

## Analysis of the CNSC Staffs Action Plan to Reflect Lessons Learned from Fukushima Accident

Sang-Kyu Ahn\*, Young Gill Yune, Hyung-Joon Ahn, Byung-Jik Kim,  
, Jin-Ho Lee

Korea Institute of Nuclear Safety, 62 Gwahak-ro, Yuseong, Daejeon, Korea, 305-338

\*Corresponding author: [k052ask@kins.re.kr](mailto:k052ask@kins.re.kr)

### 1. Introduction [1]

The combined impact of the earthquake and tsunami on the Fukushima Daiichi nuclear power plant caused a severe nuclear accident. In response to these events, the Canadian Nuclear Safety Commission (CNSC) established the CNSC Fukushima Task Force in April 2011 to review licensees' responses to the CNSC order, under subsection 12(2) of the General Nuclear Safety and Control Regulations, to re-examine the safety cases of their nuclear power plants.

On September 30, 2011, the Task Force completed its review and presented the public with the findings and recommendations in the CNSC Fukushima Task Force Report. The Task Force made 13 recommendations to further enhance the safety of nuclear power plants in Canada.

After that, the CNSC established the CNSC Staffs Action Plan based on the Fukushima Task Force's recommendations.

In Canada, 19 nuclear power reactor units are currently producing electric power, and all of them are pressurized heavy water-reactor (PHWR) types. Also, considering 2 power reactor units in Korea, Wolsung unit 1& 2, are the same reactor type, the analysis of the CNSC Staffs Action Plan will be of benefit to determining recommendations of Korea to address lessons learned from the Fukushima Daiichi nuclear power plant. Therefore, the CNSC Staffs Action Plan was introduced and analyzed in this study,

### 2. CNSC Staffs Action Plan Process to Establish the Plan [1]

The major milestones of the process consisted of the following:

- October 28, 2011 – December 1, 2011  
Posting of the CNSC Fukushima Task Force Report and CNSC Management Response for public and stakeholder review
- December 21, 2011 – February 3, 2012  
Posting of the draft CNSC Staff Action Plan and disposition of comments received on the Task Force Report for public and stakeholder review
- February 3, 2012 – March 3, 2012 (completed)  
Disposition of comments received from the public and stakeholders and revision of the CNSC Staff Action Plan as required
- February 17, 2012

Notification by the CNSC to licensees of site-specific Fukushima action items (FAIs)

- March 2, 2012 – April 3, 2012  
Posting of Commission member document (CMD) for public comment on the:
  - CNSC Staff Action Plan
  - Disposition Report of comments received from the public and stakeholder review of the draft CNSC Staff Action Plan
- May 3, 2012  
Commission public meeting on the revised CNSC Staff Action Plan

### 3. The Fukushima Task Force's Recommendations

The followings are the TF's recommendations:

- 1) Licensees should systematically verify the effectiveness of, and supplement where appropriate, the existing plant design capabilities in beyond-design-basis accident and severe accident conditions.
- 2) Licensees should conduct more comprehensive assessments of site-specific external hazards
- 3) Licensees should enhance their modelling capabilities and conduct systematic analyses of beyond-design-basis accidents to include analyses of:
  - a) multi-unit events,
  - b) accidents triggered by extreme external events, and
  - c) spent fuel bay accidents.
- 4) Licensees should assess emergency plans to ensure emergency response organizations will be capable of responding effectively in a severe event and/or multi-unit accident, and conduct sufficiently challenging emergency exercises based on them.
- 5) Licensees should review and update their emergency facilities and equipment.
- 6) Federal and provincial nuclear emergency planning authorities should undertake a review of their plans and supporting programs.
- 7) The CNSC should initiate a formal process to amend the Class I Nuclear Facilities Regulations to require NPP licensees to submit offsite emergency plans with an application to construct or operate a nuclear power plant.
- 8) The CNSC should amend the Radiation Protection Regulations to be more consistent with current international guidance and to describe in greater detail the regulatory requirements needed to address radiological hazards during the various phases of an emergency.
- 9) The CNSC should update the regulatory document

framework through:

- a) updating selected design-basis and beyond-design-basis requirements and expectations,
- b) developing a dedicated regulatory document on accident management,
- c) strengthening the suite of emergency preparedness regulatory documents, and
- d) reviewing applicable Canadian Standards Association standards.

10) The CNSC should amend all power reactor operating licenses (PROLs) to include specific license conditions, requiring implementation of accident management provisions, severe accident management and public information.

11) The CNSC should further enhance the regulatory oversight of nuclear power plants through the implementation of a periodic safety review process.

12) The CNSC should review memoranda of understanding with regulatory counterparts in countries with CANDU reactors to outline what support, if any, they would require from the CNSC during a nuclear emergency.

13) The CNSC should enhance cooperation with other nuclear regulators in addressing the lessons learned from the Fukushima Daiichi nuclear accident and thus further strengthen the capability to respond efficiently to any nuclear emergency.

The following table 1 shows the implementation time line of each recommendation.

