The Development of an Inspection System using 3-D Image Display for Detecting Inside Defects on Steam Generator Tubes

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1. Introduction

Recently, an eddy current inspection system has been developed by Central Research Institute of Korean Hydraulic & Nuclear Power Co., LTD. The system is optimized for Korean nuclear power plants. Its precision and efficiency are better than those of foreign systems. One of the subsystems consisted the system is introduced in this paper, which assists the eddy current signal analysis for the steam generator tubes of nuclear power plants.

2. Analysis of Existing System

The eddy current test gives the excellent ability for detecting crack type defects. The eddy current analysts analyzes signal manually for the existence of defects in the existing system. Because the test results could be changed by the ability of the analyst, the results are not reliable. Because the analysis is conducted manually, the analysis is the time consuming and low productivity work.

The efforts have been made for resolving the problems mentioned above. Systems acquiring data, mapping the signal intensity to 2D plane type and mapping the signal to one color 3D surface type have been developed. Therefore, to obtain the results of concerned level having no connection with the ability of analysts is not easy because it is limited to recognize the defects visually with 3D effect using the existing systems. The system introduced in this paper has been developed in order to resolve that problem.

3. Realization of the System

3.1 Analysis Flow Chart for RPC Signal

It is well known that RPC(rotating pan cake coil) has superior ability to detect the crack type defect. RPC has advantages to detect small cracks not caught by bobbin probes, to be sensitive to the primary water stress corrosion cracking(PWSCC), and to give information about the characteristics of defects. Therefore, the RPC test is used for the verification and confirmation. Various test techniques applying the RPC are used according the test scope and purpose. However, the analysis technique of the RPC is basically the same as that of the bobbin coil. The signal produced by the RPC can be expressed as graphics on the same principle as C-scan. Figure 1 shows the system flow chart for the RPC signal.

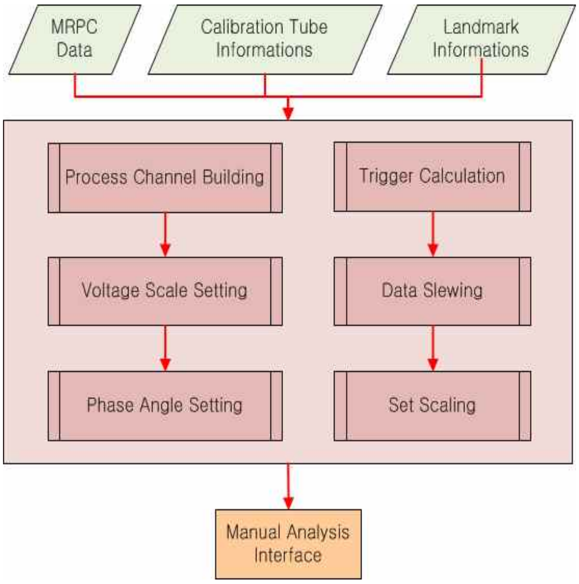

Fig. 1. SG ECT System Flow

3.2 Development of System

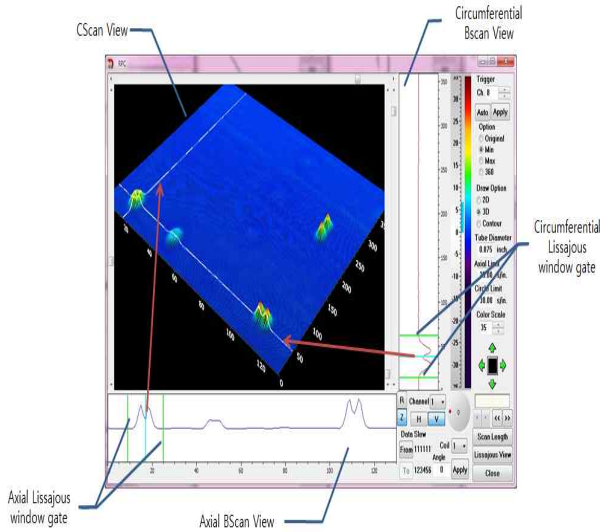

Fig. 2 Main Window

Figure 1 illustrates the main display of the system. Various functions of the system is shown in the main display. The displays loading principal functions are explained by follows:

3.2.1 Axial/Circumferential Lissajous Interface

The signal in a chosen range is illustrated as Lissajous type graphic in B-Scan display. The calibration and analysis can be conducted separating with the main Lissajous display.

