Name: [redacted]

Section B: Radiological Assessment

To the best of your knowledge, has the equipment or material at any time been:

Contaminated? ☐ Yes ☒ No
Used or stored in a contaminated area? ☒ Yes ☐ No
Been through a decontamination process? ☐ Yes ☒ No

Loose Contamination	Survey Instrument	Background (cpm)	Large Area Masslinn Contamination above background?	If Yes, 100 cm² sample: Survey Instrument	Net Counts = Gross-Background (cpm)
β/γ emitters	2929	55	☐ Yes ☒ No	–	0
α emitters	2929	0	☐ Yes ☒ No	–	0

Fixed	Survey Instrument	Background (cpm)	NET Counts = Gross-Background (cpm)
β/γ emitters	4393	160	0
α emitters	4393	0	0

Unconditional Release Form

NU-910011-FM 001 Rev. 4

Ref. Procedure NU-910011-PRO-002

Section C: Radiological Details

Was any additional monitoring required such as tritium samples, gamma spectroscopy or liquid scintillation counting?	☐ Yes	☒ No	
If Yes, give details or attach results of analyses:			
Were all of the exterior and interior surfaces monitored?	☒ Yes	☐ No	
If No, provide details:			
For items fit in the Small Article Monitor (SAM)			
For item(s) placed in SAM, did it "Clear" the SAM?	☐ Yes	☐ No	If No, provide details: n/a (no SAM on site)
For items do not fit in the Small Article Monitor (SAM)			
Did large area Massion(s) cleared the SAM?	☐ Yes	☐ No	If No, provide details: n/a (no SAM on site)
Was the gamma dose rate measured below background?	☒ Yes	☐ No	If No, provide details:
Group 1 Radiation Protection Surveyor:	[redacted]		
Once surveys are completed by Radiation Protection Surveyor, Equipment or Material must be removed from Radiation Area immediately after the item(s) have been approved for removal.			Date:

Section D: Health Physicist and Radiation Protection Program Authority Approval

Table 1: Maximum Surveyed Values for Unrestricted Use

Radionuclide	Surface Activity (Bq/cm²)	
β/γ emitters	Total	ø
	Removable	ø
α emitters	Total	ø
	Removable	ø

Table 2: Maximum Values for Unrestricted Use

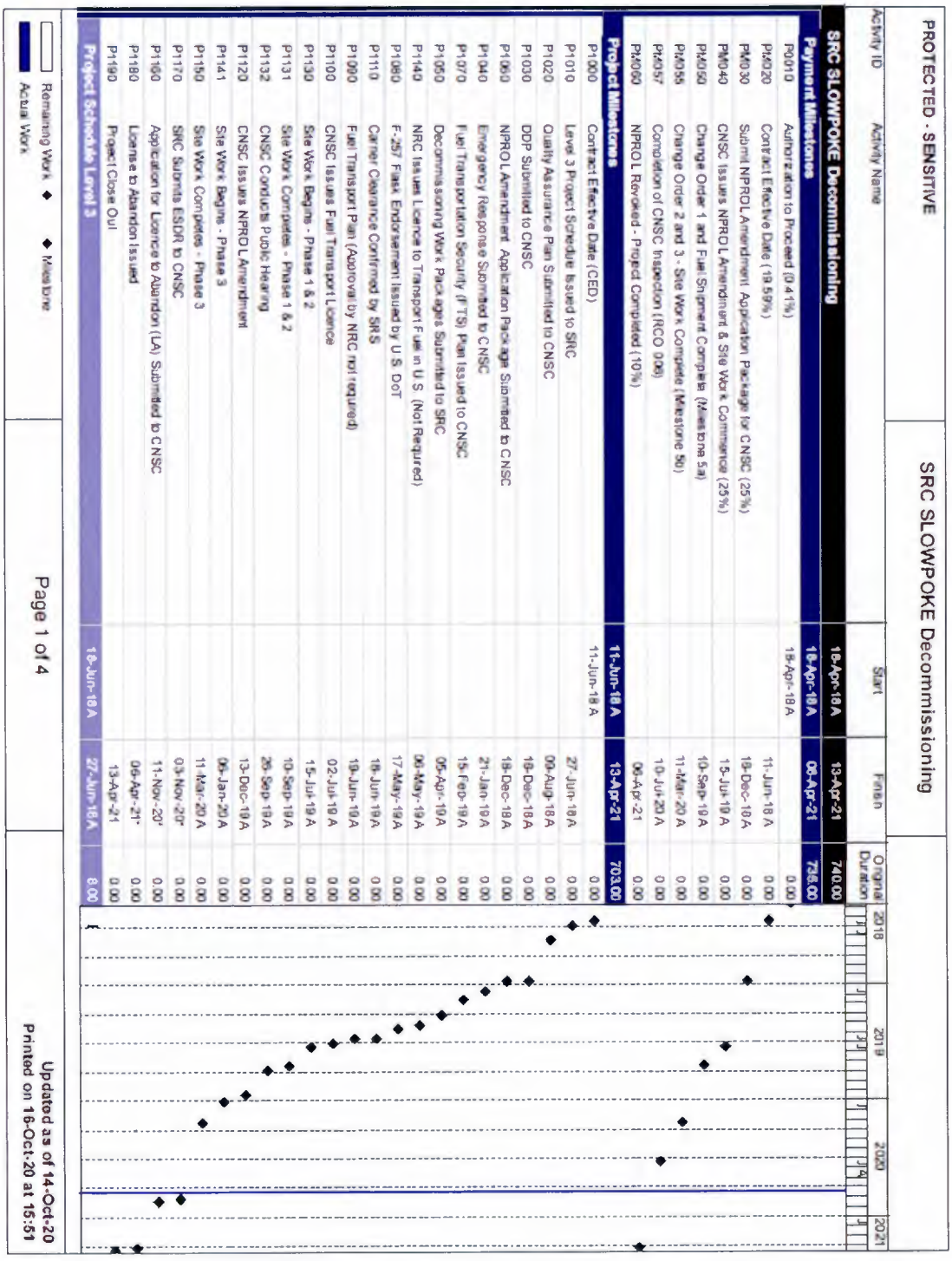
Radionuclide	Maximum Value (Bq/cm²)	
	Total	Removable
β/γ emitters	30	0.3
α emitters	0.3	0.03

