# How to Maintain Computerized Procedure System in the same Version

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## 1. Introduction

CPS(Computerized Procedure System) has been introduced in advanced nuclear power plant worldwide. Korean CPS complies with this trend. It has been applied to Shinkori3,4 and all their successors including BNPP1,2,3,4.

CPS is designed by KHNP CRI, and developed by Westinghouse or Doosan.  Initial design has been improved by reflecting operator experience, human factor V&V, and advanced engineering method.

Design improvement makes CPS differ from plant to plant. For example CPS in Shinhanul cannot interpret CP(Computerized Procedure) of ShinKori3,4. Different CPS makes it difficult to utilize CP and train operators.

Therefore it is important to keep CPS in single version. Note that typical text editors in the office are kept in single version. On the other hand, plant monitoring systems in main control room are actually different. Because CPS is positioned between text editor and monitoring system, goal to maintain CPS in single version is not an easy task.

This paper will describe CPS differences and activities to maintain in single version.

## 2. Modules of CPS

CPS consists of several modules. Independent modules enhance operation and maintenance for various users. PXS(Procedure eXecution System) is browser of CP. CPS ES is an editor system of CP. CP is data file for CPS ES and PXS.
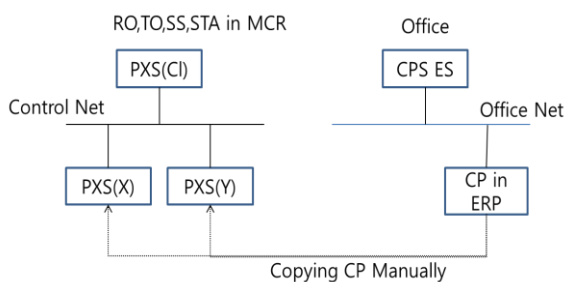


**Fig 1 Modules of CPS**

CP is written according to XML schema. Because CPS ES and PXS share the same schema, CP can be read by both PXS and CPS ES. Different behaviors of CPS might result from with or without XML schema change. Even without XML change, PXS can be made to behave differently. In this case PXS can read CPs of different nuclear plants. On the other hand, PXS can behave differently because of XML schema change. In this case PXS has difficulty to read CPs from other plants. Therefore CPS designer should not revise XML schema in principle. However it is inevitable to revise XML schema actually.

## 3.  Characteristics of KHNP CPS

One of core characteristics KHNP CPS is Flowlogic diagram to represent instructions of step. Flowlogic diagram is easy to follow instructions and powerful to integrate all instructions. Once rules to interpret Flowlogic diagram are taught, it is comprehensible and intuitive.
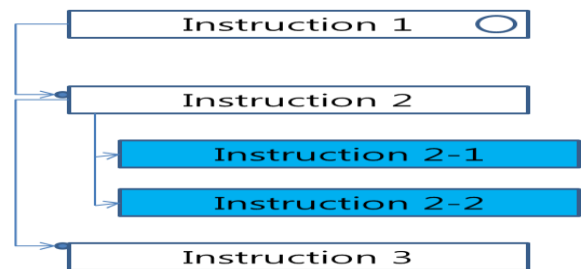


**Fig 1 Flowlogic Diagram**

Appearance and behavior of Flowlogic diagram are imbedded in PXS and CPS ES. Therefore it is not necessary to add behavioral attribute in CP with reducing CP size.



**Fig 3 User Interface of PXS**

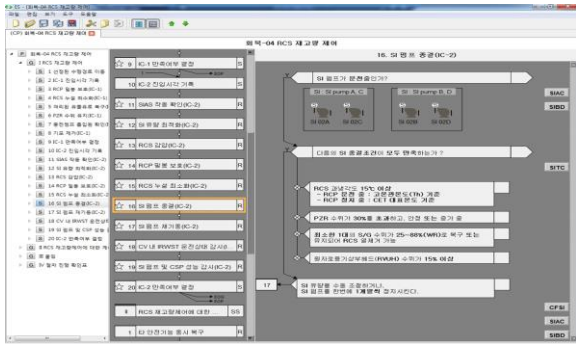The same Flowlogic diagram appears in CPS ES. So what you edited in CPS ES is what you see in PXS.