Table 1: Implementation Timeline of the Action Plan

Recommendations	Implementation Timeline		
	Short term (Dec 2012)	Med. term (Dec 2013)	Long term (Dec 2015)
<b>Technical and operational recommendations for CNSC staff and licensee actions</b>			
Recommendation 1	×	×	×
Recommendation 2		×	
Recommendation 3		×	
Recommendation 4	×		
Recommendation 5	×		
Recommendation 12	×		
Recommendation 13	×		
<b>Regulatory recommendations for Commission approval</b>			
Recommendation 6		×	
Recommendation 7		×	
Recommendation 8		×	
Recommendation 9	×	×	
Recommendation 10	×		
Recommendation 11	×		

The CNSC Staff Action Plan identifies 33 actions that address the above 13 Task Force Report recommendations. All actions are grouped in the following three categories:

Part 1 – Strengthening reactor defense in depth

Part 2 – Enhancing emergency response

Part 3 – Improving regulatory framework and processes

#### 4.1. Part 1 – Strengthening reactor defense in depth

Actions to implement by licenses are as follow:

- To submit additional evidence that provides confidence in the bleed condenser/degasser condenser relief capacity.
- To re-examine the capability of the shield tank/calandria vault relief to discharge steam produced in a severe accident.
- To 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.
- To complete the installation of passive autocatalytic recombiners (PARs) as quickly as possible.
- To evaluate the need for hydrogen mitigation if draining of the irradiated fuel bay (IFB) following a beyond-design-basis event cannot be precluded
- To evaluate the structural integrity of the IFB at temperatures in excess of the design temperature limit.
- To evaluate means to provide coolant make-up to the primary heat transport system, steam generators, moderator, shield tank/calandria vault, spent fuel pools and dousing tank where applicable.
- To provide a reasonable level of confidence that the means necessary for severe accident management and essential to the execution of SAMGs will perform its function in the severe accident environment for the duration for which it is needed.
- To ensure the habitability of control facilities under conditions arising from beyond-design-basis and severe accidents.
- To investigate means of extending the availability of power for key instrumentation and control (I&C) needed in accident management actions following a loss of all AC power.
- To procure, as quickly as possible, emergency equipment and other resources that could be either stored onsite or stored offsite and brought onsite to mitigate a severe accident.
- To complete the review of the basis for external events against modern state-of-the-art practices for evaluating external events magnitudes and relevant design capacity for these events.
- To Implement the RD-310, Safety Analysis for Nuclear Power Plants.
- To develop/finalize and fully implement severe accident management guidelines (SAMGs) at each station.
- To develop improved modelling of multi-unit plans in

#### 4. CNSC Staffs Action Plan [1]

severe accident conditions or demonstrate that the current simple modelling assumptions are adequate for only licensees of multi-unit NPPs

#### *4.2. Part 2 – Enhancing emergency response*

Actions to be implemented by Licenses are as follow:

- To evaluate and revise their emergency plans in regard to multi-unit accidents and severe external events.
- To 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.
- To review primary and alternate emergency facilities, and all emergency response equipment that requires electrical power to operate to make sure that appropriate backup power sources exist.
- To formalize all arrangements and agreements for external support, and document these in the applicable emergency plans and procedures.
- To install automated real-time station boundary radiation monitoring systems with appropriate backup power and communications systems.
- To develop source term estimation capability including dose modelling tools.

CNSC staff will meet with provincial and federal nuclear emergency planning authorities to ensure understanding of recommendations and findings.

#### *4.3 Part 3 – Improving regulatory framework and process*

The CNSC staff's activities are as follow:

- To amend the Radiation Protection Regulations to introduce additional clarity on emergency dose limits for workers and to establish return to work criteria.
- To amend applicable regulatory documents in order to incorporate the findings of the CNSC Task Force for both existing and new nuclear power plants.
- To develop dedicated regulatory documents on accident management and emergency management.
- To review of Canadian Standards Association Standards to take into account the lessons from the Fukushima Daiichi nuclear accident through its participation in the CSA Committee.
- Require licensees to have programs for accident management, severe accident management and public communication.
- To develop and submit to the Commission for approval, RD/GD-99.3, Requirements and Guidance for Public Information and Disclosure.
- To enhance the regulatory oversight of nuclear power plants through the implementation of a periodic safety review process.
- To initiate discussions with CANDU Senior Regulators to determine areas of interest where mutual support can be offered during a nuclear emergency.

- To prepare a national report for 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.

## **5. Conclusions**

From the results of the above analysis, it is recognized that the strengthening of defense in depth, emergency preparedness and the regulatory oversight of nuclear power plants in Canada were emphasized and much similar to practices of other countries [2, 3].

Public consultation process establishing the CNSC Staffs action plan has been carried out several times, in order to ensure regulatory transparency, by the CNSC staffs, and this is comparable with other countries.

It is expected that the detail analysis results [4] of the above plan will be helpful to enhance the safety of domestic operating nuclear power plants.

## **REFERENCES**

- [1] CNSC Staff Action Plan on the CNSC Fukushima Task Force Recommendations, INFO-0828, CNSC, March 2012
- [2] German Action Plan for the implementation of measures after Fukushima Dai-ichi reactor accident, December 2012
- [3] UK ONR ENSERG Related 'National Action Plan', Office for Nuclear Regulation, An agency of HSE, December 2012
- [4] Analysis of the CNSC Staffs Action Plan to Reflect Lessons Learned from Fukushima Accident, KINS/RR-1088, KINS, February 2014