

A Method of Preventing MMI Display Design Errors

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1. Introduction

It is necessary to verify and validate the design of MCR (Main Control Room) in NPPs. KHNP CRI has the “APR-MCR@CRI” as a validation facility of MCR and has used the facility to validate MCR design and CPS (Computerized Procedure System) design for constructing NPPs in Korea. APR-MCR@CRI has been improved for the new NPP’s HFE PV (Human Factors Engineering Preliminary Validation). In the process of the improvement, some design drawing errors are found out. This paper describes the types of errors and the method of preventing MMI (Man Machine Interface) display design drawing errors that revealed in preparation for the HFE PV.

2. Methods and Results

The first method of finding design errors is visual inspection by specialists who have knowledge for nuclear system including SRO (Senior Reactor Operator). And then the detected errors should be proved by standard documents such as P&ID, C&ID and CLD etc. By these workings, it is able to figure out the causes of errors and to consider the solution of error prevention.

2.1. Design Drawings

Engineering procedure consists of design and review. MMI drawings are designed by Responsible Engineer (RE) or subcontract designer. Revised drawings are issued for DRN (Design Review Notice). Then DRN is distributed to another involved departments and subcontract corporation in BOP (Balance of Plant) for design review. All reviewers must sign their signature with N/C (no comment) or W/C (with comment) on DRN cover hardcopy. If there is any comment, designer must resolve all comments and receive the confirmation from all of commenters as follows “All comments are resolved.” Afterwards, closed DRN can be issued for DDF (Document Distribution Form) and design drawing is distributed to each site by PDL (Project Distribution List).

2.2. Occurring Errors

Design errors are occurred in ‘Design’ step and its resists with not enough ‘Reviews’. Unskilled designer make mistakes such as typo, using a wrong symbol and inconsistent abbreviations. All designers must check

P&ID, C&ID and CLD when they design a drawing. If designer correctly checked all related documents and reviewed designed drawing in detail, there is no design error. But lots of human makes mistakes. Therefore, design review is the most important behavior of preventing errors.

2.3. Types of Errors - 1.Inconsistency

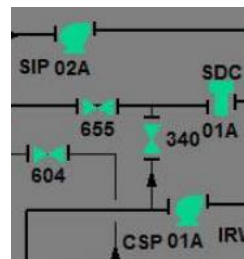


Fig. 1. Part of Mini LDP

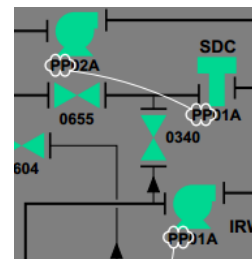


Fig. 2. Part of Mini LDP (Revised)

Fig. 1. and Fig. 2. are displaying the different tag type of pumps. All of pumps have the system acronyms in front of P(Pump) or top of symbol like SI (Safety Injection), SDC (Shutdown Cooling) and CS (Containment Spray) in former revision. But revised MMI drawing is displaying only SDC description at top of symbol. It is a result of different description location for each symbol. Deletion of system acronyms about the tags caused “Inconsistencies” like that “SIP 02A” was revised to “PP02A” and “CSP 01A” was revised to “PP01A”. But the text “SDC” was already located in top of symbol and remained with revising only tag number. For preventing these cases, adaption of consistent engineering criterion is essential for location. Designers should to refer the HFEG (Human Factors Engineering Guideline) and EPM (Engineering Procedures Manual) for decision of tags and descriptions location.

2.4. Types of Errors - 2.Wrong Symbol

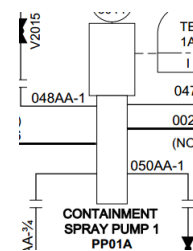


Fig. 3. CSP Symbol in P&ID

Fig. 3. is the symbol of CSP in P&ID. This symbol is representing “Vertical Pump”. The correct MMI symbol of vertical pump is SDC pump’s. SIP and CSP symbols mean not “Vertical Pump” but “Centrifugal Pump”. This type of symbol errors can find between “Gate Valve” and “Globe Valve” in Fig. 4. . Some symbols of globe valves are have no “Black Dot” in some MMI display drawings. This error is occurred with selecting the wrong symbol when the designer revising the drawing. It is able to prevent with expertly reviewing related system’s P&IDs and C&IDs.

