

Improvement Approach for the Operation of the K-HPES in Nuclear Power Plants

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1. Introduction

The human error-related events (HEREs) reporting systems have been used in many hazardous domains, such as commercial aviation, rail transport, chemical process plants, and nuclear power plants (NPPs) [4,8]. Furthermore, reporting and managing accidents and near-misses attributable to human factors is a legal requirement of NPPs in Korea. The HEREs can reveal the systemic vulnerabilities and thus can provide the opportunity for fixing them. (The conceptual distinction among failure types, such as accidents, incidents, near-misses etc., will be different among researchers or among industries. In this paper, the term 'HEREs' is used as any unexpected events that could have resulted in severely bad consequences, but which did not.)

The Korean nuclear utility, Korean Hydro and Nuclear Power (KHNP), has developed and operated Korean Human Performance Enhancement System (K-HPES) as a tool for reporting and managing the HEREs. The K-HPES, developed based on the original INPO-HPES, has several functions, such as identifying the systemic error potential, proposing the corrective recommendations, and communicating the lessons learned among other NPPs [1-3]. The regulatory body examined the status of operating the previous version of K-HPES in NPPs, and recommended implementing a near-miss reporting scheme, integrating it with the K-HPES, and revising the K-HPES to draw effective corrective actions in a systematically integrated way [4]. The nuclear utility reflected the requests of the regulatory body and internal operational experience in developing the revised web-based K-HPES.

However, The regulatory body found some problems remained in operating the current version of the K-HPES in recent periodic inspections. This paper describes the findings for the K-HPES raised through the inspection, and proposes some improvement direction of operating the K-HPES.

2. Human Error related Events Reporting and Management

2.1 The HEREs as 'free lessons'

The design concept, defence-in-depth, has pros and cons for safety management in NPPs. It reduces the possibility of occurring severe accidents. However, it makes NPPs more opaque to the people who nominally control and manage it, so make it difficult to find the latent vulnerabilities in NPPs [6]. The HEREs can occur frequently in NPPs and also can reveal the systemic

vulnerabilities without seriously bad outcomes. Therefore, they can be used as a kind of valuable sources of safety information.

2.2 Evaluation Framework for the HEREs Management

The HEREs reporting and management can be thought of as the cyclic process, and the constituents can be reasonably simplified as that of Figure 1. There are three paths, reflecting the safety culture of an organization, in this cycle: reporting, investigation, and communication & implementation. The safety culture affects to the way of treating safety information, and thus to the quality of the safety information management [5-6].

Three evaluation criteria, as shown in Table I, were selected to review the K-HPES reports. The criteria measure the quality of the information at each stages in the HEREs management process. That is, they measure how important, in a view of safety, the reported events are, and how suitable the results from the investigation and the resultant corrective actions are, and how comprehensible the event reports are to the third-parties. The implementation aspect focuses on the effectiveness of corrective actions, so it requires the trend analysis on the long-term HEREs. The review work, performed the periodic inspection, was on the K-HPES reports in 2007, so the implementation aspect was not considered.

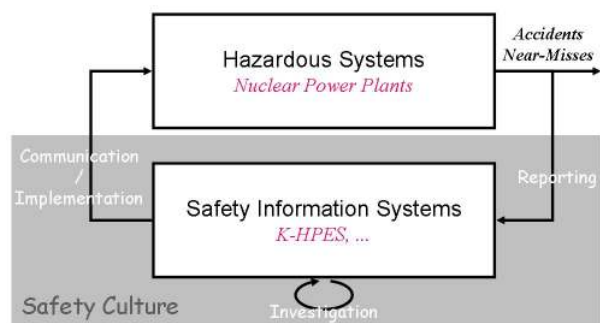


Fig. 1. HEREs Reporting and Management: the Constituents and the Information Flow

Table I: Evaluation Criteria on the HEREs Management

Stage	Criteria
Reporting	Safety-importance of the reported events
Investigation	Suitability of the reconstructed situation and corrective actions
Communication	Comprehensibility of the lessons learned

3. Findings and Discussions

We reviewed the K-HPES reports of four NPPs in 2007. The forty-three events were reported. The nuclear utility has classified the events into incidents and near-misses [3]. However, there are not clear criteria of the distinction between them [3] and these two kinds of events can be considered as belonging to the HEREs. Therefore, the events were summarized as shown in Table II, and our review results were described according to each evaluation criteria as follows.

Table II: No. of the Annual Reports of K-HPES

	HEREs
Y56	13
K34	10
Y34	10
W34	10
Total	43

Criteria 1: Safety-importance of the reported events

The K-HPES included some events that did not match well to the HEREs. We reviewed the procedure on K-HPES [3] and interviewed the safety managers in the NPPs, and then we found several problems in the reporting stage of K-HPES. First, there were no criteria that could be used to determine the safety-importance of the reported events. Second, the nuclear utility applied an unsatisfactory policy that gave each NPPs annual quotas of reporting the HEREs. As a result, many useless events, in the view of safety concerns, were inserted into the K-HPES database. Thus, the nuclear utility should set the minimum criteria that can be used to manage the quality of the collected HEREs. In addition, the utility should rethink the quota policy and need to take an alternative approach to make reporting culture more active.

Criteria 2: Suitability of the reconstructed situation and corrective actions

Many corrective actions in K-HPES reports corresponded to preventive training. Furthermore, the reconstructed situation in the reports, in many cases, were described from hindsight viewpoint. Many researchers suggested that it is useless and ineffective to find people's wrong decisions or behaviors for the purpose of reducing human errors [5-7]. The current K-HPES should be improved to avoid the hindsight bias in an investigation stage.

Criteria 3: Comprehensibility of the lessons learned

There were weak correspondence between the form and the contents, so the third-party of any other NPPs may have some trouble to understand and to learn the lessons in K-HPES reports. For example, the K-HPES

writers described the contents in the consequence cell of 'event sequence' table in different ways; someone described the direct consequence of an initiating event, and another described a conclusive result in a full view of the event, and the other made it blank.

We reviewed the procedures and training materials about K-HPES and interviewed the safety managers in the NPPs, and we found that the problem was resulted from insufficient explanation materials and training on K-HPES. The manual and training program on the K-HPES should be supplemented to support writing and communicating the lessons learned in K-HPES reports.

4. Conclusions

The safety-related events attributable to human factors can provide invaluable safety information that reveal the latent vulnerabilities in NPPs, when carried out effectively. The Korean nuclear utility has developed and operated K-HPES to report and manage the HEREs. However, recent periodic inspections found some operational problems in the K-HPES.

This paper suggested several improvement directions of K-HPES operation, such as defining the criteria to evaluate the safety-significance of the reported events, preparing an alternative way to motivate reporting culture, revising the K-HPES to avoid the hindsight bias of the investigators, and supplementing the writing materials or training programs to prevent misunderstanding of the K-HPES. For effective management of the safety information, such as the human error related events, it is an important and urgent issue to improve the management practice of the K-HPES reports.

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