

Study on the Diagnostic Method of CEDM Coils

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:: Introduction

- ❖ CEDMCS(Control Element Driving Mechanism Control System) is one of the systems that regulates the output of the primary side of a nuclear power plant.
- ❖ CEDMCS consists of logic cabinets, power cabinets, control element assemblies and etc. The output on the primary side is controlled through the interaction of these components. Nuclear power plants measure the characteristics of the CEDM coils among the CEDMCS every overhaul period to confirm the operability by checking the integrity of the CEDM coils.

:: CEDM Coil Diagnostic Method

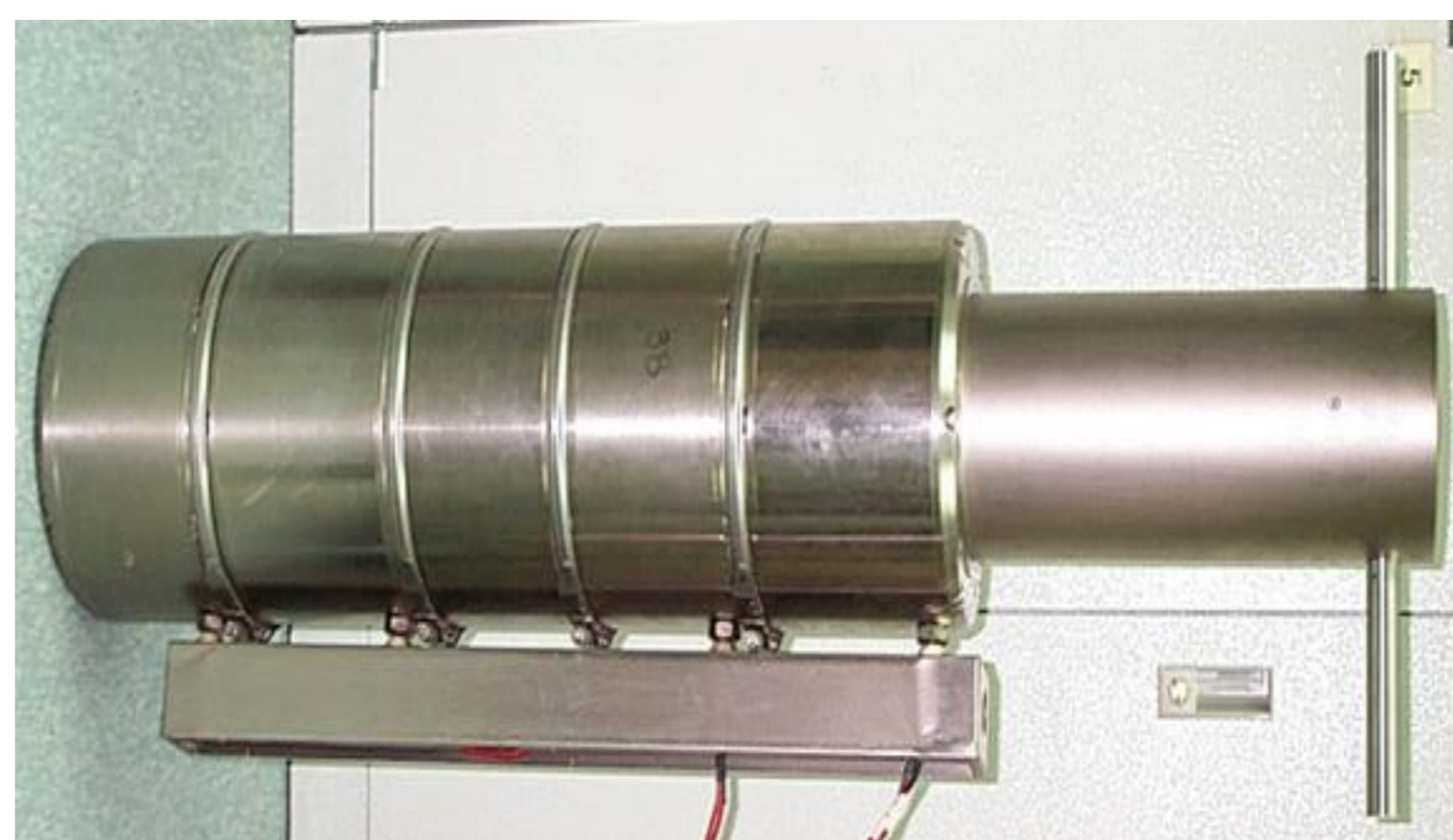
I. Initial Coil Integrity diagnostic method

