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Development of Qualified Indication and Alarm System-PAMI based on POSAFE-Q

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1 Introduction

The Qualified Indication and Alarm System – PAMI(QIAS-P) is the newly implemented system for Shin-Kori 3,4 NPP. The QIAS-P provides continuous display regarding to Post Accident Monitoring Instrumentation(PAMI) Category 1 parameters[1] and the backup displays of the Inadequate Core Cooling(ICC) variables[2].

The QIAS-P shall provide the following functions.

1. CET temperature signal processing and display
2. Primary coolant saturation margin calculation and display
3. HJTC signal processing and display
4. HJTC heater power control

DOOSAN is developing to localize the QIAS-P and will supply it for Shin-Ulchin 1,2 NPP. The platform of this system is mainly composed of the Photon MMI tool based on QNX OS and POSAFE-Q PLC which is classified as safety related class and is developed by POSCON Co. with its own technology.

2 Qualified Indication and Alarm System –PAMI

2.1 System Configuration

The QIAS-P is a nuclear safety related system that consists of two identical channels whose input signal is isolated each other. The QIAS-P cabinets for each channel are geographically distributed into channelized I&C equipment rooms. Figure 1 is the QIAS-P CH. A block diagram.

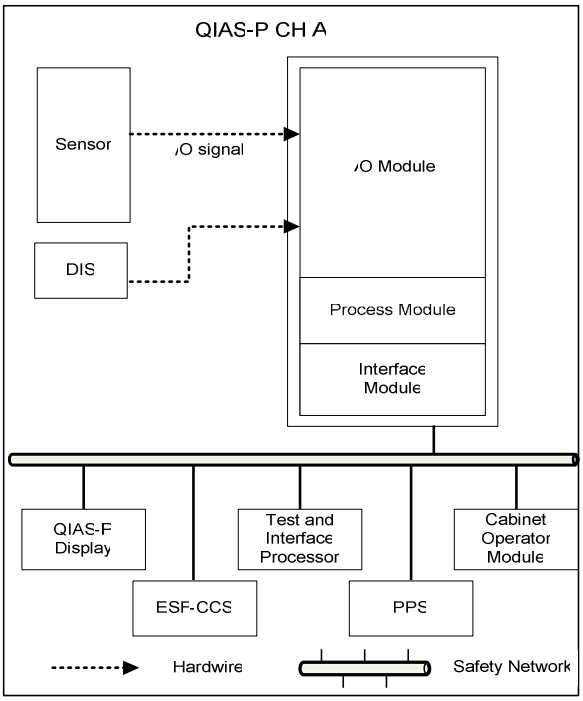


Figure 1. QIAS-P CH.A Block Diagram

2.2 System Functions

The QIAS-P Functions for each channel are as follows:[3]

A) Heated Junction Thermocouple System (HJTC) for Reactor Vessel Level(RVL) Monitoring
B) Saturation Margin Monitor(SMM)
C) Core Exit Thermocouple(CET) Monitoring
D) RG1.97 Category 1 Parameter Monitoring

E) Heater Power Control Signal Processing
F) Maintenance and Test
G) Signal Interface to The Related Systems

2.3 Hardware Design and Implementation

Each channel cabinet of QIAS-P is composed of Controller Module, Cabinet Operator Module (COM), Test Interface Processor(TIP) Module and HJTC Heater Power Control Device(HPCD). The COM is operated on industrial PC. The Controller and TIP Modules are implemented by POSAFE-Q PLC of POSCON Co. which is developed according to the qualified system requirement. The POSAFE-Q PLC of safety related class is developed in the KNICS project.[4] And HJTC HPCD is composed of power supply and relay components.

The network of QIAS-P between internal modules is PROFIBUS-FMS(Fieldbus Message Specification) and external network to QIAS-N is HR-SDL(High Reliable – Safety Data Link). One channel cabinet of QIAS-P is shown in Figure 2.

Figure 2. 1 Channel QIAS-P Cabinet

2.4 Software Design and Realization

The QIAS-P application software performs the functions referred to section 2.2 " System Function".

The logic program on PLC is developed by p-SET, the PLC Engineering Tool. And the other applications on COM are developed by Photon MMI tool on QNX, the real-time OS.

Figure 3 is the example.

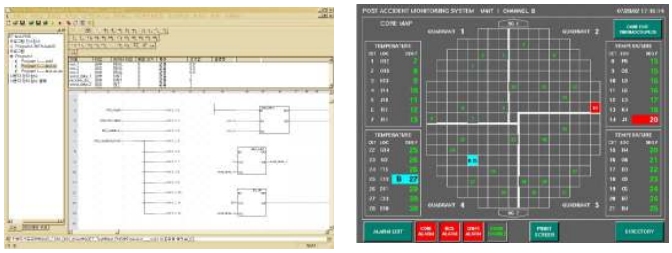
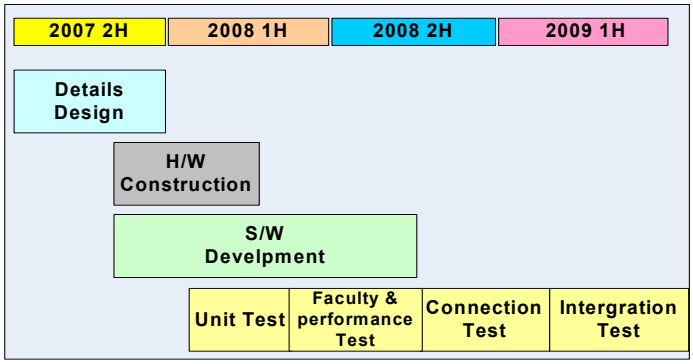


Figure 3. Logic Program &MMI Display

3 Conclusions

The QIAS-P is being developed following the milestone with the above contents. DOOSAN will commercialize it for Shin-Ulchin 1,2 NPP after the completion of development phase.



4 References

[1] USNRC Reg. Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident", Rev.03, May 1983.

[2] NUREG-0737. Section II.F.2, "Instrumentation for Detection of Inadequate Core Cooling", November 1980.

[3] KOPEC, "The QIAS-P System Design Requirements", Rev. 00, November 2007

[4] POSCON, "POSAFE-Q Safety Programmable Logic Controller" Catalog. Rev. 01, 2007