DECOMMISSIONING

- Many nuclear reactors constructed prior to the 1980s throughout the world will be coming to the end of their useful life in the coming decades.
- Nuclear decommissioning refers to the actions taken to retire a nuclear facility, location, or site permanently from service in a manner that provides for the health and safety of people and protects the environment. Decommissioning activities are subject to national policy requirements as well as a regulatory framework for safety.
- National policies on waste management and decommissioning often include decommissioning aspects that may influence the choice of a possible decommissioning strategy (immediate decommissioning, deferred decommissioning, and *in-situ* decommissioning) as well as timing, infrastructure, environmental, and socioeconomic impacts.
- In Canada, waste owners are responsible for the funding and organization for the decommissioning of their facilities, and for all applicable steps of waste management.
- As you read this discussion paper, please focus on and consider the following questions:

  1. What do you feel are important policy considerations that should influence the choice of decommissioning strategies by nuclear operators and should be considered as part of Canada's radioactive waste policy?

  2. In what ways should Canada's policy address the setting of end-state objectives for decommissioning?

Why is decommissioning important?

There are a large number of nuclear facilities that will retire from service in the near future in many countries, including Canada. Decommissioning activities result in various types and quantities of radioactive material, which may be considered as waste, or which may be recycled or reused. Consideration of appropriate strategies for its minimization and long-term management are important issues for decommissioning.

What is Nuclear Decommissioning?

Nuclear decommissioning is the last stage in the lifecycle of a facility, and refers to the administrative and technical actions that are taken to allow for the removal of some or all of the regulatory controls from a

facility, location or site where nuclear substances are managed, used, possessed, or stored. Decommissioning actions are the procedures, processes, and work activities (e.g. storage with surveillance, decontamination, dismantling, or cleanup) that are taken to retire a facility, location, or site from service with due regard for the health and safety of people and the environment. Nuclear decommissioning may produce waste that is radioactive, hazardous, or both. The waste must be stored or disposed of in a manner that is safe and adheres to technical and scientific standards in order to protect the health and safety of workers, the public, and the environment for future generations.

Phases of Decommissioning

The Canadian Nuclear Safety Commission (CNSC) is Canada's nuclear regulator responsible for setting the regulatory requirements for safe operation, including of decommissioning activities. The CNSC's regulatory scheme requires that planning for decommissioning take place throughout the lifecycle of a nuclear facility or for the duration of a licensed activity.

In Canada, the typical phases of decommissioning include:

Phase 1 – Planning for decommissioning: this generally begins at the siting/design stage (or as early as possible) and continues through operation until preparation of the decommissioning phase.

Phase 2 – Preparation for decommissioning: this begins with the decision to cease operations or the conduct of activities, and includes activities for permanent shutdown or cessation and for the transition to a stable state for decommissioning.

Phase 3 – Execution of decommissioning: this phase begins when decommissioning activities commence, which may include decontamination, dismantling and/or clean-up, and any period of storage with surveillance, until the end state is achieved.

Phase 4 – Completion of decommissioning: this phase involves verifying that all decommissioning activities have been completed satisfactorily, that the final end-state has been reached, and that all documentation has been completed. Decommissioning ends with the release of the facility, location or site from regulatory control, or if unrestricted release cannot be achieved, institutional controls are required to be in place.

Decommissioning Strategies in Canada

The approach taken to decommissioning is highly dependent on the individual case. In Canada, three approaches to decommissioning can be considered, either individually or in combination.

Immediate (prompt) decommissioning – to decontaminate and dismantle without any planned delays.

Deferred decommissioning – to place the facility in a period of storage with surveillance followed by decontamination and dismantlement, or to conduct activities directed at placing certain buildings or facilities in a safe, secure interim end-state, followed by a period of storage with surveillance, and ultimately decontamination and dismantlement.

In-situ decommissioning – to place the facility, or portions of the facility, in a safe and secure condition, in which some or all of the radioactive contaminants are disposed of in place, which may result in the creation of a waste disposal site.