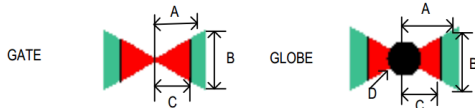


Fig. 4. Display Symbols of Valves

2. 5. Types of Errors - 3. Typo in Acronyms

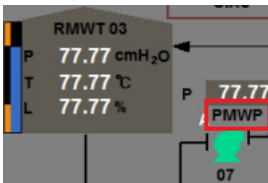


Fig. 5. Wrong Acronyms

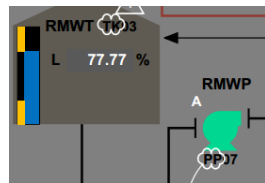


Fig. 6. Correct Acronyms

Fig. 5. shows RMWT (Reactor Makeup Water Tank) and RMWP (Reactor Makeup Water Pump). But RMWP was typed wrong acronyms as “PMWP”. This mistake is happened from incorrect recognition without looking nearby description. If designer was looked up similar description in same drawing or checked the system P&ID, this type of errors maybe reduced.

2. 6. Types of Errors - 4. Errors in Abbreviations

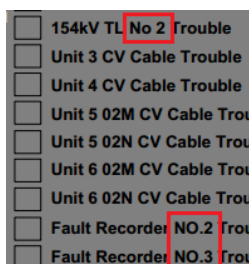


Fig. 7. Inconsistent Abbreviations

Fig. 7. shows inconsistency of using abbreviations in the same display drawing. It seems to be designed by more than two designers. Besides, maybe they had a different style of typing abbreviations. The method of preventing this error is using the same convention for abbreviations. Referring the HFEG, related standards and codes are able to remove this type of errors.

Most description of pumps is typed as “Pump” or “PP”. However, Fig. 9. is using the description “PMP” for the charging pump. Even P&ID description in CV system is

typed not Charging PMP but Charging Pump. Also, abbreviation “PMP” is not wrong. Appendix A. of HFEG describes that pump’s abbreviation is “PMP”. But different type of description is inconsistent. It is need to use the same guideline for preventing of inconsistency.

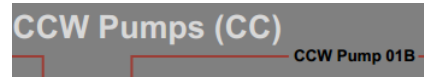


Fig. 8. General Description of Pumps

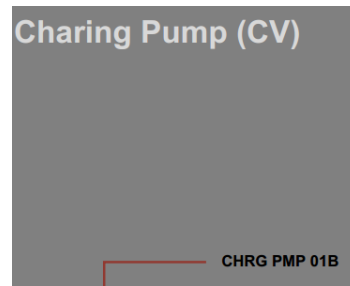


Fig. 9. Type of Title and Inconsistent Abbreviation of Pump

2. 7. Types of Errors - 5. Typo

Engineering drawings are designed in English. It can be the reason of some typos. It is hard to find typo in hundreds of drawings. At first, Select all text in drawings and copy them. And then paste it on editing tool. It is one of solution checking the typos. Using the spell checker, typos are can be found out easily.

3. Conclusions

MMI design drawings are one of the most important factors to prepare the HFE PV. The improvement of validation facility for the HFE V&V takes quite a long time to change MMI display and connect the related simulator features. But the term of construction process is almost precede the design status for the HFE V&V. If design drawing has some errors, construction process for the HFE V&V can be delayed. Using the previously mentioned methods and techniques will prevent design errors, accordingly it will contribute to preserving construction process on time.

REFERENCES

- [1] KEPKO E&C, Human Factors Engineering Guideline (SKN5&6, 9-750-J410-001, Rev.0), 2014.
- [2] KEPKO E&C, Engineering Procedures Manual (SKN5&6, 0-030-B433-001, Rev.0), 2011.