

## Establishment of Regulations on Refurbishment Activities for CANDU Reactors

Sang Kyu Lee, Manwoong Kim, Hyun Koon Kim  
*Korea Institute of Nuclear Safety, 19 Guseong-dong, Yuseong-gu, Daejeon*

HeeYung Roh, Tae Eun Jin  
*Korea Power Engineering Co., 360-9 Mabuk-dong, Giheung-gu, Yongin-si, Gyeonggi-do*

### 1. Introduction

The first domestic CANDU power reactor, Wolsong Unit 1, has been operated for about twenty years since the commencement of its commercial operation in 1983. Due to long operation, the following aging issues are currently considered as a safety issue for CANDU reactors; pressure tubes creeping and sagging, calandria tubes elongation, feeder pipes thinning, etc. To resolve these aging issues, utility is promoting the refurbishment activities for replacing these degraded components. Therefore, to prepare the licensing demand on Wolsong Unit 1 refurbishment, there is a necessary to complement regulatory requirements and guides related with refurbishment activities. In addition, considering the new issued regulatory documents by CNSC, there is a necessary to complement current national technical requirements for CANDU reactors in law with new issued regulatory requirements. In this regard, the review contents are described herein, and representative review results are presented.

### 2. Review Contents and Results

#### 2.1 Domestic Nuclear Safety Regulatory System

The replacement activities of safety related nuclear facilities are attended accompanies with modification of licensing permits. Therefore, it should be permitted according to Article 21 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 replacement activities of safety related facilities

#### 2.2 Canada Nuclear Safety Regulatory System

The major Canadian nuclear safety commission regulatory documents applicable to a new build CANDU reactor are listed as follows:

- AECB Draft Regulatory Guide C-6
- AECB Regulatory Document R-7
- AECB Regulatory Document R-8
- AECB Regulatory Document R-9
- AECB Regulatory Document R-10
- AECB Regulatory Document R-77, etc
- CNSC Regulatory Standard S-294
- CNSC Regulatory Standard S-98

These Canadian nuclear safety commission regulatory documents are applied not only new construction but also refurbishment activities of CANDU reactors. Therefore, the requirements of these regulatory documents for refurbishment activities CANDU reactors was required to consider for domestic operation modification permission related regulations.

Table 1 Regulations on replacement activities of safety related facilities

Atomic Energy Act	Enforcement Decree of the Atomic Energy Act	Enforcement Regulation of the Atomic Energy Act	Regulations on Technical Standards
Article 16 (Inspection)	Article 27 (pre-service Inspection)		MOST Notice 2005-9, 2001-43, 2005-19
	Article 28 (Application of pre-service Inspection)	Article 14 (Application on pre-service Inspection)	
	Article 29 (Time on pre-service Inspection)		
Article 21 (Operation Permission)	Article 34 (Application on Operation Modification Approval)	Article 17 (Application on Operation Modification Approval)	
Article 22 (Approval Criteria)			Article 12-49 Article 68-85
Article 29 (Acceptance Criteria)	Article 102 (safety measures on operation of power reactor)		Article 51-66

#### 2.3 Review of Refurbishment related Regulations

The following regulations on domestic operation modification permission were reviewed item by item [1].

- (1) Safety-related facilities of power reactor
- (2) Operation modification permission on enforcement decree and regulation of Act
- (3) Performance requirements and technical standards on construction permission

- (4) Technical standards on operation permission
- (5) Technical standards on pre-service inspection
- (6) Technical standards on safety measures of power reactors
- (7) Quality certification on CP and OP of power reactor facilities

The regulations of necessary to amend were confirmed from the reviewing for above regulations.

- MOST Notice 2005-8
- Article 20 (Instrument & Control Equipments)
- Article 41 (Test, Monitor, Inspection, and Repair)
- Regulations on Pre-service Inspection of Power Reactor Facilities

#### 2.4 Amendment 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 complemented for the moderator system facilities.

2. Regulations on Technical Standards for Nuclear Reactor Facilities, etc

##### Article 20 (Instrument & Control System)

On a while, the parameters in Clause 1, Article 20 of Regulations on Technical Standards are monitored in CANDU reactors. But primary coolant in Clause 1, Article 20 of Regulations on Technical Standards should be classified as coolant and moderator in case of CANDU reactors because of other contamination process due to the release of radioactive material. Also, since coolant and moderator are heavy water, matter on installation of equipments to measure tritium in the atmosphere should be added in Clause 1, Article 20 of Regulations on Technical Standards.

##### Article 41 (Testability, Monitorability, Inspectability, and Maintainability)

The design requirement on testing and inspection of CANDU reactors is included in safety design guide, SDG-002, -003, -004, -005, and -006. Since these requirements are comprehensively specified in Article 41 of Regulations on Technical Standards, this article is not required supplement. But the specific components of CANDU reactor such as pressure tubes, feeder pipes, and calandria tubes should be included the scope of

vessels and piping in Clause 3, Article 41 of Regulations on Technical Standards and Article 1 of MOST Notice 2005-25.

3. Regulations on Pre-service Inspection of Power Reactor Facilities (Notice of MOST 2005-9)

The detailed standard for Article 27 of Enforcement Decree of Act, MOST Notice 2005-9, is not included contents on pre-service inspection of CANDU reactors. Therefore, the contents on pre-service inspection of CANDU reactors should be included in MOST Notice 2005-9. The draft for amendment contents of MOST Notice 2005-9 is as follows:

- All Articles of the MOST Notice 2005-9 maintain the present state because it is applicable for both reactor types, PWRs and CANDUs.
- The contents of each asterisk (Asterisk 1 ~ 2) supplements the specific items of CANDU reactors[2]

### 3. Conclusion

The reviews on regulatory requirements and technical standards on refurbishment activities and replacement of primary facilities of CANDU power reactor such as pressure tubes, feeder pipes, and etc. were performed. The regulations of necessary to amend from the reviewing for regulations were confirmed 4 items. We are considered that these results can be utilized in review on refurbishment activities for CANDU reactors.

### REFERENCES

- [1] KINS, "Development of the Safety Regulatory Guides on the Refurbishment for the CANDU Reactors", KINS/HR-745, Chapter 4, 2006
- [2] MOST, "Development of Regulatory Technology and Requirements for CANDU NPPs", KINS/GR-244, Mar. 2002