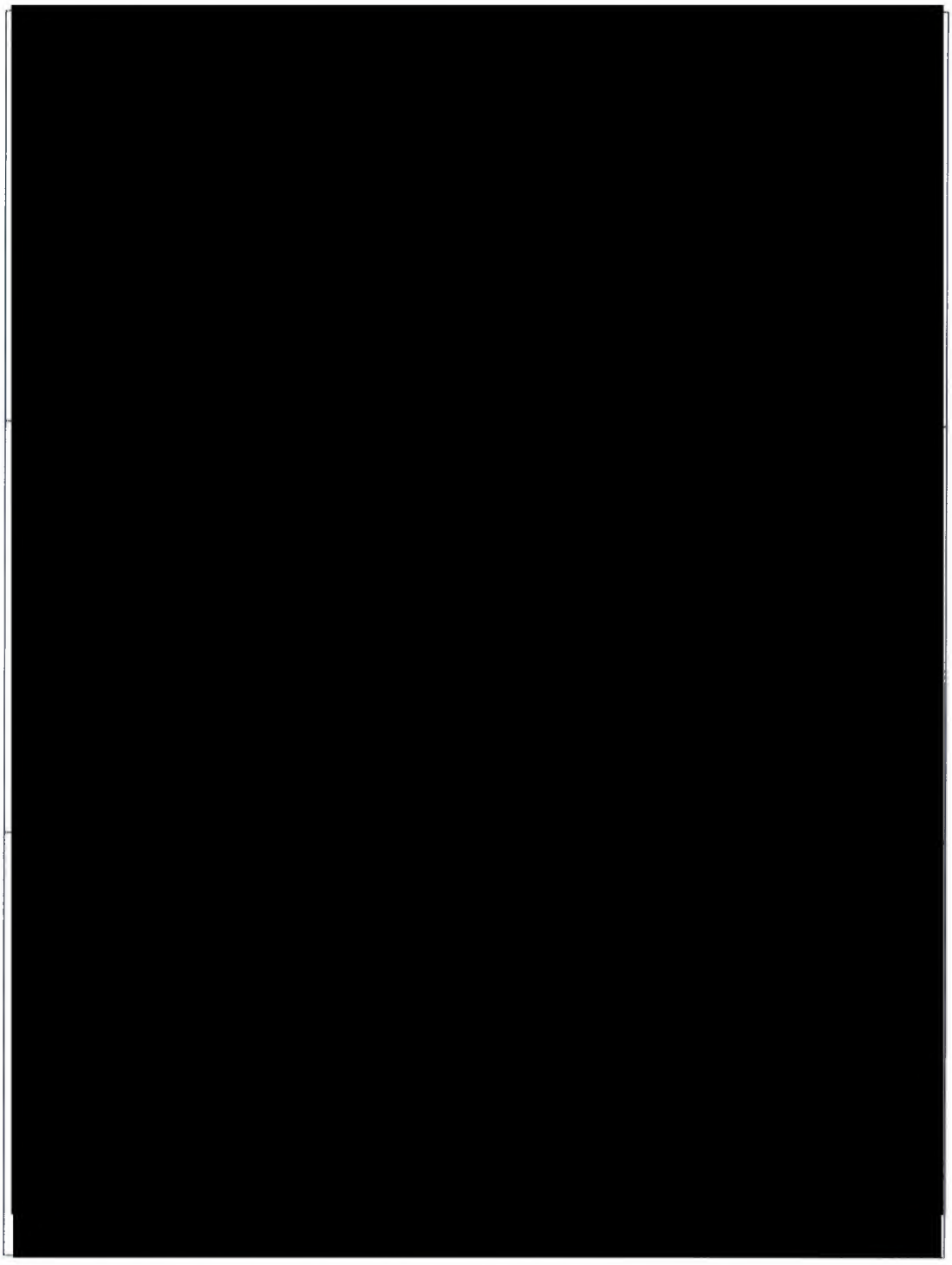
Are the results from Table 1 Less than the values given in Table 2?	☒ Yes	Removal of item is approved
	☐ No	Removal of item is rejected; notify owner from Section A
Candu Health Physicist or SRC Radiation Safety Officer	[redacted]	
Radiation Protection Program Authority		

