Connection of Emergency Action Levels with Emergency Operating Procedures

Sang Ho Kang, Chong Hui Lee, Chan Young Chung
Korea Power Engineering Co
sangho@kopec.co.kr

1. Introduction

Emergency action levels (EAL) are established to classify and announce emergencies, and to take proper action in case of a plant emergency. Logical structure of the current EALs of Korean operating NPPs are so complicated that it is difficult to judge whether the plant condition meets the emergency criteria. This led to the delay of the announcement of an emergency when a steam generator tube ruptured at the Ulchin NPP.

From this point of view, Korea Institute of Nuclear Safety (KINS) recommended that EALs be connected with Emergency Operating Procedures (EOP), which the operators concentrate on in the emergency situation. In this study, current EALs and EOPs are reviewed in detail to find a connection when an EAL meets the entry conditions of a specific EOP.

2. Methods and Results

2.1 Scope

In order to find connections and bases, this study included the following considerations;

- Review of regulatory requirements and literature
- Selection of EALs connected with EOPs
- Derivation of EAL simplification methods
- Preparation of technical basis
- Review of the operational effect of the connection
- Findings to be modified in the future

KRN 3&4, UCN 3&4 and WSN 2 were selected for this study to represent each reactor type of Westinghouse, Combustion Engineering and CANDU, respectively.

2.2 Method of connection

The connection of the EAL with the EOP requires justification. Korean law and regulatory guidance strongly recommends the connection of the EAL with EOP for the prompt judgment and announcement of the emergency. In addition, U.S. standards state that it is useful to interconnect EAL and EOP, thus many U.S. NPPs have adopted this recommendation into their EALs. Interviews with Korean plant operation staffs showed that it would be helpful for the prompt response when an abnormal condition happens.

The following procedures were applied after the justification of the connection. First, each EAL was investigated to determine its technical basis. Second, each step of the relative EOP is followed with the EAL conditions. Third, a determination is made whether the EAL conditions lead to any entry into an EOP or not. Finally, the modified EALs are compared with the same type of U.S. plant which incorporates EOP connection.

2.3 Technical Basis

For example, an EAL (Alert-4) of KRN 3&4 (Figure 1) is connected to EOP E-3 (Figure 2) based on the following considerations.

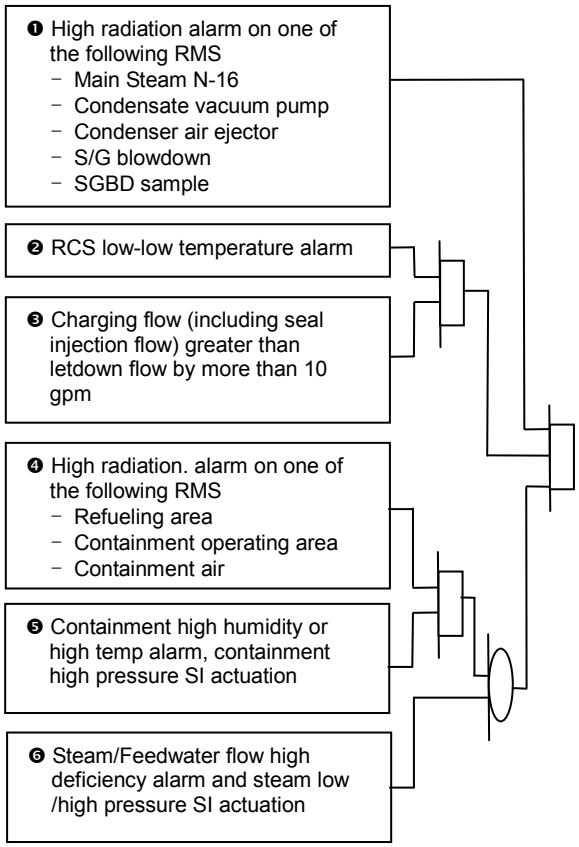

Figure 1. Current structure of Alert-4. RCS leakage to secondary side greater than 10 gpm coincident with steam line break. *Many conditions are related with AND/OR logic.*

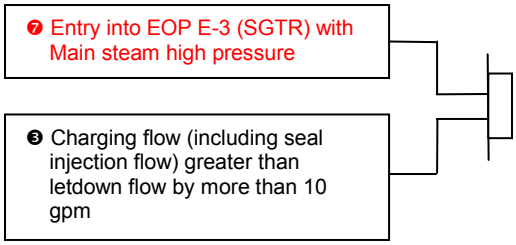

Figure 2. Modified logic of Alert-4. *Conditions are simplified with the entry of EOP E-3 (SGTR).*

