SETTING PRIORITIES FOR DECOMMISSIONING AND REMEDIATION ACTIVITIES UNDER THE FEDERAL NUCLEAR LEGACY LIABILITIES PROGRAM AT AECL SITES

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Abstract

The objective of the Nuclear Legacy Liabilities Program (NLLP) is to safely and cost-effectively reduce the federal legacy liabilities at AECL sites, using sound legacy management and environmental principles in the best interest of Canadians. The legacy liabilities consist of shutdown nuclear and industrial facilities, buried and stored wastes and contaminated lands at Chalk River Laboratories (CRL), Whiteshell Laboratories (WL), and other AECL nuclear facilities in Canada.

Although all of the legacy liabilities must be dealt with eventually they cannot all be addressed at once, especially with continuous operations at one site. Therefore the periodic ranking of the associated risks is used in deciding which liabilities to focus on in the short term. This has been achieved through the implementation of a prioritization process, which is the subject of this paper.

1. Introduction

The federal Nuclear Legacy Liabilities Program (NLLP) has been established by the Government of Canada to manage the nuclear legacy liabilities that resulted from 60 years of nuclear research and development (R&D) carried out on behalf of Canada by the National Research Council (1944 to 1952) and Atomic Energy of Canada Limited (AECL, 1952 to 2006) **[1]**. These liabilities are largely located at AECL licensed sites, and include several prototype and research reactors, other shutdown nuclear facilities, buried and stored wastes, and contaminated lands. More than half of the liabilities are attributable to Cold War activities during the 1940s, 50s and early 60s. The remaining liabilities stem from R&D for medical isotopes and nuclear reactor technology, as well as the national science programs.

Most of the liabilities are located at AECL's Chalk River Laboratories (CRL) in Ontario, and a smaller fraction is located at AECL's Whiteshell Laboratories in Manitoba. The remaining 10 percent relate largely to three shutdown prototype commercial reactors in Ontario and Quebec, which were key to the developmental stage of Canada's CANDU®[1] reactor technology. The objective of the federal Nuclear Legacy Liabilities Program (NLLP) is to safely and cost-effectively reduce the legacy liabilities, using sound waste management and environmental principles in the best interest of Canadians.

[1] ®CANDU is a registered trademark of Atomic Energy of Canada Ltd. (AECL)

The program is being implemented through a Memorandum of Understanding (MOU) between Natural Resources Canada (NRCan) and AECL. Under the MOU, NRCan is responsible for policy direction and oversight, including the control of funding, and AECL is responsible for managing the NLLP and executing the work. Further, AECL has established a Liability Management Unit (LMU) that has, amongst other responsibilities, the responsibility to undertake detailed planning of the program.

All of the legacy liabilities must be dealt with safely and effectively. One of the challenges to the NLLP is to determine the appropriate sequence of activities using a risk-informed basis to complete the program in an optimal manner. The NLLP must associate a measure of urgency to deal with the various liabilities, by prioritizing the issues to be addressed taking into consideration the associated risks to health and safety, the environment, and AECL's continuing business operations. This sequencing of activities has been achieved by implementing a prioritization process, which is the subject of this paper.

2. Evolution of the process used to set NLLP priorities

The first efforts to establish priorities in the remediation and decommissioning activities at AECL's Chalk River Laboratories took place during the period between 1992 and 1994, well before the NLLP began in 2006. Once it was determined that there were numerous legacy items that required attention at CRL it was also recognized that effort needed to be focused on those items which were having or could have the greatest impact on health, safety and the environment. The task was to assign priorities to the multiple activities that needed to be undertaken to safely remediate and decommission waste areas and waste management facilities, and to manage the resultant waste over the long term.

The first effort to establish priorities was documented in a conference paper in 1994 [2]. As an example, one of the achievements under this early priority setting effort was the installation of a groundwater collection and treatment system at Waste Management Area B (WMA B) to intercept and treat an Sr-90 plume. This first attempt developed the basis for a long-term plan to address decommissioning and remediation of the CRL waste management areas. As the process matured, the decommissioning of redundant, non-operational buildings was added to the plan.

Through the establishment of a list of items that required attention, it became apparent that existing funding levels were not sufficient to address the legacy issues in a timely manner. In order to justify additional funding, the priority setting process became more formalized with a greater diversity of activities included for prioritization as well as broader participation in the process by including representation of the various AECL Program Authorities (e.g., Environmental Protection, Radiation Protection, etc.). Eventually, the process included external experts.

