

Development of a Pilot Program for Human Factors Management in Operating Nuclear Power plants

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1. Introduction

The human factors of operating NPPs have been reviewed as a part of Periodic Safety Reviews (PSRs). This human factors PSR covers a wide range of human factors including control room man-machine interfaces (MMIs), procedures, working conditions, qualification, training, information requirements and workload. Korea Atomic Energy Research Institute (KAERI) has performed human factors PSRs from the first PSR for Kori 1.

It was determined in 2005 that for a Continuous Operation of the Korean NPPs an enhanced PSR should be performed and issues raised from the PSRs should be resolved. From the results of the PSR for Kori 1, several safety enhancement issues related to human factors were raised. KAERI is working on a resolution of some of the human factors issues for the Korea Hydro and Nuclear Power Co. (KHNP). As a part of the resolution, we are developing a human factors management program (HFMP) for Kori 1. This paper introduces the status of our development of HFMP.

2. Human Factors Aspects of PSRs

Periodic Safety Review (PSR) was introduced into Korean NPPs by the Atomic Energy Acts in 2001. The Enforcement Regulation of the Atomic Energy Act, which is the regulation that defines the licensing procedures and application methods necessary for the implementation of the Atomic Energy Act, lists the items subjected to PSRs. These items are adapted from IAEA Safety Series No. 50-SG-O12, Periodic Safety Review of Operational Nuclear Power Plants [1]. PSRs have been performed by KHNP and the results have been reviewed by the Korea Institute of Nuclear Safety (KINS).

PSR items relevant to human factors that are listed in the Enforcement Regulation of the Atomic Energy Act are as follows;

9. Human factors
 - (a) Staffing levels for the operation of a nuclear power plant with due recognition of absences, shift working and overtime restrictions
 - (b) Availability of qualified staff on duty at all times
 - (c) Programs for initial, refresher and upgrade training, including the use of simulators
 - (d) Information requirements and workload of staff
 - (e) Man-machine interface (MMI).

There are more items related to human factors in the other domains.

6. Use of experience from other plants and of research findings
 - (a) Appropriateness of the plan and system for the feedback of experience (relevant to human factors)
 - (b) Programs for the feedback of experience and research findings (relevant to human factors)
7. Procedures
 - (c) Clarity of procedures with human factor principles taken into account.

We have performed PSR human factors reviews as projects from KHNP since the Kori 1 PSR [2], [3].

3. Human Factors for KORI 1 Continuous Operation

The first NPP in Korea Kori 1 has been operated for 28 years and is under preparation for a Continuous Operation permit. The human factors activity necessary for a Continuous Operation is the resolution of PSR issues relevant to human factors.

The PSR for Kori 1 was completed at the end of 2003. It has revealed many safety enhancement issues. PSR issues relevant to human factors are listed in Table 1.

Table 1. Kori 1 Human Factors (HF) PSR issues

Issue No.	Titles of PSR Issues	Description
K1-PR-31	Development of a procedure management system	development of guidelines for managing HF in the procedures including the HF management criteria and processes
K1-HF-37	Development of an HF improvement and management system	
K1-HF-37.1	(1)	development of an integrated HF management system including MMI
K1-HF-37.2	(2)	integration and improvement of the information and monitoring functions of the plant computer system
K1-HF-37.3	(3)	improvement of the remote shutdown panel

K1-HF-37.4	(4)	improvement of the MMI elements and colors
K1-HF-38	Improvement of the main control board and the simulator	gradual improvement of the main control board and installation of a simulator
K1-PC-1	Preparation of a BISI installation plan	BISI installation, or OACS (Operation Aid Computer System) utilization, or procedure modifications
K1-OA-33	Assessment of the suitability of departmental workload and personal workload	task analysis (completed)
K1-OA-35	Enhancement of training and education	enhancement of EOP performing ability (completed)
K1-HF-36	Improvement of the shift work	man-power enhancement and organization change (completed)

Major human factors activities being performed by KAERI are the development of a human factors management program (HFMP), independent human factors reviews of the KOPEC design documents, and the revision of the Kori 1 procedures from human factors aspects. The development of the HFMP and a procedure revision from human factors aspects are to resolve PSR issues K1-PR-31 and K1-HF-37.1. The independent reviews and other activities by KAERI are to support KHNP.

4. Human Factors Management Program

From the results of the PSRs, it has been found that the human factors in NPPs need to be improved and managed in a proper way. For this reason, an HFMP was proposed to manage the human factors of NPPs well. The following are the items to be developed for the Kori 1 HFMP;

1. General human factors management program (HFMP)
 - Kori 1 human factors management procedure: a high level procedure governing the MMI, procedures, work environment, qualification, work condition, etc.
 - Human factors management guides for individual jobs: detail guides (general and specific guides) for the lower level documents relevant to a design, purchase, fabrication, installation, operation, maintenance, etc.
 - Criteria for a human factors management organization and committee
 - Criteria and process for decision making on human factors issues
 - Procedure for a change of the HFMP
2. MMI management guidelines
 - Control board design criteria: arrangement and integration criteria for analog, hybrid, and digital type control boards

- Design criteria for each device type - controllers, indicators, labels, indication lights, and recorders
 - Design criteria for computer monitors
 - Supplemental tool criteria: covers, tags, etc.
 - Environmental factor management criteria: temperature, humidity, noise, illumination, etc.
 - Criteria for a control board and device operation
 - MMI checklists
3. Guidelines for a procedure management
 - EOP management guidelines including verification and validation guidelines
 - General guidelines for a procedure management
 - Detailed human factors guidelines for writing procedures
 - Checklists and forms for procedure assessments
 4. Guidelines for a management of other human factors
 - Common human factors criteria or guidelines - terminology, abbreviations, etc.
 - Personnel management guidelines: stress, the musculoskeletal system, health, substance abuse, etc.
 - Training and education management guidelines
 - Guidelines and supporting tools for a work management and an overtime management
 - Work environment human factors management guidelines
 5. HFMP application and validation
 6. Description of the Kori 1 MCR and RSP

Items 1 to 4 form the major parts of the HFMP. Items 6 is required to provide documents like FSAR chapter 18. We will develop the HFMP by considering the end users at the Kori 1 plant and encouraging their participation in the development.

5. Conclusion

PSRs have brought about opportunities to obtain an insight into an extensive range of human factors in the operating NPPs. It was found that human factors in the operating NPPs need to be improved and managed, even for the NPPs having FSAR chapter 18. An HFMP was proposed to enhance and efficiently manage the human factors in the Korean NPPs. We expect that this HFMP could be a protocol for an enhancement and good management of the human factors in other Korean NPPs

REFERENCES

- [1] IAEA Safety Guide, Safety Series No. 50-SG-O12, Periodic Safety Review of Operational Nuclear Power Plants, IAEA, 1994.
- [2] Yong-Hee Lee et al., KAERI/TR-3123/2006, Human Factors Assessment of the Procedures for Yonggwang 1, 2 Periodic Safety Review, KAERI, 2006 (in Korean).
- [3] Yong-Hee Lee et al., KAERI/TR-3124/2006, Human Factors Assessment of the Man-Machine Interface System for Yonggwang 1, 2 Periodic Safety Review, KAERI, 2006 (in Korean).