Current conditions of ❷, ❹, ❺ and ❻ in Figure 1 are the symptoms of steam line break and conditions of ❶ and ❸ are those of steam generator tube rupture. With S/G tube leak of 10 gpm, reactor trip or SI actuation signal does not occur because charging flow increases to make up the RCS inventory and the pressurizer heaters control the RCS pressure. However, main steam line break leads to low steam pressure alarm or high containment pressure alarm thus leading to a reactor trip. This requires the operator enter E-0 procedure (Reactor trip or Safety Injection). Following the E-0 procedure, the operator checks the radiation level in the secondary side at step 23.0 and the operator enters E-3 (SGTR tube rupture) after confirming high radiation alarm in the secondary side. Therefore, conditions of ❶~❻ in current EAL could be replaced with condition ❼ of entry into E-3. However, condition ❸ should be checked independently to verify that the primary coolant leakage is greater than 10 gpm. In addition, high pressure of steam line should be confirmed separately to discriminate this EAL with steam generator tube rupture without steam line break.

2.4 Results

All the current EALs were reviewed following each step of the procedures with the method described in Section 2.3. This review found that some EALs are not directly connected to the EOP since their conditions do not meet the condition of entrance into any EOP. Table 1 shows the summarized results of the study.

Table 1. Summary of EAL connection study

No	KRN 3&4			UCN 3&4			WSN 2		
	A	S	G	A	S	G	A	S	G
Total	20	17	13	20	17	13	15	16	11
KINS	8	9	8	8	9	8	5	8	8
This Study	4	7	8	6	8	7	4	6	7
No. of Conn-ected EALs	3 4 7 11	1 2 3 4 5 7 8	2A 2B 2C 5A 5B 5C 5D 5E	3 4 7 8 9 11	1 2 3 4 5 6 7 8	2A 2B 2C 5A 5C 5D 5E	2B 2C 3 5	1 3 4 5 6 7	2A 2C 4A 4B 4C 4D 4E

*) A : Alert, S : Site area emergency, G : General emergency

3. Conclusion

Current Korean NPP EALs were established based on NUREG-0818 published in 1981. The conditions and logic are so that the operator could not easily determine the level of emergency during the urgent transient situations.

By connecting EALs with EOPs operators can take prompt action for emergency announcement and classify the type of emergency easily because they now concentrate the EOP and not on the EAL.

Acknowledgements

This study was conducted with the support of Korea Hydro and Nuclear Co. (KHNP).

REFERENCES

[1] MOST, Emergency Planning Law for Nuclear Facilities
[2] KINS, KINS/GT-N021-1, Technical guidance on EAL of power reactor, 2003
[3] IAEA, TECDOC-955, Generic Assessment Procedures for Determining Protective Actions During a Reactor Accident, 1997
[4] USEPA, EPA-400-R-92-001, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, May, 1992
[5] USNRC, Regulatory Guide 1.101, Emergency response Planning and Preparedness for Nuclear Power Reactors, Rev.5, September, 2004
[6] USNRC, NUREG-0654/FEMA-REP-1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plant", Rev.1, Nov., 1980
[7] USNRC, NUREG-0818, Emergency Action Level for LWRs, Oct., 1981
[8] NEI 99-01, Methodology for Development of Emergency Action Levels, Rev.4, Jan., 2003
[9] Nuclear Management Company, LLC, Kewaunee NPP Procedure, EPIP-AD-02, Rev.AJ, Emergency Class Determination, Jan., 2004
[10] Southern Nuclear Operating Company, Inc, Vogtle Electric Generating Plant Procedure, 91001-C, Emergency Classification and Implementing Instructions, Rev.20, Sep., 2000
[11] Virginia Electric and Power Company, Surry Power Station 1&2 Procedure, EPIP-1.01, Emergency Manager Controlling Procedure, Rev.44, Jan., 2004
[12] Constellation Energy Company, R. E. Ginna Nuclear Power Plant Procedure, EPIP-1-0, Ginna Station Event Evaluation and Classification, Rev.32, Sep., 2003
[13] Palo Verde NPP Procedure, EPIP-04, Emergency Operations Facility Actions, Rev.27, Jan., 2001
[14] Palisades Nuclear Plant Procedure, EI-1, Emergency Classification and Actions, Rev.33, Mar., 2000