Orano Canada Inc.

Radiation Protection Plan

Exploration Department

Kiggavik Project

Version 9

November 2019

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History of Revisions

Version	Revision	Date	Details of Revision
1	0	March 2007	Original submission
2	0	October 2007	Update to reflect changes in field activities/capabilities and goals of continual improvement
3	0	August 2008	Update to reflect changes in field activities/capabilities and goals of continual improvement
4	0	January 2009	Update to reflect changes in field activities/capabilities and goals of continual improvement
5	0	January 2010	Update to reflect changes in field activities/capabilities and goals of continual improvement
5	1	May 2011	Updated to reflect changes in personnel position titles.
6	0	June 2012	Updated to reflect changes in personnel titles and positions. Grammatical corrections.
6	1	May 2013	Updated to reflect changes in personnel titles
6	2	May 2014	Updated to align with the Exploration IMS Manual
6	3	January 2015	Improved formatting and minor edits for clarity
7	0	January 2017	Updated to reflect transition to Care and Maintenance phase
8	0	January 2019	Updated to reflect Corporate name change and title changes
9	0	November 2019	Updated to reflect personnel change

Table of Contents

Acronyms and Abbreviations

Term	Definition
ALARA	As Low as Reasonably Achievable
Orano	Orano Canada Inc.
CNSC	Canadian Nuclear Safety Commission
IMS	Integrated Management System
NORM	Naturally Occurring Radioactive Materials
SHEQ	Safety Health Environment and Quality
TDG	Transportation of Dangerous Goods
WSCC	Workers' Safety and Compensation Commission

1 Introduction

The Kiggavik Project is currently in a care and maintenance phase. The Radiation Protection Plan will be kept in this state, but is considered not applicable during the care and maintenance phase. This plan will be updated prior to a change in project phase to reflect the most recent information.

This Orano Canada Inc. (Orano) Radiation Protection Plan will be in effect for the duration of the Kiggavik Project located about 80 km west of Baker Lake. The Radiation Protection Program has been prepared to meet the requirements of the Nunavut Occupational Health and Safety Regulations, Mineral Exploration best practices, and the Orano Corporate Integrated Management System (IMS). Although current activities are not regulated by the Canadian Nuclear Safety Commission (CNSC), the Radiation Protection Plan is designed in accordance with the CNSC Regulations.

The Radiation Protection Plan includes the following administrative elements:

- Program documentation
- Training
- Designation of Occupational Workers
- Dose limits and dose levels
- Obligations of Occupational Workers
- Pregnant Occupational Workers

The Radiation Protection Plan includes the following program elements:

- Exposure As Low as Reasonably Achievable (ALARA)
- Radiological monitoring
- Dosimetry monitoring
- Management of radioactive materials
- Shipping of radioactive materials
- Site abandonment and restoration
- Emergency response

1.1 Revisions to Plan

During the active exploration phase, the Kiggavik Radiation Protection Plan is reviewed regularly and is updated as required to keep the information current and consistent with regulatory and procedural changes. A History of Revisions can be found at the beginning of this plan.

1.2 Responsibilities

The Manager – New Projects is responsible to ensure that this plan is implemented. Implementation may be completed by:

- Project Geologist
- Coordinator, SHEQ (Safety, Health, Environment and Quality) Exploration
- Or designate

The Vice President, Exploration is ultimately responsible for any activity being carried out by Kiggavik Project personnel.

2 Administrative Elements

2.1 Program Documentation

The Radiation Protection Program is comprised of a series of key documents, which include the Routine Radiological Monitoring Schedule and procedures for Shipping Radioactive Material. The Radiation Protection Program includes comprehensive work instructions for worker dosimetry, radiological monitoring and the safe handling of radioactive materials.

To ensure occupational exposures are managed in accordance with the ALARA principle, radiological parameters are monitored against defined Action and Administrative levels. The Action and Administrative levels define values of radiological parameters above which intervention may be required and the corresponding mitigative measures to be followed.

2.2 Training

Orano provides necessary training to all its employees and contractors to ensure worker safety and protection of the environment during exploration activities. The training programs provided are designed to meet the requirements of the CNSC *Uranium Mines and Mills Regulations,* Workers' Safety and Compensation Commission (WSCC) requirements under the *Mine Health and Safety Act* and *Regulations, ISO 14001:2015 and OHSAS 18001:2007.*

All new employees, including contractors, receive appropriate radiation protection training prior to beginning work. This includes instruction on the origins of ionizing radiation, the types of radiation, health risks, and the principles of radiation safety, protection and regulatory compliance. Training also includes the safe handling, management and disposition of radioactive materials such as drill muds, cuttings, and radioactive core. Training may be in the form of a PowerPoint presentation or interactive display.

All visitors at the Kiggavik site for more than 72 hours, or who will be left without an escort will receive radiation protection training. Visitors who have not received training must be escorted on site at all times.

