

## Improvement of the HANARO control and monitoring system

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### 1. Introduction

An integration of the control and monitoring systems distributed over the plant will be accomplished by a gradual upgrading of the current HANARO (Highly Advanced Neutron Application Reactor) I&C system over the next 10 years. The 3-Pin Fuel Test Loop (FTL) facility is a new experimental facility to be installed by the end of 2006 inside of the HANARO. The FTL operation is correlated to the HANARO operation. So that, a control and monitoring function of the FTL is integrated into the existing HANARO control system in main control room. The architecture and HMI (Human-Machine Interface) design for the FTL and HANARO control system is introduced in this paper.

### 2. Architecture of the control system

The upgrade of the operator workstation to integrate the FTL facility is under way to extend the scope of the control and monitoring by the operators in the main control room. [1]

The FTL control system is independent of other system conceptually. But it is connected with the HANARO control system for sharing of information. The FTL control system uses hybrid control systems for control and data acquisition. All controllers for the FTL facility are installed in a FTL control room. But these facilities of control room are used only during start-up of the system. Normal operation is performed at the main control room. So that, control and monitoring function is integrated to the existing control system. This controllers and networks are duplicated except data acquisition system. Each control network is connected to the existing HANARO data servers. The supervision network for workstations duplicated are connected to the tag servers also. The tag server acts as a bridge between controllers and operator workstations. [2]

The digital control system of the HANARO is duplicated from input modules to output modules. The FTL control system also fully redundant to ensure reliability. Two independent communication network link controllers each channel. The HANARO has a control local area network (LAN) and the FTL has its own control LAN. These two facilities are linked to tag servers. There are two tag servers in main control room. The tag server is a PC collecting information from the controllers and providing to workstations and a data server. The architecture of the FTL and the HANARO

is figure 1. The time of all computers and controllers are synchronized with the GPS receiver.

Other control systems like the cold neutron source (CNS) to be installed in the near future will have the same structure with the FTL control system.[3][4]

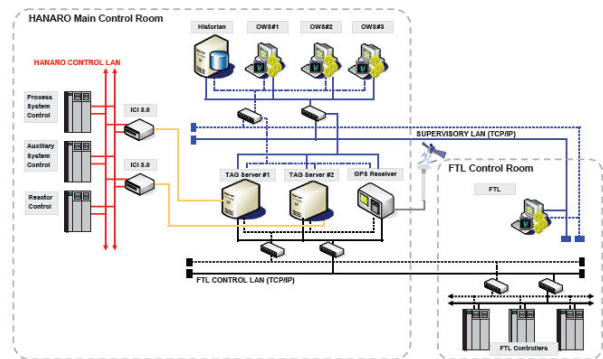


Figure 1 Architecture of the control system

### 3. Human machine interface

The current display of the operator workstation is not fancy and satisfactory in view of human engineering because the existing display was designed to keep the same configuration with the original workstation. The original workstation produced at 1992 has limitations in the hardware and software capability to display of various requirements. To overcome the limitations due to old technology, an upgrade of operator workstation is undergoing and modules for the FTL facility will be completed by the end of 2006. [5]

To comply with the human engineering requirements, a style guide was made first considering hardware, HMI tools, and operator requirements. According to the guide, displays are developed systematically. The newly designed main display is figure 2.

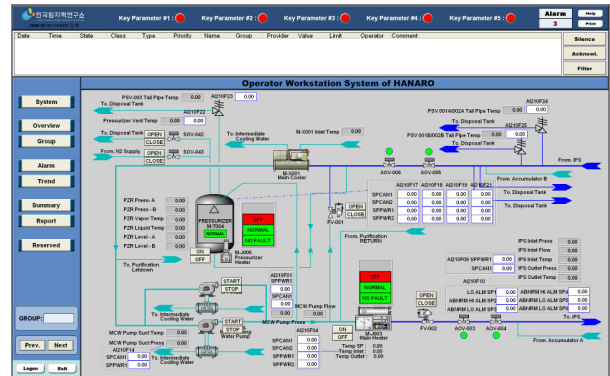


Figure 2 Sample display of the OWS

Menu area is at the left and key parameters are located at the top. These areas are fixed always during navigation for operator to quick access and recognition. Various new displays are developed at this upgrade to support operators in convenient methods. One of new displays is a table display and is shown in figure 3. The table display shows many parameters in one page and acts like annunciations on the conventional panel.

Figure 3 Table display

### 3. Conclusion

Over about 10 years, I&C system of HANARO shall be upgraded gradually and the current upgrade is a second step to integrate the FTL control system. Many improvements were made in the display style and various new displays were developed for the operator.

The final goal is an integrated digital control system encompassing the reactor facilities, the FTL systems, the cold neutron source, and other facilities in the HANARO site.

### REFERENCES

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