



CNSC Assessment of the IAEA Director General Report of the Fukushima Daiichi Accident

February 2016



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Preface

This CNSC staff assessment of the *CNSC Integrated Action Plan* against the IAEA's *Fukushima Daiichi Accident: Report by the Director General*, taking into considerations all recommendations arising from the report, was requested and accepted under the authority of the CNSC Executive Vice-President and Chief Regulatory Operations Officer, Ramzi Jammal.

The CNSC would like to acknowledge at the outset each of the contributing members who offered a unique perspective on understanding and interest in the development of this assessment. Those to whom the CNSC owe thanks include Health Canada and Public Safety Canada.

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1. Purpose

With the health and safety of Canadians and the environment as its top priority, the Canadian Nuclear Safety Commission (CNSC) continually applies a “lessons learned” philosophy to its work.

With that said, this assessment presents the key observations and lessons learned identified in the International Atomic Energy Agency’s (IAEA) report, *The Fukushima Daiichi Accident: Report by the Director General* [1]. The DG-IAEA Report not only examines the causes and consequences of the accident at the Fukushima Daiichi nuclear power plant in Japan, but also evaluates measures taken in response to the accident. The executive summary further synthesizes lessons drawn from five detailed technical studies completed by international experts.

The purpose of the CNSC staff assessment is to benchmark the observations and action items identified in two CNSC documents – the *CNSC Fukushima Task Force Report* [2] and the *CNSC Integrated Action Plan on the Lessons Learned from the Fukushima Daiichi Nuclear Accident* (CNSC Integrated Action Plan) [3] – against the DG-IAEA Report, to ensure all elements being considered by international peers are reflected in the Canadian review scope. Other organizations contributing to this review include Health Canada and Public Safety Canada.

2. Background

On March 11, 2011, a magnitude 9.0 earthquake caused a 15-metre tsunami wave that devastated the northeast coast of Japan. The tsunami resulted in the loss of thousands of lives and half a million homes. It also caused an accident that affected multiple units at the Fukushima Daiichi nuclear power plant.

Canada responded promptly. Based on the early information about the accident, the CNSC placed an immediate action on licensees requesting that they re-examine the safety cases of their nuclear power plants (NPPs). The CNSC Fukushima Task Force, supported by CNSC staff from a wide range of disciplines, was established to evaluate operational, technical and regulatory implications of the accident on Canadian NPPs. The resulting *CNSC Fukushima Task Force Report* formed the basis of a May 2012 action plan that was later expanded beyond NPPs in the 2013 CNSC Integrated Action Plan.

Looking at all major nuclear facilities, the CNSC Integrated Action Plan focused on how to:

- strengthen defence in depth
- enhance emergency response
- improve the regulatory framework and processes
- enhance international collaboration
- improve communications and public consultation

In addition, Canada incorporated lessons learned from its response to the Fukushima Daiichi accident in the update to the *Federal Nuclear Emergency Plan* (FNEP) [4], which is administered by Health Canada. The updated FNEP was endorsed in 2012 and has since been tested through a series of national, full-scale exercises.

Canada's general approach to assessing the lessons learned and developing the CNSC Integrated Action Plan was weighed against the broader objectives of the *IAEA Action Plan on Nuclear Safety* [5] and its goals for enhanced global nuclear safety. As reported in the *Canadian National Report for the Convention on Nuclear Safety: Sixth Review Meeting* (6RM) [6], the Canadian responses were well aligned with the IAEA's objectives. (Annex 8 of the 6RM Report provides extensive information about Canada's post-Fukushima actions.)

The CNSC Integrated Action Plan was revised based on three rounds of public consultation as well as two independent evaluations: one conducted by the IAEA Integrated Regulatory Review Service (IRRS) [7] and the second by the External Advisory Committee (EAC) [8]. Evaluating the CNSC's actions against the IAEA's Fukushima module, the IRRS concluded that the CNSC response to the Fukushima accident was robust and comprehensive, with an "effective and pragmatic framework" in place to implement the lessons learned. In turn, the EAC concluded that the process followed by the CNSC was appropriate. CNSC staff refined the CNSC Integrated Action Plan to reflect the IRRS and EAC recommendations and the comments received from the public and stakeholders.

3. Review

The CNSC assessment of the 45 lessons learned identified in the DG-IAEA Report is given in tabular form in the appendices. The assessment and actions taken are provided against each of the lessons learned, and are categorized in the following four areas, as per the DG-IAEA Report:

1. the accident and its assessment (section 2)
2. emergency preparedness and response (section 3)
3. radiological consequences (section 4)
4. post-accident recovery (section 5)

From these four categories, the CNSC's assessment of the lessons learned is presented as two distinct phases (phase 1 and phase 2, in appendices A and B, respectively).

While the CNSC might stipulate that an action is complete, it does not necessarily terminate the continuing responsibility for the safe operation of nuclear facilities. The CNSC ensures this is achieved through its established licensing, compliance and regulatory framework processes. Additionally, Health Canada's nuclear emergency management coordinating committees (as defined in the FNEP) and provincial-level committees provide a venue for ongoing improvements to offsite emergency preparedness activities at the national level.

Phase 1: Enhancing defence in depth and emergency response

Appendix A lists the actions taken in Canada against each lesson learned identified in sections 2 and 3 of the DG-IAEA Report. The information presented here was largely available at the time the CNSC Integrated Action Plan was developed. For this phase, the focus is on identifying any gaps in the work performed in Canada to date. The status of the actions is summarized and a conclusion is drawn.

Phase 2: Assessing radiological consequences and post-accident recovery

Appendix B lists the actions taken in Canada against each lesson learned identified in sections 4 and 5 of the DG-IAEA report. The information presented here was not available at the time the CNSC Integrated Action Plan was developed. For this phase, the focus is on ensuring appropriate processes are either in place or will be developed to address the lessons learned.

4. Conclusions

The *CNSC Fukushima Task Force Report* was issued eight months after the Fukushima Daiichi accident. The regulatory requirements of the action plan, developed within one year of the accident, focus on the prevention and mitigation of similar events of higher consequences and lower likelihood. Actions related to strengthening defence in depth, enhancing emergency response, improving the regulatory framework and enhancing international collaboration were quickly imposed on the CNSC and its licensees of major nuclear facilities. Additionally, actions to strengthen offsite emergency response were quickly identified and implemented by offsite authorities at the federal and provincial levels. The actions are well aligned with the lessons reported in sections 2 and 3 of the DG-IAEA Report. Lessons related to public communication are also well aligned. With the exception of a very small number of modifications that require design changes by the licensee (which are on schedule for completion), the implementation of the regulatory requirements has been completed.

The DG-IAEA Report was developed over a longer period and includes lessons learned that could not have been identified in the first year following the accident, specifically in the areas of radiological consequences and post-accident recovery. These areas touch on the subjects of radiation protection, recovery, remediation and communication, where Canada played a major role in development.

Post-accident recovery guidelines addressing the elements of the DG-IAEA Report that speak to offsite measures related to the transition from emergency early response to recovery are being drafted by the CNSC. These guidelines will also be based on the outcomes and lessons learned arising from the mandatory emergency exercises conducted by multiple jurisdictions (including the CNSC, other local federal/provincial authorities and the licensees) and will be reported to the Commission via regular updates.

The CNSC Integrated Action Plan and its regulatory requirements are now integral to the CNSC's licensing, compliance and communication activities to ensure continuous safety enhancement. For example, implementing periodic safety reviews in the CNSC regulatory framework are an effective tool to improve safety and guard against the risk of complacency.