- ❖ In order to check the integrity of the coil of the initial control rod, measure the coil resistance value for each temperature of the reactor coolant and check whether it is measured within the normal range.
(Refer to the manufacturer's value for the corresponding resistance value)

II. Improved coil diagnostic method

- ❖ In order to evaluate the integrity of the CEDM coils, measurement data for each nuclear power plant unit is being managed using X chart so that the cause of the abnormality due to a special pattern can be identified.
- ❖ It has been proposed that the management limit line requires attention and attention of the CEDM coils when the average value $\pm 3\sigma$ is set as the upper and lower limits. The reason why the upper and lower limit values of the management limit lines were selected is that empirical upper and lower limit values were designated in consideration of field errors (loop, environment, etc) and measurement errors (instruments and personnel, etc) due to field characteristics. When evaluating using measurements, the evaluation is performed using Table 1.

- ❖ CEDM coils measurement value is outside the upper and lower limits during overhauls, it is recommended to replace the CEDM coils. The following is an example of the results of measuring and evaluating one CEDM coil value. In the third result, it can be seen that it deviated from the lower limit unlike the previous one. These upper and lower limit CEDM coils were found in the early stages of overhaul and the integrity of the CEDM coils and systems could be maintained through replacement.



<Picture: Control rod driving coil set>



<Picture: Remove Fillings>

Table 1: CEDM coil aging evaluation table

DC Resistance	AC Resistance	Inductance	Q-Factor	Aging Evaluation	Remark
↑	Normal	Normal	Normal	Normal	Check Connections
↓	↓	↓	Normal	Aging (in progress)	Continuous Monitoring
Normal	↓	↓	↓	Aging	Replacement

