

Current Status of Periodic Safety Review of HANARO Research Reactor

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1. Introduction

A PSR for a research reactor became a legal requirement as the Nuclear Safety Act was amended and came into effect in 2014. This paper describes the current status and methodology of the first Periodic Safety Review (PSR) of HANARO that is being performed.

2. Methodology

In this section, the legal requirements, work plan, and process of implementing a PSR are described. Because this is the first PSR for a research reactor, it is our understating that the operating organization and regulatory body should communicate well with each other to complete the PSR in a timely manner.

2.1 Legal Framework

HANARO achieved a construction permit and operational license on December 23rd, 1987 and has been in operation since we achieved first criticality on February 8th, 1995. A PSR for a research reactor has been enforced as the national Nuclear Safety Act was amended on May 21, 2014, and came into effect on Nov. 22, 2014 to conform to the recommendations made at the 48th IAEA General Conference held in September 2004 [1]. According to the law, a PSR for the research reactor to be operated for more than ten years after the start of the plant operation shall be completed by the end of 2018. A penalty such as a fine and suspension of the operating license will be given if we do not fulfill the requirements. Fourteen safety factors that will be reviewed are described in article 37 of the decree of the Nuclear Safety Act [2]. We will also use the IAEA Safety Standard Series No. SSG-25 as guidance [3].

2.2 Project Plan

The major milestones to undertake a PSR are as follows.

Table 1: Project Major Milestone

Activity	Due Date
Establishment of a project management team, review plan, preparation of budget	Jun. 30, 2015
Understanding between the KAERI and Regulatory body on the general scope, requirement and outcome	Oct. 31, 2015
Preparation of Technical Specifications for Outsourcing of PSR, Tendering & Order Placement (two contractors and one internal group assigned)	Jun. 30, 2015
Search and Retrieval of PSR input data such as design documents, construction drawings, analysis	Sep. 30, 2016

report and input/output data	
Review of 14 Safety Factors	Jun. 30, 2018
Preparation of final PSR report including summaries from the safety reports, global assessment report and integrated implementation plan	Dec. 15, 2018
Submission of the final PSR report and Summary report to the regulatory body	Dec. 31, 2018
Assessment of PSR reports submitted and preparation of assessment reports, Approval by the regulatory body (End of PSR)	Dec. 31, 2019
Execution of the integrated implementation plan	From year 2020

2.3 Preparatory Study of the Project

Before starting the project, we studied the availability of our internal staff. Because our engineers and researchers were tied up to the domestic and foreign research reactor construction project, it did not appear that we could execute the first PSR for a research reactor by ourselves. Thus, we decided to outsource the PSR to an engineering company that has a lot of experience in PSRs of NPPs. The important basis for the PSR that was discussed with the regulatory body in the beginning stage were the scope and objective of the PSR, the cut-off dates, the subjected period of PSR, and the target date of submission of the final PSR report. In addition, we collected the information of the research reactor, which completed the PSR through the IAEA workshop.

2.4 Review of Safety Classification

When we begin the PSR, the first thing we have to do is to prepare a list of SSCs (Safety Structure and Components) that require a PSR. According to the information collected from foreign research reactors, BR2 is in the process of implementing a comprehensive Asset Management approach to the Plant (Plant Asset Management; PAM), which is based on three parameters: safety, availability and economy. Human factors are also considered in the plant asset management program. SSCs are allocated to four classes with differing and graded approaches to risk analysis and mitigation. OPAL is also in the process of implementing an Asset Management program using ISO 55,000 as guidance. In HANARO, we are preparing a list of SSCs through the established safety classification as follows.

- 1) Safety Class-1(SC-1): Not Applicable to HANARO
Mechanical component for nuclear safety function that forms part of the **reactor coolant**

- pressure boundary**, based on the ASME Sec. III Subsection NB & RG 1.26 Quality class A
- 2) Safety Class-2(SC-2): Not Applicable to HANARO
Other mechanical components for nuclear safety function that are not included in SC-1 but are related to **residual heat removal, containment spray** etc., based on the ASME Sec. III Subsection NC & RG 1.26 Quality Class B”
 - 3) Safety Class-3(SC-3): Applicable to HANARO
Equipment, not included in SC-1 or SC-2, designed and relied upon to accomplish the **nuclear safety functions**, based on the ASME Sec. III Subsection ND & RG 1.26 Quality Class C”, HANARO Quality Class “Q”, Seismic Category I, CSA CAN3-N285.1-M81 Class 2 & 3
 - 4) Non-Nuclear Safety (NNS): Applicable to HANARO
Equipment not included in SC-1, SC-2 or SC-3. This equipment is a commercial grade item. Quality Class “T” or “S”, Seismic Category II or Non-seismic category
 - 5) Not Applicable (N/A): Applicable to HANARO
Equipment that none of the above Safety Classes can be applied. Some of the items are also the safety related items [4].

