

Standardization of the Action Verbs used in Emergency Operating Procedures of NPPs

Tong-II Jang*, Yong-Hee Lee*, Jae-Chang Park*, Yeon-Seop Jeong**, Gang-II Chu**

* Korea Atomic Energy Research Institute

** Korea Hydro and Nuclear Power

tijang@kaeri.re.kr

1. Introduction

The action verbs used in Emergency Operating Procedures (EOPs) for each nuclear power plant are translated respectively from the action verbs used in Emergency Recovery Guidelines (ERG) of the reference plants. The action verbs used in each plant are not largely different with one another. There are, however, some cases that the meanings of the same action verbs used in different plants are not consistent with each other and translations are not exact.

In this study, the original English expressions of the action verbs and the translated verbs were compared and their accepted meanings analyzed. And then, standardization for the action verbs which are not exactly translated or which are used with different meanings among the plants was proposed.

2. The present state of the action verbs in each plant

To understand currently used action verbs, lists of the action verbs described in EOP writer's guides in each plant were identified and the action verbs were derived. Some plants did not have the list of the action verbs.

Out of currently operating 10 plants, the plants which provide the action verbs list in the EOP writer's guide were Kori #1 plant, Kori #2 plant, Yonggwang #1 plant, and Yonggwang #2 plant. In case of Ulchin #1 plant, in the EOP writer's guide, the action verbs and their definitions and the examples of applications were presented, but the original English expressions of ERG were not provided. We review the consistency and appropriateness of their utilization in EOPs respectively and compare them with each other.

Generally, the plants which comparatively recently started the commercial operation have lists of the action verbs. Lists of the action verbs of each plant are described in the below.

2.1. The action verbs of Kori #1 plant

In case of Kori #1 plant, a list of the action verbs are described in a technical administrative procedure 0-1-503 "Emergency(Abnormal) operating procedure writer's guide". Total of 39 action verbs are presented and a part of them is as Table 1.

Table 1 Action verbs of Kori #1 plant(a part).

Action verb	Meaning and usage
-------------	-------------------

작동하다 (Actuate)	Taking measures or actions. Being used automatic or various operations. ex) 안전주입을 작동한다. Phase-A 를 작동한다.
배열하다 (Align)	Arranging the equipment into desired states. ex) 정상 충전을 위해 계통을 배열한다.
차단(방지)하다 (Block)	Preventing automatic operations. ex) 안전주입 동작을 차단한다.
점검하다 (Check)	Comparing with requirements of procedures. ex) SI 를 종료할 수 있는지 점검한다.
조절한다 (Control)	Adjusting the temperature or the flow rate. ex) 가압기 수위를 조절한다.

2.2. The action verbs of Kori #2 plant

Kori #2 plant has a list of action verbs in a technical administrative procedure 71-2 "Emergency operating procedure writer's guide". Totally 42 action verbs are provided. It has 3 more action verbs than Kori #1 plant. A part of the list is as Table 2.

Table 2 Action verbs of Kori #2 plant(a part).

Action verb	Meaning and usage
결정하다 Determine	Calculating or assessing using tables or graphs ex) 최대 배기시간을 결정한다.
확보하다 Establish	Preparing or setting up mentioned conditions. ex) 제어실과의 통신수단을 확보한다.
평가하다 Evaluate	Evaluating and determining. ex) 발전소 상태를 평가한다.
시작하다 Initiate	Beginning the procedure. ex) 모든 S/G 에 급수 공급을 시작한다.
감시하다 Monitor	Same meaning with the " Check" except the situations requiring the sustained checking.

2.3. The action verbs of Yonggwang #1 plant

Yonggwang #1 plant has a list of the action verbs in a technical administrative procedure 515 "Preparation or emergency operating procedure". It has total of 42 action verbs which are same as Kori #2 plant.

2.4. The action verbs of Yonggwang #2 plant

In case of Yonggwang #2 plant, a list of the action verbs is not described in a recently revised technical administrative procedure 82(Rev.4, 2005) "Emergency operating procedure writer's guide", so the previous revised version(Rev.2, 2000) was referred. It provides total of 38 action verbs. A simple list is described in Table 3.

Table 3 Action verbs of Yonggwang #2 plant(a part).

