DECOMMISSIONING PROCESS AT CANADIAN NUCLEAR LABORATORIES

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Abstract

Canadian Nuclear Laboratories (CNL) is Canada's premier nuclear science and technology organization and has nuclear sites located in different provinces within Canada. Some of the sites are under decommissioning and some have both operational and decommissioning activities. There are various challenges in conducting safe, compliant and efficient decommissioning activities in CNL's sites.

CNL developed and implemented a Decommissioning Process, which is based on fundamental principles of decommissioning and industry best practices with the goal of achieving excellence in decommissioning. The process applies to all decommissioning activities throughout the lifecycle of a facility until the final end-state is achieved, including any required environmental remediation of soils and affected lands at a site. The Decommissioning process is divided into six process steps, which align to the respective guidelines and standards, such as the Canadian Nuclear Safety Commission (CNSC) Guideline G219 and Canadian Standards Association (CSA) Standard N294. The process utilizes a graded approach based on the individual site or facility licences, regulatory requirements, level of risk and hazards present, and complexity of activities being performed using both engineering and management judgment to determine the extent of compliance required. This graded approach provides varying levels of rigor and formality when applying controls dependent on the level of hazards present, the potential environmental impact involved and the consequence of failure. This method ensures that the depth of details required and the magnitude of resources needed for decommissioning are aligned with each facility's programmatic importance, regulatory requirements and potential safety, health, security and environmental impacts.

This paper provides an overview of the CNL's Decommissioning Process and describes the process grading criteria that have been developed based on the complexity, event consequence, desired mitigation approach, and health, safety, security, and environmental requirements.

Keywords: Decommissioning Process, grading criteria, lifecycle

1. Introduction

Canadian Nuclear Laboratories (CNL) is Canada's premier nuclear science and technology organization and manages various nuclear sites located in different provinces within Canada. The sites include Chalk River laboratories (CRL), Douglas Point, Gentilly-1, Nuclear Power Demonstration and Whiteshell Laboratories. Some of the sites are under decommissioning and some have both operational and decommissioning activities. Because of the complexity of these site, there are challenges in conducting safe and efficient decommissioning activities in CNL's sites.

CNL developed and implemented a Decommissioning Process (DP), which applies to all decommissioning activities, throughout the lifecycle of a facility, performed by CNL. The process provides a standard structure for decommissioning activities and outlines the key process steps associated with the DP. The DP is applied using a graded approach for the decommissioning facilities, buildings, engineered structures and sites dependent on the licence requirements, complexity, level of risk and hazards present. The DP translates applicable external requirements and related internal requirements into process requirements appropriate for CNL, and assists CNL management in implementing those requirements.

During the process implementation period, close collaboration between the DP and other departments resulted in improved DP through feedback from the stakeholders and members of the Decommissioning Process Working Group. In addition, various improvement initiatives have been implemented. This paper provides an overview of the DP implemented at CNL.

2. Organizational structure

At CNL, a Decommissioning Process organization has been established, as shown in Figure 1, to support development and ensure a consistent application of the DP across all decommissioning activities at CNL sites. The Decommissioning Process Owner is the Director of Facilities Decommissioning (FD) and reports to the Vice President of Decommissioning and Waste Management (D&WM). The FD is responsible for the decommissioning of facilities at CRL, Douglas Point and Gentilly-1 prototype reactor sites, and currently consists of six branches to carry out all aspects of decommissioning at the selected sites.

The Decommissioning Process working Group (DPWG) is a cross section of management and CNL staff involved in decommissioning, environmental remediation and other interface processes. The DPWG supports the development and implementation of the DP, and provides a vehicle for improved information sharing and process improvement. The DPWG also services as a review panel for DP documents.