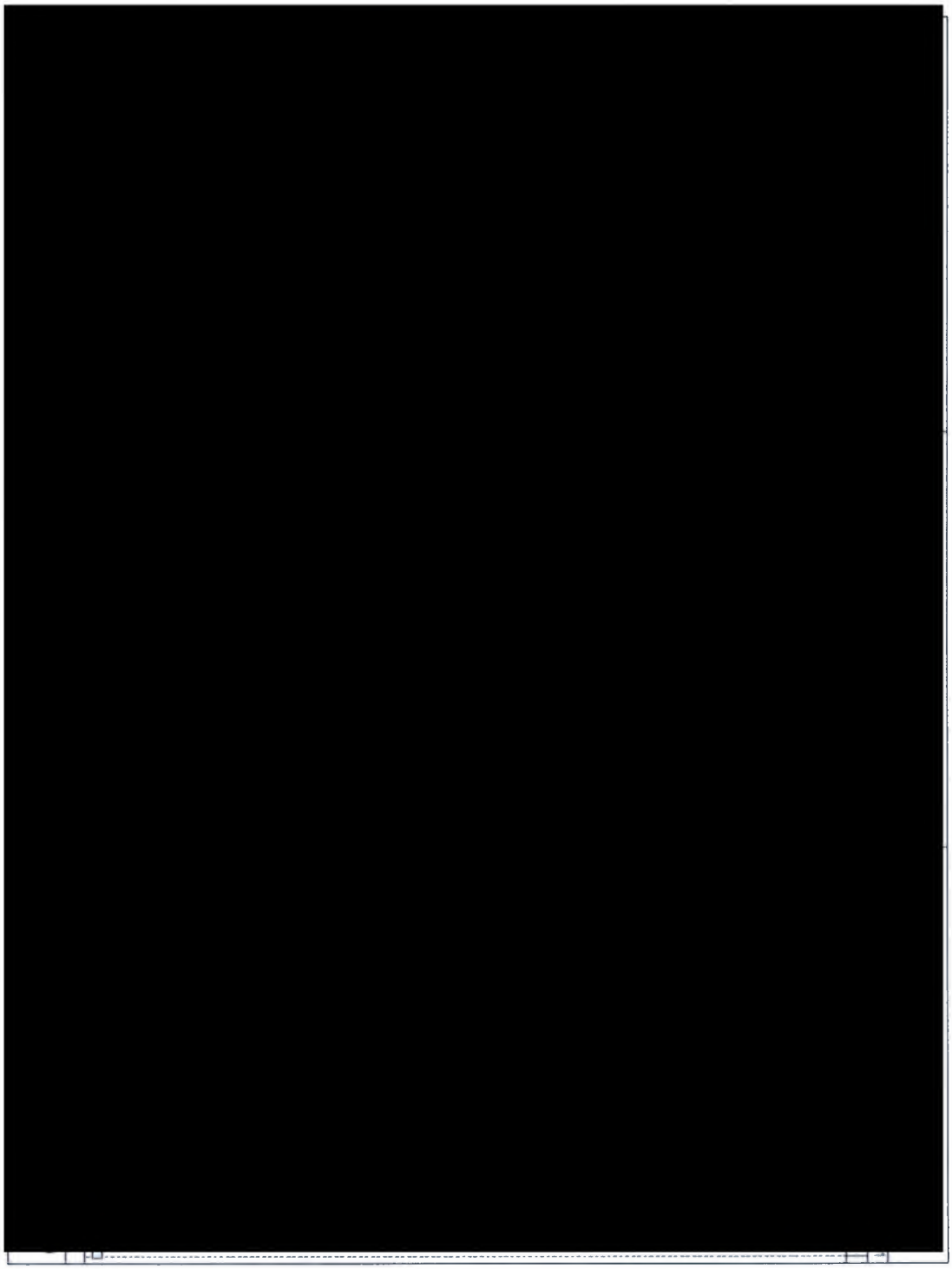
Section E: Facility Manager Approval