Personnel supervising the shipment of radioactive materials must possess a valid TDG certificate in accordance with Transport Canada *Transportation of Dangerous Goods Regulations*. If radioactive materials are to be transported by aircraft, TDG training is to include the necessary aviation components for Class 7 materials. If contractors have their own training program they must submit their documentation. Support personnel providing assistance during preparation and shipment of radioactive material do not require TDG training as long as they are working under the direct supervision of trained individuals.

Orano field personnel and contractors establishing temporary work camps and/or handle fuel, lubricants and radioactive material require spill response training. If the contractors have their own training program they

must submit evidence of the training program as per *EXP-820, Training, Awareness and Competence*. Training for Orano employees is provided in accordance with the Spill Contingency Plan. The Spill Contingency Plan is provided to Contractors, and should the contractors not have an acceptable training program in place, Orano will supply the training material and/or provide the training as required.

2.3 Occupational Workers

Workers exposed to Naturally Occurring Radioactive Materials (NORM) as a result of their regular duties are designated as occupationally exposed workers for exploration projects. The designation of a person as an Occupational (NORM) Worker is conducted in accordance with *EXP-740-01, Occupational Worker Assessment*.

2.3.1 Dose Limits and Dose Levels

An Occupational Worker is informed of the risks associated with radiation to which the worker may be exposed in the course of their work, and the applicable dose limits, during radiation protection training. Occupational Workers are limited to a maximum annual effective dose of 50 mSv in a one year dosimetry period, not to exceed 100 mSv in a five year dosimetry period (or 20 mSv/year over five years). Administrative control levels have been defined in *EXP-740-03, DRD Usage/Action and Administrative Levels for Gamma Radiation* to limit dose. Administrative levels are set to less than 0.01 mSv per day and less than 0.05 mSv per week. An Action level is set to 5 mSv per quarter. In the event of an emergency and the consequent immediate and urgent remedial work, the effective dose shall not exceed 500 mSv. A pregnant Occupational Worker is limited to 4 mSv for the balance of the pregnancy once notification has been made to the employer. The relaxation of normal dose limits in emergency situations does not apply to pregnant workers. Occupational Workers are informed of their radiation dose levels in writing, annually.

2.3.2 Obligations of Occupational Workers

Orano exploration workers deemed to be Occupational Workers are obligated to provide information required to identify them to the National Dose Registry (i.e. given name, surname, previous surname, SIN, gender, date and province and country of birth) by completing *EXP-740-01-01, Employee Information Form*.

2.3.3 Pregnant Occupational Workers

Occupational Workers are informed during training of the risks associated with radiation to which the worker may be exposed in the course of their work during orientation training. Occupational Workers are informed of their obligation to inform their employer when they become pregnant and are informed of the applicable effective dose limit of 4 mSv for the balance of the pregnancy.

3 Program Elements

3.1 ALARA

Radiation protection has its foundation in the As Low As Reasonably Achievable (ALARA) principle. The commitment to maintain worker doses ALARA is established through Orano's Radiation Protection policy. This policy is established by senior management and is approved by the President and Chief Executive Officer. This plan and the Radiation Protection Procedures follow the ALARA principle.

3.2 Radiological Monitoring

Routine radiological monitoring consists of dosimetry monitoring and contamination control. Dosimetry monitoring is conducted to determine and document worker exposures to radiological components which include gamma radiation, radon progeny (RnP) and long-lived radioactive dusts (LLRD). Contamination control measures are in place to minimize the spread of radioactive materials into unintended locations. Radiological monitoring is conducted in accordance with the *EXP-740, Routine Radiological Monitoring Schedule* and associated work instructions.

3.3 Management of Radioactive Materials

3.3.1 Radioisotopes

Nuclear materials and radiation devices are used for exploration and instrument calibration. The possession, use, storage, and disposal of nuclear materials and radiation devices are carried out in strict accordance with CNSC *Nuclear Substances and Radiation Devices Regulations* and *EXP-752-02 Safe Handling and Use of Exploration Sources*. The radioisotopes are licensed under the McClean Lake Operating Licence.

3.3.2 Core Storage

In the absence of territorial mineral exploration regulations, the storage and disposal of radioactive materials arising from project activities are to be carried out in accordance with Saskatchewan *Mineral Industry Environmental Protection Regulations, 1996*.

Permanent and long-term storage areas of radioactive material must be located at least 30 metres from the main camp and at least 100 metres from the high water mark of all water bodies.

As required by Crown Indigenous Relations and Northern Affairs Canada (CIRNAC), the gamma radiation dose rates at 1 m from the surface of a storage area should be reduced to 1 µSv/h and in no instances exceed 2.5 µSv/h. Should the levels be exceeded, the Land Use Inspector must be contacted. Radioactive storage areas must be appropriately labelled with radiation warning signs and fenced.

