Development of automatic calibration system for KOMAC

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1. Introduction

Radiation monitoring is routinely performed at nuclear utilization facilities, regardless of whether the facility's scale is large or small. For radiation monitoring, portable devices or facility-fixed radiation measurement devices that are fixedly installed at a facility's wall to monitor the radiation dose rate constantly are used. These devices must be calibrated at regular intervals determined by relevant laws and regulations to check their soundness. Within the facility that operates the 100 MeV proton accelerator, approximately 100 fixedly installed radiation measuring devices are in operation, and their performance is checked through the calibration every year. Within the facility that operates the 100 MeV proton accelerator, approximately 100 fixedly installed radiation measuring devices are in operation, and their performance is checked through the calibration every year.

The process of calibration is very tedious and requires repeating simple tasks. Also, during this process, there are elements that can cause human error. In this paper, we review the overall calibration process for Korea Multi-purpose Accelerator Center(KOMAC) and introduce an automated system self-developed.

2. Methods and Results

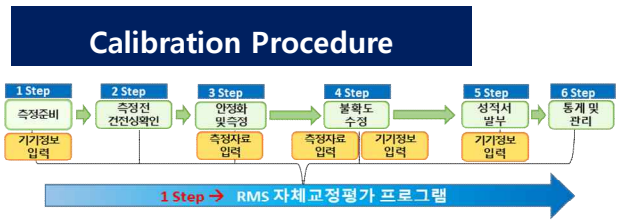
2.1 Calibration procedure and problem

Before introducing the developed calibration system, I would like to briefly explain the calibration procedure. As shown in Figure 1, the calibration of a radiation measuring device begins with the preparation step of recording information on the target device and ends with the issuance of a report. 100 In order to calibrate the measuring instrument here, the following process had to be followed. Before introducing the developed calibration system, we would like to briefly explain the existing calibration procedure.

As shown in Figure 1, the calibration of a radiation measuring device begins with the preparation step of recording information on the target device and its ends with the issuance of a report. To calibrate the measuring instrument, the following process had to be followed.

1) Review the sheet containing information on the device to calibration and print out the calibration data record sheet
2) Check the visual condition and operating status of the device subject to calibration
3) Manually input measurement data in the local field
4) Convert manually entered data into an electronic file for uncertainty calculation
5) Print out the calculated calibration factor and uncertainty in a separate form.
6) Keeping the calibration certification

The calibration process is schematically shown in Figure 1. The part where human error can occur during the calibration process is the part where information must be entered at each step.



As the number of devices that need to be calibrated reaches over 100, the device types and manufacturers are all different, so the equipment settings must also be different during the measurement preparation stage. From here, the development requirements for the calibration system can be derived as follows.

1) Minimize to input the information
2) Automation of the information input
3) Compatibility across different manufacturers and device types
4) Evaluation of uncertainty and calibration factor
5) Issuance of the calibration report
6) Statistics management

2.2 Development of the calibration system

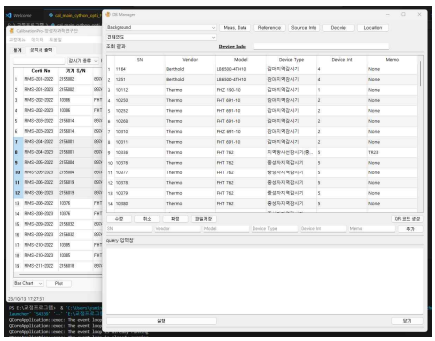
The calibration system is basically based on a database contained various basic information and calibration information about the device. By reading the QR code assigned to each device through a barcode reader, the calibration procedure, standard source information for calibration, and communication protocol that match the device to be calibrated are automatically selected and set. In all stage, a dialog box

is displayed to check whether the automatically set information is accurate. It is designed to allow users to edit and select automatically set information at each step. When entering the actual calibration procedure, it is connected to the calibration target device via a serial cable, and communication port settings and measurement value recording are automatically performed. The advantage of this system is that measurements and data organization that previously had to be performed between the field and the office can be performed in the field through a single system, and the judgment of whether the calibration has passed or not can be made at the same time as the source measurement is completed in the field. The advantage of this system is that measurements and data organization that previously had to be performed between the field and the office can be performed in the field through a single system. And the judgment of whether the calibration has passed or not can be made at the same time as the source measurement is completed in the field. If it need to re-measurement, it could be performed immediately as a result that the overall calibration time could be shortened.

1) The design of Database

The database consists of 4 tables, each table contains the information below and they are organically connected.

① Install location information table
② Device information table
③ Calibration data table
④ Standard source information table
⑤ Standard irradiator information table



2) Unique communication protocol

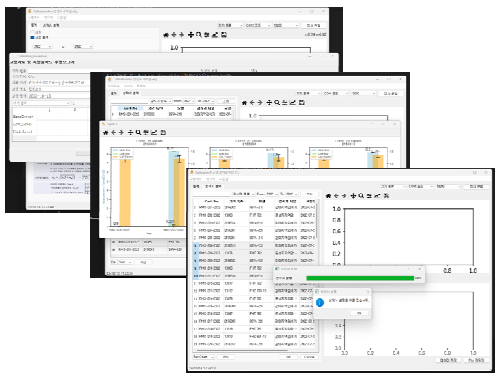
Communication protocols are implemented for used at KOMAC, and the list is as follows.

① Berthold: LB112, LB115, LB5340
② THERMO FISHER: FHT6020
③ Seyeong NDC(FLUKE): SRM200

3) Automatic calibration system feature

The self-developed calibration system has the following functions.

- QR code recognition
- Automatic recognition of communication protocols
- Automatic recording of measured values
- Calculation of calibration factor and uncertainty
- Judgment of acceptance of calibration at a local field
- Comparison of changes in calibration factor and uncertainty
- Statistics on the number of calibration attempts
- Search for calibration failure devices by year and analyze multi-year data trends
- Generate and print for the calibration certificate and uncertainty report
- Database modification feature, such as adding new devices



3. Conclusions

Currently, only certain calibration procedures are allowed, which limits the freedom of the system.

As needed, a function that allows users to configure and use their own calibration procedures within the system can be considered. I believe that this can greatly increase the versatility and the uses value of the system.

With the implementation of this system, the three-week time required to calibrate about 100 different types of radiation measuring devices using the existing method was shortened to one week. As a result, the fatigue of workers performing calibration was reduced, and the effect of preventing human errors was achieved by minimizing operator intervention during the calibration process.

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