In response to the need for increased funding to address liability reduction, the NLLP was established in 2006 June when the Government of Canada committed $520 million through Natural Resources Canada (NRCan) to fund a five-year start-up phase. Funding approval initiated the long-term strategy of managing the legacy liabilities associated with AECL's nuclear sites. Several audits associated with approving the NLLP commented on the priority setting process as a positive observation.

To help ensure the NLLP program planning included an appropriate degree of rigour, particularly with respect to health, safety and environmental risks a formal procedure has been prepared and is used, as described in Section 3. The documented procedure and report of the priority setting results also served to meet requirements of ISO 14001.

3. The current prioritization process

The overall prioritization process currently in use is outlined in Figure 1. The Strategic Planning group within the LMU leads the process. The process addresses the risks associated with liability reduction but excludes operational issues not related to the NLLP. The prioritization is carried out by assembling two panels to rate the priorities of addressing the various issues on the basis of the associated risks. The first panel is made up of experts in building decommissioning, environmental remediation, waste management and strategic planning, and who are involved in the ongoing work in the NLLP. The second panel includes members with a broader range of expertise (but less direct involvement with and focus on NLLP activities) in the areas of:

- Health and Safety;
- Environmental Protection;
- Business needs;
- Decommissioning Operations;
- Facility knowledge;
- Radiation Protection;
- Waste management;
- Historical background;
- Site monitoring;
- Site characterization;
- Safety analysis;
- Project management;
- Regulatory aspects.

Both panels rank liabilities that are listed in the Federal Nuclear Legacy Liabilities Management Plan Rev 0 [3] using health and safety, environment, and business risks as the primary concerns. The guidelines for evaluating risks in each of the three classes of risk on a scale of 1 to 4 are shown in Tables 1 to 3. The individual ratings are compiled and summed, and the sums are ordered to produce a priority ranking of the issues in each category. The health and safety risks are assigned a weighting factor of two, to reflect the importance of dealing with these immediate risks.

Health and safety risks (see **Table 1**) refer to currently occurring or potential impacts on site workers, in either routine or upset conditions. Potential impacts to individual members of the public are assumed to be an order of magnitude less than for workers. The risks to the public are one of the considerations in the environmental risks.

The Environmental risk aspect (see **Table 2**) addresses the potential for contamination to breach barriers and move from one environmental pathway to the next, potentially increasing the effort and cost to remediate the site. The potential for contaminant spread is influenced by factors such

as: methods of containment, the ability to detect releases from containment, and the ability of the contaminant to disperse into and through the surrounding environment. Emphasis is placed on the movement and spread of contamination through an environmental medium and from one medium to another. For example, contamination that is well contained would have a lower priority than contaminated materials in an unstable containment. As the contamination enters each new pathway it gets closer to biological receptors.

The reference business risk consequence (see **Table 3**) is the magnitude of the potential impacts on the ability of AECL to continue with its operations, to comply with regulatory obligations and company policies, and to fulfil its mandate while maintaining a positive public reputation.

The first panel is consulted on the list of nuclear legacy liabilities to be rated and ranked. All identified liabilities are initially considered, and the panel makes an initial selection of the items having clearly more significant associated risks. The LMU Strategic Planning group assembles issues to be prioritized into three categories of similar liabilities, plus a group of required supporting activities:

- Buildings and structures to be decommissioned;
- Wastes that must be retrieved, or managed *in situ*;
- Contaminated groundwater plumes and land that must be managed; and
- Waste management enabling facilities or capabilities that are required to support legacy activities.

The items to be prioritized may change each time the process is carried out, as new elements of the liability are identified and better understood, and as planned elements in future years of the plan come closer to the present. Refinements and updates to the characteristics of the liabilities are made on an ongoing basis, depending upon such things as ongoing public consultation, improved knowledge, changes in the regulatory environment, and changes to operating facilities status. A liability is removed from the priority list after it has been eliminated. The most up-to-date list is delivered to the panels before they meet to allow for sufficient preliminary consideration and input.

Background information is assembled on each of the items to be prioritized, which includes a description of the issue (a hazard to be reduced or a capability to be created) and at least one defined feasible path forward to deal with it. The background information is formatted the same for every item that is being ranked. Figure 2 shows the form used to collect background information on a liability. The risk associated with enabling facilities is ranked as the risk of not having the specific capability provided by the facility (e.g., the risk in not being able to characterize waste, or not being able to reduce the waste volume with a facility such as an incinerator). The lack of these facilities may have an impact on health and safety or the environment. For example, an impact on health and safety might be that without a particular processing capability the operational approach requires the double handling of waste, and thus increases the dose to workers.

