Development of Leak Position Detection System Using Noise and Reflected Wave Remove Technique

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1. Introduction

Pipeline leakage in a nuclear power plant can cause not only environmental contamination but the public and occupational exposure. It is difficult to inspect damages or corrosion of pipelines because of the deeply and intricately buried construction. With increasing various concern and awareness for the social issues, development of the reliable leakage detection system of buried pipelines in a nuclear power plant is strongly in demand.

In this study, we developed the pipeline leakage detection system which adopts cross-correlation analysis method to provide the leakage locations among underground buried pipelines

2. Materials and Methods

2.1 Design and Construction

Developed system consists of acceleration sensors for detecting signal, data acquisition system (DAQ) for collecting analog signals, analog to digital converters (ADC) for translating analog electrical signals for data processing, cables for connecting sensors and signal acquisition modules, signal transmission module for transferring converted digital signal, analysis module for analyzing and confirming transferred digital signal, a rechargeable batteries for power supplying.

In particular, the developed leakage detection system is designed to resolve the issue with portability so as to be used for underground site where the pipelines are buried. Furthermore, high signal noise ratio (SNR) was established to allow the detection of a slight amount of leakage.

2.2 Development of Software

The measured signal analysis software was programed to graphic user interface (GUI) as it was shown in the Fig. 1. It is configured with information setting function, signal detection function, leakage signal analysis function, and data manage function. When the measured vibration signal is entered to the developed software, the signal analysis algorithm will be applied to assume the leakage location.

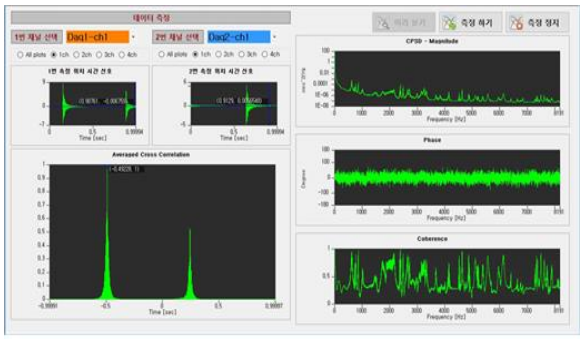

Fig. 1. Signal captured by the developed software under normal working condition.

Fig 2. Signal detection experiment using developed system (Korea Atomic Energy Research Institute, KAERI).

2.3 Leak Detection System Simulation

Practice test is performed using leakage simulation model constructed in Korea Atomic Energy Research Institute (KAERI) for performance evaluation.

3. Result and Discussion

In this study, leakage detection system is developed that can estimate the approximate location of buried pipelines in nuclear power plant.

Table 1. Result of leak detection experiemtn

Nozzle diameter (mm)	Detected location (m)	Difference (m)
2.5	18.48	-0.48
3.0	16.90	1.10
4.0	17.33	0.67
5.0	17.33	0.67
Average (m)	17.51	0.73

Table 1 shows the results of the detected location using developed system and the differences between actual and detected values. The average error in detection distance presented at 0.73 m, which included all the environmental errors and statistical errors due to the electrical noise.

In order to reduce influence of the environmental noise that can be appeared around the nuclear power plant, our group plans to apply the edge detection method into the adopted algorithm. It is expected to enhance the accuracy by applying advanced algorithm.

4. Conclusion

The newly developed leakage detection system based on signal detection technique has been presented. It is clear that ongoing project is successfully implemented by applying the time differences from reached signals to sensors. Thus, to provide accurate leakage location information, it is planned to carry out more practice test in various environment.

The results of this study will be applied to various facilities where safety needs to be secured related to complicated pipelines such as underground pipelines for water or gas.

Reference

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