

# Efficient Valve Inspection without Disassembly of Valves by Using Phased Array Sequence Scanning (PASS)

**PASS valve inspection and diagnosis system adopts the cutting edge ultrasonic technology to observe the internal components of valves**

Predictive maintenance technologies are essential for efficient and safe plant operation. PASS valve inspection and diagnosis system has been applied as a new inspection method, where advanced ultrasonic techniques powerfully supports predictive maintenance planning.



A Package of PASS valve inspection and diagnostic system

## **Nonintrusive test of valves**

Nuclear power plants have many valves to start, operate and shut down the reactor safely, and to mitigate the consequences of an accident. Check valve types are important and found throughout plant systems.

Check valves restrict the fluid flows inside pipes in only one direction. It automatically shuts off the reverse flow. In the U.S.A. the laws and regulations require periodic demonstration of the operational readiness of check valves installed in nuclear power plants. This is performed by verifying the

opening and closing functions. Therefore, actual valve data is acquired to assess operational condition of important internal components of the valve. These tests must be done by changing the flow rates and direction, even if the plants are in operating or in shutdown mode.

Currently, typical methods of nonintrusive tests for valves are acoustic emission, magnetics and radiography. In the acoustic emission method, contact noises from internal components impacting the body or seating areas are detected and analyzed. However, when the nonintrusive tests are judged to be ineffective due to the valves' characteristics,

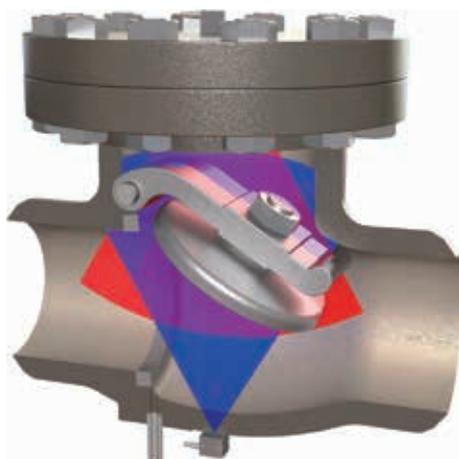


Image of acquiring PASS ultrasonic data

disassembly and visual inspections are carried out to verify the valve condition.

However, disassembly of valves brings considerable disadvantages in terms of time and cost. Particularly in nuclear power plants, disassembly and visual inspection require additional work such as installation of radiation shields, decontamination of the inside of the valves, and strict foreign material control. In addition, maintenance-induced failures such as incorrect reassembly add additional risk.

### Feature of PASS system

PASS (Phased Array Sequence Scanning) valve inspection and diagnostic system (hereinafter referred to as PASS system) is a state-of-the-art nonintrusive valve diagnostic system developed and patented by IHI Southwest Technologies, Inc. in Texas, the U.S.A. (hereinafter referred to as ISwT). ISwT has been offering a service of periodic inspections of pressure vessels, nozzles, and pipings in nuclear power plants mainly using phased array (PA) ultrasonic techniques. The service was offered to South America and Asia as well as the U.S.A. mostly. ISwT developed a particular PASS system for valve inspections based on the ultrasonic PA techniques obtained in those experiences.

The PASS system is installed in a compact portable case. It allows for efficient delivery and application to valves installed in power plants. Inspection data acquisition is carried out by attaching the ultrasound PA probe on the outside surface of a valve. This probe transmits ultrasonic waves through the body and bonnet, targeting key internal components. Ultrasonic waves are reflected and received by the probe. Time encoded data is acquired and analyzed. Furthermore, the flowmeter installed near the valve continuously records the flow rate and is correlated to the ultrasonic data.

### Advantages of PASS system

The ultrasonic data obtained from PASS systems is advantageous, i.e. more accurate and reliable, compared with data from other nonintrusive tests. As mentioned above, since

PASS system continuously accumulates ultrasonic and flow rate data, the system can measure the opening/closing speed and detect unusual dynamics of internal parts during operation. Because conventional acoustic emission methods and radiographic tests can only observe specific conditions of the valve such as fully opened/closed, they cannot detect such unusual dynamics. Therefore, such dynamic data is very useful for the trending and monitoring of the valves' operational readiness.

Importing PASS system data into PASS visualization software allows check valve engineers to interact with valve behavior in 3-D CAD. Advanced technical training is necessary to understand ultrasonic and flow rate data totally, but this software makes it easy for non-specialist users to understand valve conditions visually. This software has a database function that makes it possible to perform comparative data analysis from previous years. In addition, this software has a trend analysis function that helps to find unusual internal component dynamic in valves. These functions reduce the number of unnecessary disassembly tests and valve maintenance and provide data for efficient predictive maintenance planning.

### Future development

PASS system has already been used for nuclear power plants in the U.S.A. It is attracting attention as a new industrial standard of valve inspection technique substituting conventional nonintrusive tests.

In the future, we will increase the applicable system from check valves to other valves in order to realize more efficient plant management. In addition, we will also downsize the system and improve the portability and efficiency of data collection.

ISwT will continue to offer inspection services which support safe and secure plant management by applying our unique advanced ultrasound PA techniques.

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### Mini commentary

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Phased Array (PA) ultrasonic

It is a method of generating and receiving ultrasound waves and allows for steering and focusing of ultrasonic beams. Steering of the beams is generated by the use of multiple element probes and electronic time delays, thus creating constructive and destructive interferences.

Inquiries:

Sales Department,  
Nuclear Power Operations,  
IHI Corporation  
Phone: +81-45-759-2159  
Website: [www.ihico.jp/en/](http://www.ihico.jp/en/)

