

Development of an Investigation Method (HuRAM⁺) for Human-Related Events

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1. Introduction

The result of related studies has revealed that one of the most crucial factors for the safety of human involved facilities is inappropriate human actions (i.e., human errors) [1]. With advanced technology, such as Nuclear Power Plants (NPPs), simple mistakes or incidents may cause serious accidents. In recent years, the human actions in NPP operation are very complicated and more than 30% of incidents are attributed to the human related errors [2,3].

It is important to understand the mechanism of incidents for avoiding major accidents. Thus, Development of an investigation method has been regarded as one of the preliminary tools to reduce the occurrence of inappropriate human-related events. Considering the recent domestic human-related events, an investigation method for those human-related events was studied. It is expected that the development method is beneficial for an investigator, who is carrying out the investigation for the human-related event, because of the objectivity of the results provided by developed method.

2. Investigation Method for Human-Related Events

The necessity of an investigation 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.

Considering recent domestic human related events, Korea Institute of Nuclear Safety (KINS) developed an RCA method, HuRAM (Human related event Root cause Analysis Method), for those human and management related events [4,5]. And it has been revised, called HuRAM⁺, to help an investigator could identify root causes including organizational factors and safety culture.

The purpose of HuRAM⁺ is to develop a detailed procedure by which an investigator of the regulatory body(KINS) can identify the root cause of inappropriate human actions both systematically and consistently. Also, detailed kinds of root causes are being developed for a concrete analysis.

2.1 Structure of HuRAM⁺

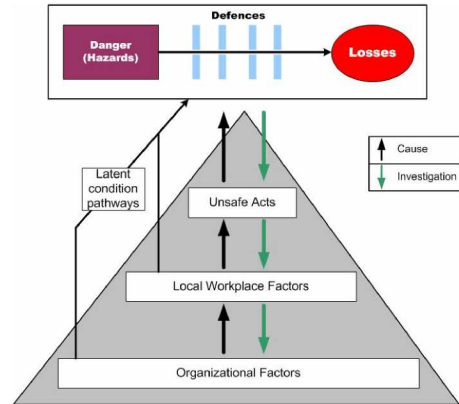


Fig. 1. Stages in the development and investigation of an organizational accident (James Reason)

James Reason proposed investigative system to understand about an organizational accident (Fig. 1) [6]. The investigative system shows how the accident occurs and the way how an investigator identifies the causes of the accident. The concept of this system has been reflected on HuRAM⁺. Using HuRAM⁺, the investigator can analyze human-related events how the unsafe acts occurred by organizational effects and local workplace factors systemically.

The structure of HuRAM⁺ is as follows.

- Outline of Event: Time, NPP type, Operation mode, etc
- Sequence of Event & Human sub-Event (HSE): Explanation of sequence of event in time-line
- HSE Basic Information: Workplace, Task type/field, Related procedure, etc
- HSE Task/Situation Information: Situation information of task preparation, Task/supervision, Organization/safety culture
- Type of Error: Error of omission/commission, Mistake/slip/lapse/violation, Latent/active failure, etc
- Cause of Error : Local workplace factors, Organizational factor/safety culture, etc

When the event occurs, HuRAM⁺ Worksheet is used by an investigator to understand and analyze why unsafe acts happened and which causes were contributed to the event. The HuRAM⁺ Worksheet consists of six steps from a. Outline of Event to f. Cause of Error . The investigator collects information of outline, basic information, task and situation of the event from step a to d . In the step e and f , he/she analyzes type and cause of errors corresponding to the target HSE, respectively. Thus, the analyzed results, i.e.

causes of the HSE, are obtained when he/she follows the steps from a to f in order. Fig. 2 shows the investigation process and the role of HuRAM⁺.

