

The Development of a Eddy Current Testing Tool(KHNP)

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1. Introduction

Eddy current test (ECT) system for steam generator tubes is one of the principal tools for the in-service inspection of nuclear power plants. There is no domestic ECT system for the steam generator tubes. Foreign systems are very expensive. Moreover, the maintenance and repair of the system are not prompt. In order to settle such problem, new ECT system has now been being developed in KHNP Central Research Institute. In this paper, the composition and functions of the steam generator ECT system are explained.

2. Composition of the System

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2.1 Composition of the System

The developed steam generator ECT system is composed of a frequency generator, and data acquisition and analysis programs. The frequency generator provides the electric current with required voltage to the probe coil, detects the modulated signal created between the coil and inspection material, and restores the detected signal to the monitor in the form of Lissajous in order to be evaluated by analysts. The part of frequency generator is consisted of a frequency synthesizer, an analog board, a central process unit (CPU) and a digital signal modulator. The frequency generator produces the signal needed for producing the eddy current signal in the frequency synthesizer. The signal modulated in the eddy current probe coil is collected in the analog board. The signal modulated in the digital signal converter is transmitted from the CPU of the frequency generator to the main computer. This signal is processed by the eddy current signal acquisition and analysis program in the main computer. In order to be evaluated the signal by analysts, the signal is displayed in the forms of the strip chart and Lissajous. Figure 5 illustrates the outline of module composition and the flow chart of data.

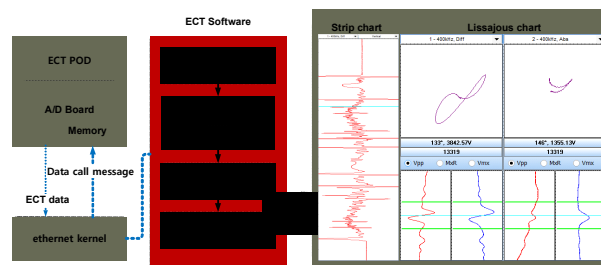


Fig. 1. Data Flow Chart of EC Program

2.2 Data Acquisition & Analysis Program

The ECT program is composed of the message process module for controlling hard ware, the data storage module for acquisition, the data mapping module for displaying the signal and the data processing module for analysis. The operating system for the ECT signal acquisition and analysis program is Windows 7 with C++ and C++ Builder 2010. The accuracy and reliance of operation and the processing time are improved by using the exclusive library. There are 3 stages in the ECT program; setup, data acquisition and analysis.

- Setup : Preparation Stage for data acquisition and analysis connected with IP/port setup, inspection variable setup and calibration.
- Acquisition : data acquisition stage in the system
- Analysis : data analysis stage

2.2.1 Setup

In order to inspect the heat exchanger tubes with the ECT system, the computer should be connected to the hardware. That means IP and Port should be connected to the hardware module in the “Connect Control” window of the ECT program. The status of “connect” or “disconnect” is represented in “State” window. “IP” and “Port” control boxes are list types, and IP address stored in “System Window” which will be described in next chapter.

2.2.2 ECT Data Acquisition Program

The ECT data acquisition program controls the frequency generator to activate the probe coil at the established frequency following the inspection condition. The initial window of the ECT data acquisition program is illustrated in Fig. 2. “Inspection Setup”, “Calibration

Setup”, Landmark”, “Material”, “Summary”, “Code editor” and “List editor” buttons are placed on the upper menu. The IP Port connection button and the button loading and storing the “Setup” are placed in the left side of the bottom of the window.

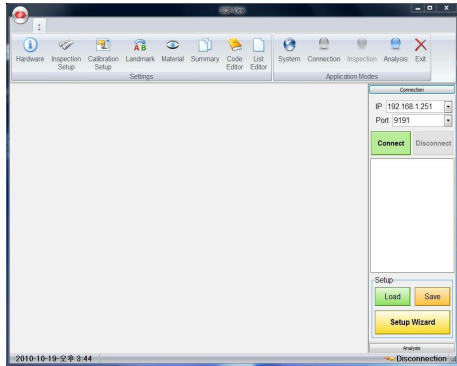


Fig. 2. Data Acquisition Program Main Window

2.2.3. ECT Data Analysis Program

“Analysis Control” window of the ECT data analysis program has buttons analyzing data and changing the chart formation in the upper part. The chart size control function, “Directory” and “File List” are in the right side of this window. The button in the right side of the bottom has “Up/Down” function to change file and set the landmark. The “Strip Chart” of the program shows the components of real part (X) and imaginary part (Y) for the ECT impedance signal. The strip chart illustrates the information of the entire length of tube, and displays the entire inspection data for a appointed channel. The amplitude, phase angle and trace of impedance signal are expressed in Lissajous window. The “Calibration Control” window is divided into “Selecting Channel”, “Position Setting” and “Cal. Curve” chart. The setup is completed if the Calibration button is clicked after selecting the condition. The “Cal.Curve” chart can be confirmed at each channel after finishing setup.

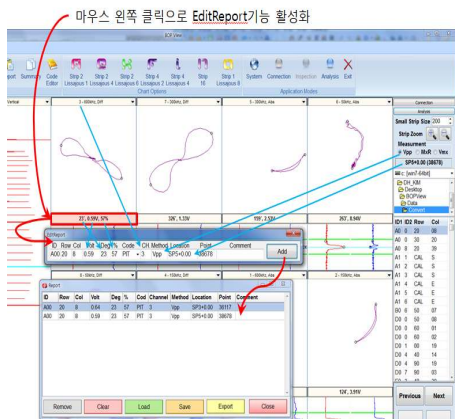


Fig. 3. Edit Report Window

3. Conclusion

An ECT system including the hardware and software has now been being developed in KHNP Central Research Institute. The constitution and functions of the data acquisition and analysis program are explained in this paper. This system will be applied to the steam generator tube inspection of nuclear power plants. The system will be improved by reflecting the experience and suggestion from the site. The ECT system is supposed to be one of the world best. Then, the ECT inspection will be conducted without foreign technology.

REFERENCES

- [1] ASNT, “Nondestructive Testing Handbook” 3rd ed, : Vol.5, Electromagnetic Testing, Columbus, OH : American Society for Nondestructive Testing, 2004
- [2] Benefield, Gabrielle, “Rolling out agile in enterprise”, In proceedings of the 41st Annual Hawaii International Conference on System Sciences, 461-470. IEEE Computer Society, 2008
- [3] Mike Cohn, “Succeeding with Agile”, Addison Wesley, 2010