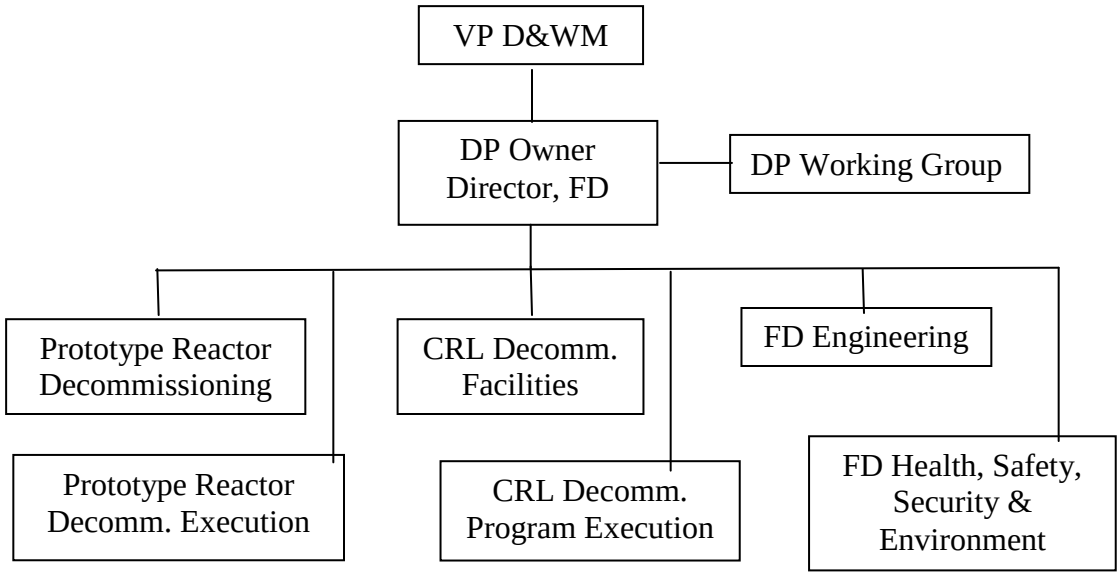

Figure 1 Position of Decommissioning Process in Decommissioning & Waste Management Unit

3. Process development and implementation

The Decommissioning Process is developed based on five key elements including 1) Policy; 2) Planning; 3) Implementation; 4) Checking and Corrective Action; and 5) Management Review.

During the DP development, the key objective of the DP is to ensure that CNL is in compliance with regulatory requirements and meets CRL Site License Conditions[1]. The activities carried out during this period were to execute the "quick win" while developing an understanding of the best practices and identifying opportunities for improvement. The key activities are described in the following subsections.

3.1 Standards and requirements

A DP overview document was created to describe the framework for decommissioning activities at CNL, including key processes, organizational structure and responsibilities. All the DP standards and requirements are detailed in the lower level documents.

The DP standards and requirements are mainly based on the Canadian Nuclear Safety Commission (CNSC) site licences, regulations and guidelines, Federal and Provincial acts, regulations and guidelines. The codes, standards and guidelines from International Atomic Energy Agency (IAEA) and Canadian Standards Association (CSA) applicable to CNL DP are also used for the development of the DP documents. As well, each CNL site aligns itself according to provincial and local/municipal requirements and programs.

The DP continues to undertake benchmarking comparisons with external organizations to understand issues and adopt best practices.

The DP documents are also in alignment with the internal nuclear compliance programs such as Radiation Protection, Environmental Protection, and Transportation of Dangerous Goods, etc. All applicable requirements from these programs, relating to decommissioning, have been incorporated into the DP.

In addition, a governing documentation index has been maintained in order to provide an easy guide of all regulations and requirements pertaining to DP. This document also provides a list of definitions used in the DP to ensure that consistent terminology is used across the organization.

3.2 Planning

A Comprehensive Preliminary Decommissioning Plan (CPDP) for CRL has been developed and is being maintained by the DP according to the CRL Site Licence requirements. This CPDP for decommissioning of the CRL site has been maintained to be consistent with the guidelines contained in the CNSC Regulatory Guide G-219 [2] and the Canadian Standards Association (CSA) Standards N294-09 [3].

The key objectives for the Decommissioning Process are:

- Providing a single, compliant, safe, and efficient decommissioning process applied to all decommissioning activities;
- Utilizing a standard graded risk-based approach to all activities to allow for grading from a licensed nuclear facility to a small non-nuclear engineered structure or area; and
- Providing procedures, forms and templates to the line organizations to streamline and standardize the execution of the process.

A DP Improvement Plan has been developed annually to improve DP through effective implementation of improvement initiatives. The annual improvement plans have been developed based on findings from audits, process review, input from stakeholders, information acquired from benchmarking and experience gained from the process development and implementation. The improvement plan identifies key elements in order to plan, implement and track associated activities essential to the success of the DP and to address identified gaps for the processes.

3.3 Process

The DP applies to all decommissioning activities throughout the lifecycle of a facility, until the final end-state is achieved. It should be recognized that the decommissioning process steps apply to lands that may require environmental remediation; either independently or as a part of the decommissioning of a facility or site.

The decommissioning process is divided into six main steps, which align to phases or stages in the respective standards. It should be noted that the process sequence is based on a new facility and appropriate grading and application will be applied and documented for legacy facilities. Figure 2 provides a Supplier, Input, Process, Output and Customer (SIPOC) diagram of the decommissioning process steps.

