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Application of Communication Error Analysis Method (CEAM)

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1. Introduction

Communication Error Analysis Method (CEAM) is a method to analyze communication-related events based on Cognitive Reliability and Error Analysis Method (CREAM) [1]. CEAM provides the systematic analysis of erroneous actions due to communication failure through antecedent-consequent links in qualitative analysis and the quantitative prediction of potential communication errors in quantitative analysis. From the results of analysis, we can foresee

In this study, CEAM is applied to an event happened in Kori NPP-Unit 3.

2. Analysis Methods

2.1 Qualitative Analysis Methods

A qualitative analysis method make a user conduct the retrospective and predictive analysis of events. We use the retrospective method to make a path of cause-effect links from the observed effect. And the purpose of applying the predictive method is to describe which type of communication errors can happen. To conduct the qualitative analysis, context conditions (CCs) to estimate the effect of the environment on communication error, error modes to categorize particular forms of erroneous actions, and antecedent-consequent links to connect the cause and effect of errors are defined [2].

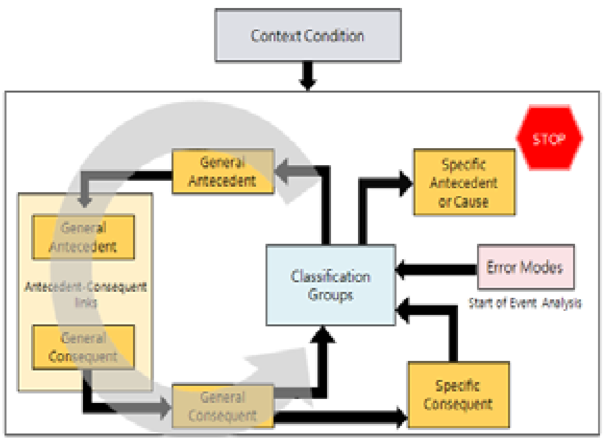

Fig. 1. Retrospective analysis of CEAM

2.2 Quantitative Analysis Methods

The aim of the quantitative analysis is to predict the probability of speaking process errors in a given plant condition. to consider speaking process errors related to human cognitive function, cognitive speaking process (CSP) is defined and CSP error types are explained in Table 1.

Table I: Problem Description

CSP	Cognitive Speaking Process Errors		
	Error Types		Norminal Value
Planning	P1	Message is sent to the wrong place or person.	1.0E-3
	P2	Message transmission is inadequate.	1.0E-3
	P3	Message production is inadequate.	3.0E-3
	P4	Message content is wrong.	5.0E-3
	P5	Message content is inappropriate for the receiver.	1.0E-3
Transmitting	T1	Message is sent at the wrong time.	3.0E-3
	T2	Message is not sent at all.	3.0E-2
	T3	Message content is inconsistent content with other information.	3.0E-3

The process of the quantitative analysis is shown in Fig. 2. The assessment of CCs mentioned in the quantitative analysis is used for the quantification. And the weighting factors in terms of the coupling relationship between CCs and CSP are defined.

With the calculated weighting factors and nominal probability values on CSP error types, we can evaluate the adjusted CSP error probability.