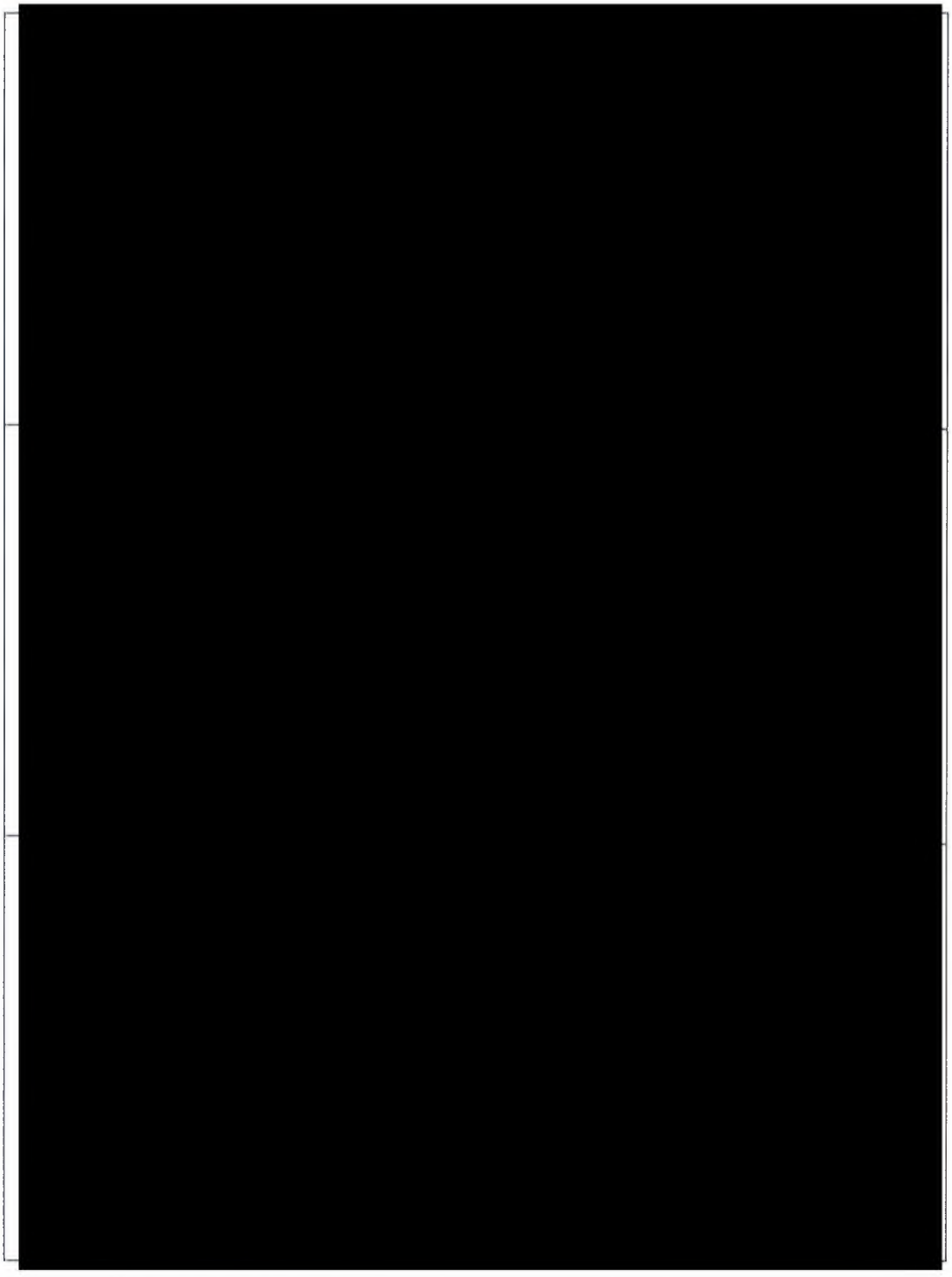
Facility Manager:	[redacted]

