

Management of Field Instruments for HANARO

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1.0 Introduction

There are a total of some 360 field instruments used in the process system of the HANARO reactor. These instruments are regularly calibrated for a safety, with their periodic cycles for a calibration having been fixed in 1998 as either one year or three years, depending on their function and relative importance. The standard measurement equipment used for the calibrations is certified by the national calibration laboratory before use.

This paper analyzed the results of oversight activities over the last ten years, to offer suggestions for a more effective management.

2.0 Related Regulations

Calibration and management of field instrument is performed in accordance with regulations concerning calibration and management of field instrument.[1] Duty responsibilities are delegated according to applicable job description, where only personnel qualified under the standards for calibration duties are assigned as calibration oversight managers.[3] Calibration records are maintained in validating the performance of process systems, and for improving their operability. Once a field instrument has undergone calibration, it is updated with a new sticker for inspection completion, as shown in Figure 1.

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Fig. 1 Sticker for inspection completion

Standard measurement equipment is kept in their designated equipment room, in accordance with the regulations concerning management of standard measurement equipment.[2] At prescribed intervals for calibration, they are adjusted by a national calibration laboratory, and only those devices which have passed such inspections are used in turn to calibrate other equipment.

3.0 Management of Field Instrument

In HANARO reactor, there are a total of some 500 field instruments, categorized as either major instrument under the periodic inspection procedure or as field instrument used for process systems.

The major instrument have inspection periods set for 6 months or 1 year, but the field instruments do not require the same scrutiny in either their function or importance, so they are calibrated under either 1-year or 3-year periods. Management of the 360 or so field instruments are performed using a list of instrument, updated each year, as follows.

3.1 Functional Classification

The functional categories for measurement are Temperature, Pressure, Flow Rate, Fluid Level, Valves and other Analyzers and such, as shown in Figure 2, with coolant measurement and controls comprising the majority.

Temperature sensors comprise the vast majority, with 97 for coolant temperature monitoring. Of those, 55 of the RTD type are the most numerous, with 33 field indicators, and 9 thermal switches. There are 155 pressure sensors, with 94 field indicators the most numerous, 53 pressure switches, and 8 air pressure sensors. Most of the flow sensors are for the air ventilation systems' air & coolant flux monitoring, at 32, with flow transducers at 11, airflow sensors at 16, and others, 5. Among the valves, motor-operated (MOV) comprise 12, pneumatic control valves 11, and two safety valves, for a total of 25.

In addition, there are 9 conductivity meters, 5 reactor power indicators, 6 leak/humidity sensors and 7 current alarm modules.

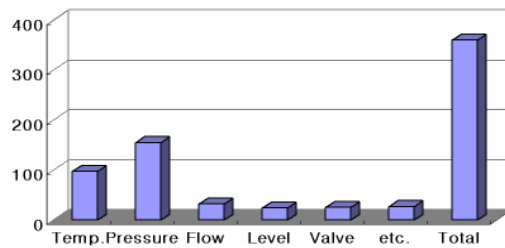


Fig. 2 Functional classification

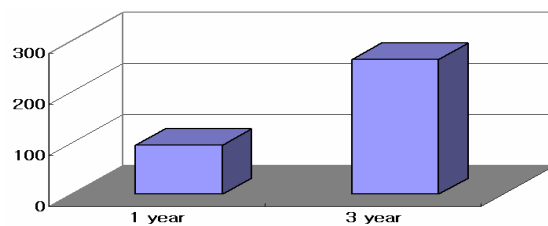


Fig. 3 Classification by Calibration Period

3.2 Classification by Calibration Period

The calibration period is 1 year and 3 years, respectively, with the former set for sensor types causal to safe outcomes, with frequent usage, or for sending signals to the MLC, and the latter for all other general instruments not directly related to safe outcomes.

There are a total of 96 equipment under the 1-year inspection cycle, with major RTD's and flow transducers, capacitance analyzers and leak detectors, fluid level transducers, and switch types which activate secondary equipment in connection with predetermined values on the field. There are a total of 264 sensors under the 3-year

inspection cycle, mainly non-safety related sensors and simple field indicators.

3.3 Calibration Record by Years

Prior to 1998, all 360 field instruments were being calibrated on an annual basis, regardless of their function or levels of importance. It became apparent there were inefficiencies in the time and human resource allocation, for field indicators with simple functions. The general functions of the field instruments were examined, to apply a new calibration schedule starting in 1998.

Calibration activities utilize reactor shutdown times with no scheduled maintenance activities, with some calibrations for field instruments to take place during reactor operations. For those devices which could not be calibrated during the previous cycle due to the failure of a sensor itself or the standard measurement equipment, adjustments are to be performed at the next annual opportunity.

Calibrations over the last ten years, at an average rate of 194 inspections each year, are shown in Figure 4.

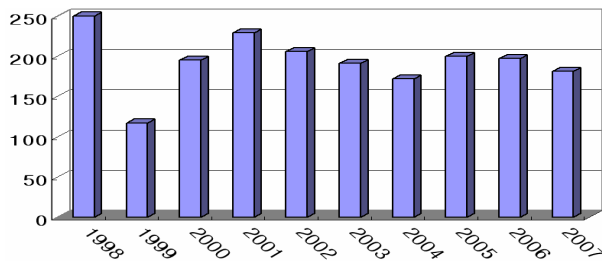


Fig. 4 Calibration Record by Years

3.4 Special Function Field Instruments

Conductivity meters to monitor a coolant fluid quality, moisture sensors to measure the humidity of air ventilation systems, and vibration sensors to monitor a cooling fan vibration are some examples.

For the conductivity meters, there are 9 in use, under an annual calibration cycle, for purification systems, reflector systems, and spent fuels. There are 3 humidity sensors for monitoring ventilation system air, under a standard humidity sampling cycle of 3 years for a calibration. The 4 vibration monitors for the cooling fan status cannot be calibrated, and are thereby replaced every 2 years.

4.0 Future Activities

Calibration of field instruments must normally utilize reactor shutdown times, with very few instruments which can be calibrated during a reactor operation. Periodic maintenance and systems repair also contribute to calibrations becoming delayed, or being put off until the next year.

Based on the calibration maintenance data over the last ten year period, a re-examination of the inspection cycles for a calibration is necessary, and additional personnel are deemed necessary for a smooth performance of the calibration work.

5.0 conclusion

This paper has reviewed the status of the management of field instruments for the last ten years. Proper management of these instruments being key to a nuclear reactor safety, the calibration of the instruments are performed each year in

accordance with the list of instruments, and the calibration procedure by each functionality. An average of 194 calibration tasks is performed each year.

For instrument calibrations which are being deferred to the subsequent annual cycle due to a reactor operational schedule or priorities given to a scheduled maintenance, a review of the calibration cycle is necessary for an adjustment, based on the relative importance of the field instrument and their frequency of usage, as recorded over the last ten years of a calibration operational experience.

REFERENCES

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