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Overview of a Cabinets Interface of the YGN Unit 3 I&C Systems

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1. Introduction

YGN 3&4 I&C systems, whose commercial operation started in 1995, will be upgraded, modernized or retrofitted in 2015 due to aging or obsolescence. The upgrade process of existing (i.e., currently operating) I&C systems was developed in a previous study [1]. Referring to that study, the analysis activity of existing I&C systems to be upgraded is required in the early stage of the process. YGN Unit 3 I&C systems are selected for the analysis from the viewpoint of a cabinets interface. We grouped the cabinets located in electrical equipment room, computer room and control room into the systems as shown in the following section of this paper.

2. Cabinets Interface of YGN Unit 3 I&C Systems

We abstractly overview the cabinets interface by grouping the cabinets with the following criteria:

- Group by electrical classes: Class 1E and non-class 1E (N1E)
- Group by I&C systems: Process instrumentation system (PIS), protection system (PS), control system (CS), monitoring system (MS) and stand-alone system (SS)

The cabinets relating to PIS are a NSSS process protective, NSSS process control and a BOP instrumentation, and interface with others as shown in Fig. 1 and 2.

When referring to the figures in this paper, solid line means analog and dotted line means digital.

The cabinets relating to PS are a plant protection system, auxiliary protection, reactor trip switchgear (RTSG), ESFAS auxiliary relay, interposing logic system (ILS) and a diverse protection system (DPS), and interface with others as shown in Fig. 3 and 4.

The cabinets relating to CS are a NSSS control system, CEDM control system, CEDMCS auxiliary and a ILS, and interface with others as shown in Fig. 5. The NSSS control system includes the reactor regulating system, feedwater control system and the steam bypass control system. Reactor power cutback system resides in the PLC of the CEDMCS. The Non-class 1E ILS includes the NSSS and BOP component control systems.

The cabinets relating to MS are an inadequate core cooling monitoring system (ICCMS), plant data acquisition system (PDAS), plant computer system, NSSS integrity monitoring system (NIMS) and a radiation monitoring, and interface with others as shown in Fig. 6 and 7. The ICCMS A and B resides in the 1E PDAS A and B, respectively. The 1E PDAS also includs the fixed in-core detector amplification system (FIDAS) for the COLSS program that runs in the PCS. Sequence-of-events (SOE) signals are gathered in the N1E PDAS. The NIMS includes the internal vibration monitoring system, acoustic leak monitoring system and the loose part monitoring system. The radiation monitoring cabinet includes the ex-core neutron flux monitoring system, wide range boronometer, gas stripper effluent radiation monitor and the process radiation monitor.

The SS, mostly supplied by a BOP supplier, is defined as a system which can be replaced with a minimum interface with other systems, as follows:

- Radiation monitoring system
- Seismic monitoring system
- Vibration monitoring system
- Leak monitoring system
- Containment monitoring system
- Fire protection system
- Radwaste control system
- Turbine monitoring and control system

3. Discussion

When planning to upgrade the existing systems, the following should be considered:

- Sensors and actuators will not be changed, but transmitters or cables may be changed according to the scope of the upgrade.
- Most I&C systems will be upgraded with computer based systems, but some specific signal conditioning modules will maintain an analog or a digital card based signal processing, due to the complexity of its signal processing.
- The upgrade should be performed in the period of a plant overhaul which takes about a month.

Network based system interconnection is a characteristic of digital based I&C systems. The applicability of a network based digital system to the existing I&C systems depends on the analysis of the cabinets interface. Through the analysis, interface complexity of a system interface can be viewed as follows:

- Most of field signals are processed by PIS. Some specific signals, such as radiation, RCP speed, in-core and ex-core neutron flux, thermocouples, reed switch position and accelerometer, are processed by specific systems. So, signal processing systems have a first complexity.
- The PDAS and PCS receive all plant raw signals. So, they have a second complexity.
- The ILS, called component control systems, receives process signals and control signals to actuate most of the plant pumps, valves, fans, breakers, etc. So, they have a third complexity.

- The NSSS CS has a fourth and the PS has a fifth complexity.

The complexity will impact on the upgrade plan. It will be used to determine whether the existing cabinets within the same group can be replaced or partly replaced. It is expected that all cabinets in the same group cannot be replaced at a time. In that case, the existing cabinet and newly installed cabinet will be operating concurrently, which is risky to a plant operability.

The MCB interface analysis is excluded from this paper, as it is out of the scope of this analysis.

4. Conclusion

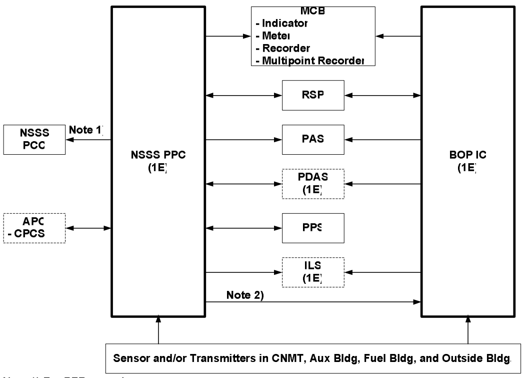
YGN Unit 3 I&C cabinets interface analysis was performed in accordance with following levels:

- Level 1 : Overview of the cabinets interface
- Level 2 : Signals interface between cabinets
- Level 3 : Size, location and power of cabinets

This paper only presents the level 1. From the analysis, the interface complexity can abstractly be viewed. The analysis result will be used to produce an overall architecture of I&C upgrade systems for the YGN Unit 3&4 and the overall milestones of the upgrade.

