HRA data collection from simulators – the list of necessary information

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1. Introduction

It is evident that human error (or the contribution of human performance related problems) is one of the decisive factors affecting the safety of complicated process control systems [1]. For this reason, it is natural to put an effort to enhance the safety of these systems by minimizing the possibility of human error. In this light, human error analysis (HRA) is the most popular approach. To this end, the collection of sufficient data that are helpful for understanding the nature of human error under a given situation (e.g., an accident condition) is very important from the point of view of the quality of HRA results [2]. For this reason, many researchers tried to collect HRA data from diverse sources, such as event reports, simulator observations, experiment results, expert judgments and interviews with plant personnel [3]. Unfortunately, since the collection of HRA data from event reports seems to be not easy because of several limitations (e.g., rare event frequency and data reliability), one of the promising solutions to unravel the limitations of event reports is to use full-scope simulators. In this regard, the list of common data items to be collected from simulation studies which are necessary for supporting HRA in NPPs is indispensable.

2. Review of existing documents

From the point of view of the development of a HRA data collection guideline, it is expected that this guideline need to satisfy at least the following three constraints: (1) it should be supportive of the provision of data contents directly supporting HRA, (2) it should be helpful for specifying common formats of HRA data, and (3) it should be useful for collecting all the necessary data contents satisfying different purposes. In this regard, one of the plausible solutions is to develop the guideline through reviewing documents dealt with the enhancement of the quality of HRA results. For example, many documents that provide how to enhance the quality of HRA results already exist with various titles such as "requirements," "standards," and "good practice." Therefore, it is anticipated that the superset of data items that are supposed to be collected from simulators can be identified from these documents [4-19]. Fig. 1 depicts an overview explaining how to identify the list of data items to be collected from simulators.
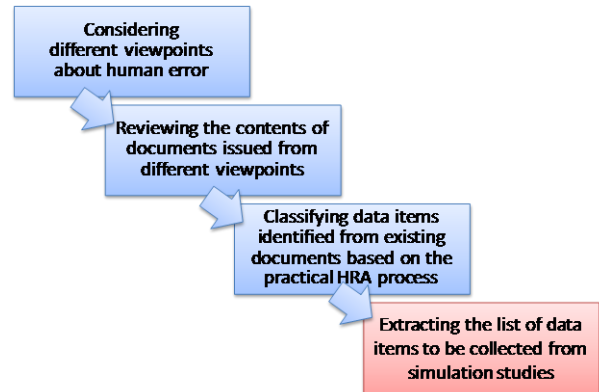

Fig. 1. identifying the list of data items to be collected from simulators

3. The list of necessary information

Based on the contents of existing documents, in total 89 data items belonging to 7 categories were identified. Table 1 summarizes a part of necessary data items included in each category.

Table 1. The list of necessary data items

Category	Data item
Environment	The appropriateness of ingress and egress paths
	The appropriateness of workspace envelop
	Adverse environment associated with the accident sequence
HMI	The existence of barriers
	The existence of buffers
	The provision of memory aids for a task to satisfy real-time constraints
	The conformity of standards, conventions and nomenclature
Organization	Operational practices based on the structure of an operating crew
	Resource limitations on the back shift or staff availability
	General training information
	Specific training information (ambiguous, unsafe and no guidance)
	Training for recovery
	The level of safety culture
Procedure	The trail (path) of procedural guidance (steps) related to a given accident sequence
	The quality of administrative controls including written work plan
	Technical correctness and completeness of contents
	Appropriate format based on PWG (procedure writer's guide)
	Appropriateness of explanations
	Compatibility between the content of procedures and the knowledge/abilities provided to personnel by training and qualification programs
Task	List of predefined HFEs
	List of procedure-specific tasks
	List of impromptu tasks
	Appropriateness of task scope

	Task type	
	Complexity of the required diagnosis	
	Complexity of the required execution	
	Expected communication devices	
	Expected communication protocols	
	Expected communication strategy	
Success criteria (SC)	CSF related SC	
	System related SC	
	Time related SC	
	Frequency, tolerance and accuracy	
Actual response	Actual working environment	
	The use of memory aids being provided for a task to satisfy real-time constraints	
	The use of decision criteria being provided for a task to satisfy real-time constraints	
	The clearness (easiness) for cue identification	
	The possibility of information misleading in HMIs	
	Crew dynamics	
	The trail (path) of procedural guidance (steps) actually followed	
	The level of stress	
	Task load	
	Workload	
	Nature of decision making	
	Operator's evaluation processes	

4. General conclusion

The purpose of this report is to provide the list of data items that could be a technical basis for the development of HRA data collection guidelines to be used in simulation studies. To this end, the contents of HRA related documents were reviewed. As a result, as summarized in Table 9, in total 89 data items included in 7 categories are identified. In addition, since these data items have been extracted from the contents of existing documents that reflect invaluable experience, knowledge and effort in HRA domain, it is strongly expected that they can be regarded as common data items to be collected from simulation studies.

Acknowledgment

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