The first panel rates the selected items using the criteria in Tables 1 to 3. Panel members individually rate the risk associated with each liability on a scale from one to four, one being minor and four representing significant risk, in the three categories of health and safety risks, environmental risks and business risks. The individual ratings of liabilities are compiled and

summed to produce an initial ranking, then are presented to the first panel in tabular form. The priority rankings by the first panel are completed before the second larger panel is brought together. The results from the first panel are kept confidential and not released to the second panel until after the second panel has also independently rated the issues. Thus the legacy issues receive two independent reviews. One of the benefits associated with using the two panels is that discrepancies in the rankings between the two panels will shed light on possibly overlooked or broader aspects of the issues being rated.

The second panel completes the priority-rating process on the first day of a two-day meeting, also using the guidelines shown in Tables 1-3 to rate each risk. The liabilities are listed on a ratings sheet, and the members of the second panel rate the associated risks in the same manner as the first panel, as described above. The individual ratings of each liability are compiled and summed, and, on the second day, the results are presented to the second panel in tabular form for discussion and to reach a consensus. The combined panels together discuss the ratings and rankings, focussing on any differences in the sets of rankings and the reasons for them and seek consensus. Individuals can revise and resubmit their ratings and then the overall result is finalized.

4. Results of the prioritization process

The results of the prioritization process are input into the annual NLLP planning process and are used in selecting the work to be conducted in the coming year or few years. Previous audits of the program have looked at whether activities identified as top priorities have in fact received due attention in annual execution plans. It has been well demonstrated that identified high priorities do translate into planned activities. Some of the high priority activities that have a significant environmental benefit to them are also incorporated into AECL's Environmental Plan [4], which gives additional assurance that the highest consideration is given to the activity in assigning resources.

The results from some of the earlier prioritization efforts are described briefly in the next few paragraphs, and it is important to note that the highest priorities have not changed significantly over the last 15 years. These highest priorities have been and continue to be focussed on issues related to:

- Stored liquid wastes – either in tanks, or in waste management area burials, or water in fuel storage bays;
- Stored used fuel – recovery of selected used fuel from current storage systems, and placement into upgraded storage;
- Shutdown contaminated wooden buildings.

With the availability of increased funding through the establishment of the NLLP, the biggest change to priorities was how special waste burials like solvent bunkers and waste emplaced in the 1950's rose in the rankings. One of the conclusions from that change was that in the establishment of priorities, participants had previously been implicitly considering the number of different activities as a constraint until additional funding was available.

It was also apparent in the years prior to the establishment of the NLLP that funding was insufficient to launch activities on high priority items, and this became important in demonstrating why additional support and funding was required. The results of the early prioritization processes were thus used in establishing the NLLP.

The results of the latest prioritization in 2009 February were similar to the previous ones, with stored liquid wastes and used reactor fuel stored in early designs of tile holes rating high, along with liquid waste and interim solid waste forms that will need further processing. The decommissioning and removal of shutdown contaminated wooden buildings was also ranked as important.

With each prioritization there has been considerable discussion regarding whether the item to be prioritized should be the next "action" to be performed on a particular liability item, or the larger issue of the risk associated with that liability item. As an example, the next step with respect to recovery of a buried waste object might be characterization activities and preparation of required documentation, plans and approvals – so panel members might look at the proposed activities and rate them as a low priority because no risk reduction would be achieved. However, the overall goal is to reduce the risk associated with highly rated liabilities, so over time the process has put more emphasis on the "liability" itself rather than the next "activity" to deal with it.

The term "Enabling Facilities/capabilities" was coined to describe those facilities, structures and equipment that are required to allow or enable decommissioning and remediation activities to proceed. Some examples of enabling facilities are a Waste Clearance Facility, Waste Storage Facilities (for solid as well as liquid wastes), Waste Incinerator, etc. It was difficult to prioritize the enabling facilities as stand alone items because the need for them is driven by which buildings are to be decommissioned or wastes are to be recovered, and on what time scale. One of the refinements to the prioritization process in its latest revision was to separate out the enabling facilities from the actual liabilities themselves. In the future, the timing for constructing the various enabling facilities will be determined by the schedule of waste processing requirements to deal with the prioritized liabilities.

One of the issues that has long been of concern is how to present and describe the risks of each liability in a clear and similar manner, so that it is easier to compare the different liabilities and rate them. Accordingly, a standard form (see **Figure 2**) was developed for the latest prioritization to present the information on each liability.

5. Future refinements of the process

A future refinement to the process will be to have the background information about each liability presented in a more standardized format, by answering specific questions such as, "What is the worst case scenario if control over this liability is lost?" or "What is the probability of this liability becoming a worst case scenario?" and, "How is the liability being mitigated right now?"

