

# Considerations for the Development of a Maintenance Support System using Digital Technology for Research Reactors

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## 1. Introduction

Digital technology continues to evolve and advance day by day. We at KAERI constructed a 5 MWth research and training reactor in Jordan, called the JRTR, in 2016. While constructing the JRTR, we found that it was hard to test and calibrate instruments located inside the reactor building because working staffs could not carry many documents and drawings that they needed. It took too much time to go back and forth between the office and the reactor building to carry other documents and drawings. The staffs had only pager phones on the walls inside the reactor building to communicate with staffs in the main control room. It was hard to use the pager phones while they are working at the equipment. Thus, a tool based on digital technology was important to assist and improve maintenance work such as test and calibration inside the reactor building.

There are some criteria and limitations in the application of digital technology to nuclear facilities because of safety regulations. This paper describes several considerations for the development of a maintenance support system using digital technology for research reactors. We targeted a research reactor first for the application. Most research reactors operate under ambient temperature and pressure whereas nuclear power plants operate under high temperature and pressure. Since research reactors have inherent safety features, we will apply the digital-based maintenance support system to research reactors first.

## 2. Considerations for the Development of a Maintenance Support System

The motivation of the maintenance support system is to support the staffs to perform their missions carrying a portable computer such as a tablet inside the reactor building as shown in Fig. 1. We select three items to consider for the development: mobility and information sharing ability, digital documentation ability and cyber security [1]. The considerations of the three items are described in following subsections.

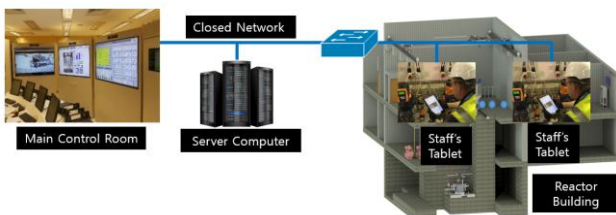


Figure 1 Concept of the maintenance support system

## 2.1 Mobility and Information Sharing Ability

The first goal of the maintenance support system is to provide the maintenance staffs with tablet (or mobile) computers for their work inside the reactor building. The staffs can access the documents and drawings stored in an access control server through the tablets inside the reactor building in a real-time manner. Thus, they do not need to bring many documents and drawings into the reactor building. They can also use video calls with staffs in the main control room and in other sites of the reactor building through the tablet. Moreover, the staffs in the main control room can monitor and assist the workers inside the reactor building through the tablet.

The staffs inside the reactor building can do video calls to assist each other. Thus, they don't need to access the pager phones during the maintenance work. They can take a picture or moving pictures of equipment inside the reactor building and share the pictures with staffs in other locations to get the assistance. The system can increase information sharing ability among the staffs.

The maintenance staffs can access some important process values such as values of pressure, temperature and so on through the tablet. The staffs can also judge and log the situation inside the building while performing the maintenance work. This can enable the staffs to promptly evacuate the reactor building under emergency cases.

## 2.2 Remote Digital Documentation Ability

The second goal of the maintenance support system is to make the staffs record field and tested data into the maintenance procedure using the tablet inside the reactor building. The staff can download the procedure into the tablet from the server, record the data into the procedure, and upload the procedure into the server. The staffs can also download other documents and drawings for the maintenance works using the tablet. Thus, they do not need to carry them inside the building and go back and forth between the office and the building. The system can support the staffs to make digital documentation remotely.

## 2.3 Cyber Security

We must consider the cyber security issue in order to apply the digital technology to the nuclear facility. The best way to prevent a cyber-attack is to disconnect the

network from the outside digital equipment. We apply a closed and private network only dedicated to the system. We will install electrical power-line modems inside the reactor building. We also install antivirus program on the tablet and server and a firewall on the server to prevent digital access from outside sites. Thus, the system can be protected from the outside cyber threats.

### **3. Conclusions**

This paper presents several considerations for the development of a maintenance support system using digital technology for research reactors. It is a mobile-based system using a closed network, which is a new and evolutionary approach for nuclear facilities. The system will contribute improving the maintenance work inside the reactor building. This improvement will also reduce human errors by maintenance workers. An architecture will be developed for the maintenance support system in the future.

### **Acknowledgement**

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### **REFERENCES**

[1] TDR-076-400-600-002, Requirements for Network-based Smart Maintenance System Development, KAERI, Sep. 30, 2020.