Analysis of the Human-Related Events using Root Cause Analysis Method

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1. Introduction

According to existing literatures, it seems that one of the most crucial factors for the safety of human involved facilities is inappropriate human activities (i.e., human errors) [1- 3]. In recent years, the human activities in a Nuclear Power Plant (NPP) operation are very complicated and more than 30% of incidents are attributed to the human related factors [4]. Thus, analyzing inappropriate human activities that can has an effect directly or indirectly on complex systems such as NPPs gives insights for the prevention of recurring significant or near-miss events. Considering recent domestic human-related events, a root cause analysis (RCA) method for those human- and management-related events was studied. As a result, a draft version of the detailed procedure to assess the proper specific root causes has been developed [5].

It is expected that the developed method is beneficial for an inspector, who is carrying out the inspection for the human-related event, because the objectivity of the results of a RCA could be secured.

2. Root Cause Analysis Method for Human-Related Events

The necessity of an RCA method for human related events is evident for an inspector who can identify the root causes of inappropriate human activities in systematic as well as consistent. It also can provide concrete data that can be used as a technical basis to determine a mid- and long-term regulation perspective.

2.1 Structure of the Root Cause Analysis Method

The root causes of human-related events were divided into six categories – Human engineering, Supervision, Training, Procedure, Communications, and Management System. To guide an inspector to appropriate root cause categories, this method provides guidelines for sequencing event as well as identifying causal factors for an inspector. In addition, each category has several questionnaires to lead an inspector to one or more appropriate root causes. Table 1 shows the six categories with the number of the corresponding near root causes and root causes.

| Root Cause Category	No. of Questions	No. of Near Root Cause	No. of Root Cause
Human Engineering (HE)	18	2	6
Supervision (SUP)	11	4	9
Training (TR)	9	4	8
Procedure (PR)	29	4	25
Communications (COM)	9	3	12
Management System (MAN)	24	6	20

Table 1. Root cause categories

2.2 Analysis of Human-Related Events

The human related events occurred in NPPs from 1986 to 2006 were analyzed using the developed RCA method. Of 137 human related events occurred in this period, 116 events were analyzed because it was determined that 21 events were either not appropriate or had characteristics of latent failures. The number of human-related events occurred in the primary system of NPPs was 37 and that in the secondary system was 79.
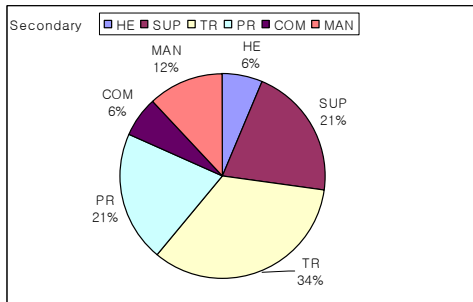
2.3 Results

Fig. 3 is the analyzed results of the 116 human-related events. Here, Fig. 1(a) shows the contribution of each root cause category to human-related events. In addition, Fig. 1(b) and Fig. 1(c) depict the contribution of each root cause category to human-related events that have occurred in the primary system and the secondary system, respectively.
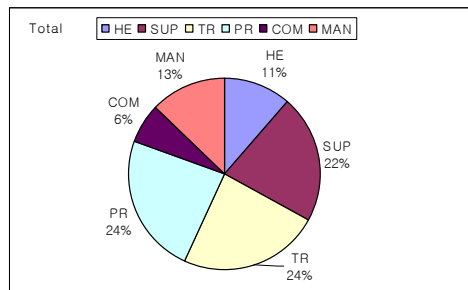
(a) Analyzed result of human-related events
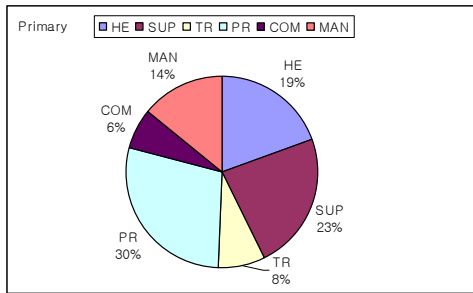
(b) Analyzed result occurred in the primary system

(c) Analyzed result occurred in the secondary system

Figure 1. Analyzed results from RCA method proposed in this study

According to these results, Training, Procedure, and Supervision seem to be the main contributors of human-related events occurred in NPPs. However, if we distinguish the location of human related events, slightly different contributors can be identified. For example, more than half of human-related events occurred in the primary system was due to Procedure and Supervision. Meanwhile, although Procedure and Supervision are important contributors in the primary system, Training is the largest contributor resulting in human-related events of the secondary system.

3. Conclusion

An RCA method that could sufficiently cover the features of root cause analysis identifying activities has developed. This method could allow an inspector to proper root causes of human-related events.

It is true that many problems should be additionally resolved to enhance the quality of the RCA method. Nevertheless, if we recognize the fact that effective countermeasures to prevent the recurrence of inappropriate human actions are drawn from the identification of proper root causes, it is expected that the results of this study can provide a gambit to setup a proper direction for corrective actions and furthermore for the operational experience feedback.

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