NSSS Component Control System Design of Integral Reactor

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1. Introduction

MMIS(Man Machine Interface System) of an integral reactor is composed of a Control Room, Plant Protection System, Control System and Monitoring System which are related with the overall plant operation.
MMIS is being developed with a new design concept and digital technology to reduce the Human Factor Error and improve the systems' safety, reliability and availability. And CCS(component control system) is also being developed with a new design concept and digital hardware technology
A fully digitalized system and design concept are introduced in the NSSS CCS.

2. NSSS Component Control Systems

2.1 MCP Control System

There are four(4) MCPs vertically installed on the top annular cover of the RPV(Reactor Pressure Vessel). Each MCP is an integral unit consisting of a canned asynchronous three phase motor and an axial-flow single-stage pump. CCS for MCP regulates the MCP speed with a 1100/1800/3600 rpm velocity and a 30rpm/sec variation limitation.

2.1.1 Configuration

MCPCS is fully digitalized and independently operated regardless of the individual CCS failures. MCPCS is composed of a microprocessor board, photo coupler, switch driver, SMPS and so on. MCPCS configuration is shown in figure 1.

2.1.2 Individual/Group Controller

Each controller individually regulates each MCP. A group controller controls every individual controller. When an individual controller is failed, overall system is operated normally.

Each individual controller is designed with an independency. RRS (Reactor Regulating System) introduces the signal (such as rotation speed demand signal) to all the MCPCSs which control the MCPs. RRS functions as a group controller of all the MCPCSs

2.1.3 SMPS(Switched Mode Power Supply)

SMPS is the power conversion equipment for modulating the frequency of the AC power source. SMPS is composed of a 3 phase rectifier, switching device (such as IGBT, MOSFET), photo coupler, switching drivers and a snubber circuit. SMPS shall accommodate the maximum 480V, 100A capacity.

2.2 CEDM Control System

Control Element Drive Mechanism Control System(CEDMCS) receives CEA insertion, withdrawal, motion speed demand signals from the RRS, Pre-scram CS and CEDMCS can control forty nine (49) CEAs for the purpose of regulating a reactivity. Each CEDM is an integral unit consisting of a step motor and a mechanical CEDM set. CEDMCS controls the CEA motion speed with a 0.25mm/sec. or 2mm/sec. velocity and it also regulates the magnetic force in order to pull or drop the CEAs.

RRS sends the signal for the motion speed and direction to the CEDMCS sequentially.

2.2.1 Configuration

CEDM control system consists of a microprocessor board, photo coupler, switch driver and a SMPS. Figure 2 shows the simplified block diagram of the CEDMCS.

2.2.2 Individual/Group Controller

Control system consists of individually a controller and group controller. Each controller operates individually. When one controller is failed, the overall system is operated normally. Group controller receives the signal which is the motion speed and motion direction demand signal from the RRS. The functions of the group controller are to synchronize and check the timing of CEAs motion which is controlled by individual controller. Individual/group control concept prevents the CEA or CEA group from withdrawing abruptly.

2.2.3 SMPS(Switch Mode Power Supply)

SMPS is the power conversion equipment for modulating the frequency of the AC power source. Main Function of the SMPS is to provide a modulated/varied 4 phase pulse voltage source for the step motors which move CEAs up or down. There are a total forty nine (49)

CEDM SMPSs which receive CEA motion demand signals from the CEDM group controller.

SMPS is composed of a 3 phase rectifier, switching device (such as IGBT, MOSFET), photo coupler and switching drivers and a snubber circuit. SMPS accommodates the maximum 120V, 5A capacity.

3. Conclusion

NSSS CCS was developed with a new design concept and digital technology to reduce the Human Factor Error. NSSS CCS was introduced with an individual controller and group controller in integral reactor in order to increase the system reliability and availability.

NSSS CCS system was composed of microprocessor board, SMPS and so on. Overall CCS is operated normally in spite of the local system failures. The characteristics of CCS in an integral reactor have high redundancy and availability because of the introduction of the individual/group controller.

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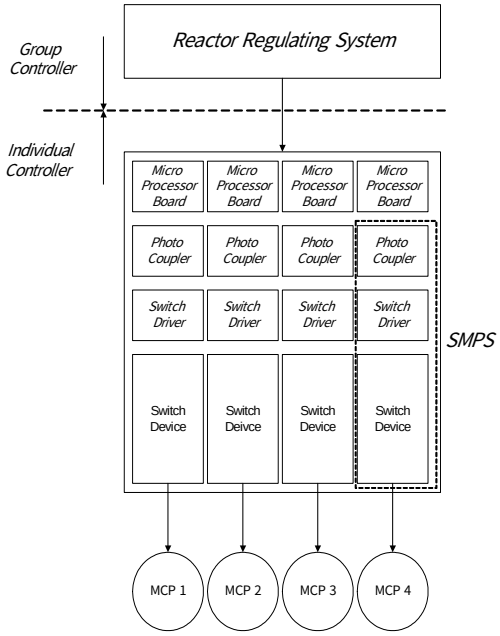

Figure 1. Simplified Block Diagram of Main Coolant Pump Control System

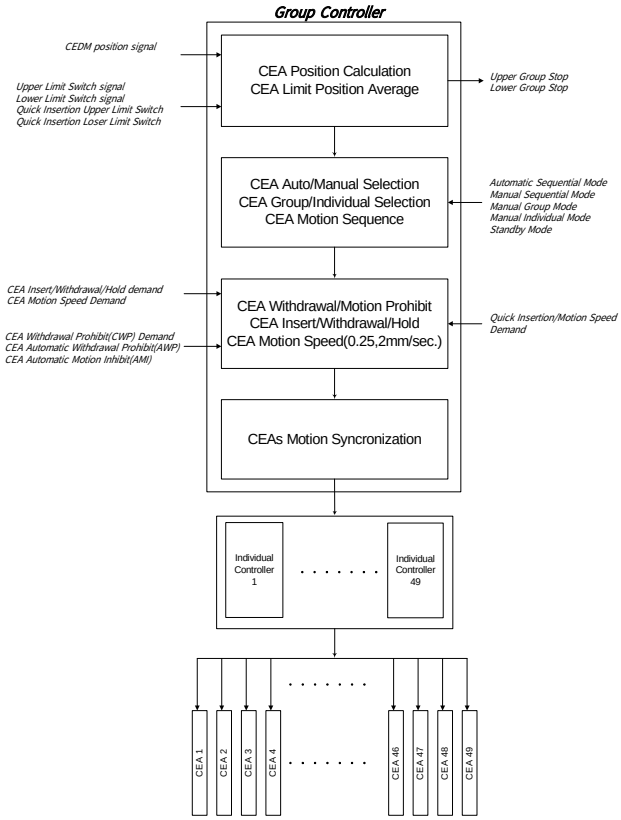

Figure 2. Simplified Block Diagram of CEDMCS.