# Applications of RFID into Nuclear Power Plant Maintenance System

Seung Min Lee and Poong Hyun Seong [*]
*Department of Nuclear and Quantum Engineering, KAIST*
*373-1, Guseong-Dong, Yuseong-Gu, Daejeon, South Korea, 305-701*
[*]*Corresponding author: phseong@kaist.ac.kr*

## 1. Introduction

RFID (Radio Frequency Identification) system, one of the most anticipated ubiquitous technologies is an automatic identification method using devices called RFID tags [1]. RFID antenna detects each approach of RFID tags and recognizes the tags` ID and transfer to reader to do information processing. Since first introduced in the logistics industry, production management and maintenance organization in various fields of domestic and foreign enterprises introduce the RFID [2]. Nuclear power plants are also using RFID to manage materials lately. However, the current status on the use of RFID is just a little more advanced on the use of bar code. Therefore, it seems that the important characteristic of RFID is not enough actualized to keep seeing.

In point of Maintenance Information Field based on ubiquitous technology, the most important concept is real-time information processing. And RFID is quite proper to develop this information field system because it satisfies for the matter of that concept.

The leading content in ubiquitous maintenance system is that maintenance personnel can get information what he needs and he can also transfer information what he gets whenever and wherever he is. In this paper, some examples of applying RFID in development of ubiquitous maintenance system are suggested.

## 2. Application scenarios in Nuclear power plant

In this section I propose applying RFID prototype for a nuclear power plant. What explained following are material management system, real-time location system and mobile sensing.

### 2.1 Smart Inventory System

It is required to compose real-time material management system using RFID in order to get information about materials needed by connecting with management server directly.

Material department of nuclear power plants are using RFID, but there are lots of uncomfortable about movement of reader in narrow space and an increase of work due to interlock with the existing ERP system. Especially, in a view point of taking real-time information, the current system provides information restricted on that time in which maintenance personnel checks tags with reader. Therefore, it would be too limited to get correct information especially when there are too much taking of goods in and out of the warehouse or loss.

To consider the unmanned real-time inventory shelves, one rack is assigned a specific reader and one shelf has its own antenna. Each antenna can read tags only laid down on the shelf on which the antenna put on. The rack contains its own reader compared to existing system there is no need of a person who has to operate reader. Furthermore, it is possible to know the position of materials by matching the antenna and the shelf (Tool X is at rack Y and shelf Z).

### 2.2 Real-Time Location System

The principle of Real-time location system is that a mobile tag sends a radio wave which is received by three or more location receivers (readers). Each receiver records the Time of Arrival (TOA) of the same wave. Location receivers send TOAs to server. Because receivers are in known, fixed locations, each pair of TOAs generates a hyperbola of possible unit positions. The intersection of these positions is location estimate.

If this RTLS applied to nuclear power plant, it would be possible not only to instruct tasks and to understand status but to help prompt treatment when it is interlocked with other system with checking the position of maintenance personnel.

As shown in Fig. 1, if the server of main control room perceives an accident, then it let the operator or maintenance personnel located closest to that accident point knows that he needs to be committed immediately.
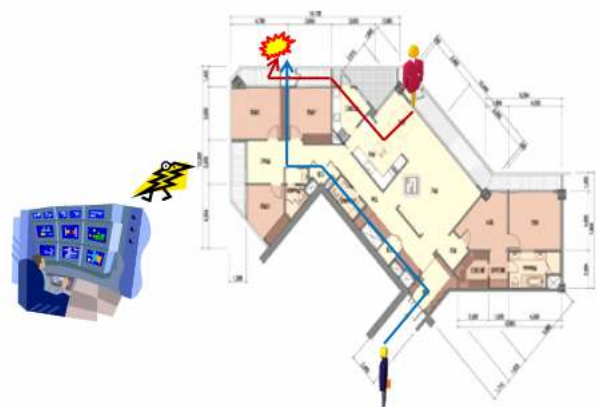


Fig. 1. An application scenario of Real-Time Location System in Nuclear Power Plant.

Especially as shown in Fig. 2, if it is linked with Smart Inventory system suggested,  it could be possible

to monitor the position where the maintenance personnel is located, to find those who is at the most close place and to chase where the one is going. In addition, the one can send his status or information he has when problems are happened.
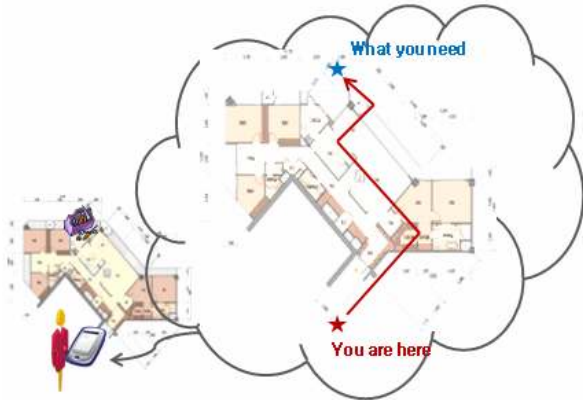


Fig. 2. An application scenario of Real-Time Location System linked with Inventory System.

*2.3 Mobile Sensing*

It is possible to implement the mobile sensing system by using mobile PC like PDA, UMPC (Ubiquitous mobile pc) and USB type RFID reader [3]. In this case, process that a person gets data directly from the instrument through human senses would be changed to one that the mobile pc connected with reader gets the tags` information attached on instruments. So on the whole, the process from getting data to write or save it will be simple. Therefore it could be possible to avoid the human errors, incorrect identify of instrument data, fill out wrong information or miss filling out data and also to reduce accidents that can be happened from these causes.

it can be used to measure instrument data as well as to know the status, lifespan of equipment that it will help prevent a variety of accidents and incidents like leakage.

## 3. Conclusions

RFID is required in development of ubiquitous maintenance system to realize the real-time information system.  Actually only with the fact that the accurate collect of the latest information is possible using RFID it can be avoided to come about a variety of human errors.

RFID smart inventory system can reduce time and workforce waste by enabling real-time management of materials. It also help material supply and information offer smoothly and reduce the errors happened during that process.

RTLS can be used itself or by liking with other system and makes it possible to check the position of maintenance personnel.

The realization of mobile sensing can identify and save the state information like temperature, pressure or flow

rate of many devices. It makes maintenance personnel comfortable as well as operator, especially the process checking and writing the meaningful values. So this can also reduce the human errors that can be happen during this process.

RFID system that uses active tags like RTLS and mobile sensing is slowly underway on commercial scale. And only a narrow range of building network is being considered because of the concern of malfunctioning equipment by interference from the propagation of radio communications equipment. Many applications of RFID will be capable if there is a vigorous improvement on the functional level of RFID and if the stability of nuclear power plant on radio wave in confirmed.

## REFERENCES

[1] Paul M. Goodrum, Matt A. McLaren and Adam Durfee, The application of active radio frequency identification technology for tool tracking on construction job sites, Automation in Construction, vol.15, 292-302, 2006
[2] Thomas Diekmann, Adam Melski and Matthas Schumann, Data-on-Network vs. Data-on-Tag: Managing Data in Conplex RFID Environments, Proceedings of the 40th Hawaii International Conference on System Sciences, p.2007
[3] J.Y.Jung, J.H.Yeo, H.S.Lee, C.S.PyoTechnology Trend of RFID Sensor Tags, 전자통신동향분석, vol.22, p.38-45, 2007