Appendix K PROJECT SCHEDULE

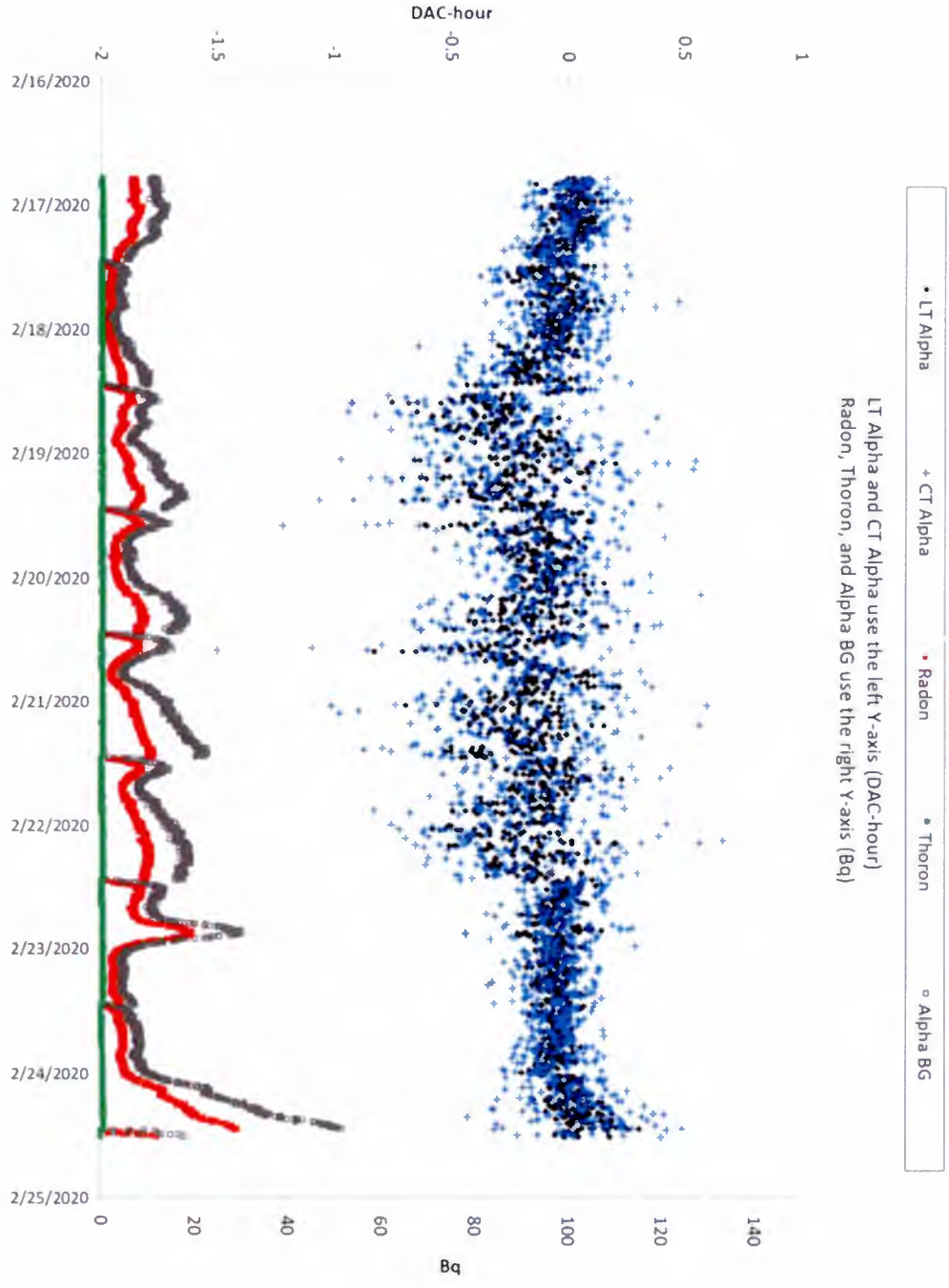








Appendix L ICAM REPORT



Appendix M
DOSE REPORT

204

Occupational Radiation Exposure Report
Rapport sur l'exposition aux rayonnements en milieu de travail

REPORT NO: / N° DE RAPPORT : 18351 ACCOUNT NO: / N° DE COMPTE : C2349 LOCATION: / EMPLACEMENT : 00000SPA

C/S:A

REPORT TO:
DESTINATAIRE DU RAPPORT:
SASKATCHEWAN RESEARCH COUNCIL
GLORIA DRADER - SPARES
125-15 INNOVATION BLVD

SASKATOON, SK S7N 2X8
CANADA

DATE BADGES RECEIVED / DATE DE RÉCEPTION DES DOSIMÈTRES :	07/05/2020
DATE BADGES REPORTED / DATE DU RAPPORT SUR LES DOSIMÈTRES :	JUN 4, 2020
PAGE / PAGE: 2	OF: / DE: 2
LICENSE NO: / N° DE PERMIS:	
PURCHASE ORDER NO: / N° DE BON D'ACHAT:	