2.2 Analysis Process of HuRAM⁺

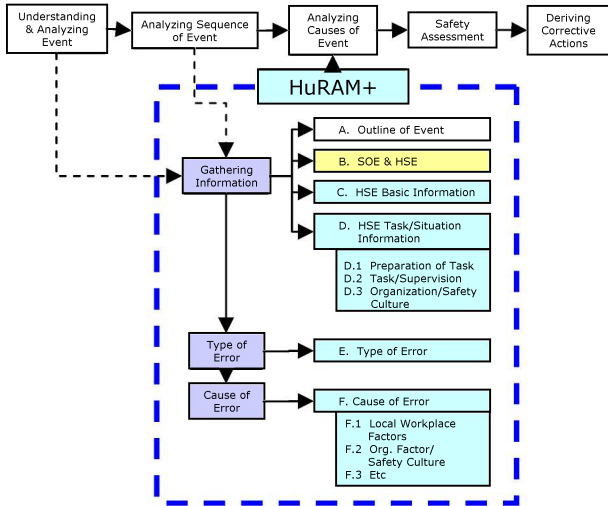


Fig. 2. Investigation and HuRAM⁺ work process for human-related event

The root causes of HuRAM⁺ are divided into ten cause groups: Local Workplace Factors (7), Organizational Factors/Safety Culture (2), Etc Factor (1).

- Local Workplace Factors: Procedure/Job order, Workload, Training, Human System Interface (HSI), Communication, Worker (Team), Supervision
- Organizational Factors/Safety Culture: Management /Organization, Safety Culture
- Etc: Dynamic characteristics, uncommon situation/condition, etc

Brief explanations of each cause group are as follows.

- Procedure/Job order: No procedure/guideline, Wrong-incomplete procedure
- Workload: Excessive mental workload
- Training: No/inappropriate training
- HSI : No alarm/indicator/controller , Inappropriate design/installation
- Communication: No communication, Inappropriate communication
- Worker(Team): Inappropriate performance of worker(team), mental/physical problem
- Supervision: No supervision, Inappropriate supervision
- Organization/Management: No/inappropriate Management or training related documents, Inappropriate/careless of job planning and preparation, Inappropriate management of corrective action
- Safety Culture: Inappropriate reporting/suggestion, Inappropriate safety culture

Each cause group has several cause categories composed of root causes. The cause group is selected

based on the task and situation information of the investigator's activities such as interview, field inspection, collected documents, etc. Then, cause categories and root causes are analyzed. Table 1 is a part of the HuRAM⁺ Worksheet .

Table 1: Example of HuRAM⁺ Worksheet (Local workplace factors)

Cause Group	Cause Category	Root Cause	Remark
Procedure/Job order	<input type="checkbox"/> No Procedure/Job order	<input type="checkbox"/> No procedure/job order for the work	
	<input type="checkbox"/> Wrong-incomplete procedure	<input type="checkbox"/> No actions <input type="checkbox"/> Wrong sequence <input type="checkbox"/> Wrong facts <input type="checkbox"/> Format confusing <input type="checkbox"/> Inadequate details <input type="checkbox"/> No second checker <input type="checkbox"/> No warnings-noets <input type="checkbox"/> Wrong revision <input type="checkbox"/> Etc	
Workload	<input type="checkbox"/> Excessive metal workload	<input type="checkbox"/> Monitoring greater than 30 min. <input type="checkbox"/> Monitoring excessive number of items/variables simultaneously <input type="checkbox"/> Time limitation <input type="checkbox"/> Stressful task environment <input type="checkbox"/> Etc	
	<input type="checkbox"/> No Training	<input type="checkbox"/> No training related to task	
Training	<input type="checkbox"/> Inappropriate Training	<input type="checkbox"/> Inappropriate training/evaluation program <input type="checkbox"/> Incomplete instruction-training material <input type="checkbox"/> Failure to reflect lessons learned <input type="checkbox"/> Inappropriate training about the changed operation/procedure/guideline/design <input type="checkbox"/> Simulator fails to mimic the actual system <input type="checkbox"/> Etc	

3. Conclusions

The HuRAM⁺ helps an investigator to find appropriate root causes if he/she carefully follows the predefined process. Therefore, it is expected that the HuRAM⁺ could be effective to reduce the burden of the investigators, who have to collect a lot of information to determine the causes. In addition, the HuRAM⁺ could be helpful to draw a critical decision by which the root causes of inappropriate human actions are determined.

However, there are some obstacles (e.g., the validity as well as the subjectivity of an investigator, etc) that should be overcome to enhance the quality of the HuRAM⁺. Nevertheless, if we recognize the fact that effective countermeasures to prevent the recurrence can be drawn from the identification of root causes, it is expected that the HuRAM⁺ can play an important and useful role in searching the corrective actions as well as in the Operational Experience Feedback.

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