Canadian actions in response to the Fukushima Daiichi accident are compatible with and address the lessons learned reported in the DG-IAEA Report. They will also prove to be a valuable resource for future actions and updates against the lessons learned identified in the CNSC Integrated Action Plan. This assessment affirms that the CNSC was and continues to be on the right path with respect to its continuous enhancements to safety through committed work and verification under normal licensing, compliance, regulatory framework and communications processes – and that these processes are commensurate with maintaining the high level of safety achieved in Canada.

Appendix A

Phase 1: Enhancing defence in depth and emergency response

Table A.1 below reproduces the lessons learned identified in sections 2 and 3 of the DG-IAEA Report and provides information about Canada's actions related to each lesson. The lessons are numbered based on the section of the DG-IAEA Report in which they appear.

Table A.1: Assessment of sections 2 and 3 of the DG-IAEA Report

LL#	IAEA lesson	CNSC action and assessment
2. The accident and its assessment		
2.1	<i>The assessment of natural hazards needs to be sufficiently conservative. The consideration of mainly historical data in the establishment of the design basis of NPPs is not sufficient to characterize the risks of extreme natural hazards. Even when comprehensive data are available, due to the relatively short observation periods, large uncertainties remain in the prediction of natural hazards.</i>	<p>CNSC action:</p> <p>This lesson is addressed in the CNSC Integrated Action Plan, with the following action items applicable to all sites:</p> <p>A.2.1.1: <i>Re-evaluate, using modern calculations and state-of-the-art methods, the site-specific magnitudes of each external event to which the plant may be susceptible.</i></p> <p>A.2.1.2 <i>Evaluate if the current site-specific design protection for each external event assessed in 1 above is sufficient. If gaps are identified a corrective plan should be proposed.</i></p> <p>These action items are closed (or are on track for closure) for all Canadian nuclear power plant (NPP) licensees based on an acceptable probabilistic safety assessments (PSAs) and plans for additional work. This additional work is still ongoing and subject to CNSC review. Verification is integrated into licensing and compliance processes.</p> <p>Note: Implementation of CNSC regulatory standard S-294 has since been replaced with REGDOC-2.4.2, <i>Probabilistic Safety Assessment (PSA) for Nuclear Power Plants</i>, which includes improvements based on the lessons learned from the Fukushima Daiichi accident.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth. • The assessment of natural hazards will be updated periodically to reflect gained knowledge and changes in requirements. <p>No outstanding actions.</p>
2.2	<i>The safety of NPPs needs to be re-evaluated on a periodic basis to consider advances in knowledge, and necessary corrective actions or compensatory measures need to be implemented promptly.</i>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan, with the following action item applicable to CNSC staff:</p> <p>A.11.1 <i>The CNSC will consider the development of a regulatory framework for the implementation of the periodic safety review process.</i></p> <p>In April 2015, the CNSC published REGDOC-2.3.3, <i>Periodic Safety Reviews</i>, as part of its regulatory framework for implementing the periodic</p>

LL#	IAEA lesson	CNSC action and assessment
		<p>safety review process.</p> <p>Note: The CNSC has always re-evaluated the safety of NPPs with frequent reviews (typically conducted every five years) in support of licence renewals and scheduled safety analysis report updates (also covering a five-year period). Larger re-evaluations (i.e., integrated safety reviews) have been performed in support of NPP life extensions to identify practicable upgrades. Nevertheless, the <i>CNSC Fukushima Task Force Report</i> recommended the implementation of periodic safety reviews in Canada.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Improves the regulatory framework. Re-evaluation of NPP safety on a periodic basis is implemented via the established compliance program and is a licence requirement for all Canadian licensees of operating NPPs. <p>No outstanding actions.</p>
2.3	<p><i>The assessment of natural hazards needs to consider the potential for their occurrence in combination, either simultaneously or sequentially, and their combined effects on an NPP. The assessment of natural hazards also needs to consider their effects on multiple units on an NPP site.</i></p>	<p>CNSC action:</p> <p>Natural hazards and combinations of hazards are included in PSAs to meet the requirements of the following action items outlined in the CNSC Integrated Action Plan:</p> <p>A.2.1.1 <i>Re-evaluate, using modern calculations and state-of-the-art methods, the site-specific magnitudes of each external event to which the plant may be susceptible.</i></p> <p>A.2.1.2 <i>Evaluate if the current site-specific design protection for each external event assessed in 1 above is sufficient. If gaps are identified a corrective plan should be proposed.</i></p> <p>Accidents on multiple units are considered in action items A.3.1 (extension of severe accident management guidelines to include multi-unit accidents) and A.3.2 (improved modelling of multi-unit severe accidents):</p> <p>A.3.1 <i>Licensees should:</i></p> <ol style="list-style-type: none"> <i>develop/finalize and fully implement severe accident management guidelines (SAMGs) at each station.</i> <i>expand the scope of SAMGs to include multi-unit and IFB [Irradiated Fuel Bay] events.</i> <i>demonstrate effectiveness of SAMGs. Licensees should validate and/or refine SAMGs to demonstrate their adequacy in the light of lessons drawn from the Fukushima Daiichi nuclear accident.</i> <p>A.3.2. <i>Licensees of multi-unit NPPs should develop improved modelling of multi-unit plans in severe accident conditions, or demonstrate that the current simple modelling assumptions are adequate. This assessment should consider elements of HOP [Human and Organizational Performance] under accident conditions.</i></p> <p>Action items are closed for all Canadian NPP licensees based on the following:</p> <ul style="list-style-type: none"> Acceptable PSAs and plans for additional work. This additional work

LL#	IAEA lesson	CNSC action and assessment
		<p>is still ongoing and subject to CNSC review as it pertains to site-wide PSA.</p> <ul style="list-style-type: none"> • Implementation and expansion of accident management guidelines, including coverage for spent fuel storage and multi-unit accidents. • Development of simplistic analysis models for multi-unit severe accidents and concrete plans for developing more realistic models. The CNSC has evaluated the plans and is in agreement with the direction being taken. <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
2.4	<p><i>Operating experience programmes need to include experience from both national and international sources. Safety improvements identified through operating experience programmes need to be implemented promptly. The use of operating experience needs to be evaluated periodically and independently.</i></p>	<p>CNSC action:</p> <p>Operating experience (OPEX) programs were assessed and were not identified as a weakness in Canada by the <i>CNSC Fukushima Task Force Report</i> (see sections 6.3.7, 6.4.1, 6.5, 9). No actions were raised on licensees.</p> <p>The CNSC continues to perform periodic evaluation of licensees' OPEX programs and has introduced an OPEX clearinghouse to make OPEX reviews more systematic.</p> <p>Licensees use the peer reviews of the World Association of Nuclear Operators, the CANDU Owners Group and other organizations to obtain independent review of their programs, including OPEX. In addition, the CNSC reports to the IAEA Event Database on events and incidents.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Defence in depth is acceptable. • Verification is integrated into licensing and compliance processes. <p>No actions required.</p>
2.5	<p><i>The defence in depth concept remains valid, but implementation of the concept needs to be strengthened at all levels by adequate independence, redundancy, diversity and protection against internal and external hazards. There is a need to focus not only on accident prevention, but also on improving mitigation measures.</i></p>	<p>CNSC action:</p> <p>Parts A1 to A6 of the CNSC Integrated Action Plan were aimed at strengthening defence in depth and improving emergency response. Actions covered all levels of defence in depth, with the majority aimed at improvements to levels 4 and 5. The CNSC's regulatory philosophy has shifted from prevention to prevention and mitigation.</p> <p>The related action items are closed for all Canadian NPP licensees.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth and enhances emergency response. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>

