Essential Variables for Reliability Improvement in Inspection of DMW

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1. Introduction

Currently, for the Korean performance demonstration (KPD) program of dissimilar metal weld (DMW) which has tapers, related research to detect the flaws in inspection volume is in progress. DMW is made especially for connect the carbon steel reactor pressure vessel to the stainless steel piping. Due to the effect of different materials, difficulties exist during in-service inspection for weldment integrity. One of them is high attenuation and scattering of ultrasonic beam resulting from the ferrite, austenitic steel, and weldment. To do so, it is necessary to understand the potential effects of a change for characteristics of essential variables in order to increase the resolution of acquired images. In this study, the values related to the setting of the essential parameters to improve the ability of the inspector to detect flaws[1].

Fig. 1. Picture of dissimilar metal weld

2. Inspection technique

The phased array ultrasonic testing (PAUT) is being used in nuclear power plant because of the benefits such as beam focusing and steering controlling the timing or phase of each segmented individual element[2].

The focal law of PAUT is a group of parameters such as probe/wedge setting, focal depth, and equipment connection during signal transmission and reception to focus the ultrasonic energy on desired position. In this study, in order to visualize difference in defect characteristics according to the change of the essential variables, the data evaluation was performed at the sectorial scan imaging.

3. Experimental setup

3.1. Description of equipment

The OmniScan MX 32:128PR phased array instrument was used for the signal acquisition. The instrument, phased array probe and wedge configurations selected are shown in Figure 2. For dissimilar metal welds, less than 2.5 MHz in longitudinal wave is most commonly used because of the resolution and penetration. It is used primarily for axial scanning for circumferentially oriented flaws. The number of data points for data processing of OmniScan is up to 8,000.

Fig. 2. Instrument for PAUT

3.2. Essential Variables

The quality and image resolution of the inspection will be impacted by the essential variables associated with the technique or procedure. The essential variables handled in this study are presented in the following table.

Table I: Essential variable list

	Essential variables	note
1	Focal depth	Law file
2	Compression	Instrument
3	Focusing type	Law file
4	Angular separation	Law file

For example, the advantage of compression is that the file size of acquisition data is substantially smaller. Each sectorial scan image is affected by the compression factor[3,4].

4. Results

4.1. Angular separation

The acquisition data changing the essential variables were evaluated by UltraVision3 3D. It is obvious that at value which is not suitable for applications, the images become abnormal and blocky. Therefore, the inspector

has to understand when higher angular resolution is needed as shown in Figure.3. For the distance of given metal path the distance between two beam center can be calculated. If the inspector wants to use the longer metal path, the angular resolution can become an issue.

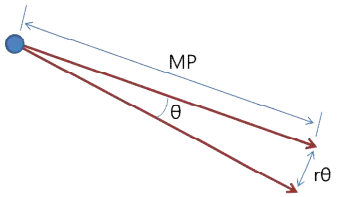

Fig. 3. Angular separation

4.2. Compression

The OmniScan MX digitizes a maximum of 8000 points for a scan data. The default point quantity of OmniScan MX is 320 for A-scan and it is changeable to 640 and auto. Actually, the compression varies proportionally followed by the point quantity. Since most of inspectors do not change the point quantity from the default values, this variable can impact on image resolution.

5. Conclusion

This research aimed to improve the resolution of flaws image for accurate depth sizing in inspection volume adjacent to the dissimilar metal welds. It is expected that optimal essential variables will increase the reliability of the defect evaluation results. Finally, the setting that satisfies the code or standard is required since the quality of the flaw is related to the data acquisition and processing speed according to the data size.

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