NOTIFICATION LEVELS / NIVEAUX D'AVIS		
DEEP / PROFOND	SHALLOW / SUPERFICIEL	EXTREMITY / EXTRÉMITÉ
4.00	10.00	50.00

SHIP TO:
ADRESSE D'EXPÉDITION:
SASKATCHEWAN RESEARCH COUNCIL
GLORIA DRADER - SPARES
125-15 INNOVATION BLVD

SASKATOON, SK S7N 2X8
CANADA

WEARER IDENTIFICATION / IDENTIFICATION DU PORTEUR (columns 1–14); DOSE EQUIVALENT IN MILLISIEVERTS FOR PERIODS INDICATED BELOW / ÉQUIVALENT DE DOSE EN MILLISIEVERTS POUR LES PÉRIODES INDIQUÉES CI-DESSOUS (columns 15–31): MONITORING PERIOD / PÉRIODE DE SURVEILLANCE (15–16); CURRENT / ACTUEL (17–21); QUARTER TO DATE / DEPUIS LE DÉBUT DU TRIMESTRE (22–24); YEAR TO DATE / DEPUIS LE DÉBUT DE L'ANNÉE (25–28); LIFETIME TO DATE / DEPUIS LE DÉBUT DE LA VIE (29–31)

1 WEARER NUMBER / NUMÉRO DU PORTEUR	2 SLOT NUMBER / NUMÉRO DE LOT	3 PROCESS CONTROL NUMBER / NUMÉRO DE SUIVI DU PROCESSUS	4 SURNAME OR OTHER DESIGNATION / NOM DE FAMILLE OU AUTRE APPELLATION	5 FI / PP	6 MI / SP	7 ID TYPE / TYPE D'ID	8 SIN / ID / NIPID	9 BIRTH DATE / DATE DE NAISSANCE	10 SEX / SEXE	11 BADGE TYPE / TYPE DE DOSIMÈTRE	12 BODY REGION / ZONE CORPORELLE	13 BODY PART / PARTIE DU CORPS	14 SERVICE / SERVICE	15 FIRST DAY / PREMIER JOUR	16 LAST DAY / DERNIER JOUR	17 Hp(10) DEEP (EDE) / Hp(10) PROFOND (EDP)	18 Hp(3) EYE (LDE) / Hp(3) ŒIL (EDC)	19 Hp(0.07) SHALL. (SDE) / Hp(0.07) SUP. (EDS)	20 NEUT. / NEUT.	21 PROC NOTES / REM. TRAIT.	22 Hp(10) DEEP (EDE) / Hp(10) PROFOND (EDP)	23 Hp(3) EYE (LDE) / Hp(3) ŒIL (EDC)	24 Hp(0.07) SHALL. (SDE) / Hp(0.07) SUP. (EDS)	25 Hp(10) DEEP (EDE) / Hp(10) PROFOND (EDP)	26 Hp(3) EYE (LDE) / Hp(3) ŒIL (EDC)	27 Hp(0.07) SHALL. (SDE) / Hp(0.07) SUP. (EDS)	28 NO. RPTS / NBR. RAPP.	29 Hp(10) DEEP (EDE) / Hp(10) PROFOND (EDP)	30 DOSE HISTORY ADJUSTMENTS / REDRESSEMENTS DE L'HISTORIQUE DES DOSES	31 INCEPTION DATE / DATE DU DÉBUT LIFETIME TOTAL À VIE
390		0245763	SPARE							16	WB		Q	01/01/2020	21/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
391		0245763	SPARE							16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
392		0245763	SPARE							16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
393		0245763	SPARE							16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
394		0245763	SPARE							16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
395		0245763	SPARE [redacted]							16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
396		0245763	SPARE [redacted]							16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
397		0245763	SPARE [redacted]							16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/04/2019
170		0245763	SPARE [redacted]						M	16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/01/2015
179		0245763	SPARE [redacted]						M	16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/01/2015
171		0245763	SPARE [redacted]						M	16	WB		Q	01/01/2020	31/03/2020					D6	0	0	0	0	0	0	1	0		01/01/2015
172		0245763	SPARE [redacted]						M	16	WB		Q	01/01/2020	31/03/2020	0.16	0.16	0.16	-		0.16	0.16	0.16	0.16	0.16	0.16	1	0.16		01/01/2015
173		0245763	SPARE [redacted]						M	16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/31/2015
174		0245763	SPARE [redacted]						M	16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/01/2015
175		0245763	SPARE [redacted]						M	16	WB		Q	01/01/2020	31/03/2020	-	-	-	-		0	0	0	0	0	0	1	0		01/01/2015
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SEE REVERSE SIDE FOR COMPLETE REPORT DETAILS BY COLUMN NUMBER
VOIR AU VERSO LE DÉTAIL DU CONTENU DU RAPPORT PAR NUMÉRO DE COLONNES
IT IS RECOMMENDED THAT YOU KEEP THIS REPORT FOR YOUR RECORDS
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MIRION TECHNOLOGIES

Mirion Technologies (GDS) Inc.