LL#	IAEA lesson	CNSC action and assessment
2.6	<i>Instrumentation and control systems that are necessary during beyond design basis accidents need to remain operable in order to monitor essential plant safety parameters and to facilitate plant operations.</i>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.1.8 <i>Licensees should provide a reasonable level of confidence that the means (e.g., equipment and instrumentation) necessary for severe accident management and essential to the execution of SAMGs will perform their function in the severe accident environment for the duration for which they are needed. This assessment should consider elements of HOP under accident conditions.</i></p> <p>The action item is closed for all Canadian NPP licensees.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
2.7	<i>Robust and reliable cooling systems that can function for both design basis and beyond design basis conditions need to be provided for the removal of residual heat.</i>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.1.7 <i>A plan and schedule for optimizing existing provisions and putting in place additional coolant make-up provisions and supporting analyses.</i></p> <p>All action items are closed for all Canadian NPP licensees. All key equipment is now in place and the associated changes to procedures, training and drills have been completed.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
2.8	<i>There is a need to ensure a reliable confinement function for beyond design basis accidents to prevent significant release of radioactive material to the environment.</i>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.1.3 <i>Licensees should evaluate the means to prevent the failure of the containment systems and, to the extent practicable, unfiltered releases of radioactive products in beyond-design-basis accidents including severe accidents. If unfiltered releases of radioactive products in beyond-design-basis accidents including severe accidents cannot be precluded, then additional mitigation should be provided. This assessment should consider elements of HOP under accident conditions.</i></p> <p>Hydrogen mitigation has been expanded by accelerating the installation of passive autocatalytic recombiners at all NPPs. Filtered containment venting is either installed or committed to at most NPPs.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth. • Verification is integrated into licensing and compliance processes.

LL#	IAEA lesson	CNSC action and assessment
		No outstanding actions.
2.9	<i>Comprehensive probabilistic and deterministic safety analyses need to be performed to confirm the capability of a plant to withstand applicable beyond design basis accidents and to provide a high degree of confidence in the robustness of the plant design.</i>	<p>CNSC action:</p> <p>Per LL #2.1, comprehensive PSAs are performed to meet the requirements of action item A.2.1.1 of the CNSC Integrated Action Plan:</p> <p>A.2.1.1 <i>Re-evaluate, using modern calculations and state-of-the-art methods, the site-specific magnitudes of each external event to which the plant may be susceptible.</i></p> <p>Although deterministic safety analyses were in place from initial licensing and have been continuously updated, further improvements to meet the more modern requirements of RD-310, <i>Safety Analysis for Nuclear Power Plants</i>, were already in progress as identified in action item A.2.2:</p> <p>A.2.2 <i>Implementation of RD-310, Safety Analysis for Nuclear Power Plants, is already in progress and being tracked by the CNSC/Industry Safety Analysis Improvement Initiative working group.</i></p> <p>RD-310 has since been updated as REGDOC-2.4.1, <i>Deterministic Safety Analysis</i>, with increased emphasis on multi-unit events and cliff-edge effects. Implementation of the requirements of REGDOC-2.4.1 is phased in through safety report update work.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth and improves the regulatory framework. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
2.10	<i>Accident management provisions need to be comprehensive, well designed and up to date. They need to be derived on the basis of a comprehensive set of initiating events and plant conditions and also need to provide for accidents that affect several units at a multi-unit plant.</i>	<p>CNSC action:</p> <p>This lesson is directly addressed through the following actions items in the CNSC Integrated Action Plan:</p> <p>A.3.1.1 <i>Where SAMGs have not been developed/finalized or fully implemented, provide plans and schedules for completion.</i></p> <p>A.3.1.2 <i>For multi-unit stations, provide plans and schedules for the inclusion of multi-unit events in SAMGs.</i></p> <p>A.3.1.3 <i>For all stations, provide plans and schedules for the inclusion of IFB events in station operating documentation where appropriate.</i></p> <p>A.3.1.4 <i>Demonstrate the effectiveness of SAMGs via table-top exercises and drills.</i></p> <p>Work was phased, beginning with completing the implementation of SAMGs under A.3.1.1 (which was almost complete at the time of the Fukushima accident) and then expanding to include irradiated fuel bays (spent fuel storage) under A3.1.3 and multi-unit SAMGs under A.3.1.2. Implementation work for A.3.1.2 is still in progress. The effectiveness of the SAMGs (A.3.1.4) has been demonstrated, but further demonstrations will be made as work continues.</p> <p>All action items are closed for Canadian NPP licensees.</p>

LL#	IAEA lesson	CNSC action and assessment
		<p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth and improves the regulatory framework. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
2.11	<p><i>Training, exercises and drills need to include postulated severe accident conditions to ensure that operators are as well prepared as possible. They need to include the simulated use of actual equipment that would be deployed in the management of a severe accident.</i></p>	<p>CNSC action:</p> <p>Per LL #2.10, this lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.3.1.4 Demonstrate the effectiveness of SAMGs via table-top exercises and drills.</p> <p>All licensees have demonstrated the capability to deploy mobile equipment in the prevention and mitigation of a severe accident.</p> <p>This action item is closed for Canadian NPP licensees.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth and enhances emergency response. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
2.12	<p><i>In order to ensure effective regulatory oversight of the safety of nuclear installations, it is essential that the regulatory body is independent and possesses legal authority, technical competence and a strong safety culture.</i></p>	<p>CNSC action:</p> <p>The CNSC's independence, legal authority, technical competence and safety culture have been assessed by the IAEA's Integrated Regulatory Review Service (IRRS) missions.</p> <p>Canada hosted an IRRS mission in 2009 that included a thorough peer review of the CNSC's independence, legal authority, adequacy of human and financial resources, corporate culture, and technical and scientific support. These areas were assessed to ensure they met the relevant IAEA requirements.</p> <p>Canada hosted a follow-up IRRS mission in 2011 that assessed the new (at that time) IRRS Fukushima core module as well as the CNSC's responses to the findings of the 2009 mission. There were no new findings related to the CNSC's regulatory independence, legal authority, technical competence or strong safety culture. The 2011 IRRS mission concluded that the CNSC response to the Fukushima nuclear accident was robust and comprehensive, and that the CNSC had an "effective and pragmatic framework" in place to implement the lessons learned from Fukushima.</p> <p>Results of the IRRS missions were made publicly available.</p> <p>The CNSC currently has in place an initiative to define and strengthen its safety culture as a regulator.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhances international collaboration and improves communication and public consultation. <p>No outstanding actions.</p>

