Round Robin Test for Performance Demonstration System of Ultrasound Examination Personnel in Nuclear Power Plants

Young Ho Kim, Seung Han Yang, Yong Sik Kim, Byung Sik Yoon, Hee Jong Lee
Korea Electric Power Research Institute (KEPRI), 103-16, Munji-Dong, Yuseong-Gu, Daejeon, 305-380, Korea
advanced@kepri.re.kr

1. Introduction

Ultrasound testing performance during in-service inspection for the main components of NPPs is strongly affected by each examination person. Therefore, ASME established a more strict qualification requirement in Sec. XI Appendix VIII for the ultrasound testing personnel in nuclear power plants. The Korean Performance Demonstration (KPD) System according to the ASME code for the ultrasonic testing personnel, equipments, and procedures to apply to the Class 1 and 2 piping ultrasound examination of nuclear power plants in Korea was established. And a round robin test was conducted in order to verify the effectiveness of PD method by comparing the examination results from the method of Performance Demonstration (PD) and a traditional ASME code dB-drop method. The round robin test shows that the reliability of the PD method is better than that of the dB-drop method. As a result, application of the PD method to the in-service inspection of the nuclear power plants will improve the performance of ultrasound testing.

2. Methods and Results

6 persons from 3 ISI vendors participated in round robin test. 2 persons from each company are composed of who has more than 100 months experience in field and who has less than 100 months experience. Test was done by below sequence.

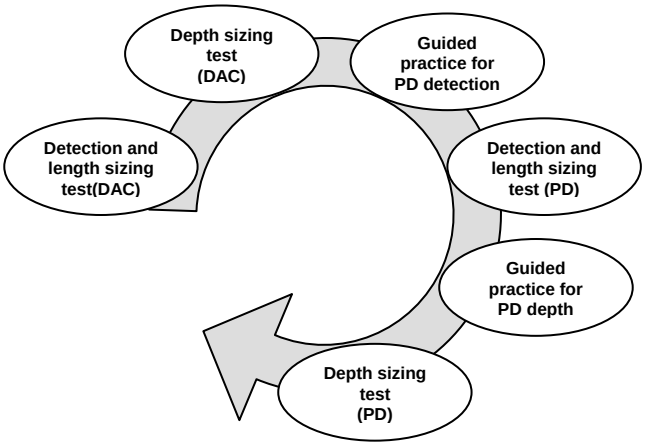

Fig. 1 Flow chart for round robin test

2.1. Test Specimen

Test specimens for detection and length sizing were composed of 7 austenitic piping and 4 ferritic piping. These 11 specimens contained 7 thermal fatigue cracks and 5 mechanical fatigue cracks in view of flaw type and 11 circumferential cracks and 1 axial crack in view of flaw orientation. 6 wide weld crown, 6 counterbore and 2 cladding conditions were included in these samples for geometry limitation. Below table shows length distribution in samples.

Table 1. Flaw length distribution

Length of flaw	Number
1.0″ ~ 2.0″	3 flaws
2.0″ ~ 3.0″	3 flaws
3.0″ ~ 4.0″	1 flaws
Greater than 4.0″	5 flaws

Test specimens for depth sizing were composed of 4 austenitic piping and 4 ferritic piping. These 8 samples contained 4 thermal fatigue cracks and 4 mechanical fatigue cracks in view of flaw type and all flaws were circumferential cracks. 5 counterbore and 2 cladding conditions were included in these samples for geometry conditions and all samples are flat topped. Below table shows depth distribution in samples.

Table 2. Flaw depth distribution

Depth of flaw	Number
0 ~ 30% of thickness	2 flaws
30 ~ 60% of thickness	4 flaws
60 ~ 100% of thickness	2 flaws

2.2. Round Robin Test Results

The length sizing of DAC method uses 6 dB drop method; Adjust the signal response from the flaw indication to 80% FSH(Full Screen Height) and scan along the length of the flaw in each direction until the signal response reduced to 40% FSH. But the length sizing of PD method uses 12 dB drop method; Adjust the signal response from the flaw indication to 80% FSH(Full Screen Height) and scan along the length of the flaw in each direction until the signal response reduced to 20% FSH. From the fig. 2, the results of PD method are more precise than the results of DAC method and also fit to the ideal line.

The depth sizing of DAC method uses DAC curve but the depth sizing of PD method uses Absolute Time Arrival Technique (AATT) or Relative Time Arrival Technique (RATT). Both AATT and RATT relies upon obtaining a direct signal response from flaw tip. From the fig 3, the results of PD method are more precise than the results of DAC method.

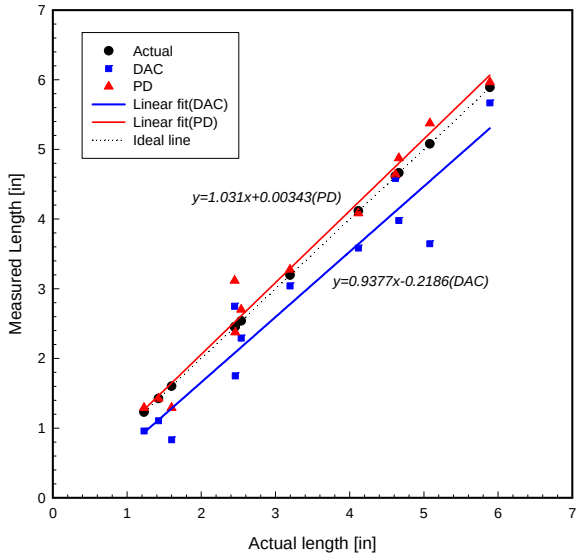

Fig. 2 Estimated flaw length comparison

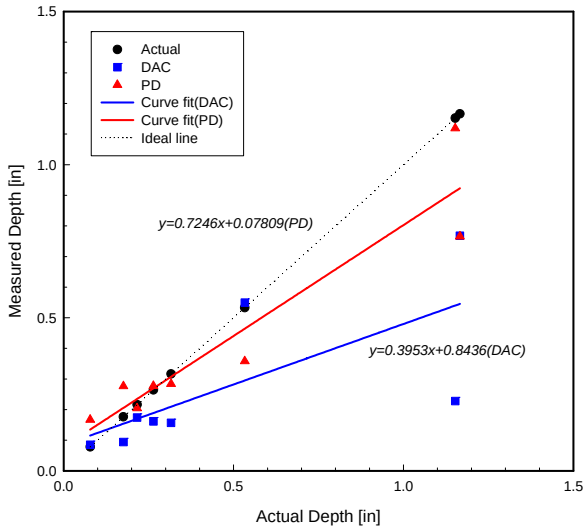

Fig. 3 Estimated flaw depth comparison

3. Conclusions

KEPRI and KHNP had been preparing KPD system to fulfill the performance demonstration requirements in ASME Sec. XI. Appendix VIII. Before the implementation of KPD system, round robin tests were conducted to evaluate the accuracy and reliability of examination result by comparing the result of DAC method and the result of PD method. The results of PD method are more precise and accurate than the DAC method in length sizing and depth sizing regardless of field experience and EPRI PD qualification status.

By the enforcement of performance demonstration for the domestic nuclear power plants the following results are expected.

- Improvement of the reliability of in-service inspection results
- Standardization of inspection due to the usage of standard non-destructive testing procedures
- Providing qualified inspection personnel steadily because the education and examination for the performance demonstration are conducted in Korea
- Improvement of the level of non-destructive testing techniques

References

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