**Fig 4 User Interface of CPS ES**

## 4. Design Improvements

### 4.1 Bigoverview enhanced

KHNP CPS provides two types of overviews. One is normal overview to show forest of procedure, the other is bigoverview to diagnosis path of procedure. The bigoverview is used currently to dragonize design basis events. However bigoverview can be utilized further for other procedures. Therefore user interface and hierarchy of bigoverview have changed.
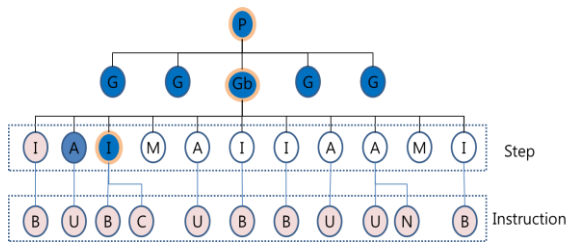


**Fig 5 Hierarchy for Bigoverview**

### 4.2 Lending status of procedure is refined

Procedure execution takes hours or days according to their purpose. In addition procedures can be open for browsing or executing. Therefor it is important to classify lending status of procedure. Lending status includes 'new', 'desk', 'logged' and 'complete'. The lending status are improved as Fig.6
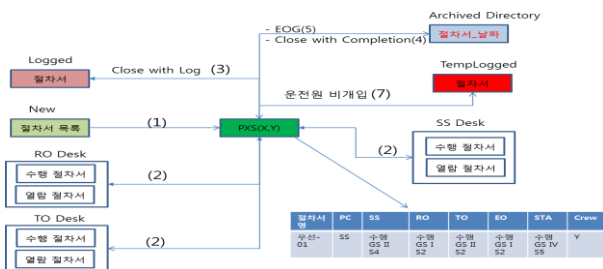


**Fig 6 Lending status of procedure**

### 4.3 Refine Step control buttons

Steps are carried out sequentially by clicking complete or postpone buttons as follows. But it is commented that operators are not easy to decide what button is adequate for further execution. Therefore behavior of step control is simplified and refined.

**Table 1 Behavior of step control buttons**

| Navigation button | Complete | Postpone | Check | Reexecute | Undo |
|---|---|---|---|---|---|
| The button is activated when | UE **and** Next target is determined | UE a**nd** NOT Hold | Executed | Executed | Most recent UE |
| Next Step | Determined by focused step | +1 | The same step as previous execution | No transition | The previous step |
| Execution Transition for current step | UE -> Executed | UE -> UE | No change | Executed ->UE | UE->NotExecuted |
| Execution Transition for next step | No Change except ( Not Executed -> UE) | No Change except ( Not Executed -> UE ) | No change | N/A | As-Was |
| Online Hardcopy | Yes | Yes. | No | No | No |

### 4.4 Enhancing consistency between IPS and CPS

Control, monitoring, alarm, and procedure are major components of main control room. CPS supporting procedure had its specific interfaces such as lots of information and confirm dialogs. Actually frequent popup dialogs might hinder primary operation. Therefore popup dialogs shall be suppressed as less as possible, and shall be treated in the alarm system. PXS has been improved to indicate its alarm with the alarm system rather than in CPS.

## 5. Conclusions

From Shinkori3,4, lots of improvements are achieved in CPS. This improvement surely makes operation easy and will not introduce human errors.

Side effect of improvement is that PXS and CPS ES may not be compatible among nuclear power plants. So the side effect should be avoided by minimizing change of XML.

Initial XML had been developed for Shinkori3,4. The XML has been modified slightly for Shinhanul1,2. PXS and CPS ES are being developed for the same version for all nuclear power plants of APR1400.

Slight changed XML can be handled by introducing configuration files for each nuclear power plant.