LL#	IAEA lesson	CNSC action and assessment
2.13	<i>In order to promote and strengthen safety culture, individuals and organizations need to continuously challenge or re-examine the prevailing assumptions about nuclear safety and the implications of decisions and actions that could affect nuclear safety.</i>	<p>CNSC action:</p> <p>The CNSC has in place a comprehensive human and organizational performance program that assesses elements such as licensees' safety culture.</p> <p>In addition, the CNSC issued a discussion paper titled <i>Safety Culture for Nuclear Licensees</i>. This paper highlights the importance of safety culture in the nuclear industry and what has been done, both internationally and in Canada, to promote safety culture. It also sets the CNSC's strategy for safety culture in the Canadian nuclear industry.</p> <p>The discussion paper predates the Fukushima accident. However, because safety culture was already an integral part of the licence review process (under the established safety and control area of the CNSC's management system requirements), the CNSC Fukushima Task Force did not identify safety culture as a gap. Safety culture is continuously evaluated by CNSC staff.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Improves the regulatory framework and improves communication and public consultation. <p>No outstanding actions.</p>
2.14	<i>A systemic approach to safety needs to consider the interactions between human, organizational and technical factors. This approach needs to be taken through the entire life cycle of nuclear installations.</i>	<p>CNSC action:</p> <p>The CNSC has in place a comprehensive human and organizational performance program that assesses elements such as licensees' safety culture.</p> <p>The action items listed in the CNSC Integrated Action Plan included consideration of human and organizational performance.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Strengthens defence in depth. Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3. Emergency preparedness and response		
3.1	<i>In preparing for the response to a possible nuclear emergency, it is necessary to consider emergencies that could involve severe damage to nuclear fuel in the reactor core or to spent fuel on the site, including those involving several units at a multi-unit plant possibly occurring at the same time as a</i>	<p>CNSC action:</p> <p>Offsite emergency response is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.4.1 <i>Licensees should evaluate and revise their emergency plans in regard to multi-unit accidents and severe external events. This activity should include an assessment of their minimum complement requirements to ensure their emergency response organizations will be capable of responding effectively to multi-unit accidents or to severe natural disasters. This assessment should consider elements of HOP under accident conditions.</i></p> <p>(For onsite emergency response, see LL #2.10.)</p>

LL#	IAEA lesson	CNSC action and assessment
	<i>natural disaster.</i>	<p>This action item is closed for Canadian NPP licensees.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhances emergency response. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.2	<p><i>The emergency management system for response to a nuclear emergency needs to include clearly defined roles and responsibilities for the operating organization and for local and national authorities. The system, including the interactions between the operating organization and the authorities, needs to be regularly tested in exercises.</i></p>	<p>CNSC action:</p> <p>The need for emergency exercises is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.4.2 <i>Licensees should review their drill and exercise programs, to ensure that they are sufficiently challenging to test the performance of the emergency response organization under severe events and/or multi-unit accident conditions. This assessment should consider elements of HOP under accident conditions.</i></p> <p>Emergency exercises involving all responsible agencies have been performed. Verification is integral to CNSC regulatory oversight.</p> <p>Roles and responsibilities of responding organizations at the federal level, along with interfaces between the federal and provincial/territorial levels, were addressed in the update to the <i>Federal Nuclear Emergency Plan</i> and are further described in the all-hazards <i>Federal Emergency Response Plan</i>.</p> <p>Federal and provincial nuclear emergency management coordinating committees meet routinely to ensure common understanding of roles and responsibilities across all jurisdictions.</p> <p>Exercises that include all offsite response authorities are incorporated into an integrated nuclear exercise calendar maintained by Health Canada. They are also integrated with a national all-hazards exercise calendar.</p> <p>This action item is closed for all Canadian NPP licensees.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Strengthens defence in depth and enhances emergency response. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.3	<p><i>Emergency workers need to be designated, assigned clearly specified duties, regardless of which organization they work for, given adequate training, and be properly protected during an emergency. Arrangements need to be in place to integrate into the response those emergency workers who</i></p>	<p>CNSC action:</p> <p>This lesson is being addressed through amendments to section 15 of the <i>Radiation Protection Regulations</i>, which addresses doses to emergency personnel, to ensure it is in line with international practices. (The amendments are currently being drafted by the Department of Justice.)</p> <p>Coordination of offsite emergency workers is addressed in offsite response plans through the implementation of emergency worker centres. At the federal level, emergency workers who may be mobilized to assist with offsite monitoring activities are pre-designated, trained and assigned specific roles and responsibilities according to the existing concept of operations and standard operating procedures. Coordination and protection of emergency workers was tested in recent exercises; lessons learned are being addressed through inter-jurisdictional activities related to emergency</p>

LL#	IAEA lesson	CNSC action and assessment
	<i>had not been designated prior to the emergency, and helpers who volunteer to assist in the emergency response.</i>	<p>worker operations and safety, and through updates to standard operating procedures. Future exercises to test these arrangements are incorporated in a nuclear emergency exercise calendar maintained by Health Canada.</p> <p>In addition, this lesson is being addressed through:</p> <ul style="list-style-type: none"> • Health Canada's 2016 update to the <i>Canadian Guidelines for Protective Actions during a Nuclear Emergency</i> • Ontario's 2016 update to the <i>Provincial Nuclear Emergency Response Plan</i> • an update to the CSA N1600 <i>General requirements for nuclear emergency management programs</i>, issued in 2014 with a second edition in 2015 <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhances emergency response and improves the regulatory framework. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.4	<i>Arrangements need to be in place to allow decisions to be made on the implementation of predetermined urgent protective actions for the public, based on predefined plant conditions.</i>	<p>CNSC action:</p> <p>The CNSC Fukushima Task Force verified that the responsibilities for making decisions about urgent protective actions are adequately defined. No action was necessary in Canada. Discharge of responsibilities has been tested in emergency exercises such as Huron Challenge at Bruce Power and Exercise Unified Response at Darlington Nuclear Generating Station.</p> <p>In addition, the <i>Study of Consequences of a Hypothetical Severe Nuclear Accident and Effectiveness of Mitigation Measures</i> has determined that, if the identified protective measures are applied in accordance with plans, they will be effective in ensuring protection of the public.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Emergency response is acceptable. • Verification is integrated into licensing and compliance processes. <p>No actions required.</p>
3.5	<i>Arrangements need to be in place to enable urgent protective actions to be extended or modified in response to developing plant conditions or monitoring results. Arrangements are also needed to enable early protective actions to be initiated on the basis of monitoring results.</i>	<p>CNSC action:</p> <p>The CNSC Fukushima Task Force verified that the responsibilities for making decisions about urgent protective actions are adequately defined.</p> <p>Monitoring is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.5.3 <i>Licensees should install automated real-time station boundary radiation monitoring systems with appropriate backup power and communications systems.</i></p> <p>Health Canada also maintains a national real-time radiation monitoring system, with monitoring stations around all nuclear power plants and across the country to support the initiation of early protective actions based on monitoring results.</p>

LL#	IAEA lesson	CNSC action and assessment
		<p>This action item is closed for all Canadian NPP licensees.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Enhances emergency response. Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.6	<p><i>Arrangements need to be in place to ensure that protective actions and other response actions in a nuclear emergency do more good than harm. A comprehensive approach to decision making needs to be in place to ensure that this balance is achieved.</i></p>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.5.4 <i>Licensees should develop source term estimation capability, including dose modelling tools.</i></p> <p>The important subject of balancing risks is addressed by provincial and federal off-site plans to a certain extent.</p> <p>Health Canada is currently revising its protective action guidance to align with the recommendations of the IAEA with respect to generic criteria and operational intervention levels aimed at doing more good than harm. Decision makers are encouraged to weigh the possible dose consequences with other prevailing conditions, such as weather, traffic and time of day, all of which can influence the success or failure of actions such as evacuation.</p> <p>Health Canada will also participate in the development of a new IAEA document on considerations in the development of protection strategies for a nuclear emergency at a CANDU reactor.</p> <p>This action item is closed for all Canadian NPP licensees.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Enhances emergency response. Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.7	<p><i>Arrangements need to be in place to assist decision makers, the public and others (e.g. medical staff) to gain an understanding of radiological health hazards in a nuclear emergency in order to make informed decisions on protective actions. Arrangements also need to be in place to address public concerns locally, nationally and internationally.</i></p>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.6.1 <i>CNSC staff will meet with provincial and federal nuclear emergency planning authorities, to ensure understanding of recommendations and findings.</i></p> <p>It is also addressed through emergency exercises such as Huron Challenge at Bruce Power and Exercise Unified Response at Darlington Nuclear Generating Station.</p> <p>While not specific to decision makers, the CNSC has made available a great deal of information on its website (e.g., videos, infographics, feature articles, online modules) to explain complex concepts, particularly the effects of radiation and its sources, in a way that is easily understood by the public.</p> <p>Per LL #3.6, this action item is complete.</p> <p>The CNSC and Health Canada are participating in the development of the</p>

