

# Automated Fuel Inspection System Services

## Background

Westinghouse offers an automated, ultrasonic inspection system designed to non-destructively identify individual failed fuel rods within an irradiated fuel assembly. The Westinghouse automated fuel inspection system (AFIS) is an upgrade of the original ABB failed fuel rod detection system and has been in use since the early 1990s; however, a major upgrade was completed in 2006. The new system is designated as AFIS II.

## Description

The AFIS inspection is based on using ultrasonic pulses passing from a transmitter to a receiver. Transmitter and receiver crystals are attached to the inside surfaces of a two-fingered probe, which has been designed to be inserted into the fuel assembly through the water channels on either side of a row of fuel rods. The probe is normally inserted near the bottom of the fuel assembly above the first grid. The ultrasonic signal normally represents amplitude and signal travel time through the surrounding water. When a fuel rod is encountered, the signal transit time is reduced due to the increased propagation velocity of the ultrasonic waves through the metal cladding compared to the water. The presence of water within the fuel rod is indicated by changes in the amplitude and signal transit time of the ultrasonic pulse signal.

The amplitude of the signal also is reduced due to scattering of ultrasonic waves at the fuel rod-to-water interface. If the rod is defective, i.e., if it contains water, the amplitude of the signal is further reduced by the additional scattering caused by water inside the rod. Thus, failed fuel rods are usually readily detected by identifying the reduced amplitude of the transmitted signals.

## Equipment

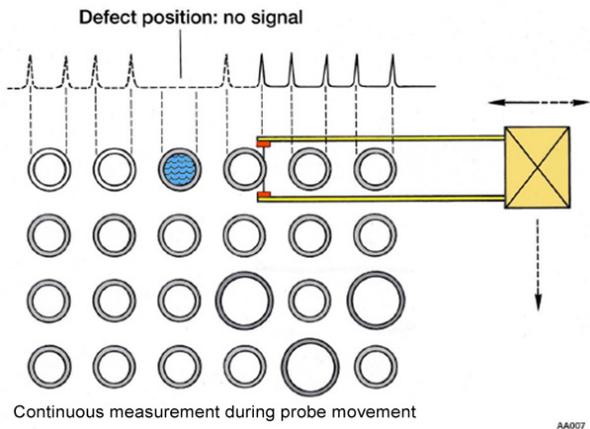
The AFIS consists of an ultrasonic probe, an underwater manipulator to deliver the probe to the fuel assembly, and electronic/ultrasonic controls for operating the system and capturing data.

The electronic/ultrasonic control system contains the ultrasonic testing instrument used for transmitting and receiving the signal from the transducer. In addition, it includes the data acquisition system and the motion controller.

The manipulator system for positioning the probe assembly rests atop the spent fuel storage racks. The fuel assembly remains suspended on the spent fuel handling tool for the duration of the inspection. The fuel assembly is raised or lowered to adjust the inspection elevation.

The underwater manipulator consists of a sealed box that contains a pair of synchronous motors, resolvers and lead screws used to provide precise X-Y positioning and control of the probe assembly. When the probe is fully extended, the probe tip extends completely through the fuel assembly. When the probe is fully retracted, the probe tip is outside the fuel assembly.

During an inspection, the probe is driven by the motion controller forward and back through each fuel rod channel. The probe is then advanced to the next channel of the fuel assembly, and the process is continued until all fuel rods have been inspected. Probe positioning is accomplished by two electric motors housed in the manipulator and controlled by the system motion controller. The total inspection time for a fuel assembly is approximately 15 minutes, including the time required for handling the fuel assembly.



Westinghouse AFIS II inspection process



AFIS II manipulator mounted in lift rig

## Benefits

The Westinghouse AFIS II system offers the following advantages.

- Provides real-time indication of failed fuel rods
- Allows fast, automated inspection (approximately five minutes for actual test)
- Requires no modification to plant equipment prior to use
- Design-for-use in the spent fuel pool allows for testing to be completed off outage



AFIS control console

Westinghouse Electric Company  
1000 Westinghouse Drive  
Cranberry Township, PA 16066

[www.westinghousenuclear.com](http://www.westinghousenuclear.com)