

Development of Regulatory Requirements and Inspection Guides for CANDU Reactors

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1. Introduction

The first domestic CANDU power reactor, Wolsong unit 1, has been operated for about twenty years since commercial operation in 1983, and has been raised common aging issues of CANDU reactors in pressure tubes, calandria tubes, feeder pipes, etc. To solve these aging issues, utility is promoting the refurbishment activities for these major components. Therefore, confirmation and improvement for insufficient requirements considering the CNSC regulatory documents, regulatory principles between regulatory body and utilities related with refurbishment activities are required. These 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.

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 supplemented 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 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 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.

4. Safety Inspection Guides for Re-tubing and Refurbishment of CANDU Reactors

According to the re-tubing and refurbishment activities for Wolsong Unit 1, the pre-service (installation and performance) inspection guides for CANDU reactors are developed. The contents on pre-service inspection guides for CANDU reactors are consisted of 17 guidelines in compliance with activities of the re-tubing and refurbishment for Wolsong Unit 1.

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. In addition, 17 inspection guides for the re-tubing and refurbishment program of Wolsong Unit 1. There 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