LL#	IAEA lesson	CNSC action and assessment
		<p>new IAEA safety guide DS475, which will focus on arrangements for public communications in preparedness and response for a nuclear or radiological emergency.</p> <p>The <i>Federal Nuclear Emergency Plan</i> includes arrangements to ensure that decision makers are informed, in plain language, of potential impacts of a nuclear emergency.</p> <p>Health Canada and its partners deliver periodic training on radiological health hazards and treatment to first responders and medical staff through the Medical Emergency Treatment for Exposures to Radiation (METER) program. This training program will soon be available online to increase its reach. Health Canada has also published the <i>Canadian Guide on Medical Management of Radiation Emergencies</i>.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhances emergency response. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.8	<p><i>Arrangements need to be developed at the preparedness stage for termination of protective actions and other response actions, and transition to the recovery phase.</i></p>	<p>CNSC action:</p> <p>Canada has begun developing a framework for the post-accident recovery and remediation phases of a nuclear accident or a radiological emergency. This includes the issue of transitioning from the emergency phase to the post-accident phase.</p> <p>In particular, the CNSC has engaged with some of its federal partners in the development of the strategy for post-accident recovery and there are plans to host either a workshop or exercise to test this phase of the response once the framework is either finalized or close to final.</p> <p>CNSC staff have completed benchmarking the guidelines and strategies developed by other countries, including France, the United States, the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden), and other nuclear organizations.</p> <p>In addition, Health Canada is currently revising its guidelines for protective actions during a nuclear emergency. While the focus of the new draft guidelines remains on the early and intermediate phases of the emergency, recommendations for protective actions, such as temporary relocation and food and drinking water control, could continue to be applied during the recovery phase.</p> <p>The CNSC is participating in the development of the new IAEA safety guide DS474, which focuses on arrangements for the termination of a nuclear or radiological emergency.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhances emergency response and enhances international collaboration. <p>No outstanding actions.</p>

LL#	IAEA lesson	CNSC action and assessment
3.9	<p><i>Timely analysis of an emergency and the response to it, drawing out lessons and identifying possible improvements, enhances emergency arrangements.</i></p>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.6.1 <i>CNSC staff will meet with provincial and federal nuclear emergency planning authorities, to ensure understanding of recommendations and findings.</i></p> <p>Per REGDOC-2.10.1, <i>Nuclear Emergency Preparedness and Response</i>, the CNSC also requires applicable licensees to ensure a sufficient quantity of iodine thyroid-blocking agents is pre-distributed to all residences, businesses and institutions within the designated plume exposure planning zone, along with instructions on the proper administration of these agents.</p> <p>Potassium iodide (KI) pills have been made available to residents in a 50-kilometre radius around the facilities, with delivery to the doorstep of every household within an 8- or 10-kilometre radius.</p> <p>The distribution of KI pills is accompanied by ongoing information and education programs that explain why the pills are available, how they should be stored and under what circumstances they should be administered.</p> <p>The CNSC has also published the <i>Study of Consequences of a Hypothetical Severe Nuclear Accident and Effectiveness of Mitigation Measures</i>, which sheds light on the importance of considering sensitive receptors (i.e., children) in emergency planning efforts such as KI pill administration.</p> <p>Both the <i>Federal Emergency Response Plan</i> and <i>Federal Nuclear Emergency Plan</i> include the requirement to analyze an emergency and the response to it, and then develop after-action reports and management response action plans based on the lessons identified. At the federal level, Health Canada's nuclear emergency management coordinating committees, as well as the Continuous Improvement to Federal Emergency Response (CIFER) process managed by Public Safety Canada, provide for implementing and tracking corrective actions.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Enhances emergency response and improves communication and public consultation. Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.10	<p><i>The implementation of international arrangements for notification and assistance needs to be strengthened.</i></p>	<p>CNSC action:</p> <p>Requests for assistance are directly addressed in the CNSC Integrated Action Plan:</p> <p>A.5.2 <i>Licensees should formalize all arrangements and agreements for external support, and should document these in the applicable emergency plans and procedures. This assessment should consider elements of HOP under accident conditions.</i></p> <p>Regarding international arrangements, part A4 of the CNSC Integrated Action Plan addresses strengthening international collaboration. In particular, action items A.12.1 and A.13.1 placed actions on CNSC staff to:</p> <ul style="list-style-type: none"> initiate discussions with CANDU senior regulators to determine areas

LL#	IAEA lesson	CNSC action and assessment
		<p>of interest where mutual support can be offered during a nuclear emergency</p> <ul style="list-style-type: none"> participate in collaboration with industry and other government stakeholders at the Second Extraordinary Meeting of the Convention on Nuclear Safety in August 2012 <p>A.12.1 <i>The CNSC is to initiate discussions with CANDU senior regulators, to determine areas of interest where mutual support can be offered during a nuclear emergency.</i></p> <p>A.13.1 <i>Canada, as a signatory to the Convention on Nuclear Safety, is required to participate in triennial review meetings of the Convention and any extraordinary meeting that may be agreed to by contracting parties. The CNSC on behalf of Canada is responsible for coordinating the preparation and submission of the national reports for peer review and the participation of Canadian delegates at the review or extraordinary meetings. The CNSC in collaboration with industry and government stakeholders is to prepare a national report for peer review by contracting parties and to participate at the 2nd Extraordinary Meeting of the Convention on Nuclear Safety on the sharing of lessons learned and actions taken by contracting parties in response to the Fukushima Daiichi nuclear accident.</i></p> <p>In keeping with its international commitments, the CNSC will continue to cooperate with other regulators and industry representatives in the implementation of the <i>IAEA Action Plan on Nuclear Safety</i>, promote global nuclear safety through the use of IAEA standards, and continue to support the Convention on Nuclear Safety and the International Emergency Centre.</p> <p>As Competent Authorities for the Convention on Notification of a Nuclear Accident, Health Canada and the CNSC have strengthened their standard operating procedures for communicating with the IAEA, and have practised these in recent exercises. Health Canada has implemented a statement of intent with the United States Department of Energy that includes arrangements for bilateral notifications of a nuclear emergency.</p> <p>Health Canada, as Competent Authority for the <i>Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency</i>, is actively engaged with the IAEA on activities to strengthen these arrangements. Canada has also registered biodosimetry assets under the IAEA's Response and Assistance Network, and continues to identify additional assets that can be registered to support international assistance.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Enhances emergency response and enhances international collaboration. Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>
3.11	<p><i>There is a need to improve consultation and sharing of information among States on protective</i></p>	<p>CNSC action:</p> <p>This lesson is directly addressed in the CNSC Integrated Action Plan:</p> <p>C.1.6 <i>The CNSC is to enhance collaboration with international peers through active participation at various international forums to</i></p>

LL#	IAEA lesson	CNSC action and assessment
	<i>actions and other response actions.</i>	<p><i>exchange communications best practices and lessons learned from the Fukushima crisis.</i></p> <p>This action item is complete. Canada provided significant resources in support of the IAEA report on the Fukushima Daiichi accident.</p> <p>Health Canada is an active participant in the IAEA International Radiation Monitoring Information System (IRMIS), whose objective is to share national real-time radiation monitoring data with Competent Authorities of other IAEA Member States during normal and emergency situations.</p> <p>Canada has also contributed to the development of the IAEA's assessment and prognosis function.</p> <p>Finally, Health Canada has put in place a statement of intent with the United States Department of Energy, which includes provisions for the sharing of information during a nuclear emergency.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhances emergency response and enhances international collaboration. • Verification is integrated into licensing and compliance processes. <p>No outstanding actions.</p>

Appendix B

Phase 2: Assessing radiological consequences and post-accident recovery

Table B.1 reproduces the lessons learned identified in sections 4 and 5 of the DG-IAEA Report and provides information about Canada's actions related to each lesson. The lessons are numbered based on the section of the DG-IAEA Report in which they appear.