In cases where the end-state for *in-situ* decommissioning results in a waste disposal site, the project proponent is required to satisfy all regulatory requirements for a radioactive waste disposal facility and demonstrate safety via a safety case and safety assessment of the disposal facility.

In-situ decommissioning cannot be considered a reasonable decommissioning option for planned decommissioning of existing or future nuclear facilities and situations where removal is possible and practicable. *In-situ* decommissioning may be considered a solution only under exceptional circumstances (e.g. following a severe accident) or for legacy sites. Legacy sites specifically refer to research and demonstration facilities or facilities dating back to the birth of nuclear technologies in Canada for which decommissioning was not planned as part of the design. *In-situ* decommissioning for legacy sites is only considered viable in situations where: it can be carried out in a manner which is protective of workers, the public, and the environment; decommissioning was not planned as part of the design; the fuel has been removed; and the site will remain under institutional control for the period defined in the safety case.

In-situ decommissioning with a disposal end-state is an accepted practice for uranium mines and mills.

There are various factors that can influence the decommissioning strategy that nuclear facility operators choose to take when decommissioning and dismantling their nuclear facilities. These include timing, infrastructure, environmental and socioeconomic impacts, such as:

- national radioactive waste management policy and regulatory requirements of the *Nuclear Safety and Control Act* and other applicable laws;
- public engagement;
- potential impacts on Indigenous and/or treaty rights;
- Indigenous engagement;
- potential environmental impacts;
- end-state objectives and site redevelopment plans;
- potential revenues, costs, and available funding;
- other political, social, and economical considerations;
- the availability of waste management facilities and disposal capacity; and
- the availability of a fuel disposal facility if applicable.

In Canada, waste owners are responsible for the funding and organization for the decommissioning of their facilities, and for all applicable steps of waste management.

End-state objectives

A country's decommissioning policy may include target interim and the end-state objectives of decommissioning. This end-state generally falls into two categories: 1) unrestricted, where sites are released for unrestricted use, or 2) restricted, where there are some restrictions on the use of sites after decommissioning. Documentation and record keeping are key aspects to the decommissioned end-state. Preserving necessary information in the form of records ensures that any changes in decommissioning

plans or delays do not result in loss of knowledge about the facility. Thus, proper knowledge management plays an important role in planning and implementing decommissioning.

Waste minimization and decommissioning

Waste minimization is important for decommissioning, as the process may generate large quantities of waste that is radioactive, hazardous, or both, in various forms such as solids, liquids, and gases. Waste minimization approaches that can be utilized in decommissioning include decontamination, reuse, and recycling. A description of these approaches is provided in the Discussion Paper on Waste Minimization.

International Context

As an International Atomic Energy Agency (IAEA) member state Canada is committed to developing policies guided by international best practices and IAEA guidance. IAEA safety standards are consensus standards at an international level and provide guidance to Member States in developing their national framework; they are meant to be adapted to the national context of each Member State.[1]

The IAEA currently recognizes the decommissioning strategies of immediate dismantling and deferred dismantling, with *in-situ* decommissioning being an acceptable strategy under special circumstances. IAEA Safety Reports Series No. 50, *Decommissioning Strategies for Facilities Using Radioactive Material*, describes each decommissioning strategy, including advantages and disadvantages.

We need to know

1. What do you feel are important policy considerations that should influence the choice of decommissioning strategies by nuclear operators and should be considered as part of Canada's radioactive waste policy?

2. In what ways should Canada's policy address the setting of end-state objectives for decommissioning?

[1] Many of the IAEA safety standards, in particular those addressing aspects of safety in planning or design, are intended to apply primarily to new facilities and activities. The requirements established in the IAEA safety standards might not be fully met at some existing facilities that were built to earlier standards. The way in which IAEA safety standards are to be applied to such facilities is a decision for individual states.