Design of the backup-hardcopy in A4 size

Hyekyoung Kim [*], Nokyu Seong, Sungjin Lee, Yeonsub Jung
Instrumentation & Power Engineering Laboratory, KHNP Central Research Institute, 70, 1312 beon-gil, Yuseong-daero, Yuseong-gu, Daejeon
[*]*Corresponding author: hyeswp@khnp.co.kr*

1. Introduction

As a part of Advanced Power Reactor 1400 (APR1400), Computerized Procedure System(CPS) was introduced in digital Main Control Room(MCR) whereas Paper based Procedures(PBPs) are used in analog MCR. On contrary to PBPs, there is no necessity of turning back any Indications or Alarm Panels to go to PBP shelves since Computerized Procedures(CPs) are implemented in workstations for every operator.

The main difference between PBPs and CPS are : CPS has an operator evaluation support function which shows a computed evaluation to compare an operator's evaluation. Also, CPS displays a procedure related display on your right side monitor and operators are able to operate a device by clicking it on that display.

When CPS fails or malfunctions, backup to CPS should be warranted for while the system is repaired [1]. Thus, the backup-hardcopy is introduced. At the beginning of applying the backup-hardcopy, it was A3 size which looks like a CPS displays. Human Factor Engineering Verification and Validation (HFE V&V) found that it is too big for a desk in MCR and keeping it [2]. The backup-hardcopy in A4 size, therefore has been developed, which is described herein.

2. The backup-hardcopy

At operators' suggestion, in Korea Hydro and Nuclear Power Plant (KHNP), the backup-hardcopy keeps in the similar standard format of KHNP procedures [2].

As having contingency actions, EOPs are written in a dual column format. One column lists operator instructions and the opposite column defines its contingency actions [3]. That provides a time-efficient operation and clear recognition between an normal instruction and its contingency in PBP. In the same way, there are two main types of Backup-hardcopy : Emergency Operating Procedures(EOPs) and the others(i.e. Abnormal Operating Procedures (AOP), Alarm Response Procedures (ARP), etc.).

From HFE V&V, a Human Factor Engineer pointed out that DCS objects are not necessary to be printed out since the backup-hardcopy does not show a real time status of them. But, smooth transfer between CPs and PBPs and vice versa by the degree to which their formatting is consistent is required by NUREG-0700[1] and the operators. Thus, in spite of missing real time status expression of DCS objects, backup-hardcopy still prints them.

2.1 In A3 size

The backup-hardcopy in A3 size is developed earlier as Fig. 1 and Fig. 2. They are almost the same as CPS displays and there is a remarkable consistency between the two. However, as results of HFE V&V, the size is matter.
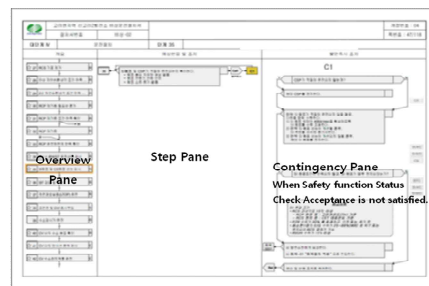

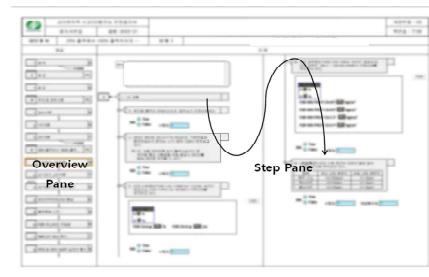Fig. 1. The backup-hardcopy in A3 size for (EOPs)

Fig. 2. The backup-hardcopy in A3 size for the other procedures

2.2 In A4 size

There are the features of the A4 sized backup-hardcopy to meet KHNP operator's requirement and HFE V&V results.

For EOPs as Fig. 3 :

· No Overview Pane in the Contingency Pane.

· Numbering each contingency to tell each other among contingencies in a step.

· Both of a normal instruction with contingency in Step Pane and its contingency action in Contingency Pane, distinguished by the numbering, show in a face. Plus, the contents of the both instructions cannot be divided into 2 pages. Intentionally blanks can be printed.

· A normal instruction without contingency action, "No Contingency" is printed in Contingency Pane.

· Instead of Overview pane, Safety Function Status Check Acceptance and Place-keeping sheets are provided for EOPs. Safety Function Status Check Acceptance consists of several check boxes in a normal instruction to mark whether a condition in the instruction is satisfied. Place-keeping sheets list steps similarly to Overview pane. Its step has several Check boxes from beginning to end of the step so an operator marks how many times the step performed.

· Place-keeping sheets for steps are prepared in A3 to check in fixed position when EOPs are performed and fold and keep it.

Fig. 3. The backup-hardcopy in A4 size for EOPs

Overview pane for other Procedures as Fig. 4 :

· The status of transition lines are the same in CPS display.

· Every character for Step name is showed by an automatic line breaking in 2 lines.

· HOLD or KEY from Step property is not printed at the same time.

Fig. 4. The backup-hardcopy in A4 size for EOPs

3. Conclusions

The backup-hardcopy is an essential requirement for backup to CPS under unexpected circumstance such as CPS fails or malfunctions. The backup-hardcopy described herein solves a size problem from HFE V&V

and added KHNP operators' suggestions as well. Thus, the backup-hardcopy in A4 is using at Final HFE V&V.

REFERENCES

[1] J.M. O'Hara and W.S Brown, BNL/ESTd, P.M.Lewis and J.I.Persensky, NRC/RES/DSARE, 2002, Human-System interface Design Review Guidelines, NUREG-0700, Rev.02.
[2] Sungjin Lee, Nokyu Seong, Hee-Taek Lim, 2012, The Revision Report of SUN 1&2 CPS System Specification
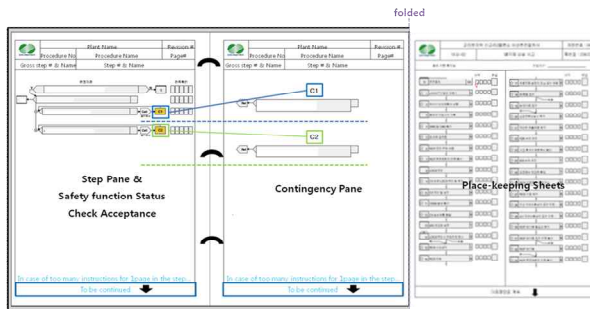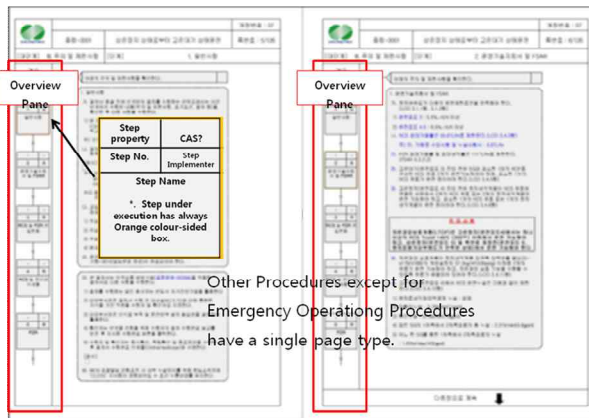 [3] KEPCO E&C, 신형경수로 1400 비상운전지침서, Rev01