It is noted that some of the items in an N/A class are also safety related items, but none of the above classification can be applied. This makes it somewhat difficult to determine SSCs that require a PSR.

2.5 Preparation of List of Inputs for PSR

When we are in the design stage of the project, we usually prepare an equipment list, a design document/drawing list, and an instrument list. However, when we are in the operation stage, these lists are no longer used and their existence is forgotten. Because the first PSR of HANARO is being carried out more than 20 years after the first criticality, it is very difficult to find such lists at present. Therefore, preparing such lists is one of the important tasks before the actual review starts. Once we finish making these lists, the second PSR will be a lot easier. Another important task is to retrieve the design documents and drawings. In 1980s, the drawings were made through blueprints and documents using an old word processor application that is now obsolete. Thus, they were stored originally as micro films or as a hard copy, but were transformed into picture files by a scanner later. This is why searching and retrieving the required file becomes very tedious and troublesome work. It will not be difficult in the future because all drawing and documents are completely digitalized and stored in digital media these days. Therefore, an efficient search engine will play an

important role when we build an archive to keep the QA record.

2.6 Current Issues

At this stage of the PSR, the issues that need to be considered are;

- 1) Determination of SSCs and the items for the PSR
Since the PSR is applicable to not only the Safety Class SSCs but also a part of the NNS items that are related to Safety, we have to be very careful to determine the list of items that require PSR as these are of significant importance for successful completion of PSR.
- 2) Application of Graded Approach
Nuclear research reactor is not a nuclear power plant and has much less potential hazard than the nuclear power plant. So the level of grading must be considered and agreed with the regulatory body in all the aspect of the PSR.
- 3) Establishment of a task force for reviewing the PSR reports
Even if we outsourced the preparation of the PSR reports, it is still our responsibility to review the PSR reports for submission to the regulatory body. We will have to establish a task force to do such activity in near future.

2.7 Advice from experts of other research reactors

We held the International PSR Workshop in June of this year to gather information from the foreign research reactors that finished their PSR. The following are the main advice of experts who participated in the workshop.

- 1) The Regulatory Body needs to be involved in all stages of the PSR and not just in the review of the final PSR report. Expectations of the objectives and outcomes of the PSR must be understood and agreed by all parties to prevent any waste of resources and to minimize the potential for reworking of the PSR and the need for an additional assessment and review.
- 2) The application of a graded approach to the PSR is not only appropriate, but also necessary, to prevent the imposition of overly onerous requirements and/or commitments on both the operating organisation and the Regulatory Body. For example, an overly detailed and proscriptive PSR of a relatively low risk research reactor (as compared to a NPP) will not only result in excessive resources being required from the operating organization to perform the PSR, it will also result in a similar excessive use of resources by the Regulatory Body in the review and assessment of the PSR.
- 3) The PSR must be adequately resourced within the operating organization even if the actual

review activities are undertaken by a contractor. This should include an appropriately qualified and experienced project manager, appropriate administrative resources, and the full involvement of operating personnel (operations, engineering, maintenance, and utilization) who by definition have better knowledge and expertise in the facility than any contractor.

2.8 Preparation of PSR Report and Review by the Operating Organization

A PSR report will be issued five times according to the progress and purpose of review: an Interim Report, a Preliminary Report, a Final Report for the regulatory review, a Summary Report for the regulatory review, and a Final Report that incorporates the regulatory comments. Because we have two contractors and an internal group that will prepare their own PSR reports, their PSR reports will be integrated as a global report. Therefore, we will need a number of resources in each area of expertise when the PSR reports are prepared and issued for review.

3. Conclusions

The first PSR of HANARO is under way. In order to achieve a successful result, activities of the operation organization such as scheduling, maintaining consistency in input data for review, and reviewing the PSR reports that will require intensive resources should be well planned. Although an actual review and preparation of PSR reports are carried out by contractors owing to the operating organization's own capabilities and resources, it should be kept in mind that the operating organization is the responsible body for the PSR and should take ownership. This means the operating organization needs to incorporate appropriate measures to ensure the transfer of knowledge and expertise arising from the PSR via a contractor to the operation organization.

It is desirable for the Regulatory Body to be involved in all stage of the PSR to prevent any waste of resources and minimize the potential for a reworking of the PSR and the need for an additional assessment and review as recommended by foreign experts.

REFERENCES

- [1] Article 34 of Nuclear Safety Act no. 12666 amended on May 21st, 2014 and made effective on Nov. 22nd, 2014
- [2] Article 37 of Decree no. 25747 of the Nuclear Safety Act amended on Nov. 19th 2016.
- [3] IAEA SAFETY STANDARD SERIES No. SSG-25 PERIODIC SAFETY REVIEW FOR NUCLEAR POWER PLANTS (SPECIFIC SAFETY GUIDE)
- [4] Article 3.2.1.2 of HANARO Final Safety Analysis Report