3.3.3 Disposition of Drill Cuttings

During drilling activities, drill mud solids or cuttings in non-mineralized zones are deposited on the ground, in a selected natural low-lying depression. This natural depression must be located, at a minimum, 31 m beyond the ordinary high level water mark of any nearby water bodies, and where direct flow into the water body is not possible. A radiological survey is conducted before and after drilling to ensure elevated readings are not occurring. If necessary, depressions are backfilled and contoured, as much as possible, back to natural pre-existing conditions.

When mineralized core is intercepted, drill mud and cuttings are collected in appropriate containers and categorized as radioactive through appropriate radiation measurements. Drill mud or cuttings with uranium content greater than 0.05% will be collected and stored at the radioactive storage compound with an appropriate containment system in place. Down hole disposal of cuttings is not often practical at Kiggavik. Drill holes are sealed by cementing/grouting the upper 30 m of bedrock or the entire depth of the hole, depending on the presence of mineralization or otherwise approved of by the appropriate regulatory agencies in writing.

3.4 Shipping of Radioactive Materials

Shipping and receiving radioactive material is carried out in accordance with the CNSC Packaging and Transport of Nuclear Substances Regulations, the Transport Canada Transportation of Dangerous Goods Regulations, and the Orano EXP-752 Shipping Radioactive Material procedure and work instructions. Kiggavik personnel trained in the International Air Transport Association (IATA) Dangerous Goods Regulations complete the packaging and shipment of radioactive materials.

3.5 Site Abandonment and Restoration

Site abandonment and restoration is carried out in accordance with the Abandonment and Restoration Plan. Gamma radiation surveys are conducted at each site prior to drilling and prior to final abandonment. Contaminated soil or cuttings are collected in appropriate containers and stored in the radioactive storage compound for future handling, which may include transfer to an operating mine site. Drill sites are cleaned to ensure that the gamma dose rate at a height of 1 metre from surface is less than 1 μSv/h above ambient background.

Materials and equipment leaving the Kiggavik site are monitored for contamination in accordance with the *EXP-740, Routine Radiological Monitoring Schedule.* Materials or equipment that cannot be decontaminated to meet unrestricted release criteria are either stored in the radioactive storage compound or shipped to a licensed facility such as the McClean Lake Operation in accordance with the CNSC *Packaging and Transport of Nuclear Substances Regulations*, the Transport Canada *Transportation of Dangerous Goods Regulations,* and the Orano *EXP-752 Shipping Radioactive Materials* procedure and work instructions.

3.6 Emergency Response

Emergencies could include such incidents as spills, lost or damaged radioactive sources and transportation incidents. Emergencies involving radioactive materials are responded to in accordance with the Emergency Response Manual. In the event of an incident involving radioactive material, immediate actions are taken to minimize worker exposures. In the event of any incident involving radioactive material, the Coordinator, SHEQ Exploration or designate is notified immediately, and the incident is reported to the Vice President, Exploration within 24 hours and appropriately investigated. Emergency response is co-ordinated through the corporate Emergency Response and Assistance Plan (ERAP) that details the organization, responsibilities, procedures and mitigative measures to be followed in the event of an offsite emergency involving the transport of radioactive material. Environmental emergencies are secondary to the safety of personnel. In the event of any incident involving a radiation source, federal and territorial agencies are notified in accordance with applicable regulations.

The uncontrolled or accidental release of any radioactive materials including drill mud solids and cuttings is considered a spill. Spills of radioactive material are appropriately reported and responded to in accordance with the Spill Contingency Plan. In the event of a spill, radioactive materials are collected and necessary site remediation undertaken to meet the site abandonment criteria of less than 1 μSv/h above background at a height of 1 metre. In accordance with the Spill Contingency Plan, in the event of a spill involving radioactive material, actions are taken to contain the spill, limit the spread of contamination and to control access to the spill area. Appropriate radiological and dosimetry monitoring is performed to ensure worker doses remain ALARA. Mitigation measures to be followed include recovery of radioactive material and decontamination of affected areas. Material collected during the clean-up is stored in appropriate containers in the radioactive storage compound for future handling.

In the event a radiation source is damaged, it is removed from service immediately and stored in a secure location. The removal of a damaged source from site is coordinated with the Coordinator, SHEQ Exploration and the McClean Lake Operation Radiation Protection Group as per *EXP-752-02 Safe Handling and Use of Exploration Sources*. If at any time it appears that a radiation source has been lost, misplaced or stolen, the Project Geologist or designate, the Coordinator, SHEQ Exploration, the Vice President, Exploration, and the McClean Lake Radiation Protection Group are notified immediately.

4 References

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EXP-752 Shipping Radioactive Materials

EXP-752-02 Safe Handling and Use of Exploration Sources

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Workers' Safety and Compensation Commission. 2012. Nunavut Occupational Health and Safety Regulations. January 2012.