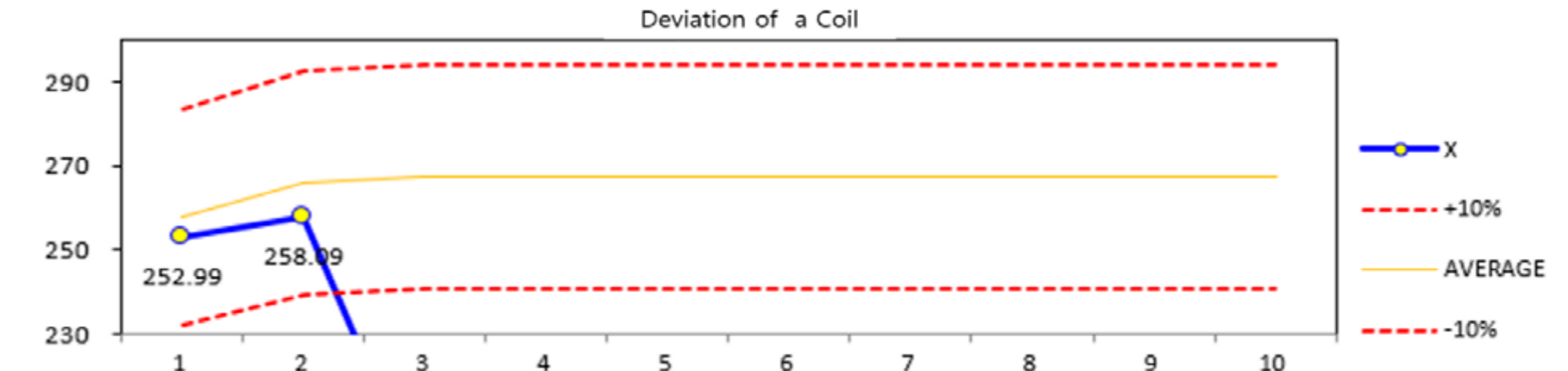
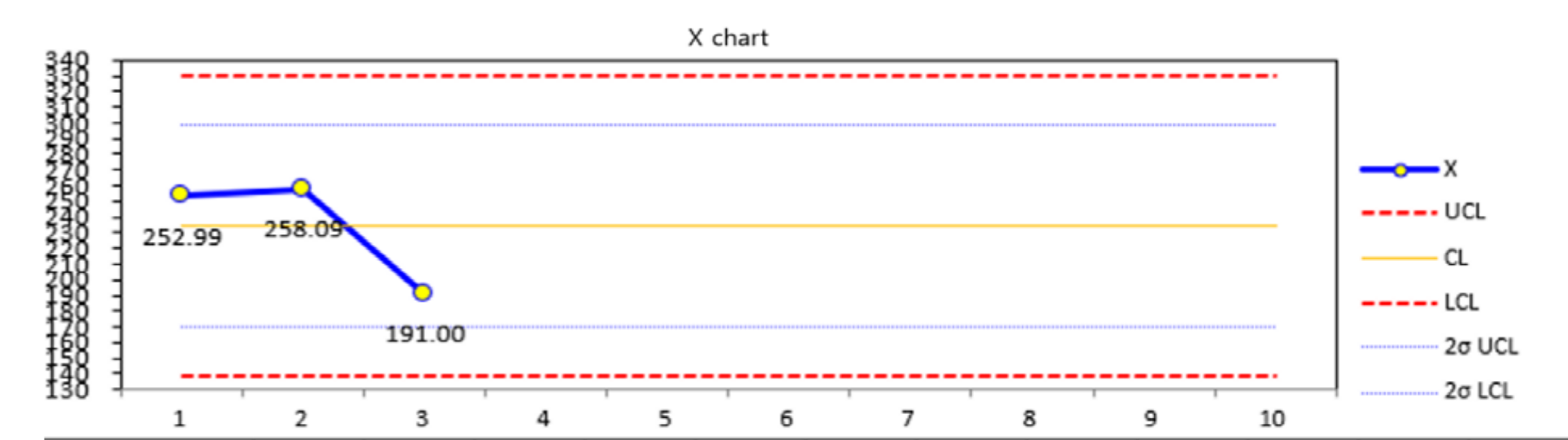
:: Results and discussion

I. Example of Improved coil diagnostic method

- At the start of OH, the characteristic value of the CEDM coil acquired at the high temperature of the RCS
- Comparison of characteristic values with previous OH records is performed.
- Check the coils outside the allowable range.
- When the allowable range is exceeded, the cause of the value of DC Resistance, AC Resistance, Inductance, Q-Factor and etc. is estimated.
- When determining coil aging, it is recommended to replace the coil.

II. Additional improvement requirements

- Detail the diagnosis result according to the change in the characteristic value of the CEDM coils.
- Clarify requirements for accurate value measurement when acquiring characteristic values
- Record Management for Coil Replacement.



<EXAMPLE: X chart and deviation(CEDM coil)>



<Picture: Aged control rod driving coils>

:: Conclusion

- ❖ Inspection of the CEDM coils in nuclear power plants has been continuously carried out every overhaul. It was confirmed that the operation efficiency of a nuclear power plant could always be improved by managing the elements that could check the function of the CEDM coils when operating the control element assemblies of the CEDMCS.
- ❖ It is considered that the improved CEDM coil management technique could be applied through continuous data acquisition and analysis related to the CEDM coils.