

# Methodology of Period Safety Review for Seismic Qualification of Equipment in Operating Nuclear Power Plants

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## 1. Introduction

According to Korean nuclear energy act, the safety review should be performed for operating nuclear power plants every ten year. In case of other countries, the review for seismic qualification of equipment is included in Periodic Safety Review (here in after called 'PSR') of IAEA Safety Series<sup>1)</sup>. With the PSR of Kori Nuclear Power Plant (here in after called 'NPP') unit 1 beginning in May 2001, the PSR of Wolsong NPP unit 1 and Kori NPP units 2, 3, 4 were performed, and now the PSR of Yonggwang NPP units 1, 2, 3, 4 are performing. The PSR of Ulchin NPP units 1, 2 will be started soon. As the scope of seismic PSR is six items related to equipment qualification on Korean nuclear energy act, the purpose of this paper is to contribute to guarantee of safety in operating NPPs through PSR. In this paper, the overall methodology of PSR for seismic qualification of equipment will be introduced in operating NPPs including induction of safety enhancement. And also the control plan and procedure will be suggested as induced safety enhancement through seismic PSR.

## 2. Review Scope

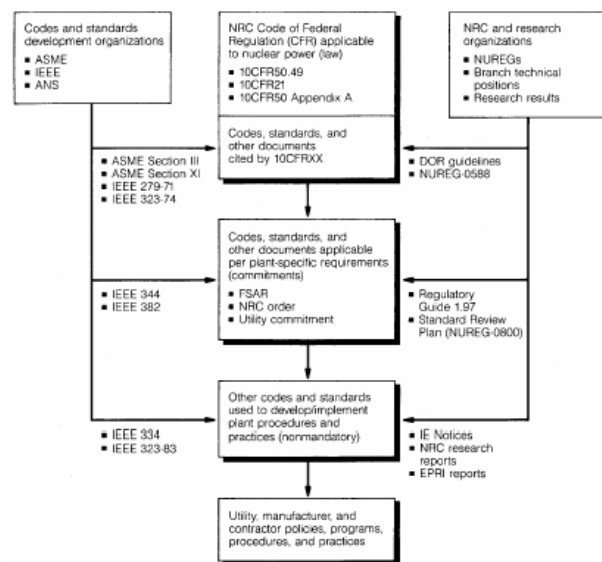
NPP equipment important to safety should be properly qualified to ensure its capability to perform its safety functions under postulated service conditions, including those arising from external events and accidents in a manner consistent with the safety classification. A qualification procedure should confirm that the equipment is capable of meeting, throughout its service life, the requirements for performing safety functions while subject to the environmental conditions existing at the time of need, and taking into account aging degradation of the equipment that occurs during service<sup>2)</sup>. The scope of seismic PSR is six items on the enforcement decree 19.2 of Korean nuclear energy act as follows<sup>3)</sup>.

- List and control procedure of qualified equipment
- Method of equipment qualification and quality assurance
- Analysis of the effect of equipment failures
- Monitoring environmental conditions

- Physical condition and functionality of qualified equipment
- Records of qualified equipment

## 3. Regulations and Standards

The qualification concepts and process have found their way into the many regulations and standards regarding equipment qualification. Various plants of different vintages are committed to different regulations and evolving various of standards. Regulations and standards regarding the review of seismic PSR can be classified into four categories, such as terms by law, and items described by Final Safety Analysis Report (here in after called 'FSAR'), and requirements by regulatory authority, and items by utility's promise, etc. As additional required regulations and standards, the enacted and the amended regulations have been included since design of reference NPP. Figure 1 presents a sample hierarchy of the regulations and standards applicable to equipment qualification<sup>4)</sup>.



Note: Bulleted items are examples

Figure 1. Sample hierarchy of equipment qualification requirements, standards, and practices

## 4. Review Methods

The review of seismic qualification should be determine (a) whether assurance of the required equipment performance capability was initially provided and (b) whether equipment performance has been preserved by ongoing application of measures such as scheduled maintenance, testing and calibration and has been clearly documented. It should be noted that a review relating to (a) may not be necessary if a previous review has concluded that adequate initial seismic qualification was established; and a review relating (b) should provide assurance that seismic qualification will be satisfactorily preserved in future. A plant walk-down of installed equipment should be performed to identify for qualified equipment any differences from the qualified configuration.

### 4.1 List and control procedure of qualified equipment

The review should be performed whether the equipment list, and qualification reports, and their control procedures of qualified equipment are managed systematically including exchanged equipment in operation, and also confirmed whether the classification of seismic category of equipment is suitable for regulatory guide.

### 4.2 Method of equipment qualification and quality assurance

The review should be performed whether methods of seismic qualification are set up and seismic qualification is performed suitably. For this, the documents at that time of design of NPP should be examined, and also the regulations and standards of seismic qualification applied should be evaluated, and the suitability for the procedure of quality assurance should be confirmed for guarantee of seismic safety.

### 4.3 Analysis of the effect of equipment failures

The review should be performed whether the effect of equipment failures is analyzed for original performance of qualified equipment and control procedure of equipment is maintained suitably at that time of repair or exchange of equipment.

### 4.4 Monitoring environmental conditions

The review should be performed whether periodic environmental conditions are monitored suitably according to considered conditions at that time of seismic qualification and the effect is examined when excess of conditions and protections of equipment is planned.

### 4.5 Physical condition and functionality of qualified equipment

The physical condition and functionality of qualified equipment should be reviewed. From this, plant walk-down by macrography should be performed and the items influenced on seismic safety are drawn from evaluation.

### 4.6 Records of qualified equipment

The review should be performed whether all records regarding seismic qualification is preserved in auditable form for the life of the plant at a specified place, that say documented evidence of qualification, and seismic qualification report, and equipment list, and procedure, etc. Especially, the seismic qualification report is requisite document for seismic qualification of equipment, because all factors regarding seismic qualification are included in the report.

## 5. Suggestion

To enhance safer operation and maintain more reliable management of NPPs, the standardized technical administrative procedure and review procedure need for maintenance and control of seismic qualification included equipment list based on tag number, seismic category, location, qualification method. All reports as well as documents, evidences regarding seismic qualification should be preserved in case of repair and exchange of equipment.

## 6. Conclusion

In this paper, the overall methodology of seismic PSR is introduced to enhancement of the seismic safety of equipment in operating NPPs included the review scope, regulations and standards, and review methods.

As a safety enhancement item drawn from a result of seismic PSR, systematic and efficient review and control procedure need to be enhanced more safe operation and to be maintained more reliable management of NPPs.

## REFERENCES

- [1] IAEA Safety Series No. 50-SG-O12, Periodic Safety Review of Operational Nuclear Power Plants, IAEA, Vienna, 1994
- [2] IAEA Safety Series DS 307, Periodic Safety Review for Nuclear Power Plants, IAEA, Vienna, 2002
- [3] Korean nuclear energy act, Periodic Safety Review of Operating Nuclear Power Plants, Ministry of Science and Technology
- [4] EPRI, Nuclear Power Plant Equipment Qualification Reference Manual, 1992