REFERENCES

[1] C.H. Sung, H.Y. Jeong, S.J. Cho, "Study on the Upgrade Methodology of I&C Systems in Operating Nuclear Plant", KNS, Korea, 2004.



Note 1) For PZR control
PZR L-110X: PPC A(PA-26JA) -> PCC(PA-36J)
PZR L-110Y: RSP(RS-01JB)->PPC A(PA-26JB) -> PCC(PA-36J)

Note 2) For ESFAS AFAS initiation
PPC A sends SG1 L-1113A and SG2 L-1123A to BOP IC A, BOP IC determines LO-LO and sends to ILS
PPC B sends SG1 L-1113B and SG2 L-1123B to BOP IC B, BOP IC determines LO-LO and sends to ILS

Fig. 1 PIS(1E) cabinets interface diagram

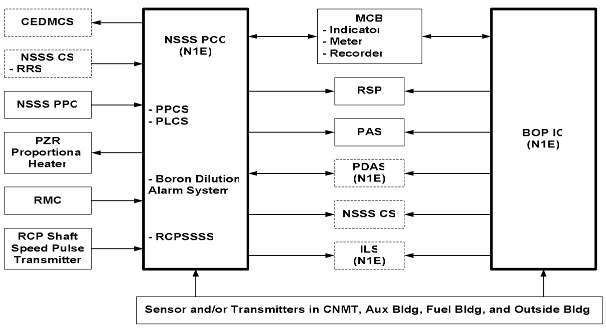


Fig. 2 PIS(N1E) cabinets interface diagram

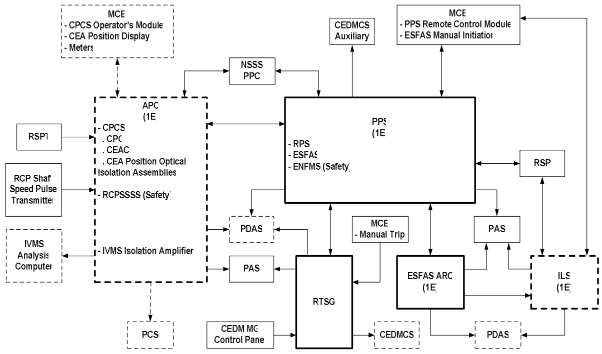


Fig. 3 PS(1E) cabinets interface diagram

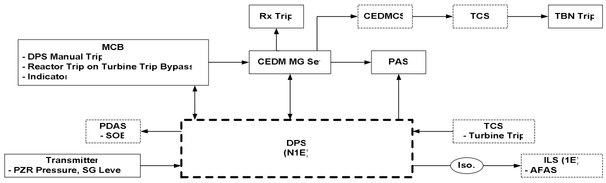


Fig. 4 DPS(N1E) cabinets interface diagram

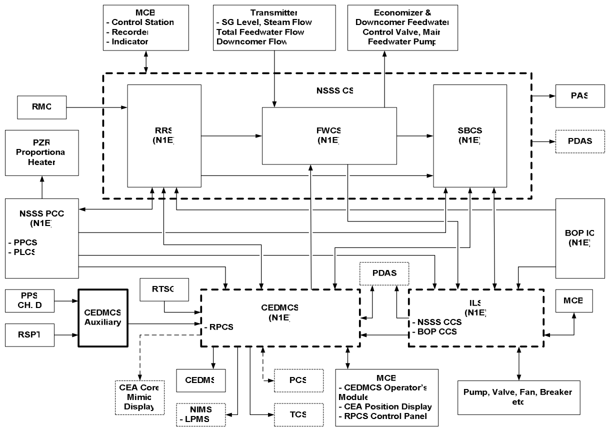


Fig. 5 CS(N1E) cabinets interface diagram

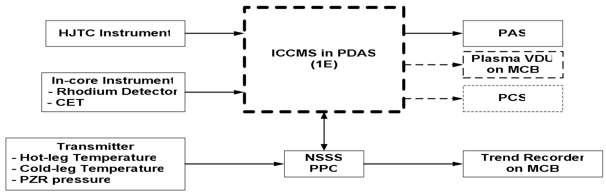


Fig. 6 MS(1E) cabinets interface diagram

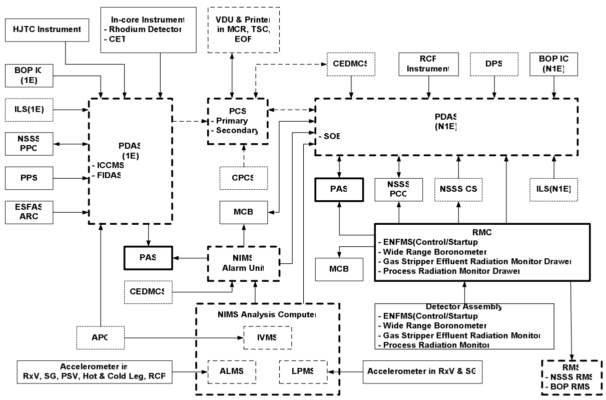


Fig. 7 MS(N1E) cabinets interface diagram