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The System Design Documentation for the Development of a PLC-based Reactor Protection System for KNICS

Inkoo Hwang, Seop Hur, Hyunchul Lee, Cheolkwon Lee, Dongyoung Lee, *Yangmo Kim
Korea Atomic Energy Research Institute, 150 dukjin-dong Yuseong,Daejeon, Korea
E-mail: ikhwang@kaeri.re.kr
*Chungnam National University, 220 Gung-dong, Yuseong, Daejeon, Korea

1. Introduction

Documentation plays a key role in the development and design of a safety related system for nuclear plants. It becomes a bottom line to develop a system systematically and an evidence to demonstrate the system's capability. This paper presents the documentation structure of a microprocessor-based safety system, IDiPS-RPS(Intelligent Digital Protection System - Reactor Protection System), developed as a part of KNICS(Korea Nuclear Instrumentation and Control System) which is under development for future Korean nuclear plants[1-6].

2. System Design Documentation Structure

The top document to initiate a design is a 'System Design Requirement' [2]. It defines a system to be developed. The document includes the general and high level requirements of the role, functions, performance, operation and maintenance, qualification and test, reliability, quality assurance, and other special features to be required for the system to be applied to nuclear power plants. If the 'System Design Requirement' requires that the system use only analog components, the design and development should proceed toward a system implemented with analog circuits and devices.

When a system has more complexity and functionality, it is necessary to further break down the documentation depending on the features of the system to be developed. It is conceivable that one document should be developed by one designer rather than by two or more.

The second document was a 'Design Specification' [3]. We used this document as a center of the direction to the corresponding specific technical requirement documents for the divided parts of the system development.

The 'Design Specification' provides an overall picture of the system to perform the goal that the prior 'System Design Requirements' intends to achieve. It basically proposes the system architecture and defines the list of specific functions to be allocated to each processor and channel in the system. The document also illustrates the what-to-do and how-to-do items to construct a system for nuclear usage. Equipment Qualification, and SW V/V are typical examples of the items specially required for nuclear I&C systems.

Since the design specification document contains comprehensive and all the items for development and design, it is not sensible to compile and describe all the details of information in a single document by one designer. This induced us to extract and develop the detail specifications for the specific areas in separate documents. As a base camp or directional pointer, the 'Design Specification' defines which specific document will contain the detailed information on a certain discipline of engineering and design process. It only provides a list or summary of the expected functions on each processor in the structure of the system and refers to a document(s) which will include all the detail and unique functional items to be implemented in the processor. For example, a designer needs to concentrate on the hardware and software features of the micro-processor of the system to develop the testing and diagnostic functional requirements, so that a single document was devoted to containing all the specific test and diagnostic functions to be equipped in the system.

Therefore, a document, 'Functional Requirements,' describes only the details of normal operational functions, and the other document, 'Test Function Requirements,' includes all the specifications on the test and diagnostic functions[4-5]. Those functional requirement documents are used to develop the software design requirement documents of the system.

A detail - 'Interface Requirements' - document was developed in order to extract all the necessary signal lists for communication between the processors in the system as well as to other systems[6]. These signal lists provide a guidance to integrate all the processors and components, to coordinate the communication software of the individual processors, and to manage the data between the processors in the development process of software for the system. The 'Design Specification' defines only the anticipated kinds of interface information between processors based on the allocated functions to each processor and component. The draft information can be extracted by analyzing and answering on 'what

information would be coming from outside of the processor to perform an assigned function to the processor?' and 'which subsystem or component would be the first candidate to transmit the information?' The detail signal lists for the 'Interface Requirements' document can be developed in the same way by answering the above questions based on the additional detail functional specifications in the 'Functional Requirements' and 'Test Function Requirements'.

Fig. 1 illustrates the documentation flow used in IDiPS -RPS

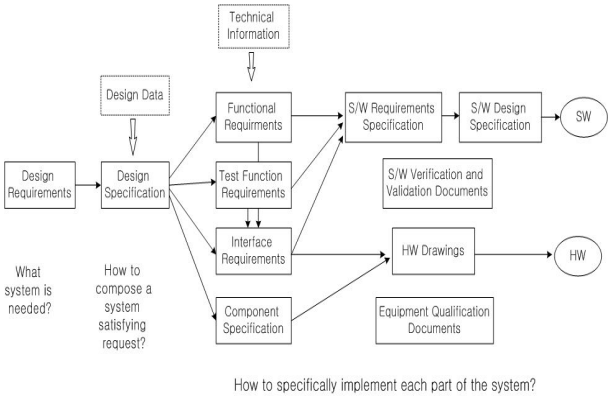

Fig. 1 Design Documentation Flow for IDiPS-RPS

3. Software and Hardware Documentation Structure

From the above system design documents, the necessary software development documents and the hardware implementation documents are split to produce the corresponding H/W(hardware) and S/W(Software) components. 'Software Requirements Specification,' 'Software Design Specification,' and other testing and V/V related documents are followed to develop the necessary S/W codes performing the SW driven functions and to qualify their performance. The detailed component specification, drawings, and other equipment qualification documents are followed to build the H/W and to assure the H/W quality.

4. Conclusion

While the 'Design Specification' document has acted as a centered director for the development of IDiPS-RPS, the 'Interface Requirements' document played the most important role in composing and integrating the processors in the system and it has been referred to all through the design and implementation process. Therefore, it required more feed-back and revision than other documents. Whenever any design change and confinement happens in the entire development period, it influences the 'Interface Requirement' specifications.

Acknowledgements

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