Table B.1: Assessment of sections 4 and 5 of the DG-IAEA Report

LL#	IAEA lesson	CNSC action and assessment
4. Radiological consequences		
4.1	<i>In case of an accidental release of radioactive substances to the environment, the prompt quantification and characterization of the amount and composition of the release is needed. For significant releases, a comprehensive and coordinated programme of long term environmental monitoring is necessary to determine the nature and extent of the radiological impact on the environment at the local, regional and global levels.</i>	<p>CNSC action:</p> <p>Boundary monitoring is directly addressed in the CNSC Integrated Action Plan:</p> <p>A.5.3 <i>Licensees should install automated real-time station boundary radiation monitoring systems with appropriate backup power and communications systems.</i></p> <p>Health Canada's fixed monitoring sites provide additional capabilities for real-time data. This data is available in real time to emergency response authorities through Health Canada's web-enabled mapping tool, EMAP. Health Canada is also an active participant in the IAEA International Radiation Monitoring Information System (IRMIS), whose objective is to share national real-time radiation monitoring data with Competent Authorities of other IAEA Member States during normal and emergency situations.</p> <p>Arrangements for comprehensive, long-term environmental monitoring are described in federal and provincial emergency response plans, which include fixed and mobile capabilities as well as centralized laboratories for radiological analysis of various environmental media. In addition to provincial authorities, several federal organizations contribute to this comprehensive capability, including Health Canada, Natural Resources Canada and Atomic Energy of Canada Limited / Canadian Nuclear Laboratories. The CNSC has provided and continues to provide support in terms of technical expertise.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Enhances emergency response/preparedness. <p>No outstanding actions.</p>
4.2	<i>Relevant international bodies need to develop explanations of the principles and criteria for radiation protection that are understandable for non-specialists in order to make their application clearer for decision makers and the</i>	<p>CNSC action:</p> <p>Annex C of the CNSC Integrated Action Plan encompasses a series of actions related to improving communication with the public:</p> <ul style="list-style-type: none"> Enhancement of social media tools such as Facebook and YouTube to ensure the CNSC website provides, in plain language, information to the public, including information on the safety aspects of nuclear facilities and measures to deal with nuclear emergencies. Development of a crisis website that can be activated in the event of a

LL#	IAEA lesson	CNSC action and assessment
	<p><i>public. As some protracted protection measures were disruptive for the affected people, a better communication strategy is needed to convey the justification for such measures and actions to all stakeholders, including the public.</i></p>	<p>nuclear emergency in Canada.</p> <ul style="list-style-type: none"> • Enhancement of the existing educational resources section on the CNSC website by targeting a broader audience. CNSC Online is a Web-based educational tool that presents highly technical concepts (such as the nuclear fuel lifecycle and nuclear safety) in plain language to Canadians. Where practicable, this interactive tool has made effective use of animated graphics and illustrations. • Exploration of partnerships with science-based media organizations to provide media training to specialists and subject-matter experts (with greater emphasis on crisis communications) so they can better convey information in plain language. • Development of a graphic that clearly illustrates to the public the sequence of potential events during and immediately following an extreme accident at a Canadian nuclear power plant. <p>In terms of specifics, a series of items have been developed and posted on the CNSC website about concepts related to emergencies that the public should understand. These include fact sheets on managing doses to the public during a nuclear emergency and a fact sheet on reference levels. Several YouTube videos have also been created, including a series of “ask the expert” videos that address various emergency-related topics.</p> <p>Under the <i>Nuclear Safety and Control Act</i>, one of the CNSC’s objectives is to disseminate objective scientific, technical and regulatory information to the public concerning the Commission’s activities and how both the environment and Canadians’ health and safety are affected by the development, production, possession and use of nuclear substances and prescribed equipment.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhancing communications and public education. • Communication strategies and means are continuously improved at the CNSC as new information/technologies become available. <p>No outstanding actions.</p>
4.3	<p><i>Conservative decisions related to specific activity and activity concentrations in consumer products and deposition activity led to extended restrictions and associated difficulties. In a prolonged exposure situation, consistency among international standards, and between international and national standards, is beneficial, particularly those associated with drinking water, food,</i></p>	<p>CNSC action:</p> <p>The CNSC agrees that consistency among international standards – and between international and national standards – is beneficial.</p> <p>In Canada, controls on foodstuffs (including milk) are established by Health Canada and guidelines are presented in the <i>Canadian Guidelines for the Restriction of Radioactively Contaminated Food and Water Following a Nuclear Emergency</i>. These guidelines are being revised as part of Health Canada’s broader revision of its protective action guidelines for nuclear emergencies. The CNSC subscribes to Health Canada’s guidelines on drinking water.</p> <p>The CNSC will also address this lesson when establishing post-emergency recovery guidelines for consumer products. Both the CNSC and Health Canada have begun discussions on developing a framework for post-accident issues, which will include criteria for a range of recovery strategies.</p>

LL#	IAEA lesson	CNSC action and assessment
	<i>non-edible consumer products and deposition activity on land.</i>	<p>CNSC assessment:</p> <ul style="list-style-type: none"> Improves the CNSC regulatory framework/processes and emergency preparedness. <p>Work is ongoing under the CNSC and Health Canada with completion planned by 2017.</p>
4.4	<i>Personal radiation monitoring of representative groups of members of the public provides invaluable information for reliable estimates of radiation doses and needs to be used together with environmental measurements and appropriate dose estimation models for assessing public dose.</i>	<p>CNSC action:</p> <p>The CNSC agrees with this lesson learned. This effort would be carried out collaboratively by a number of government organizations and others. For example, Health Canada has instruments and expertise that can be used to carry out personal dose estimates. Health Canada's National Dosimetry Services, which provides emergency dosimetry services for emergency responders, can provide personal dosimetry for representative members of the public on request of a province or territory. Expertise is also found within the CNSC, applicable provincial authorities and many commercial organizations. There are currently provisions in place to allow for both the calculation and measurement of dose. However, details in terms of guidance material specific to this topic are needed and should be addressed as part of the recommendations for the post-recovery phase of the emergency.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Improves the CNSC regulatory framework/processes and emergency preparedness. <p>Work is ongoing under the CNSC and Health Canada with completion planned by 2017.</p>
4.5	<i>While dairy products were not the main pathways for the ingestion of radioiodine in Japan, it is clear that the most important method of limiting thyroid doses, especially to children, is to restrict the consumption of fresh milk from grazing cows.</i>	<p>CNSC action:</p> <p>Provisions to restrict the consumption of foodstuffs such as milk are currently covered in the <i>Canadian Guidelines for the Restriction of Radioactively Contaminated Food and Water Following a Nuclear Emergency</i>. These guidelines are being revised as part of Health Canada's broader revision of its protective action guidelines for nuclear emergencies.</p> <p>During an emergency, the provincial decision maker responsible for emergency response would lead in the restriction of local food and water consumption. The Canadian Food Inspection Agency (CFIA) and Health Canada would be involved in the testing of food and water samples, with the CFIA taking any necessary regulatory actions, such as product recalls, to ensure food safety.</p> <p>Provincial plans also include provisions for longer-term ingestion and assurance monitoring to ensure appropriate restrictions are put in place following an emergency. Health Canada and the CFIA work with the provincial authorities to manage these restrictions.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Improves Canada's regulatory framework/processes and emergency preparedness. <p>No outstanding actions.</p>

