

Analysis of Critical Characteristics for Safety Graded Personnel Computers in the KNICS Architecture

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1. Introduction

Critical characteristics analysis of a safety related item is to identify characteristics to be verified to replace an original item with the dedicated item. It is sure that the dedicated item meeting critical characteristics would perform its intended safety function instead of the specified item [1].

KNICS project developed two safety systems: IDiPS RPS (Reactor Protection System) and IDiPS ESF-CCS (Engineered Safety Features-Component Control System). Two safety systems of IDiPS are equipped with personnel computers, so-called COMs (Cabinet Operator Modules), in their cabinets. The personnel computers, COMs, are responsible for safety system monitoring, testing, and maintaining [2].

Even though two safety systems are safety critical system, the personnel computers of two systems, i.e. COMs, are not graded as safety-graded items.

Regulation requirements are expected to be strengthened, and the functions of the personnel computer may be enhanced to include safety-related functions and safety functions, it would be necessary that the grade of the personnel computers is adjusted to a higher level, the safety grade.

To try to upgrade a non safety system, i.e. COMs, to a safety system, its safety functions and requirements, i.e. critical characteristics, must be identified and verified.

This paper describes the process of the identification of critical characteristics and the results of analysis.

2. Identification

Representative critical characteristics for digital equipment are as follows [3];

- Physical Characteristics
 - Product/part identification
 - Hardware characteristics
 - Device interfaces
- Performance Characteristics
 - Required functions
 - Performance requirements
 - Environmental condition
 - Behavior under unusual condition
- Dependability Characteristics
 - Built-in quality
 - Configuration control and traceability

The processes for identifying critical characteristics of COMs, personnel computers, are as follows:

(1) Review of design documents of COMs

Critical characteristics can be determined from design documents such as design requirements, design specification, interface requirements, and functional requirements.

Inherent and unique characteristics or requirements of COMs different from usual personnel computers, were identified from design documents.

Saliently different characteristic of COMs is the qualification requirements.

(2) Anticipation of safety functions

As COMs were not designed as safety equipment, design documents regarding to COMs do not give explicit critical characteristics for safety function. However, it is possible to define safety functions and requirements if COMs are assumed to carry out certain safety functions without changing the architectures of IDiPS RPS and ESF-CCS.

Safety functions that could be performed on COMs are;

- To monitor states
 - actuation states, testing status, and test results
- To manage tests
 - test conditioning, test prioritization, test scheduling, test results comparison
- To transfer test values
 - test identification, test value generation,

It was important to consider hardware quality, devices for interfaces in order to anticipate critical characteristics of COMs on the basis of defined safety functions. The expected critical characteristics were added to the results of (1).

(3) Review of existing equipment

DPPS (Digital Plant Protection System) in UCN 5&6 is equipped with the MTP (Maintenance and Test Panel) that is analogue to COMs of IDiPS RPS. The MTP of DPPS is designed as a safety item.

The DPPS technical manual was reviewed and following items were compared with the results of (1).

- Hardware configuration of DPPS
- Interface requirements

■ Safety-related functions

(4) Other system requirements review

APR1400 has an advanced and digitalized MCR (Main Control Room). Thus many computer systems are implemented and operators control plant process through digital devices such as trackball, LDP (Large Display Panel), LCD monitor, and touch screen. Most of digital devices are connected to personnel computers or equivalent equipments.

To enlarge the utilization of personnel computers dedicated to the COMs, design requirements of those personnel computers connected to digital devices were reviewed and compared with the results of (1).

(5) Code conversion

Nuclear industry requires environmental, seismic, and EMI/RFI qualification. These qualification requirements are defined in IEEE standards and a Regulatory Guide (RG). Design documents produced in nuclear domain specify appropriate IEEE codes, KEPIC codes or RGs to represent desired features. However, personnel computer companies do not know the IEEE codes, KEPIC codes, and RGs, but are familiar with other codes such as military standards, ISO (International Standard Organization), UL (Underwriters Laboratories), and so on.

To evaluate whether a personnel computer meets the critical characteristics, it is necessary to convert specified IEEE codes, KEPIC codes, and RGs to other codes that PC vendors understand.

3. Conclusion

To upgrade the safety class of COMs of IDiPS, critical characteristics of them were identified.

To identify critical characteristics, design documents of IDiPS, DPPS, and other personnel computer based system were reviewed, and safety functions were anticipated.

Identified critical characteristics could be use to evaluate or dedicate a personnel computer that is expected to carry out safety functions.

REFERENCES

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