

Seismic Periodic Safety Review of Safety-related Equipment in Ulchin Nuclear Power Plant Units 1&2

Kwang-Ho Joo, Byung-Soo Lee

PSR Assessment Team, NETEC, Korea Hydro & Nuclear Power Co., jookh@khnp.co.kr

1. Introduction

PSR (Periodic Safety Review) is to determine, for an operating nuclear power plant, the extent to which the plant confirms to current standards and practices, the extent to which the licensing basis remains valid, the adequacy of the arrangements that are in place to maintain safety until the next PSR, and the safety improvements to be implemented to resolved the safety issues that have been identified. PSR process consists of comprehensive assessment including the review of seismic qualification. With the beginning of Kori 1 PSR on May 2001, half of all Korean operating NPPs carried out and is performing PSR, so lots of experiences were accumulated through PSR. In this paper, the assessment methods and results of seismic PSR in Ulchin 1&2 are introduced including safety improvements to enhance the safety. Also walk-down procedure and an evaluation sheet format is presented, which were established through this seismic PSR of Ulchin 1&2.

2. Scope

The objective of the seismic safety review is to determine whether safety-related equipment of NPP is qualified to perform its designated safety function throughout its installed service life. The equipment important to safety should be properly qualified to ensure its capability to perform its safety functions under earthquakes. 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 condition existing at the time of need, and considering the aging degradation of the equipment that occurs during services. The scope of seismic review as a part of PSR is six items on the Enforcement Decree 19.2 Korean Atomic Energy Act. The six items are [1]:

- ① List and control procedure of qualified equipment
- ② Method of equipment qualification and quality assurance
- ③ Analysis of the effect of equipment failures
- ④ Monitoring environmental condition
- ⑤ Physical condition and functionality of qualified equipment
- ⑥ Records of qualified equipment

3. Methods and Results

The review of seismic qualification focuses on: (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) is not 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 the qualified equipment and any differences from qualified configuration. Figure 1 shows SSE horizontal site design response spectra to be used for the qualification basically.

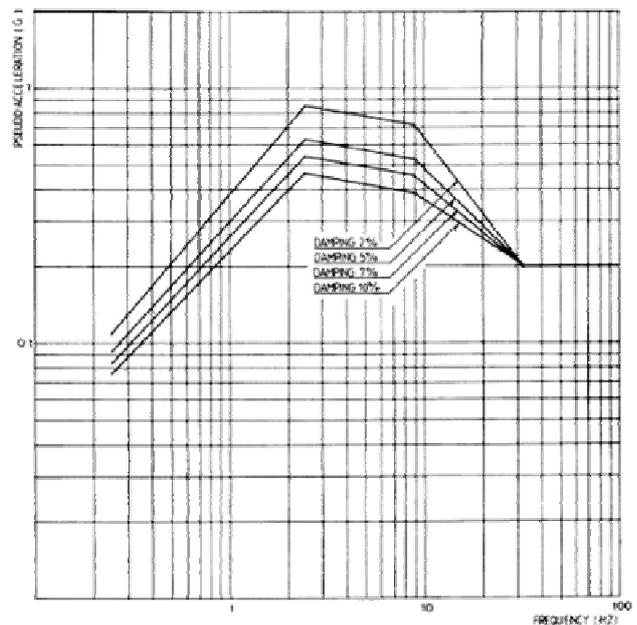


Figure 1. SSE horizontal site design response spectra.

3.1 List and Control Procedure of Qualified Equipment

FSAR chapter 3.2 provides listing of components and equipment and identifies those which are seismic category 1. Those which are not seismic category 1 are identified as NO.

3.2 Method of Equipment Qualification and Quality Assurance

The qualification methods used to evaluate the performance of the equipment under seismic condition

are defined in RCC-E [2, 3] which meets the IEEE standard 344.

3.3 Analysis of the Effect of Equipment Failures

The analytical procedure of the effect of equipment failures has been already built through the KONIS (Korea Nuclear Information System) and the ERP (Enterprise Resource Planning) system of KHNP.

3.4 Monitoring Environmental Condition

To monitor environmental condition, the five OBEs are followed by an SSE during seismic test after an environmental qualification and the seismic monitoring system is also operated.

3.5 Physical Condition and Functionality of Qualified Equipment

The physical condition and functionality of qualified equipment are reviewed through the plant walk-down by visual inspection. Majority of the qualified equipment is managed suitably. Figure 2 shows a sample sheet for walk-down evaluation.

3.5.1 Walk-down procedure and evaluation sheet

The walk-down procedure consists of: (a) selection of inspection equipment from safety-related equipment, (b) review of drawings such as P&ID and equipment layout, (c) planning of walk-down considering duration, manpower, and the line of flow, (d) performance of walk-down with recording of evaluation sheet and taking photos, (e) choice of seismically vulnerable equipment, (f) planning of reinforcement by inside job, and (g) performance of reinforcement work at plant.

The evaluation sheet is divided into three parts, (a) equipment description including its tag number and location or room, (b) check list for visual inspection considering physical condition and seismic interaction effects based on structural integrity of body and anchorage, and (c) photos of equipment body and anchorage.

3.6 Records of Qualified Equipment

Records of all qualification measures taken during the installed service life of the equipment should be preserved in an auditable form. UCN 1&2 needs to be established the systematic integrated management system as for seismic qualification.

4. Suggestions

To improve seismic safety of equipment, it should be supplemented according to Korean Atomic Energy Act: both NSSS (Nuclear Steam Supply System) and BOP (Balance of Plant) equipment lists based on tag number,

equipment location or room number, frequency range, seismic category, and qualification method. Also, a standardized technical procedure should be made. Finally, all reports as well as documents, evidences regarding seismic qualification should be preserved in case of new and replacement equipment.

Seismic PSR
UCN 1&2 1

Walk-down Evaluation Sheet																																																																													
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Figure 2. Sample walk-down evaluation sheet.

5. Conclusion

In this paper, the overall scope, methods and results of seismic of PSR in UCN 1&2 are introduced including safety issues to improve seismic safety of equipment.

As an issue for safety improvements drawn from results of seismic PSR, systematic and integrated control procedure and management system should be set up for safer operability and higher reliability of UCN 1&2.

REFERENCES

- [1] Korean Atomic Energy Act, Periodic Safety Review of Operating Nuclear Power Plants, Ministry of Science and Technology, Korea, 2001.
- [2] RCC-E, Design and Construction Rules for Electrical Equipment of nuclear Islands.
- [3] UTE C 20-420, Guide for Equipment Seismic Testing Procedures, December, 1978.