

Integration of the CAR Interface module for the RRS of Research Reactor

Sang Hoon Bae*, Dane Baang, Gee Yong Park, Young San Choi, Young Ki Kim
Korea Atomic Energy Research Institute, 105 Dukjin-dong, Yusong-gu, Daejeon, Korea, 305-353
*Corresponding author: shbae@kaeri.re.kr

1. Introduction

In a research reactor, a CAR(Control Absorber Rod) interface module which receives the control information from the RRS(Reactor Regulating System) control computer and transfer control signal to a step motor in a CAR has been composed of an interface card, an indexer card and a driver card. Due to such separated interface components, the additional interface for each component was inevitable. That is, a CAR interface was more complicated and its corresponding communication ports, drivers and signal cables were unnecessarily required. To simplify this stuff, the interface card and indexer card are integrated to one module and integrated communication network including a step motor driver card can be established through backplane network.

The CAR interface module has not been redundant because power operation excluding a CAR by a failure in CAR could be available thanks to remained CARs. But, actually in spite of one CAR failure, operation with remained CARs normally is likely impossible to keep track of rapid dynamics. To solve this problem, the modular redundant structure is introduced herein and this method will let us anticipate the high reliability.

2. Improvement of the CAR interface design

In this section, how the CAR interface design is to be improved is described and redundant structure on that is also introduced. Furthermore, how these features are actually applied is explained briefly.

2.1 Integration of the CAR interface module

As above described, the basic function of the CAR interface is to change control signals from the control computer into pulse/phase signal to actuate a step motor. To perform this function effectively, a general CAR interface module consists of an interface card, an indexer card and a driver card. An interface card has essential data bits about the number of steps, direction, a CAR selection and reset, etc. An indexer card changes the data bit signals from the interface card into ASCII code. A driver card sends the phase signals with power to the step motors. In order to match signal type of each component, the corresponding interface is additionally required and this may make system more complicated. Besides, the communication that one bit data per a cable is transferred may cause reliability reduced. Therefore an indexer card is advised to be replaced into some functional programs.

But, thanks to full digitalization of CAR interface module, new interface card which is implemented as an integrated logic can perform micro-stepping and pulse generation which is an indexer card function including original interface card's function. This new interface card as shown in Fig 1 can be also implemented by software program on basis of PLC and can be easily modified whenever it is needed.

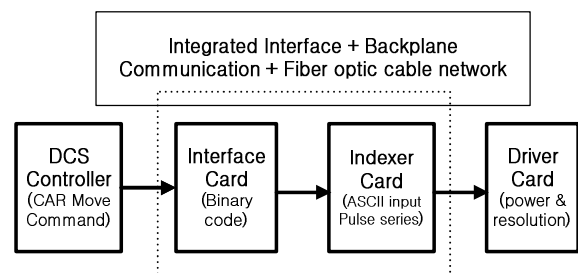


Fig 1. Integrated CAR interface module

Especially to improve the reliability of signal transfer, this interface scheme has different communication from previous type. The first thing is that all I/O signals related with CAR interface is processed through an interface I/O card and all data are transferred to RRS control computer by two fiber optic cables connected to network switch in the CAR interface panel to simplify data communication. The communication between an interface card and driver card are also performed by backplane network to ensure more reliability.

2.2 Consideration of dual redundant CAR interface

The hierarchy of CAR interface for the RRS is composed of four control loops and each control loop consists of single control components. If any single failure from components in a CAR interface module occurs, this results in a CAR failure and then makes it difficult to regulate the reactor power normally. To solve this problem the hierarchy with redundancy based on duplicate modular method is proposed to cover any failure from single components. This also means, even if any fault happens simultaneously from any other single component in CAR interface control loop, the RRS system has fault tolerance against it. This concept as shown in Fig 2 is mainly different from hot standby method and rather close to voting one out of two. The higher reliability can be prospected by this redundant CAR interface. For completeness of it, every processor in the CAR interface is required to have self diagnostic

function and also provide the applicable alarms to I/O server with appropriate ways.

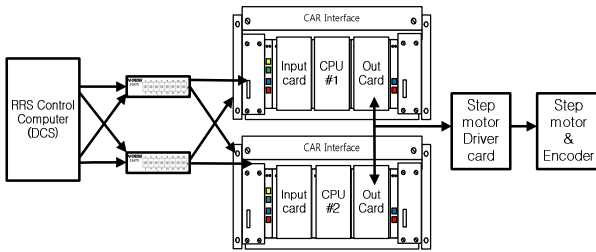


Fig 3. Integrated CAR interface module with redundancy

3. Conclusion

We are trying to deal with several occurred problems while implementing integrated CAR interface module. Also the interface module with redundancy is expected to enhance the RRS system's reliability and will be accompanied with FMEA for this analysis. This paper proposes feature and advantage of the integrated CAR interface module and is desired to give some motivation of some application for the more efficient and user-friendly interface implement.

REFERENCES

- [1] Young ki Kim, Design Guide on Instrumentation and Control System for an Advanced Research Reactor, KAERI/TR-2884, 2004.
- [2] Young San Choi, The Domestication of Interface Device for HANARO Control Rod, KAERI/TR-4201,2010