Mirion Technologies (GDS) Inc.
2652, avenue McGaw, Irvine (CA) 92614
US/ Canada : (800) 251-3331
États-Unis/Canada : (800) 251-3331
Worldwide: 949-419-1000

REPORTS APPROVED BY NVLAP SIGNATORY REP 4047_INT 10/01/07
RAPPORTS APPROUVÉS PAR LE SIGNATAIRE DU NVLAP REP 4047_INT 10/01/07

214

...pational Radiation Exposure Report
...pport sur l'exposition aux rayonnements en milieu de travail

C/S:A

REPORT NO: / N° DE RAPPORT: 17932 ACCOUNT NO: / N° DE COMPTE: C2349 LOCATION: / EMPLACEMENT: 00000SPA

REPORT TO:
DESTINATAIRE DU RAPPORT:
SASKATCHEWAN RESEARCH COUNCIL
GLORIA DRADER - SPARES
125-15 INNOVATION BLVD

SASKATOON, SK S7N 2X8
CANADA

DATE BADGES RECEIVED / DATE DE RÉCEPTION DES DOSIMÈTRES	21/10/2019
DATE BADGES REPORTED / DATE DU RAPPORT SUR LES DOSIMÈTRES	NOV 4, 2019
PAGE: / PAGE:	1 OF / DE 2
LICENSE NO. / N° DE PERMIS	
PURCHASE ORDER NO. / N° DE BON D'ACHAT	

NOTIFICATION LEVELS / NIVEAUX D'AVIS		
DEEP / PROFOND	SHALLOW / SUPERFICIEL	EXTREMITY / EXTRÉMITÉ
4.00	10.00	50.00

SHIP TO:
ADRESSE D'EXPÉDITION:
SASKATCHEWAN RESEARCH COUNCIL
GLORIA DRADER - SPARES
125-15 INNOVATION BLVD

SASKATOON, SK S7N 2X8
CANADA

WEARER IDENTIFICATION / IDENTIFICATION DU PORTEUR — DOSE EQUIVALENT IN MILLISIEVERTS FOR PERIODS INDICATED BELOW / ÉQUIVALENT DE DOSE EN MILLISIEVERTS POUR LES PÉRIODES INDIQUÉES CI-DESSOUS

