

How to Cope with the Rare Human Error Events Involved with Organizational Factors in Nuclear Power Plants

Sa Kil Kim*, Meiling Luo, Yong Hee Lee

I&C and Human Factors Division, Korea Atomic Research Institute, Daejeon, Korea

**Corresponding author: sakilkim@kaeri.re.kr*

1. Introduction

In order to ensure the safety of Nuclear Power Plants (NPPs) in aspects of the personnel, the human errors has been dealt with as an important research issues by many researchers (Khalaquzzaman et al., 2010; Vaurio, 2009, etc.) specially since the TMI accident. Human error means that something has been done that was not intended by the actor; not desired by a set of rules or an external observer, or that led the task or system outside its acceptable limits (Sender and Moray, 1991). To prevent the human errors, the most researchers and analysts insist that the root causes be made clear. The making them clear, however, is difficult because their root causes are very various and uncertain. The current human error guidelines (e.g. US DOD handbooks, US NRC Guidelines) are representative tools to prevent human errors. These tools, however, have limits that they do not adapt all operating situations and circumstances such as design base events. In other words, these tools are only adapted foreseeable standardized operating situations and circumstances.

In this study, our research team proposed an evidence-based approach such as UK's safety case to coping with the rare human error events such as TMI, Chernobyl, Fukushima accidents. These accidents are representative events involved with rare human errors. Our research team defined the 'rare human errors' as the follow three characterized events;

- Extremely low frequency
- Extremely high complicated structure
- Extremely serious damage of human life and property

A safety case is a structured argument, supported by evidence, intended to justify that a system is acceptably safe. The definition by UK defense standard 00-56 issue 4 states that such an evidence-based approach can be contrast with a prescriptive approach to safety certification, which require safety to be justified using a prescribed process. Especially, a nuclear safety case is a set of documents that describe the radiological hazards in terms of a facility or site and modes of operation and the measures that prevent or mitigate against harm being incurred. The safety case should provide a coherent demonstration that relevant standards have been met and that risks to persons have

been reduced to as low as reasonably practicable (NS-TAST-GD-051 rev. 3, UK HSE). Recently the IAEA introduced the safety case in the field of radioactive waste (IAEA Specific Safety Guide 23).

Safety managements and safety regulatory activities based on safety case are effective to control organizational factors in terms of integrated safety management. Especially safety issues relevant with public acceptance are useful to provide practical evidences to the public reasonably. European Union including UK has developed the concept of engineered safety management system to deal with public acceptance using the safety case. In Korea nuclear industry, the Korean Atomic Research Institute has firstly performed a basic research to adapt the safety case in the field of radioactive waste according to the IAEA SSG-23(KAERI/TR-4497, 4531). Excepting the radioactive waste, there is no try to adapt the safety case yet.

Most incidents and accidents involved human during operating NPPs have a tendency to be structured by complicated and various organizational, individual, and environmental factors. The rare human errors being induced by complicated interactions are easy to be exclusive in the band of the safety management generally because the rare human errors occur infrequently.

In this study, the rare human error event was named as 'Unsafety Case'. Through this challenging try based on evidences to the human errors could be useful to prevent rare and critical events can occur in the future. The proposed approach, however, will be depend on the operating companies, which companies should develop more various unsafety cases and prepare the unsafety case reports according to the structured writer's guidance.

2. Methods and Results

We developed five unsafety cases, which are relevant with rare human errors especially involved organizational factors. The unsafety cases are described using the fault tree to provide structured relations among various human error hazards. Figure 1 is an example of the unsafety cases.

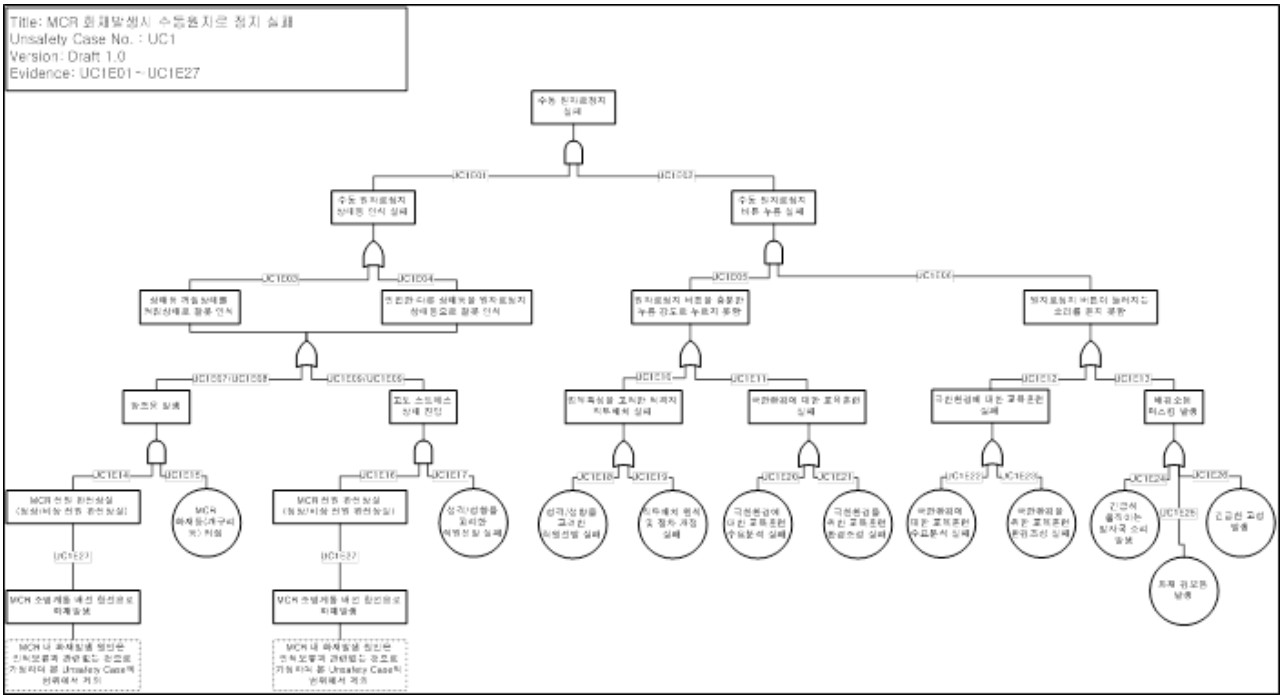


Figure 1. An example of the unsafety case

3. Conclusions

The unsafety cases involved rare human errors are based on evidences which are consist of theory, revealed real case, and expert judgment. To prevent rare human error events, operating company should prepare the analysis report as a formal unsafety case report. The regulatory requirements for the report do not exist yet. The proactive preparedness against rare human errors, however, will be necessary to be leading company in the world nuclear industry.

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