HANARO SPI

Safety Performance Indicators

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CONTENTS

INTRODUCTION

❑ HANARO generals

- 1st criticality in 1995
- 30 MW open-tank-in-pool type
- Max. thermal flux : 5×10^{14} n/cm^2·sec
- Fuel U_3Si-Al, 19.75 w/o ^{235}U enriched
- 7 Beam tubes & 32 irradiation thimbles

❑ Safety enhancement program in HANARO

- **Seminars and lectures related to safety matters**
- **Survey on safety culture attitudes**
- **E-learning education**
- **Peer reviews**
- **Application of SPIs**

Development of SPI

HANARO SPI

Focus

- Reactor Safety
- Radiation Safety
- Utilization Safety

Basis

HANARO Characteristics

Reference

- **KINS** OPIS Operational Performance Information System for NPP
- **U.S.NRC** PI Performance Indicators For NPP
- **HANARO** OSPI Operational Safety Performance Indicators

Applications of SPI

- 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

SPI Selection & Evaluation Basis

- ***Reactor operation experience***
- ***Maintenance & test experience***
- ***Technical specification (SAR)***
- ***Other references***
  (*Korean Nuclear Energy Laws, PIs for NPP; etc*)

Evaluation : 4 times / yr

HANARO Safety Performance Indicators

Area (3)	Category (6)	Indicators (12)
Reactor safety	Safe operation	Operational reliability (Unplanned scram)
	Safety system reliability	Emergency water supply system
		Emergency ventilation system
		Radiation monitoring system
	Safety barrier	Fuel integrity
		Reactor coolant integrity
		Reactor building integrity
		Emergency preparedness
Radiation safety	Onsite radiation safety	Occupational exposure
	Offsite radiation safety	Expected public exposure
Utilization safety	Experimental safety	Availability of RIPF
		Availability of beam facilities

[Example 1]

Operational reliability = Unplanned scrams

- Reactor operation time / Reactor operation time + shutdown time

Grade	Evaluation		
Excellent	0.90 ≤	V	< 1.00
Good	0.80 ≤	V	< 0.90
Average	0.70 ≤	V	< 0.80
Warning	0.00 ≤	V	< 0.70

[Example 2]

Emergency Preparedness

- Training 40% : procedures & active countermove
- Education 30% : participation & test
- Facilities 30% : availability, utilization & periodic test

Grade	Evaluation		
Excellent	0.90 ≤	V	< 1.00
Good	0.80 ≤	V	< 0.90
Average	0.60 ≤	V	< 0.80
Warning	0.00 ≤	V	< 0.60

[Example 3]

- Reactor building integrity = confinement leakage

➢ Leakage (m^3/hr) / 570 m^3/hr

(allowable limit specified in SAR)

Grade	Evaluation		
Excellent		V	< 0.88
Good	0.88 ≤	V	< 0.92
Average	0.92 ≤	V	< 0.96
Warning	0.96 ≤	V	

Evaluation Results in 2011

Color	Grade
Green	Excellent
Cobalt	Good
Yellow	Average
Red	Warning

INDICATORS	Color classification	
	Jan.-Mar.	Apr.-Sep.
Operational Reliability (Unplanned scram)		
Emergency Water Supply System		
Emergency Ventilation System		
Radiation Monitoring System		
Fuel Integrity		
Reactor Coolant Integrity		
Reactor Building Integrity		
Emergency Preparedness		
Occupational Exposure		
Public Exposure		
Availability of RIPF		
Availability of Beam Facility		

Summary

- 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 research and utilization.
- HANARO determined an evaluation formula for each indicator and systematically gathered data on the operation and maintenance.
- SPI will be used as input data to the ANSIM (Advanced Nuclear Safety Information Management) and Digital HANARO for digitalization, automation, and common information processing related to the operation and utilization of the reactor and experimental facilities.
- The SPI evaluation provides an opportunity to review the overhaul safety status.
- It is necessary to continuously pursue the trends of the operational safety attributes of its performance for effective safety management.

THANK YOU!