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Development of Parts History Management System (PHMS) for the Fault Diagnostic Monitoring of Safety Systems

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1. Introduction

In the operation of large nuclear facilities, various devices and instruments to function in a systematic way are designed. Even when you are looking at one system, several local devices and sensors are organically connected to perform its own function. For example, radiation monitoring system of a radiation utilization facility uses a monitoring software and hardware connected organically such as a number of local radiation detectors, electronic rate meters, etc in order to perform the function to monitor potential hazards that may occur. When there is some situation in which one of the many parts and sub-terminals constituting the system become the fail condition and cannot perform its functions, the operation of the facility may be interrupted until it is recovered. Therefore, the preventive maintenance regularly is necessary for the normal operation of the facility.

The purpose of this project is to develop an intelligent self-diagnosis and prognostic system that can prevent the unplanned halts of facility operation and potentially apply in the operation system of large nuclear facilities.

This has to include the following technical developments.

- Data collection system (The parts history management system, PHMS)
- Development of the RF tag and complex sensor to monitor the parts status and to manage the part history
- Development and demonstration of the fault diagnosis algorithm
- The graphic interactive monitoring system

In this paper, we'd like to introduce the PHMS of the radiation monitoring system developed for the fault diagnostic monitoring of safety systems as the first step.

2. Development of PHMS

2.1 Protection targets

In nuclear utilization facilities, 'Personal Safety Interlock System' and '(Real-time) Radiation Monitoring System' are usually operated as the safety system to prevent abnormal situations that may occur during operation and to protect individuals from accidents. The personal safety interlocking system is in charge of the access control in normal condition and the safety interlock for emergency situations. And through real-time radiation monitoring system operation, it functions to constantly monitor radiation for facility sites and management areas. The PHMS is set up to protect this safety systems. The schematic configuration is shown in Figure 1 and Figure 2 below. The safety systems consist of programs and servers in charge of access control, radiation monitoring, and interlock control and they can be interlocked with terminal devices in the field.

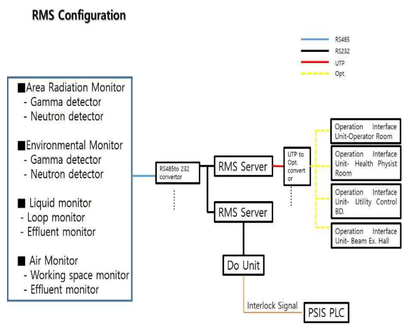

Fig. 1 Radiation Monitoring System Configuration for KOMAC

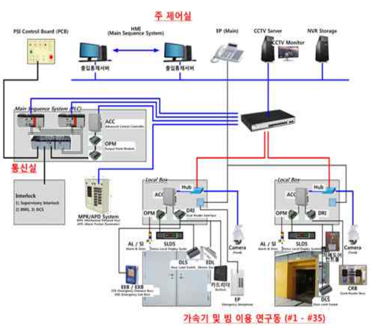

Fig. 2 Personal Safety Interlock System Configuration for KOMAC

2.2 The functions criteria of PHMS

The PHMS consists of the 'RF tag reader' to input and query the history of equipment parts in the field and the graphic based interface to display, edit, and report in the form of a user-specified condition. The system includes the following functions:

- Current status check and its own parts history management for the safety system and equipment related
- Real-time communicates with the safety system
- User Interface / Data Base implementation considering additional expansion
- Redundancy file system for backup data

The PHMS is based on the QR code or RF tag recognition. By scanning the code assigned to the local device with a 'tag reader', the device history can be input or modified and be saved. Graphical-based user panel loads the data stored in the data-base (DB) by recognizing the tag with reader and helps to process the data according to the user's intention. The PHMS collects the unique number, installation location, replacement history, repair history (cause of failure), operation cycle (time), and spare parts status of each component of target devices. The system configuration diagram and data flow chart are shown in Figure 3. The failure diagnosis monitoring system consists of DB made from accumulated prognosis symptoms and from the sensor that can monitor the field devices status, and the program that performs failure diagnosis prediction from these data.

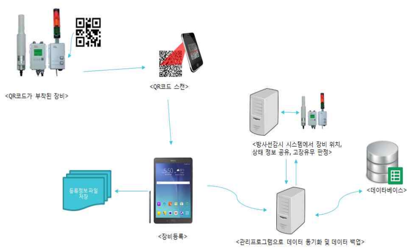

Fig. 3 Data Flow of the Part History Management System

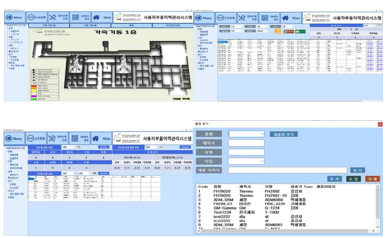

Fig. 4 Graphical-based user panel

The failure diagnosis monitoring system consists of DB made from prognosis symptoms accumulated and from the sensor that can monitor the field devices status, and the program to perform the failure diagnosis prediction from these data.

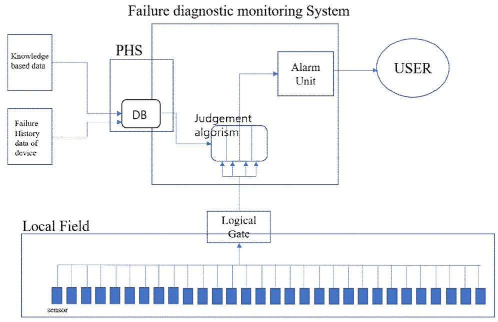

Fig. 5 Outline of the failure diagnostic monitoring system

3. Summary

This paper presents the current status of the parts history management system that is one of component for failure diagnostic monitoring system. The parts history system is in the progress of the collecting information. And if more data is collected, it is expected that it can be applied as the experience-based data that will be used as input data of the judgment algorithm of the failure diagnosis monitoring system. Ultimately, the goal of this system is an application of the failure diagnostic monitoring system in radiation utilization facilities.

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