

## Review of Regulations on Continued Operation for CANDU Reactors

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### 1. Introduction

The first CANDU type reactor, Wolsong Unit 1, has been operating for twenty four years since the commencement of its commercial operation in 1983 and its lifetime will be completed until end of 2012. Hence the licensee, KHNP, is considered a continued operation for Wolsong Unit 1 in economic point of view. Regarding to the license of the continued operating of nuclear power plants including CANDU reactors, a regulatory body is developing the regulatory requirements on continued operation for reviewing the technical requirements of safety assessment and management of aging for structures, systems and components (SSC) in the nuclear power plants. Regarding to this, in this paper the review contents are described and general review results are presented.

### 2. Review Contents and Results

#### 2.1 Nuclear Safety Regulatory System

The evaluation for continued operation of nuclear power plants over the design lifetime should be performed in compliance with the legal provisions, the periodic safety review. Therefore, licensing documents for continued operation should be permitted according to Article 23-3 of Atomic Energy Act and the related regulations. These regulations are as follows:

- Enforcement Decree of the Atomic Energy Act: Presidential Decree
- Enforcement Regulation of the Atomic Energy Act: Prime Ministerial Ordinance
- Regulations on Technical Standards for Nuclear Reactor Facilities, etc
- Regulations on Technical Standards for Radiation Safety Management, etc
- Notice of the Minister of Science and Technology

Table 1 is shown regulations on continued operation of nuclear power plants that are expired design lifetime

#### 2.2 Canada Nuclear Safety Regulatory System

The regulatory guide on life extension of Canada nuclear power plants was recently developed [1]. The Canadian Nuclear Safety Commission has not issued explicit requirements on aging management. However, a number of age-related regulatory requirements are included in several regulatory documents, including [2]:

- AECB Regulatory Document R-7
- AECB Regulatory Document R-8
- AECB Regulatory Document R-9
- CNSC Regulatory Standard S-98

In order to address aging, Canadian CANDU nuclear power plant utilities are required to inspect and perform material surveillance according to the technical requirements of CSA standards. Therefore, the requirements of regulatory documents and CSA standards should be considered in the aging assessment and management for continued operation of CANDU reactors.

Table 1 Regulation on continued operation for domestic power reactors

Atomic Energy Act	Enforcement Decree of the Atomic Energy Act	Enforcement Regulation of the Atomic Energy Act	Regulations on Technical Standards
Article 23-3 (Periodic Safety Review)	Article 42-2 (Time, etc. for Periodic Safety Review)		1. Location of Reactor Facilities 2. Structure, Installations & Performance of Reactor Facilities 3. Operation of Reactor Facilities 4. QA regarding Construction and Operation of Reactor Facilities
	Article 42-3 (Contents for Periodic Safety Review)	Article 19-2 (Details of Periodic Safety Review)	
	Article 42-4 (Methods and Standards for Periodic Safety Review)	Article 19-3 (Criteria for Periodic Safety Review)	
	Article 42-5 (Review Period for Periodic Safety Review Report)		
Article 24 (Revocation, etc. of Operating License)			MOST Notice 2002-5, 2007-XX
Article 111 (Delegation of Authority)			
Article 119 (Penal Provisions)			

#### 2.3 IAEA Safety Series

IAEA safety series includes concepts and principles, basic requirements, recommendations, and practical examples and detailed methods to ensure safety. IAEA has specially developed following technical standards on assessment and management of aging for long term operation.

- (1) IAEA Safety Series No. 50-P-3 [3]
- (2) IAEA Technical Report Series No. 338 [4]
- (3) IAEA Safety Report Series No. 15 [5]
- (4) IAEA TECDOCs

Safety Series No. 50-P-3 provide advice on data needs and on an effective and practical system for data collection and record keeping in connection with the

evaluation and management of nuclear power plant aging and service life. Technical report series No. 338 provides the methodologies for selection of NPP component and aging management studies. Finally, Safety report series No. 15 provides objective, concept, scope, and implementation of an aging management program. Therefore, these technical standards should be considered in the aging assessment and management for continued operation of power reactors.

#### *2.4 Review of Regulations on Continued Operation*

The following particulars of regulations on continued operation based on the regulatory guide and IAEA safety series on long term operation of nuclear power plants were reviewed.

- Particulars regarding the Assessment of Continued Operation
- Particulars regarding the Scoping and Screening for Aging Management Assessment
- Particulars regarding the Assessment for Aging Management Plan
- Particulars regarding the Lifetime Evaluation for Continued Operation

As a result of reviewing, the regulations necessary to amend were confirmed as follows:

- Regulation on the Other Safety-related Facilities of Reactors (Notice of MOST 2005-8)
- Article 56 (Operating Procedure) of Regulations on Technical Standards for Nuclear Reactor Facilities, etc
- Article 63 (Testability, Monitorability, Inspectability, and Maintainability) of Regulations on Technical Standards for Nuclear Reactor Facilities, etc

#### *2.5 Amendment Direction of Regulations*

1. Regulation on the other safety-related facilities of reactors (Notice of MOST 2005-8)

The moderator system for CANDU reactors, one of the safety-related systems, is not included in safety-related facilities of Article 9, Enforcement Decree of Act or MOST Notice 2005-8. Since the moderator system facilities are considered the specific system of CANDU reactors, Clause 1 and asterisk in Clause 2, Article 2 of MOST Notice 2005-8 should be supplemented the moderator system facilities.

2. Article 56 (Operating Procedure) of Regulations on Technical Standards for Nuclear Reactor Facilities, etc

Aging management for safety-related facilities is important to maintain the integrity for operating plants as well as nuclear power plants that expired design life. Therefore, the management of aging effects should be

considered in operating procedures on administration, operation, testing, and maintenance.

3. Article 63 (Testability, Monitorability, Inspectability, and Maintainability) of Regulations on Technical Standards for Nuclear Reactor Facilities, etc

Aging effects for pressure tubes such as creeping, diametral expansion, sagging, and etc. have considered as a safety issue in CANDU reactors. The activities for monitoring, evaluation is necessary for aging management of pressure tube. Therefore, Article 63 of regulations on technical standards should be complement for pressure tubes on equal terms with reactor pressure vessel.

### **3. Conclusion**

The regulatory requirements and technical standards on aging assessment and aging management of CANDU power reactors were reviewed. The regulations of necessary to amend from the reviewing for regulations were confirmed some items. We are considered that those results can be utilized in review on continued operation of CANDU reactors.

### **REFERENCES**

- [1] CNSC, "Life Extension of Nuclear Power Plants", Reg. Guide G-360, May 2006
- [2] IAEA, "Nuclear Power Plant Life Management Processes: Guidelines and Practices for Heavy Water Reactors", IAEA-TECDOC-1503, June 2006
- [3] IAEA, "Data Collection and Record Keeping for the Management of Nuclear Power Plant Ageing", Safety Series No. 50-P-3, 1991
- [4] IAEA, "Methodology for the Management of Ageing of Nuclear Power Plant Components Important to Safety", Technical Report Series No. 338, 1992
- [5] IAEA, "Implementation and Review of a Nuclear Power Plant Ageing Management Programme", Safety Report Series No. 15, 1999