A future improvement to the process that will be considered is to provide more time for the panels to discuss the issues under consideration. One of the benefits of the prioritization process is information sharing, so that the more discussion takes place, the better informed panel members will be with respect to assigning ratings. Long after the priority setting process

meetings are over, the panel members act as knowledgeable advocates of the program who are able to inform others as to why these activities need to be performed.

In future prioritizations, the Enabling Facilities/Capabilities group will be rated separately from the three groups of Legacy Liabilities. The top-ranked liabilities will define the urgency for putting a particular enabling facility/capability in place.

An additional rating category will be added to the next version of the prioritization procedure- the potential to reduce the continuing costs of maintenance and repairs, and to reduce the liability itself. This category could be titled Liability Reduction. This is in recognition that the overall NLLP objective is to reduce the liabilities in a timely manner (as quickly as possible). Deferral of dealing with liabilities incurs unrecoverable costs and effort at the expense of funds being devoted to progress in eliminating liabilities.

6. Conclusions

The NLLP comprises a large set of varied decommissioning and environmental restoration activities at several AECL sites. A process has been developed to rate and rank the priorities of dealing with the numerous liabilities using criteria based on the associated risks to health and safety, the environment and AECL's continual business operations. The process has confirmed the high priority items in consideration of these risks are being addressed in the program.

Table 1 Health and safety risks

Risk Rating	Guidance on Health and Safety Risks	Magnitude of hazard	Stability
1	Health and safety hazards are minor and stable: • The consequence involved would be considered unimportant if it occurred; • The situation is stable and unlikely to change; or • Monitoring of the hazard is simple and safe.	Minor	Stable
2	Health and safety hazards are low and stable: • Hazard can be reduced in a reasonable and practical fashion utilizing known methods; • The situation is stable and unlikely to change, or will change only very slowly; or • The probability of the consequence being realised is predictable and well known.	Low	Stable
3	Health and safety hazards are moderate, or are low at present but will increase over time: • Prudent management indicates early risk reduction measures to avoid potential for significant radiation doses to workers; or • The situation is changing with increasing risk over "long" timeframes.	Moderate	Gradually increasing
4	Health and safety hazards are significant at present or are unstable: • Near-term risk reduction is necessary because the probability of personal injury or health effects is significant; or • The situation is unstable, and rapid changes are possible and are likely to occur.	Significant	Possible sudden changes in hazard level

Table 2 Environmental risks

Risk Rating	Guidance on Environmental Risks	Magnitude	Stability
1	Environmental hazards are minor and stable: • Resulting ecological damage would be considered unimportant; or • The situation is stable and unlikely to change; or • Monitoring of the hazard is simple and safe.	Minor	Stable
2	Environmental hazards are minor and stable: • Resulting ecological damage would be considered low; or • The situation is stable and unlikely to change.	Low	Stable
3	Environmental hazards are moderate, or low at present but will increase over time: • Prudent management indicates early risk reduction measures to avoid potential for more significant impacts. Known methods can be used to remedy the situation; or • The situation is changing with increasing risk over "long" timeframes, but changing in a predictable manner. Contamination is spreading.	Moderate	Gradually decreasing stability
4	Environmental hazards are significant, with the potential to seriously contaminate part of the site and would not easily be remediated: • Actions are required for near-term risk reduction; delay would result in the spread of contamination that would be difficult to remediate; or • The situation is unstable and rapid changes are possible and likely to occur.	Significant	Possible sudden changes in hazard level

Table 3 Business risks

Risk Rating	Guidance on Business Risks	Magnitude	Stability
1	Only minor, predictable, stable operational, compliance, economic or social effects on AECL activities would be expected. • Resulting impacts would be considered unimportant; or • Risk reduction is not an identifiable business concern, or the situation is stable or improving.	Minor	Stable
2	Potential for operational, compliance, economic or social effects is low and stable, but sufficient enough to be identified as a risk in business plans. • Risk reduction can be achieved in a reasonable and practical fashion by application of known methods; or • The situation is stable and unlikely to change, or will change only very slowly.	Low	Stable
3	Business risk is moderate. Regulatory or internal Safety Review Committee (SRC) concern has been expressed. Public concern has been expressed. • Risk reduction actions are required to respond; or • The situation is changing, with risk increasing over "long" time frames, but in a predictable manner.	Moderate	Gradual decreasing stability
4	Business risk is significant, and involves continuing non-conformance with licensing and/or policy guidelines. AECL's internal limitations and control points on operations and/or regulatory authorities' licence requirements are threatened. Liabilities may escalate significantly. • Actions are required for near-term risk reduction. Delay would result in negative impacts for AECL, i.e., the company would be in non-compliance with regulatory requirements, and damage to AECL's public image is likely; or • The situation is unstable and rapid changes are possible and likely to occur.	Significant	Possible sudden change in hazard level

