System Design for Calibration Evaluation and Management of Radiation Monitoring Equipment

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1. Introduction

The calibration process of radiation monitoring equipment is divided into two groups as the measurement for on-site calibration and the paperwork for a preparation of documents such like calibration certificates and calibration reports. On this process, there is an inefficient in that work is duplicated because the calibration data already written in the on-site must be re-entered in the designated form. Also, since a calibration certificate and a calibration report must be prepared for each detector, it takes a long time to calibrate a large number of detectors. During the calibration, the worker has to perform device calibration and data input work while moving the work place frequently. [1] In this process, the work flow becomes complicated, so the work fatigability is increased. Even after calibration is completed, additional work remains, such as evaluating statistics on detector failures or recalibration events, and managing them with accumulated data historically every year. [2]

Therefore, in order to improve the inefficiency of work, the 'Calibration evaluation and Management System' for Radiation monitoring equipment is designed and planned to be introduced into the work.

Figure 1. Calibration Evaluation and Management System Schematic

2. Methods

In order to simplify and speed up the calibration procedure and ensure that data is accurately managed, it should be designed as an integrated system with functions such as data input, statistical processing, and report output. [3]

The current calibration procedure is divided into six steps. Step 1 and 2 are grouped as the on-site work, which are the measurement for calibration on-site and input the raw data on a form. And the paperwork for a preparation of documents is following like that.

Step 3: to transfer the raw data form to the data calculation sheet,

Step 4: data statistical processing work,

Step 5: evaluation of calibration result,

Step 6: lastly to output calibration data as a report or certificate form.

The 'calibration evaluation and management system' can unify the above-mentioned multi-step work methods into one step. Through establishing this system, it is possible to reduce the fatigability of workers and improve the work efficiency by reducing the time required performing calibration work.

The detailed functions of the system are as follows.

Figure 2. System function diagram

2.1 Input of measurement data and judgment

Input the basic information such as detector model, manufacturer, device number, and calibration date. Then, the system calculate average value, standard deviation, uncertainty, correction factor, etc. through its own algorithm to determine the pass or fail. Since this processing is performed on site in real time, re-calibration can be performed immediately if the calibration fails, and the number of recalibrations is also recorded. When calibration is not possible, the corresponding detector is treated as un-calibration.

The information typed and calculated in this step are used as the basis of the calibration report later.

2.2 Statistics of calibration data

In this function, not only arithmetic and statistics of calibration data, but also the recalibration quantity, recalibration rate, failed equipment quantity, equipment failure rate, etc. of the detectors can be identified and stored information can be checked. Through this function, it is possible to check calibration trend and current status by year.

2.3 Inquiry of calibration history

In this function, calibration history can be inquired for each detectors by searching the calibration period for detectors that have been calibrated. In addition, past calibration data and calibration factors can be compared with this year's one, and the uncertainty, errors, and standard deviations of the measured data can be checked. Through this menu, the status of operation history and calibration of detectors can be checked by year.

2.4 Management of basic data

The basic information about the detectors can be entered into the storage in advance and also can be added or modified. Basic information such as detector type, model, device number, and information of calibration source for the calibration procedure does not change unless a special reason occurs. Therefore, related information is classified as basic data so that it can be stored and managed in the storage. Information corresponding to basic data is automatically entered in the system during calibration, and is also entered as basic data when issuing a calibration report or a calibration certificate. This function reduces the time required for the calibration by reducing a repeated manual input of data.

2.5 Report Creation

When the calibration is completed, a document must be created in the form of a certificate or report reflecting the calibration results only for the detectors that passed.

In the current calibration procedure, it is necessary to input calibration data again through other device, write a report, and print it out. In this process, duplication of inefficient work occurs again. A long working time is required because a report could be prepared for each detectors. Using this designed system, the calibration results can be confirmed at the same time as input the data, and that information is automatically entered into a pre-deigned form to create the report. The report format can be modified by user and can be applied to some devices or to all devices at once. In summary, through this system, the worker can obtain data such as calibration factor, uncertainties, calibration results and calibration report for the devices in a short time through one-time data input.

Table I: Calibration Procedure Comparison

Current Calibration Procedure		Calibration Management System
Step 1.	Device Calibration	1 Step.
Step 2.	Input data on form	
Step 3.	Input data on the Calibration sheet	
Step 4.	Data Statistical Processing	
Step 5.	Calibration Result Evaluation	
Step 6.	Report Output	

3. Conclusions

Through the development and introduction of this system, it is possible to reduce the time required for calibration by eliminating a repeated work in the calibration procedure and simplifying the procedure. In addition, by performing the overall work procedure related to calibration in one step within the system, the calibration work can be performed consistently, enabling faster and more accurate data management than before. Therefore, the worker's movement flow line is simplified and the time required for calibration per one detector is reduced. And above of all, work tiredness is also reduced, so the work can be performed more efficiently. It is expected that this will help in preemptive failure prevention by enabling prompt action in case of equipment failure and securing spare parts.

REFERENCES

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