1 Wearer number / Numéro du porteur	2 Slot number / Numéro de lot	3 Program control number / Numéro de suivi du programme	Surname or other designation / Nom de famille ou autre appellation	F.I. / P.P. · M.I. / S.P. · ID type / Type d'ID	MN I.D. / MP-ID	Birth date / Date de naissance	10 Sex / Sexe	11 Badge type / Type de dosimètre	12 Body region / Zone corporelle	13 Body part / Partie du corps	14 Service	15 First day / Premier jour	16 Last day / Dernier jour	17 Current: Deep (DDE) / Profond (EDP)	18 Current: Eye (LDE) / Cristallin (EDC)	19 Current: Shallow / Superficiel	20 Neut	21 Proc notes / Rem trait	22 Quarter to date: Deep / Profond	23 Quarter to date: Eye / Cristallin	24 Quarter to date: Shallow / Superficiel	25 Year to date: Deep / Profond	26 Year to date: Eye / Cristallin	27 Year to date: Shallow / Superficiel	28 No. rpts / Nbre rapp	29 Lifetime to date: Deep / Profond	30 Dose history / Historique des doses	31 Inception date / Date du début
		0244080	CONTROL					16			Q	01/07/2019	30/09/2019															
198		0244080	SPARE [redacted]				M	16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	3	0		01/07/2015
199		0244080	SPARE				M	16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	3	0		01/07/2015
200		0244080	SPARE				M	16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	3	0		01/07/2015
201		0244080	SPARE				M	16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	3	0		01/07/2015
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203		0244080	SPARE				M	16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	1	0		01/07/2015
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205		0244080	SPARE				M	16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	1	0		01/07/2015
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389		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
390		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
391		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
392		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
393		0244080	SPARE [redacted]					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
394		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	1	0		01/04/2019
395		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
396		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
397		0244080	SPARE					16	WB		Q	01/07/2019	30/09/2019	.	.	.	.		0	0	0	0	0	0	2	0		01/04/2019
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SEE REVERSE SIDE FOR COMPLETE REPORT DETAILS BY COLUMN NUMBER
VOIR AU VERSO LE DÉTAIL DU CONTENU DU RAPPORT PAR NUMÉRO DE COLONNES
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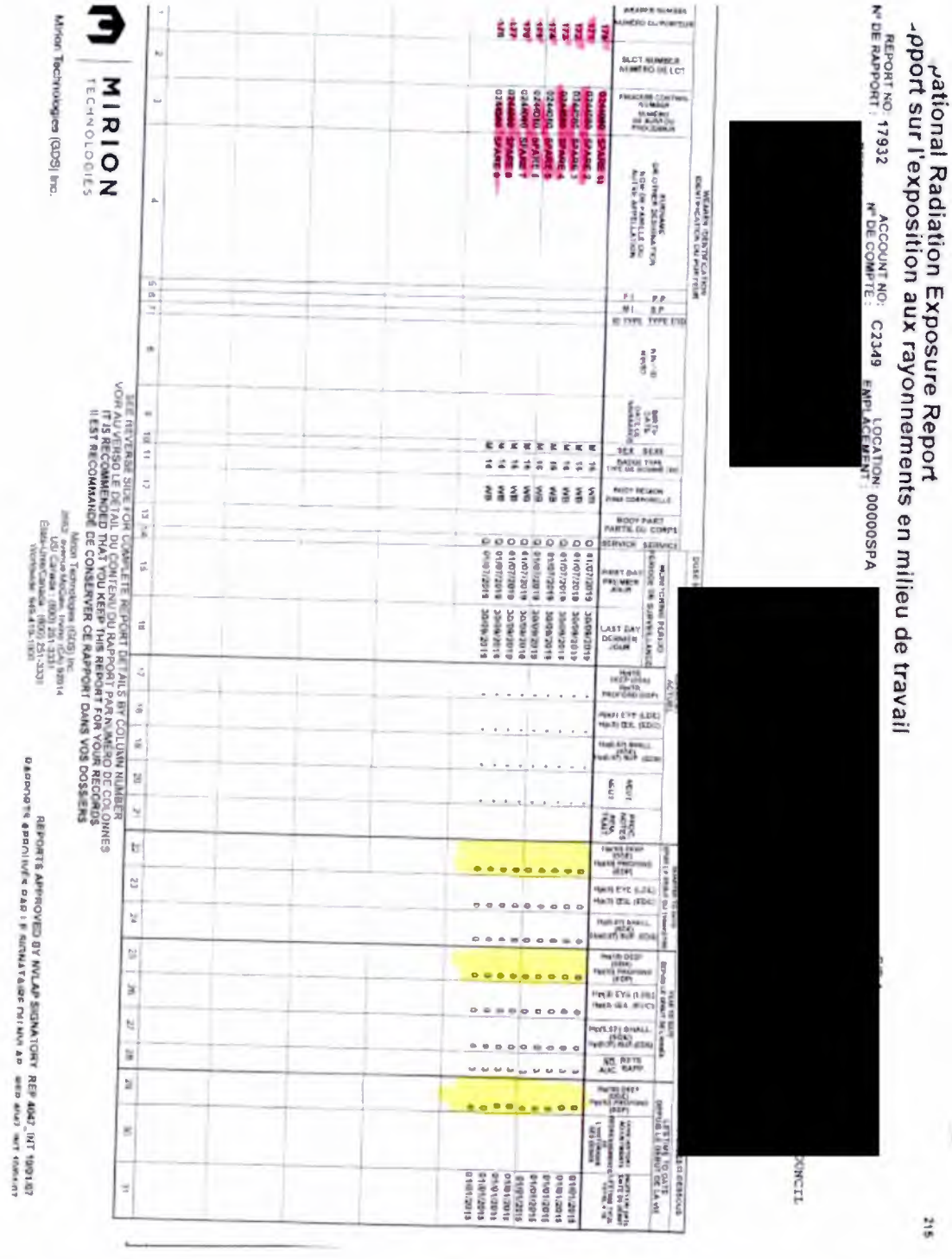
REPORTS APPROVED BY NVLAP SIGNATORY REP 4047_INT 10/01/07
RAPPORTS APPROUVÉS PAR LE SIGNATAIRE DU NVLAP REP 4047_INT 10/01/07



Appendix N PROJECT BUDGET UPDATE SRCSF

Cost Element	Budget
Labour	$2,935,000
Materials	$763,000
Equipment	$178,000
Waste Management	$850,000
Environmental Assessment	$56,400
Monitoring	$178,000
Administration (e.g., training, safety, project management, government and public liaison	$1,066,000
Energy	$5,926
Taxes	$285,500
Regulatory agency fees	$0
Contingency plans	$348,000

The actual project cost is less than the budgeted cost.