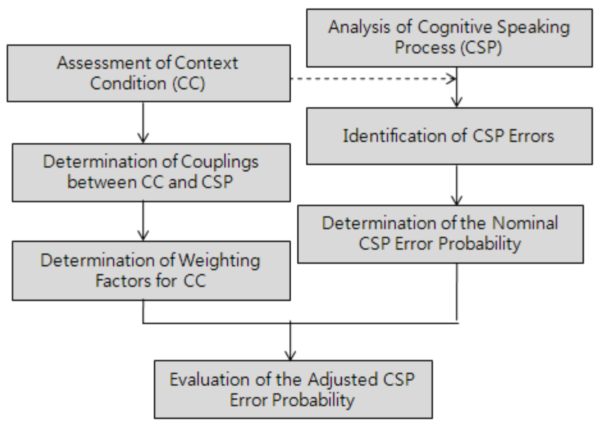

Fig. 2. Prediction of an error probability

3. Application

During the completion of annual overhaul, the Kori Unit-3 experienced a valid Safety Injunction (SI) actuation due to the pressurizer (PZR) low pressure on May 25, 2008. The PZR low pressure was caused by inadvertent opening of the PZR Power Operated Relief Valve (PORV) due to personnel error. During this event, two tests: i.e., the 'RCS RTD cross calibration test' and the 'Engineered Safety Features (ESF) subgroup relay functional test' were sequentially performed. For the preparation of RCS RTD calibration test, they confirmed the COPS selector switch being in 'BLOCK' position but that test was invalidated and delayed because of the RCS temperature being beyond the acceptance criteria. In the meantime, for the subsequent ESF subgroup relay functional test, the COPS selector switch was temporarily placed in 'ARM' position to carry out a step for the PZR COPS control signal and the test was finished. However, when they recommenced the RCS RTD calibration test, they did not confirm the position of the COPS selector switch and communication between the test engineer and the Main Control Room (MCR) operators was not sufficient. Therefore, when they withdrew the R/I card, an invalid RCS temperature signal of 0℃ was given to the COPS system which, in conjunction with the selector switch for the Train 'B' Cold Over Pressure Protection Signal (COPS) in 'ARM' position, resulted in opening of the PORV.

The CCs of the selected events are defined and expressed in bold in Table II. These are estimated by the report [3,4] and the interview of the event investigator. In qualitative analysis, it was reported that the error in this case is designated as a "message is not sent at all" error type for the timing error mode. Through the relationship between error mode and general antecedent, the inadequate timing and the inadequate team characteristic are assigned. Through the person related antecedent-consequent links, distraction and insufficient written procedure is decided as root causes. Through the organization related links, membership, trust, forthrightness are estimated as root causes.

In quantitative analysis, the communication error "message is not sent at all" is deemed a "transmitting" process error. In terms of coupling relationship, weighting factors are determined. Therefore, the combined weighting factor is 6.4 and the adjusted probability is estimated as 1.92E-1.

According to CREAM, the probability results are categorized into four types and we can speculate the meaning of results. The estimated result is included in opportunistic and scramble mode which has interval from 1.0E-2 to 0.5E-0 and from 1.0E-1 to 1.0E-0 respectively. In this case, the communication is determined by the salient features of the context rather than on stable intentions. The choice of communication is even unpredictable or haphazard. [1]

Table II: Problem Description

Context Condition			**CSP**			
			P		**T**	
CC name	**Level**	**PR**	**CR**	**W**	**CR**	**W**
Adequacy of Organization	Very efficient	I	S	0.5	M	0.8
	Efficient	**N**		1.0		**1.0**
	Inefficient	R		1.5		1.2
	Deficient	R		5.0		2.0
Working Condition	Advantage	I	W	1.0	M	0.8
	Compatible	**N**		1.0		**1.0**
	Incompatible	R		1.0		2.0
Adequacy of Equipments	Supportive	I	W	1.0	S	0.5
	Adequate	**N**		1.0		**1.0**
	Tolerable	N		1.0		1.5
	Inappropriate	R		1.0		5.0
Availability of Procedure	Appropriate	I	S	0.5	M	0.8
	Acceptable	N		1.0		1.0
	Inappropriate	**R**		5.0		**2.0**
Workload	Fewer than capacity	N	S	1.0	M	1.0
	Matching capacity	N		1.0		1.0
	More than capacity	**R**		5.0		**2.0**
Available Time	Adequate	I	S	0.5	S	0.5
	Temporarily inadequate	**N**		1.0		**1.0**
	Continuously adequate	R		5.0		5.0
Time of Day	**Adjusted**	**N**	M	1.0	W	**1.0**
	Unadjusted	R		1.2		1.0
Expertise Level	**High experience**	**I**	S	0.5	M	**0.8**
	Low experience	N		1.0		1.0
	Inadequate	R		5.0		2.0
Crew Collaboration Quality	Very efficient	I	S	0.5	M	0.8
	Efficient	N		1.0		1.0
	Inefficient	N		1.0		1.0
	Deficient	**R**		5.0		**2.0**
Total influence of Context Condition					**6.4**	

PR: Performance Reliability,
I: Improved, N: No significant, R: Reduced,
CR: Coupling Relationship, W: Weighting factor
S: Strong, M: Medium, W: Weak

4. Conclusions

CEAM targets only the analysis of specific communication-related accidents so that it helps much better understand and foresee the communication errors. This method is applied to an accident happened in Kori Unit-3. From the result, we can foresee the effect of the environment on human communication and reduce the possibility of error occurrences.

REFERENCES

[1] E. Hollagel, Cognitive Reliability and Error Analysis Method, Elsevier, 1998.

[2] S.M.Lee, J.S.Ha, P.H.Seong, Communication Error Analysis Method based on CREAM, Transactions of the Korean Nuclear Society Spring Meeting, May.27-28, 2010, Pyeong Chang, Korea.

[3] OPIS: Operational Performance Information System for NPP (http:/opis.kins.re.kr)

[4] Public Release Information, 2008-5 (080525K3), KINS, 2008.