

HANARO SAFETY PERFORMANCE INDICATORS

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Abstract

HANARO is a 30 MW open-tank-in-pool type multi-purpose research reactor. Safety improvement activities have been implemented and the importance of safety management in nuclear activities for reactor application and utilization has also been emphasized. Safety performance indicators (SPIs) are used to assess the safety management status, in combination with other factors such as safety culture, human performance and operation status. The SPI system can provide a proactive approach to complement other safety assessment activities. HANARO has tried to develop a programme for the establishment of safety performance indicators. In this paper the application experience of safety performance indicators in HANARO is described.

1. INTRODUCTION

Safety is a common goal to everyone involved in the operation and utilization of nuclear research facilities. A safety management system comprises those arrangements made by the organization for the management of safety in order to promote a strong safety culture and achieve good performance. HANARO reactor operation and utilization have managerial objectives such as safe operation, performance improvement, and utilization satisfaction. Safety culture activities and events have been conducted continuously to enhance its safe operation, such as seminars and lectures related to safety matters, participation in international workshops, the development of safety culture indicators, the preparation of a safety text book, the development of an e-learning program for safety education, a peer review by specialists, and the development of operational safety performance indicators (SPIs). SPIs are used to assess a safety management status, in combination with other factors such as safety culture, human performance, and operational status. A plant that has established an SPI programme is able to achieve a good understanding of safety performance in order to identify early signs of degradation, and thus to prepare countermeasures against unanticipated accidents/incidents. The SPI system can provide a proactive approach to complement other safety assessment activities. HANARO has tried to develop a programme for the establishment of specific operational SPIs, adopting the framework of IAEA-TECDOC-1141 for NPP [1]. A draft of the SPI programme was reviewed by the operation and utilization groups, who found it to be a good approach for establishing a comprehensive SPI programme, but some indicators that are duplicated need to be simplified for application. A new set of SPIs reduced from the previous set was prepared to characterize the overall performance of HANARO. The Korean Regulatory body (KINS, Korea Institute of Nuclear Safety) has an OPIS (Operational Performance Information System) program for NPP, which suggests 15 performance indicators. The NRC regulatory framework for reactor oversight consists of three key strategic performance areas: reactor safety, radiation safety, and safeguards [2].

2. HANARO SAFETY PERFORMANCE INDICATORS

Referring to the SPI suggested by KINS OPIS and the NRC Reactor Oversight Process, HANARO has selected 12 new indicators. A set of SPI covers the plant's general

performance: nuclear safety, environmental safety, utilization safety, and aspects of safety culture and management. The key objective of the SPI is to monitor performance in three broad performance areas including reactor safety, radiation safety, and utilization safety. Table 1 shows six safety categories and twelve performance indicators that support the safety of plant operation in three broad performance areas.

TABLE 1: HANARO SAFETY PERFORMANCE INDICATORS

Area	Category	Indicators
Reactor safety	Safe operation	1) Unplanned scrams
	Safety system reliability	2) Emergency water supply system 3) Emergency ventilation system 4) Radiation monitoring system
	Safety barrier	5) Fuel integrity 6) Reactor coolant system 7) Reactor building leakage 8) Emergency preparedness
Radiation safety	Onsite radiation safety	9) Occupational exposure
	Offsite radiation safety	10) Expected public exposure
Utilization safety	Experimental safety	11) Availability of RIPP 12) Availability of beam facility

A SPI should be evaluated periodically through qualitative estimation in order to understand the trend of plant safety. Each indicator is estimated through a specific formula. Its safety grade can be evaluated into 4 grades according to the estimation results. The limit value of each grade was determined in consideration of the past fifteen years of operating experience. Table 2 shows the color classification according to the safety grade.

TABLE 2: CLASSIFICATION OF COLOR GRADE

Color		Grade
G	Green	Excellent
C	Cobalt	Good
Y	Yellow	Average
R	Red	Warning

3. EVALUATION RESULT IN 2011

In the first half of 2011, the results of the SPI evaluation have shown mostly excellent performance except the indicator of an unplanned scram. There was an unplanned reactor shutdown caused by a high radiation of the pool surface due to a malfunction of the NTD mechanism. The table 3 shows the evaluation results of the HANARO SPI.

TABLE 3: EVALUATION RESULTS OF SPI IN HANARO

Indicator	Color	Grade
Unplanned scram	C	Good
Emergency Water Supply System	G	Excellent
Emergency Ventilation System	G	Excellent
Radiation Monitoring System	G	Excellent
Fuel Integrity	G	Excellent
Reactor Coolant System	G	Excellent
Reactor Building Leakage	G	Excellent
Emergency Preparedness	G	Excellent
Occupational Exposure	G	Excellent
Expected Public Exposure	G	Excellent
Availability of RIPP	G	Excellent
Availability of Beam Facility	G	Excellent

4. APPLICATION OF SAFETY PERFORMANCE INDICATORS

KAERI (Korea Atomic Energy Research Institute) has developed a computerized business system termed ANSIM (Advanced Nuclear Safety Information Management) for all nuclear facilities at the site. HANARO has also initiated a project "Digital HANARO" for digitalization, automation, and common information processing related to the operation and utilization of the reactor and experimental facilities [3]. The SPI will be used as input data to the ANSIM and Digital HANARO systems.

The potential applications of the SPI are as follows:

- To identify the results of operation and utilization with quantitative values;
- To evaluate the safety performance status;
- To promote effective management through a trend analysis of performance;
- To provide understandable safety performance information to the public.

5. REMARKS

The purpose of SPI application is to monitor safety performance during operation, research, and utilization. The evaluation of an SPI is an effective way to help in monitoring and enhancing the safety of nuclear research and utilization. This year, HANARO determined an evaluation formula for each indicator and systematically gathered data on the operation and maintenance. The SPI evaluation provides an opportunity to review the overhaul safety status. HANARO will continuously pursue the trends of the operational safety attributes of its performance for effective safety management.

REFERENCES

- [1] WU, J.S., et al., "Development of Safety Performance Indicators for HANARO", IAEA International Conference on Research Reactors, Safety Management and Effective Utilization, Sydney, 2007, IAEA, Vienna (2008).
- [2] NUCLEAR REGULATORY COMMISSION, NUREG-1649, NRC Reactor Oversight

Process (2010).

- [3] JUNG, H.S., et al., "Development of Digital Information System on Reactor Trip and abnormal condition in HANARO," HANARO Symposium, 2009