Action verb	Meaning and usage
시료분석~ Sample	Picking the representative sample, and then examining ingredients and presenting results. ex) S/G의 방사능을 분석한다.
설정~ Set	Physically Regulating the adjustable properties into setting values. ex) 디젤 펌프 회전수를 ~rpm 으로 설정한다.
기동~ Start	Beginning the operation of electrical or mechanical facilities by directly or remotely. ex) RCP를 기동한다.
트립~ (개방~) Trip	Stopping equipment manually by actuating the mechanism or opening the breaker of electrical circuits. ex) 터빈을 트립한다, 차단기를 트립한다.

3. Standardization of the action verbs

In the result of review for expression methods and definitions of the action verbs which are presented in the lists of the emergency operating procedure writer's guide, there were no noticeable and considerable differences in meanings and expressions. Standardization, however, is performed to accord partial differences of expression methods and definitions.

Lists of the action verbs of four plants were presented to several operations experts who have more than 10 years experience as RO(Reactor Operator)/SS(Shift Supervisor) and/or a career as simulator instructors. They were requested to choose the most suitable translated expressions of the original English action verbs. And also, definitions of each action verb were chosen by the same method. Through this method, we could suggest a proposal for the standardization of the action verbs. A part of the suggested list of the action verbs is in Table 4.

Table 4 A list of the suggested action verbs(a part).

Action verb	Translated verb	Meaning
Actuate	작동하다	Taking measures or actions. Being used automatic or various operations.
Align	정렬하다	Arranging the equipment into desired states.
Bypass	우회하다	Disabling the actuation of automatically started system or equipment.
Check	점검하다	Comparing with requirements of procedures.
Control	제어하다	Adjusting the temperature or the flow rate and so on.
Do	수행하다	Instructing to perform a step a of specific procedure.
Ensure	확인하다	Doing something in accordance with intention by required and proper actions.

Establish	확보하다	Preparing or setting up mentioned conditions.
Exit	종료하다	Escaping from executing procedures.
Operate	조작하다/ 운전하다	Turning on or turning off something as required actions to accomplish intended conditions.
Perform	수행하다	Executing a series of operators' actions.
Reset	리세트하다	Removing output signals from logical circuits under the conditions that input signals are existed.
Start	기동하다	Beginning the operation of electrical or mechanical facilities by directly or remotely.
Stop	정지하다/ 중지하다	Interrupting the operation.
Throttle	조절하다	Adjusting valves to proper position to maintain the flow rate appropriately.
Verify	확인하다	Observing desired conditions and characteristics.

4. Discussion and Conclusions

To resolve the concerns about the differences among the action verbs of EOPs in each NPP, we reviewed four different sets of EOP action verbs, and suggest a new list of the standardized action verbs. The proposed list requires further verifications through, for example, the simulator study and/or human factors experiments.

Standardization of action verbs can help operators to rapidly adapt to EOPs. In cases of job rotation among plants, it might be beneficial to prevent a decline in the operating performance and reduce human errors.

REFERENCES

- [1] D.H.Lee, T.I.Jang, Y.H.Lee, Suggestion of a New Writer's Guideline to reduce Human Errors Found in EOPs of NPPs, J. of Erg. Soc. of Korea, vol. 29, pp.129~138, 2010.
- [2] KHNP, Technical Administrative Procedure 0-1-503, Emergency(Abnormal) Operating Procedure Writer's Guide Rev.4, Kori #1 plant, 2006.
- [3] KHNP, Technical Administrative Procedure 71-2, Emergency Operating Procedure Writer's Guide Rev.1, Kori #2 plant, 1998.
- [4] KHNP, Technical Administrative Procedure 515, Preparing Emergency Operating Procedure Rev.7, Yonggwang #1 plant, 2007.
- [5] KHNP, Technical Administrative Procedure 82, Emergency Operating Procedure writer's guide Rev.4, Yonggwang #2 plant, 2005.
- [6] KHNP, Technical Administrative Procedure 64-2, Preparing Emergency Operating Procedure Rev.5, Ulchin #1 plant, 2009.
- [7] T.I. Jang, et al., An Experimental Evaluation of a Flowchart Type Operating Procedure for NPPs, Proc. IEEE 8th Conf. on HFPP and 13th HPRCT Mtg. 2007.