

The Development of CPSES Plug-in(CPMP) for APR1400 Computerized Procedure Effective Maintenance

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1. Introduction

Plant procedures are instructions to guide operators in monitoring, decision making, and controlling nuclear power plants (NPPs). While plant procedures historically have been paper-based, computerized-based procedures are being developed to overcome the drawbacks of paper-based procedures [1]. The Computerized Procedure System (CPS) is one of the Man Machine Interface (MMI) resources of the Shin-Kori 3&4 nuclear power plants. The CPS is a computerized operator support system that enables operating crew to execute procedures in an accurate and fast manner [2-4]. The Computerized Procedure (CP) is the XML data file in executable format that can be installed in the Procedure eXecution System (PXS) for execution. The CP contains specific information related to a particular procedure (i.e. LOCA) [5]. These computerized procedures such as Alarm Response Procedures (ARP) are separated into individual alarm procedure to maximize function interface between CPS and DCS. E.g. 'Procedure open by alarm list'. The procedure writer's burden to manage many procedures has been increased because of separated procedures. This paper introduces Computerized Procedure System Engineering System (CPSES) plug-in that is computerized procedure management program (CPMP) to reduce procedure writer's burden.

2. Computerized Procedure Management Program

To support procedure writer or CPS maintainer, CPMP features are as follows:

- Editing procedure object attributes (e.g. revision number, revision date, procedure number, etc.)
- Managing computerized procedures (e.g. installation, printing backup paper based procedures, data base update etc.)

2.1 CPMP user interface

CPMP is simply designed because CPMP is a plug-in of CPSES as well as a kind of managing program. CPMP has itself result window to remove errors in editing computerized procedure, printing pdf, in the progress of extraction. And also CPMP has CPP list window for operator to confirm CPPs. The below figure shows user interface of CPMP.

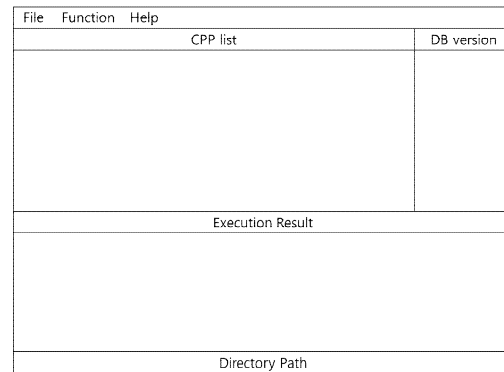


Fig. 1. User interface of CPMP

2.2 Editing attributes of procedures object

The computerized procedures have been revised to reflect plant system characteristics. When the computerized procedure is revised the revision number and revision date shall be changed. But the procedure writer cannot change revision number and revision date of all separated procedures. CPMP provides procedure writer with editing function about computerized procedure. The procedure writers easily can edit attributes of procedure object in selected procedure list. Contents of instruction object, title of step and gross step object can be edited in editing function.

2.3 Extraction of computerized procedure and images from computerized procedure project

The Computerized Procedure Project (CPP) encapsulates all data/documents resulted from the process of developing the computerized procedure using ES. The computerized procedures and related images of CPP are only executed in PXS. The below figure describes the structure of CPP.

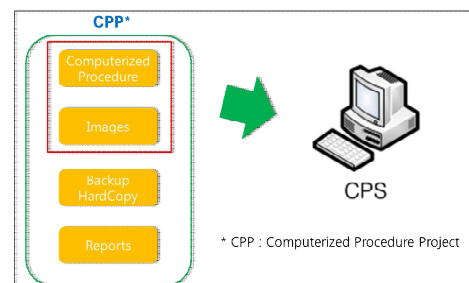


Fig. 2. [The structure of computerized procedure project



CPS maintainer can easily extract computerized procedure and image files from all CPP by using CPMP.

2.4 Printing backup hardcopy in portable document format (PDF)

All computerized procedures in PXS shall be printed in backup hard copy in case of CPS fail, therefore CPMP supports procedure writer to print backup hardcopy.

There are two options to print computerized procedures in CPMP. First is emergency operating procedures format and the other is normal operating procedures format. CPMP loads all CPPs to be printed and analyzes procedure type of computerized procedure. If procedure type is one of PTP, FRP, EOP then computerized procedure is printed in emergency operating procedures format otherwise computerized procedure is printed in normal operating procedure format automatically.

2.5 Update distributed control system (DCS) data base (DB)

The one of main features of computerized procedure is to contain the DCS data and symbols itself. Consequently if DCS data base updates then DCS data of computerized procedure also shall be updated. CPMP interprets DB version of CPP and shows DB version on CPP list therefore procedure writer can easily update old DB into new DB.

3. Conclusions

This paper introduces the main features of CPMP. CPMP reduces procedure writer's or CPX maintainer's burden. This program is implemented and tested by program design requirement. Currently CPMP prototype version has been released to SKN 3&4 unit before final version released. CPMP can be applied to computer based procedure as well as following APR1400 CPS.

REFERENCES

- [1] Computer-Based Procedure Systems: Technical Basis and Human Factors Review Guidance, NUREG/CR-6634.
- [2] Sung Han Cho, Sung Kon Kang, Yeong Cheol Shin, Sungjae Cho, "Introduction of the Engineering System for development and maintenance of procedure software of the Shin Kori 3&4 Computerized Procedure System", Proceedings of ICAPP '05 Seoul, Korea, May 15-19, 2005
- [3] Sungjin Lee, Yungoo Kim, Hyunnam Kim, "Implementation of Concurrent State-based Procedure Execution Using the Hierarchical State Machine and the Active Object", Transactions of the Korean Nuclear Society Autumn Meeting Jeju, Korea, October 21-22, 2010.

- [4] Sungjin Lee, Nokyu Seong, Yeonseob Jung, "Mobile Computerized Procedure System for the Improved Situation Awareness between Field Workers and Main Control Room Operators", Transactions of the Korean Nuclear Society Autumn Meeting Jeju, Korea, October 24-25, 2013.
- [5] System Specification for Computerized Procedure System(DDS1), Korea Hydro & Nuclear Power, 2009.

