The Operation of a Domestic Interface Device for the HANARO Control Rod

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1.0 Introduction

The interface device for the HANARO control rod which was supplied by a foreign company put difficulties on reactor operation due to the obsolescence of the products and lukewarm technical support from the manufacturer. The development of the interface device based on domestic technology has been completed in order to solve the problems in this issue and to ensure safe and reliable reactor operation.

This paper describes the development process of the domestic interface device conducted which was over 5 years, the field test results, and the reactor operation application results.

2.0 Design of Domestic Device

This device, a safety related item for CAR(Control Absorbing Rod) driving, was developed for perfect verification after selecting the range of domestication. The domestic device was produced after verifying performance by producing a prototype.

2.1 Determination of the domestication range

The figure 1 shows the circuit diagram of the CAR driving system. The range of domestication of this system included the components with signal lines between CAR and MLC(Multi Loop Controller). The dotted line portion that takes care of signal processing was replaced for the digital concept device, and the CAR and control program remained in their present condition, which is shown in Figure 1[2].

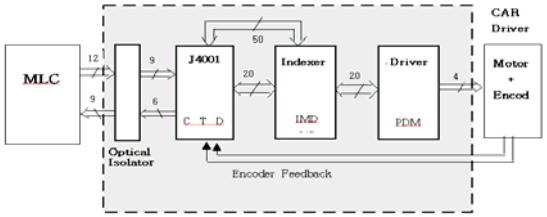

Fig. 1 Circuit Diagram of the CAR driving system

2.2 Composition of the prototype device

This device consists of a motor driver, a motor controller, an I/O module, and two pulse counters. The motor driver controls the driving conditions of the stepping motor, and the controller monitors the abnormal conditions of the motor. The I/O module converts to TTL signal the contact signal coming from the MLC, and displays MLC and input/output signal conditions in LED. Two pulse counters were enabled to perform self diagnosis by instructing on the number of MLC instruction steps and that of actual driving steps.

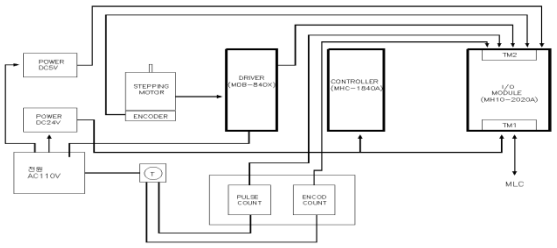

Fig. 2 Circuit Diagram of the Domestic Interface Device

Test of prototype was conducted for 3 months for the simulation of all the potential cases. In this process, 10 cases or so of design defects were found, for which proper measures were taken. In the test where the same load as the actual CAR was applied, no abnormal phenomenon was found.

3.0 Field Test with the Test Program

3.1 Development of the Test program

In order to apply the developed interface device in a reactor, the soundness of this unit must first be demonstrated. The method of using the MLC accompanied by the risk of taking off the circuit boards in the local panel and this may violate the safe operation of reactors. Instead of using the MLC, a test program was developed to give operation commands to the unit and a monitor the motor status[4].

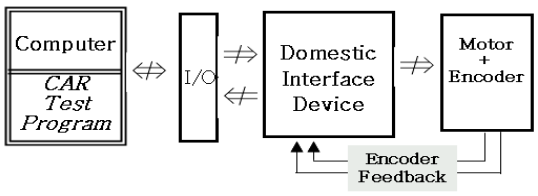

Fig. 3 Hardware Composition for Pre-verification

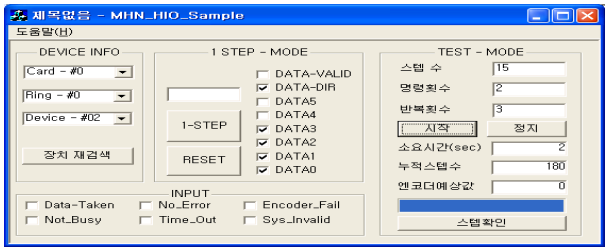

Fig. 4 Main Screen of the Test Program

The verification of the signal processing unit with the test program consists of the test program developed which uses Visual C++ 6.0, the I/O module in charge of the input and output for the signal processing unit, and an RS485 communication card. This composition is shown in Fig. 3 and 4.

3.2 Field Test(Level 1, 2, 3)

The domestic interface device is to control the CAR Stepping Motor, and it should be proved that the performance of the device is same as that of the previous product. The main focus includes the accuracy in the processing command signals and the signal compatibility between the previous interface device and the MLC[3].

The level 1 test was the initial test after the completion of the manufacturing of the sample and it was to identify the problems while operating the normal command steps and the limited command steps. From the tests, which continued for three months, about 10 cases were identified. After changing the design, the manufacturer solved these problems.

The level 2 test was performed with a load that has the same weight as the actual CAR by repeating the normal command steps from Step 1 to Step 15 for a certain number of times. In this test, no abnormal events occurred.

The level 3 test was performed by temporarily installing the sample instead of the previous interface device in the actual CAR in order to test for signal compatibility. It was found that the CAR driving state and the error state all operated normally.

4.0 Application to HANARO Operation

In Aug. 2009, a failure occurred to the previous interface device of CAR #2, and the domestic interface device was installed in it. The board installed in the existing panel was removed, and instead a domestic interface device was inserted, followed by the completion of the wiring work as shown in Figure 5.

Fig. 5 Before and After the Installation of the Device

After one of the locally produced device was normally used for 6 months in the reactor, another one was installed in CAR #2, and is still in use so far the past 3 months. Concerning the rest devices, the verification of operation spare parts will be completed by applying them to reactor operation for a 6 months period[5].

3. Conclusions

This paper describes the development process of a domestic interface device which has been conducted for 5 years or so, the results of field test, and the reactor operation application results. Since a verification of the prototype could be done only while the reactor's operation was stopped, the development period was long, but all the processes were completed normally.

With successful domestic manufacturing, it is now possible to reduce the dependency on foreign technology and instead to secure spare parts and provide technical support domestically.

REFERENCES

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