LL#	IAEA lesson	CNSC action and assessment
4.6	<p><i>A robust system is necessary for monitoring and recording occupational radiation doses, via all relevant pathways, particularly those due to internal exposure that may be incurred by workers during severe accident management activities. It is essential that suitable and sufficient personal protective equipment be available for limiting the exposure of workers during emergency response activities and that workers be sufficiently trained in its use.</i></p>	<p>CNSC action:</p> <p>The CNSC agrees with this lesson learned. This lesson is also partly addressed through the following action items in the CNSC Integrated Action Plan:</p> <p>A.8.1.1 <i>The CNSC will prepare and consult on a discussion paper on potential amendments to the Radiation Protection Regulations which will include proposed amendments to the emergency provisions in the regulations.</i></p> <p>A.8.1.3 <i>The CNSC will review results of consultation and prepare final amendments to the Radiation Protection Regulations and propose them to the Commission for enactment.</i></p> <p>Canada's <i>Radiation Protection Regulations</i> require licensees to ascertain and record the magnitude of effective dose and equivalent dose received by and committed to all workers, including during severe accident management activities. Workers' radiation doses must also be monitored to ensure they are below Canada's regulatory dose limits and maintained as low as reasonably achievable (ALARA), social and economic factors taken into account.</p> <p>The CNSC has drafted revised regulations on emergencies and emergency dose limits for Canada's <i>Radiation Protection Regulations</i>, which will be submitted for consultation in the <i>Canada Gazette</i>, Part I. These amendments are based on international benchmarking on the control and minimization of doses to persons in accordance with the severity of an emergency. They also address requirements related to pregnant workers, keeping doses ALARA and when a dose limit is exceeded in the context of an emergency.</p> <p>As for the availability of adequate radiation personal protective equipment (PPE) and sufficient training to persons on the use of such equipment, plans are in place. The CNSC has verified licensees' adequacy for PPE and instruments and found them acceptable.</p> <p>Health Canada provides services to support the monitoring and recording of occupational radiation doses. Health Canada's National Dosimetry Services will provide dosimeters to emergency workers to support external dose control. Health Canada also maintains the National Dose Registry for recording and tracking the occupational doses of all workers in Canada. In response to a recent national exercise in Canada, a multi-jurisdictional working group has been established to better define roles, responsibilities, resources and a concept of operations for emergency worker protection.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Improves Canada's regulatory framework and processes. <p>No outstanding actions.</p>
4.7	<p><i>The risks of radiation exposure and the attribution of health effects to radiation need to be clearly presented to stakeholders, making it</i></p>	<p>CNSC action:</p> <p>See LL #4.2 above concerning public communication initiatives. Greater efforts on risk communication are ongoing. As one example, this lesson links very closely with the CNSC's development of quantitative health objectives. These objectives will be communicated to the public so that the health risk associated with a possible emergency (for example) is</p>

LL#	IAEA lesson	CNSC action and assessment
	<i>unambiguous that any increases in the occurrence of health effects in populations are not attributable to exposure to radiation, if levels of exposure are similar to the global average background levels of radiation.</i>	<p>better understood.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Work is ongoing under continuous improvement. <p>No outstanding actions.</p>
4.8	<i>After a nuclear accident, health surveys are very important and useful, but should not be interpreted as epidemiological studies. The results of such health surveys are intended to provide information to support medical assistance to the affected population.</i>	<p>CNSC action:</p> <p>The CNSC will be involved in a health survey (in the case of a nuclear emergency) and will ensure the purpose and limitations of such a survey are clear.</p> <p>Health Canada has produced the <i>Canadian Guide on Medical Management of Radiation Emergencies</i>, which includes some guidance for longer-term follow-up health surveys. Although the roles and responsibilities for these surveys still need to be clarified, they will likely include provincial health authorities as well as, at the federal level, the Public Health Agency of Canada and Health Canada. Health surveys will be included in the recovery framework currently being discussed by the CNSC and Health Canada.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Enhances domestic and international cooperation. <p>No outstanding actions.</p>
4.9	<i>There is a need for radiological protection guidance to address the psychological consequences to members of the affected populations in the aftermath of radiological accidents. A Task Group of the ICRP has recommended that “strategies for mitigating the serious psychological consequences arising from radiological accidents [should] be sought.”</i>	<p>CNSC action:</p> <p>Although addressing the psychological consequences of a nuclear accident is not within the CNSC’s mandate, some elements of this lesson will be covered as part of the CNSC’s development of a post-emergency strategy. Provisions for managing psychological consequences are included in some provincial health emergency response plans, such as the <i>Radiation Health Response Plan</i> produced by the Ontario Ministry of Health and Long-Term Care. Health Canada has produced the <i>Canadian Guide on Medical Management of Radiation Emergencies</i>, which includes guidance for managing psychological consequences.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Improves Canada’s regulatory framework/processes and guidance during radiological emergencies <p>No outstanding actions.</p>
4.10	<i>Factual information on radiation effects needs to be communicated in an understandable and timely manner to individuals in affected areas in order to</i>	<p>CNSC action:</p> <p>In times of emergency, the ability to think logically is greatly hampered by fear. As such, the majority of the effort should be on communication and education during non-emergency periods. (For more details, see LL #4.2 concerning public communication initiatives.)</p> <p>Additionally, this issue is being addressed as part of the CNSC’s</p>

LL#	IAEA lesson	CNSC action and assessment
	<i>enhance their understanding of protection strategies, to alleviate their concerns and support their own protection initiatives.</i>	<p>development of a post-emergency strategy.</p> <p>Under the <i>Federal Nuclear Emergency Plan</i>, the Technical Assessment Group includes a “support to communications” function whose task is to formulate technical information into plain language for decision makers and the public. As follow-up to a recent national exercise, Health Canada is also working with its partners to provide plain-language training for designated officials.</p> <p>CNSC assessment:</p> <p>Work is ongoing under the CNSC and Health Canada with completion planned by 2017.</p>
4.11	<i>During any emergency phase, the focus has to be on protecting people. Doses to the biota cannot be controlled and could be potentially significant on an individual basis. Knowledge of the impacts of radiation exposure on non-human biota needs to be strengthened by improving the assessment methodology and understanding of radiation-induced effects on biota populations and ecosystems. Following a large release of radionuclides to the environment, an integrated perspective needs to be adopted to ensure sustainability of agriculture, forestry, fishery and tourism and of the use of natural resources.</i>	<p>CNSC action:</p> <p>To inform regulatory oversight, CNSC staff will continue to monitor the research being conducted at Fukushima and Chernobyl to understand the large-scale consequences of radioactive contamination in the environment on populations, communities and the general ecosystem. Based on the information to date, the CNSC’s current approach to assessing radiological effects on non-human biota from nuclear accidents (e.g., as part of environmental assessments) remains valid.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> • Continuous monitoring of international activities to ensure all elements being considered by international peers are reflected in the Canadian review scope. <p>No outstanding actions.</p>
5. Post-accident recovery		
5.1	<i>Pre-accident planning for post-accident recovery is necessary to improve decision making under pressure in the immediate post-accident situation. National strategies and measures for post-accident recovery need to be prepared in advance in</i>	<p>CNSC action:</p> <p>The CNSC is currently drafting post-accident recovery guidelines that address these issues.</p> <p>The CNSC and Health Canada are discussing approaches for developing a broader recovery framework involving all relevant partners.</p> <p>Additionally, the CNSC Commission has powers under sections 46 and 47 of the <i>Nuclear Safety and Control Act</i> to make decisions regarding contaminated lands and to take any measures necessary to protect human health during emergencies.</p>