Figure 2 CNL Decommissioning Process

The six main process steps include:

1. Perform preliminary decommissioning planning
2. Safely shutdown and turnover for decommissioning
3. Execute safe storage and maintenance
4. Perform detailed decommissioning planning
5. Execute decommissioning project
6. Complete decommissioning

Performing preliminary decommissioning planning should start during the design phase or prior to the construction of a new facility. The eventual decommissioning should be considered in the Preliminary Decommissioning Plan (PDP). Planning should include but not limited to: 1) designing for the eventual decommissioning, 2) planning for the decommissioning based on the anticipated hazards at the end of the operation phase, 3) estimation of the decommissioning cost including the waste storage/disposal costs, and 4) decommissioning waste volume and types.

When a facility reaches the end of its operational life, and is decided to permanently shutdown for decommissioning, the facility needs to be safely shutdown and turned over to decommissioning. In general, the facility staff will prepare and execute safe shutdown plans to remove radioactive materials (e.g. fuel and other process materials) and hazardous substances, and drain and clean process systems to the extent practical within the conditions of the operating limits. Certain shared systems may be isolated from continuing operations while ensuring adequate emergency services are supported. The goal should be to achieve a safe, stable state for the facility in preparation for turnover to decommissioning. Prior to turnover, the decommissioning staff will prepare plans and obtain approvals for the safe storage and maintenance of the facility. Once shutdown is complete and the storage and maintenance plan is accepted, turnover from Operations to Decommissioning can take place.

Once safe shutdown has been achieved, a period of storage and maintenance will occur, where remaining contaminated materials, equipment and the facility are monitored and maintained within safe storage and maintenance until the end-state is achieved. The length of time this will require will vary depending on the decommissioning strategy.

The detailed decommissioning planning can begin, building on the earlier PDPs. Detailed decommissioning planning will include gathering information and developing for the radiological and industrial hazard assessments and characterizations, defining the packages of decommissioning work, conducting environmental risk assessments, developing waste plans, waste estimates, and decommissioning cost estimates.

Decommissioning project execution is described in project plans and activities, as the physical work to be performed and how it is controlled based on the approved Detailed Decommissioning Plans (DDPs). Some deviation from the DDPs during the execution of decommissioning work may be allowed as long as the applicable requirements of the licence is fulfilled. The overall execution plan is defined through detailed work plans which describe decontamination, dismantling, demolition and environmental remediation. Work planning for decommissioning or environmental remediation activities follows the same basic requirements, but specific or additional supplementary requirements in governing procedures may apply. Decommissioning work shall be executed with due regard for:

- Protecting the health and safety of workers and the public;
- Protecting the environment;
- Complying with regulatory requirements;
- Keeping radiation exposures as low as reasonably achievable (ALARA);

- Managing all radioactive and hazardous materials generated by the decommissioning;
- Security; and
- Safeguards.

Decommissioning is considered complete once the planned decommissioning activities have been completed and all materials, wastes, equipment and structures have been dispositioned and any risks to personnel, the public and the environment have been reduced or eliminated to achieve the final end-state objective and the facility has been released from regulatory control. The project closeout, final survey, verification and final end-state reports must have been completed and all approvals and licence changes are received, any remaining structure or land will be turned over for re-use, for institutional control or to a 3rd party owner.

3.4 Grading approach

Grading will be applied to the Decommissioning Process based on the individual site/facility licences, regulatory requirements, level of risk they pose, and safety significance of the activity being performed using both engineering and management judgment to determine the extent of compliance required.

A graded approach provides for varying levels of rigor and formality when applying controls dependent on the level of hazards present, the potential environmental impact involved and the consequence of failure. This method ensures that the depth of detail required and the magnitude of resources expended for decommissioning are aligned with each facility's programmatic importance, regulatory requirements and potential safety, health, security and environmental impact.

A graded approach has the following characteristics:

- the significance and complexity of an activity are determined;
- the potential impacts of the activity on health, safety, security, the environment, and the achieving of quality and the organization's objectives are determined;
- the consequences if the process fails or if the activity is carried out incorrectly are taken into account;
- the applicable level for each activity, system, equipment or item will be clearly identified in the programmatic documentation;
- for all licensed activities, every specified condition and criteria continues to apply irrespective of the level selected, i.e., for any given level, no condition or criteria can be disregarded (for any level, no condition or criteria can result in zero activity); and
- the overriding requirement is that the licensee shall comply with the licensing basis, in particular the information submitted by the licensee in support of the application for renewal of the licence. Therefore, any graded approach to compliance with requirements will have been expressed and explicitly documented in these licensing basis documents. The expression of the principle of graded approach alone is not

sufficient. The exact measures, which are different from the full approach, will need to be explicitly defined.