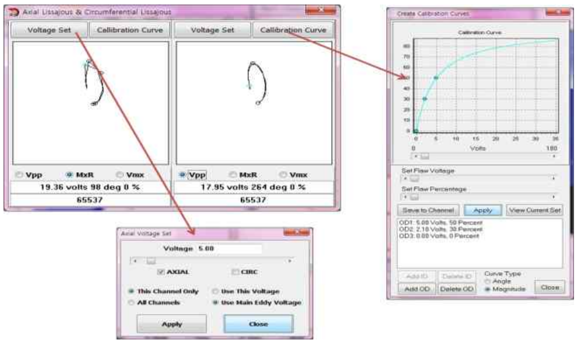

Fig. 3 Axial & Circumferential Lissajous

3.2.2 Contour Line Image

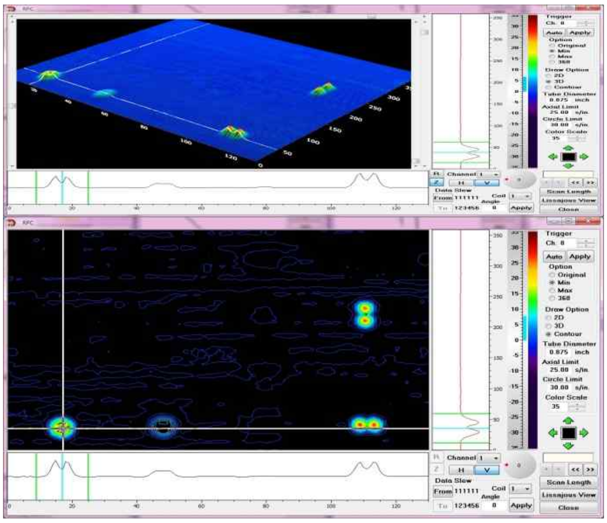

Fig. 4 Contour Line Image Lissajous

Figure 4 represents the contour line image Lissajous window. The defect size is easily measured even the display represents the contour line.

3.2.3 Flaw Sizing

The measuring the length of the defect estimated by 3.2.2 is explained by Figs. 5, 6 and 7. Press the measuring button after moving the gate bar to the starting point of the defect as shown by Fig. 5. After that, if the measuring button is pressed again at the end of the defect (Fig. 6), the length of defect is shown as in Fig. 7.

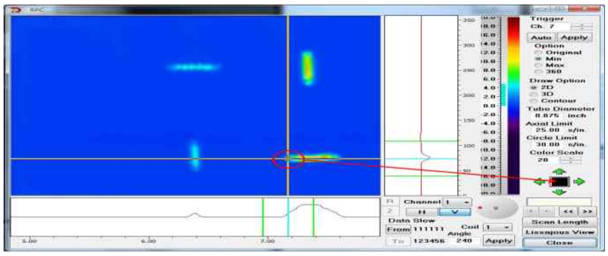

Fig. 5 Flaw Sizing-1

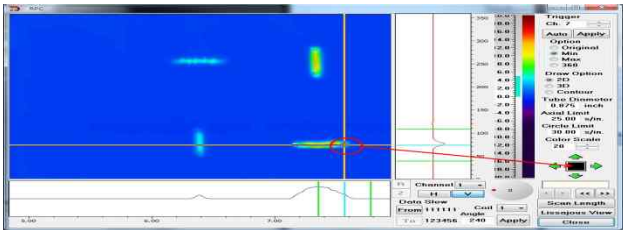

Fig. 6 Flaw Sizing-2

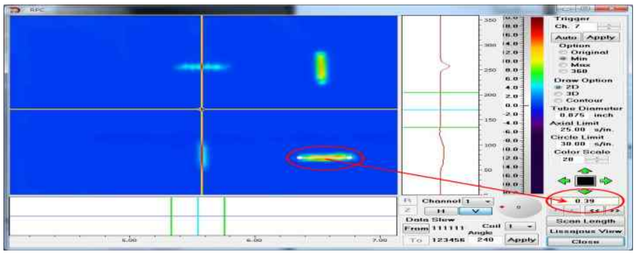

Fig. 7 Flaw Sizing-3

4. Conclusions

The system introduced in this paper can help the analyst judge to detect defects easily and precisely. The system has been developed by supplementing the existing system mapping 2D plane type and one color 3D surface type. The system is planned to be used in the PSI of Shin-Kori nuclear power plant unit 4.

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