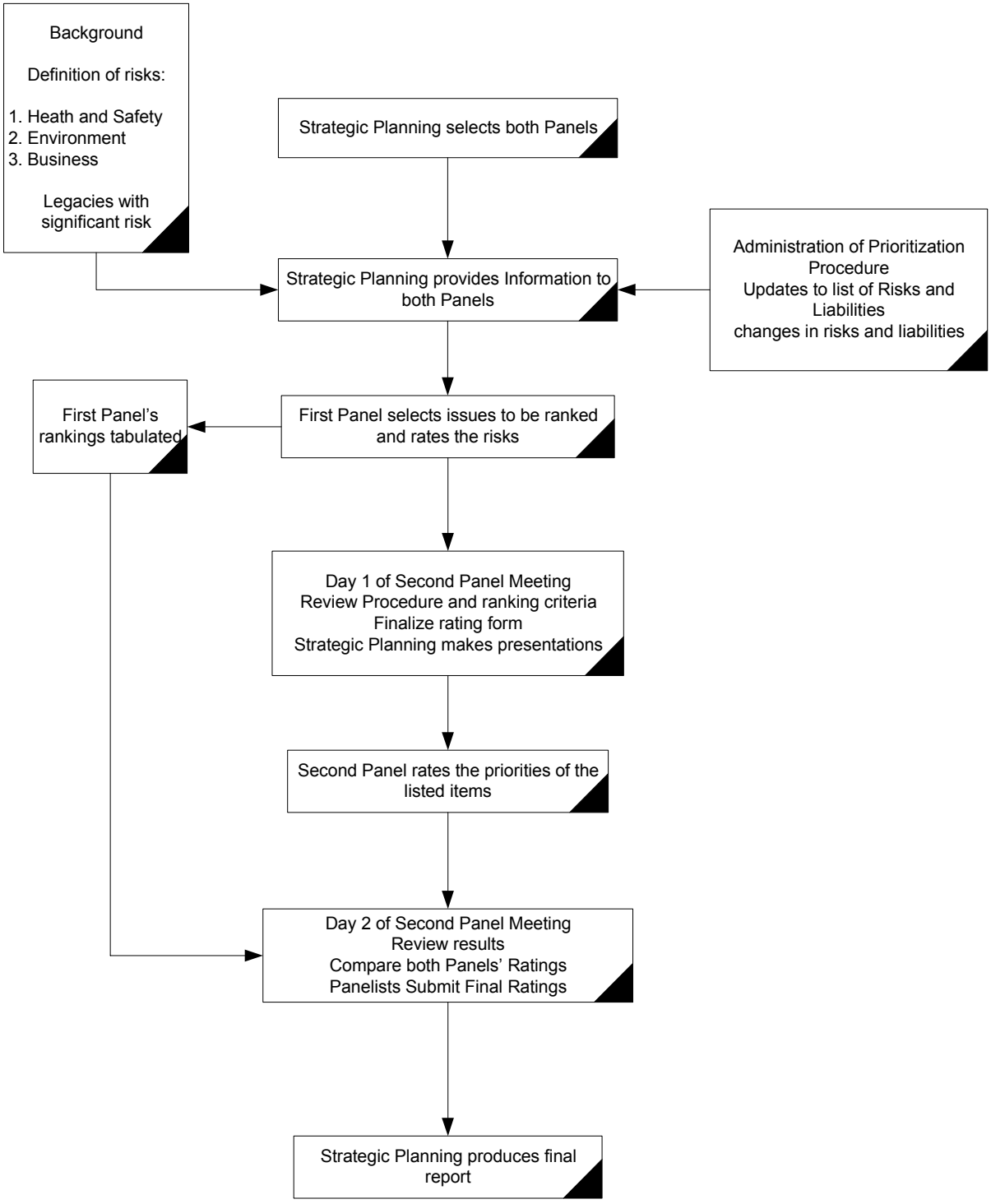

Figure 1 The prioritization process for the Nuclear Legacy Liabilities Program

Liability/issue #	

Description of the Liability

History and current state of the liability	
Effect or potential effect of the liability on health & safety	
Effect or potential effect of the liability on the environment	
Effect or potential effect of the liability on AECL's ability to do business	

Strategy to manage the liability

Action/Proposed Actions. Include any prerequisite steps and sequencing.	Start	Finish

Figure 2 Nuclear legacy liability background information form

7. Acknowledgement

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8. References

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