Improvements in Logic Diagram of Computerized Procedure System of APR1400

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1. Introduction

The Computerized Procedure System (CPS) has been improved since it is installed in Shin-Kori 3&4 Nuclear Power Plants. It is one of operating support systems of digital Main Control Room (MCR) and provides many functions to operators in executing the procedure. CPS can effectively remove the human errors by supporting the procedure flow and logic diagram[1-4].

This paper describes the logic diagram of CPS of reference power plant and shows the improved logic diagram of CPS of Shin-Kori unit 5&6

2. Logic Diagram of CPS

The logic diagram consists of parent instruction and child instruction and the result of parent instruction is automatically calculated by the combination of results of child instructions. The CPS provides the following types logic diagram[4-5].

- AND
- OR
- SEQUENCE

2.1 And

The below figure shows the 'AND' logic function of CPS.

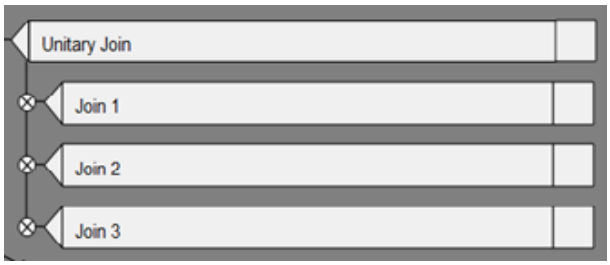

Fig. 1. 'And' Logic of CP

The symbol of 'AND' is (X) and the 'AND' operates below truth table I.

1) If all child instructions are TRUE then parent instruction is TRUE.
2) All child instructions have to be evaluated.

Table I. Truth Table AND

Child 1	Child 2	Child 3	Parent
0	0	0	0
0	0	1	0
0	1	0	0
1	0	0	0
0	1	1	0
1	1	0	0
1	0	1	0
1	1	1	1

2.2 Or

The below figure shows the 'OR' logic function of CPS.

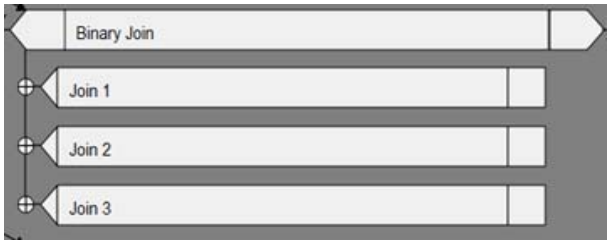

Fig. 2. 'OR' Logic of CP

The symbol of 'OR' is (+) and the 'OR' operates below truth table II.

1) If one of the child instructions is TRUE then parent instruction is TRUE.
2) All child instructions have to be evaluated.

Table II. Truth Table OR

Child 1	Child 2	Child 3	Parent
0	0	0	0
0	0	1	1
0	1	0	1
1	0	0	1
0	1	1	1
1	1	0	1
1	0	1	1
1	1	1	1

2.3 Sequence

The below figure shows the 'SEQ' logic function of CPS.

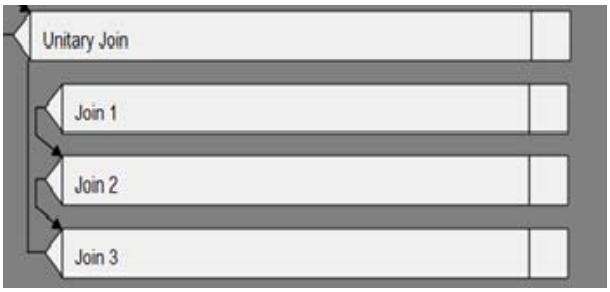

Fig. 3. 'SEQ' Logic of CP

The symbol is an arrow between upper instruction and lower instruction. In 'SEQ' logic, there is a sequence between child instructions. The operators shall evaluate the top instruction and operators cannot move to the next instruction before completing the current instruction.

3. Improved Logic Diagram

The parent instruction displays the result of combination of child instructions in respective logic operator. But the parent instruction does not display the result of calculating before evaluating all child instructions in CPS of reference plant in 'AND' or 'OR' logic operator. But this method which operators evaluate all child instructions is conservative operation because the result of parent instruction is made, the parent instruction displays the result for fast operation. E.g. In AND logic , if the result of one of the child instructions is FALSE, the result of parent instruction is FALSE and 'OR' logic operator if the result of one of the child instructions is TRUE, the result of parent instruction is TRUE.

Because an arrow symbol of 'SEQ' can be confused to operators, the "S" is applied to improved CPS. This symbol is consistent with other symbol of AND and OR logic operator. Fig. 4. shows the improved symbol of SEQ.

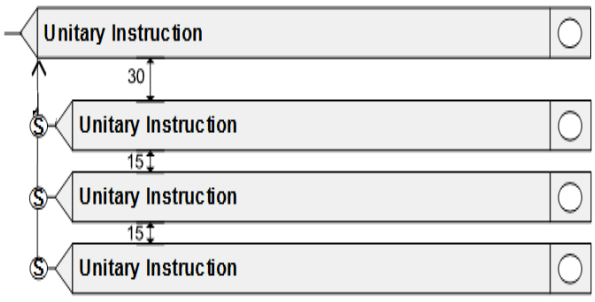

Fig. 4. Improved 'SEQ' Logic of CP

4. Conclusions

This paper describes the current logic diagram of CPS and suggests improved design for logic diagram. The improved logic diagram shall be validated through human factors engineering verification and validation. The improved design will help operators execute the computerized procedure fast and remove the human error.

REFERENCES

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