LL#	IAEA lesson	CNSC action and assessment
	<i>order to enable an effective and appropriate overall recovery programme to be put in place in case of a nuclear accident. These strategies and measures need to include the establishment of a legal and regulatory framework; generic remediation strategies and criteria for residual radiation doses and contamination levels; a plan for stabilization and decommissioning of damaged nuclear facilities; and a generic strategy for managing large quantities of contaminated material and radioactive waste.</i>	<p>In a post-accident situation, Health Canada will work with its partners to provide analysis and communication of radiological analysis of various environmental media. This approach is currently being followed to manage ongoing concern from the public about the potential contamination of Canadian ocean waters due to the Fukushima accident.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Guidelines for food and water controls are currently in place as part of provincial and federal emergency offsite planning. <p>Work is ongoing under the CNSC and Health Canada with completion planned by 2017.</p>
5.2	<i>Remediation strategies need to take account of the effectiveness and feasibility of individual measures and the amount of contaminated material that will be generated in the remediation process.</i>	<p>CNSC action:</p> <p>This issue will be considered in the development of post-accident recovery guidelines.</p> <p>CNSC assessment:</p> <p>Work is ongoing under the CNSC and Health Canada with completion planned by 2017.</p>
5.3	<i>As part of the remediation strategy, the implementation of rigorous testing of and controls on food is necessary to prevent or minimize ingestion doses.</i>	<p>CNSC action:</p> <p>This issue has been considered in the development of post-accident recovery guidelines.</p> <p>In a post-accident situation, Health Canada will work with its partners to provide analysis and communication of radiological analysis of various environmental media. This approach is currently being followed to manage ongoing concern from the public about the potential contamination of Canadian ocean waters due to the Fukushima accident.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Guidelines for food and water controls are currently in place as noted previously. <p>Work is ongoing under the CNSC and Health Canada with completion planned by 2017.</p>

LL#	IAEA lesson	CNSC action and assessment
5.4	<i>Further international guidance is needed on the practical application of safety standards for radiation protection in post-accident recovery situations.</i>	<p>CNSC action:</p> <p>The CNSC agrees with this lesson and is monitoring the work of the international community.</p> <p>CNSC assessment:</p> <ul style="list-style-type: none"> Continuous monitoring of international activities to ensure all elements being considered by international peers are reflected in the Canadian review scope. <p>No outstanding actions.</p>
5.5	<i>Following an accident, a strategic plan for maintaining long term stable conditions and for the decommissioning of accident-damaged facilities is essential for on-site recovery. The plan needs to be flexible and readily adaptable to changing conditions and new information.</i>	<p>CNSC action:</p> <p>The CNSC agrees with this lesson. This kind of strategic plan would be integrated and aligned with licensees' already established preliminary decommissioning plans and radiation protection programs in accordance with Canada's <i>Radiation Protection Regulations</i>.</p> <p>CNSC assessment:</p> <p>No outstanding actions.</p>
5.6	<i>Retrieving damaged fuel and characterizing and removing fuel debris require solutions that are specific to the accident and special methods and tools may need to be developed.</i>	<p>CNSC action:</p> <p>Retrieving damaged fuel and developing special tools fall under the licensee's responsibilities. (See the response to LL #5.7 below.)</p> <p>CNSC assessment:</p> <p>No outstanding actions.</p>
5.7	<i>National strategies and measures for post-accident recovery need to include the development of a generic strategy for managing contaminated liquid and solid material and radioactive waste, supported by generic safety assessments for discharge, storage and disposal.</i>	<p>CNSC action:</p> <p>The safety assessment should include characterization of contaminated waters resulting from potential incidents related to CANDU reactors and taking into account the siting guidelines for Canadian NPPs. Based on the results, the safety assessment should address how contaminated waters will be safely managed to protect the environment. This may include addressing storage capacity and location, treatment technology and monitoring.</p> <p>As part of the <i>Nuclear Substances and Radiation Devices Regulations</i>, the CNSC has unconditional and conditional clearance criteria for the disposal of solid material. The act of remediation differs from decommissioning in that it is done outside of lifecycle planning. Regulatory oversight of the remediation activities must be clear, fair and commensurate with the risks involved.</p> <p>The International Commission on Radiological Protection (ICRP) has developed the concept of "reference levels" to address the decision-making challenges associated with regulating accidents. The CNSC will be incorporating remediation as a topic in an upcoming discussion paper on waste management and decommissioning, planned for publication in 2016.</p>

LL#	IAEA lesson	CNSC action and assessment
		<p>CNSC assessment:</p> <ul style="list-style-type: none"> This topic will be covered in a discussion paper on waste management and decommissioning. Development of the discussion paper is currently in progress. <p>No outstanding actions.</p>
5.8	<p><i>It is necessary to recognize the socioeconomic consequences of any nuclear accident and of the subsequent protective actions, and to develop revitalization and reconstruction projects that address issues such as reconstruction of infrastructure, community revitalization and compensation.</i></p>	<p>CNSC action:</p> <p>Addressing this issue is beyond the CNSC's mandate. It is a government policy.</p> <p>CNSC assessment:</p> <p>No outstanding actions.</p>
5.9	<p><i>Support by stakeholders is essential for all aspects of post-accident recovery. In particular, engagement of the affected population in the decision making processes is necessary for the success, acceptability and effectiveness of the recovery and for the revitalization of communities. An effective recovery programme requires the trust and the involvement of the affected population. Confidence in the implementation of recovery measures has to be built through processes of dialogue, the provision of consistent, clear and timely information, and support to the affected population.</i></p>	<p>CNSC action:</p> <p>The CNSC has established policies and practices that optimize openness, transparency and stakeholder engagement, including stakeholder involvement in the decision-making process. However, the importance of stakeholder involvement has been recognized and is addressed in the draft document on post-emergency recovery, with further development to be based on best practices from the cleanup of other contaminated sites.</p> <p>As stated in this lesson, confidence in the implementation of recovery measures has to be built through processes of dialogue with the affected population. This dialogue must take place before an accident happens (i.e., while there is no state of panic or fear-mongering by interested parties).</p> <p>The CNSC and Health Canada are currently discussing approaches for developing a broader recovery framework involving all relevant partners and stakeholders.</p> <p>CNSC assessment:</p> <p>Work is ongoing under the CNSC and Health Canada with completion planned by 2017.</p>

References

- 1 [*The Fukushima Daiichi Accident – Report by the Director General*](#), September 2015.
- 2 INFO-0824, [*CNSC Fukushima Task Force Report*](#), October 2011.
- 3 [*CNSC Integrated Action Plan On the Lessons Learned From the Fukushima Daiichi Nuclear Accident*](#), August 2013.
- 4 [*Federal Nuclear Emergency Plan*](#), Health Canada, April 2014.
- 5 [*IAEA Action Plan on Nuclear Safety*](#), September 2011.
- 6 [*Canadian National Report for the Convention on Nuclear Safety: Sixth Report*](#), August 2013.
- 7 [*Integrated Regulatory Review Service \(IRRS\) Follow-up Mission to Canada*](#), December 2011.
- 8 [*Report of the External Advisory Committee Examining the Response of the Canadian Nuclear Safety Commission to the 2011 Japanese Nuclear Event*](#), April 2012.