A scoring system is being developed to assist the process users for determining the level of documentation required for their decommissioning activities based on the risk-basis grading approach.

3.5 Communication

Communication and training are important tools for providing all stakeholders with the standards, knowledge and support to ensure that the DP requirements are met. The tools include:

- Creation of the DP webpage on CNL's internal web site for information on DP requirements;
- Communication bulletins on CNL's internal web site and articles in CNL's publications to promote improved DP practices;
- Creation of DP awareness training for employees to describe the applicable standards and practices for decommissioning.

Communications with various organizations have been established to share the experience, to understand and discuss issues of common concern.

For internal communication, the essential information needed by workers carrying out facility maintenance, surveillance, and decommissioning work is communicated to them in various methods such as: work plans, procedures, checklists, pre-job briefs, branch meetings, work requests and work permits.

3.6 Records

With respect to the need for long-term management and retention of records, the Decommissioning Process is subject to Section 14 of the *Class I Nuclear Regulations* [4], under the *Nuclear Safety and Control Act* [5], which lays out the requirements for the types of records to be kept and retained.

Essential and non-essential records (electronic and hard copy) shall be identified, maintained, stored, retained, and routinely inspected to ensure their preservation and protection from loss, deterioration, or destruction.

All the formal documents identified in the DP are permanent records and shall be filed in the CNL information and records management system.

4. Improvement initiatives

Decommissioning process improvement initiatives at CNL are developed based on four key areas:

- Process Improvement and planning;

- Process Implementation and Operations;
- Monitoring and Oversight; and
- Management Review and Improvements.

Under these four focus areas decommissioning process improvement initiatives are implemented to achieve a single, compliant, safe, and efficient Decommissioning Process applied to all decommissioning activities at CNL sites. Several different task areas such as process training, process assessment, benchmarking and compliance assessment of process have been established to:

- ensure that applicable code and standards are reviewed periodically to ensure process compliance;
- develop decommissioning procedure templates and checklists in support of standard implementation of the process during of all six steps of the process,
- monitor and review internal and external OPEX for trend analysis and adjust performance measure criteria as required; and
- identify risk areas related to the process for prioritizing activities and management oversight.

5. Performance measures

The adequacy, suitability and effectiveness of the DP are monitored through the internal process review, audit and the self-assessment processes. Through these processes, the gaps and opportunities for improvement are identified. Remedial and corrective actions are also identified and carried out to address the gaps and to continuously improve the DP performance.

On an annual basis, the Decommissioning Process Owner and Working Group will establish Performance Measures for the Decommissioning Process and will be documented and reported on throughout the year. These may be categories such as:

a) Process Management, which includes:
   - Program issues raised with the process;
   - Training and qualification on the process; can include training compliance and the number of staff trained on the process;
   - Process documentation to support the process; and
   - Process improvements.

b) Process Performance, which includes:
   - Implementation of the process; and
   - Process Interfaces and feedback.

c) Process Assessment, which includes:

- Management System Assessment;
- Benchmarking, Conferences, Committees, and sharing of Operating Experience (OPEX);
- Self-Assessments and Nuclear Performance Review Board (NPARB) reviews;
- Issues identification and corrective actions; and
- Audits.

6. Conclusion

Significant progress has been made for the development and implementation of the Decommissioning Process at CNL. The DP is maturing and now focusing on the areas that have not been fully developed such as oversight activities. The DP continues to make improvements in decommissioning activities at CNL through implementation of initiatives and is undergoing process review and self-assessment to assess and continuously improve the adequacy, suitability, and effectiveness of the process.

7. References

[1] Canadian Nuclear Safety Commission, Nuclear Research and Test Establishment Operating License Chalk River Laboratories, License Conditions Handbook CRL-508760-HBK-001, Rev. 3, 2015 March 09.

[2] Canadian Nuclear Safety Commission, G-219, CNSC Regulatory Guideline on Decommissioning Planning for Licensed Activities.

[3] Canadian Standards Association, CSA-N294-09, Decommissioning of facilities containing nuclear substance.

[4] Canadian Nuclear Safety Commission, SOR/2000-204, Class I Nuclear Facility Regulations.

[5] N-28.3, Nuclear Safety and Control Act.