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AUTOMATED ULTRASONIC SCANNING OF FLAT PLATE NUCLEAR FUEL

Summary

Flat plate nuclear fuel is subject to at least two fabrication induced flaws which lend themselves to ultrasonic detection. This paper describes a production inspection system designed at the INEL that combines separate ultrasonic immersion techniques to detect thin cladding[1] and bonding of fuel to cladding. Clad thickness refers to the amount of aluminum cladding remaining over the fuel after hot rolling, while bonding refers to the quality of bond between the fuel and its aluminum matrix or cladding.

The cladding thickness measurement uses a unique 50 MHz transducer operating in pulse-echo mode to detect interfaces as close together as 0.15 mm in aluminum. The transducer is held to within $\pm$ 0.1 mm of a given position during high speed scanning by an electro-mechanical servo. The bonding measurement uses two transducers in a thru transmission configuration. A lack of bonding causes a significant loss of signal which is recognized as a flaw.

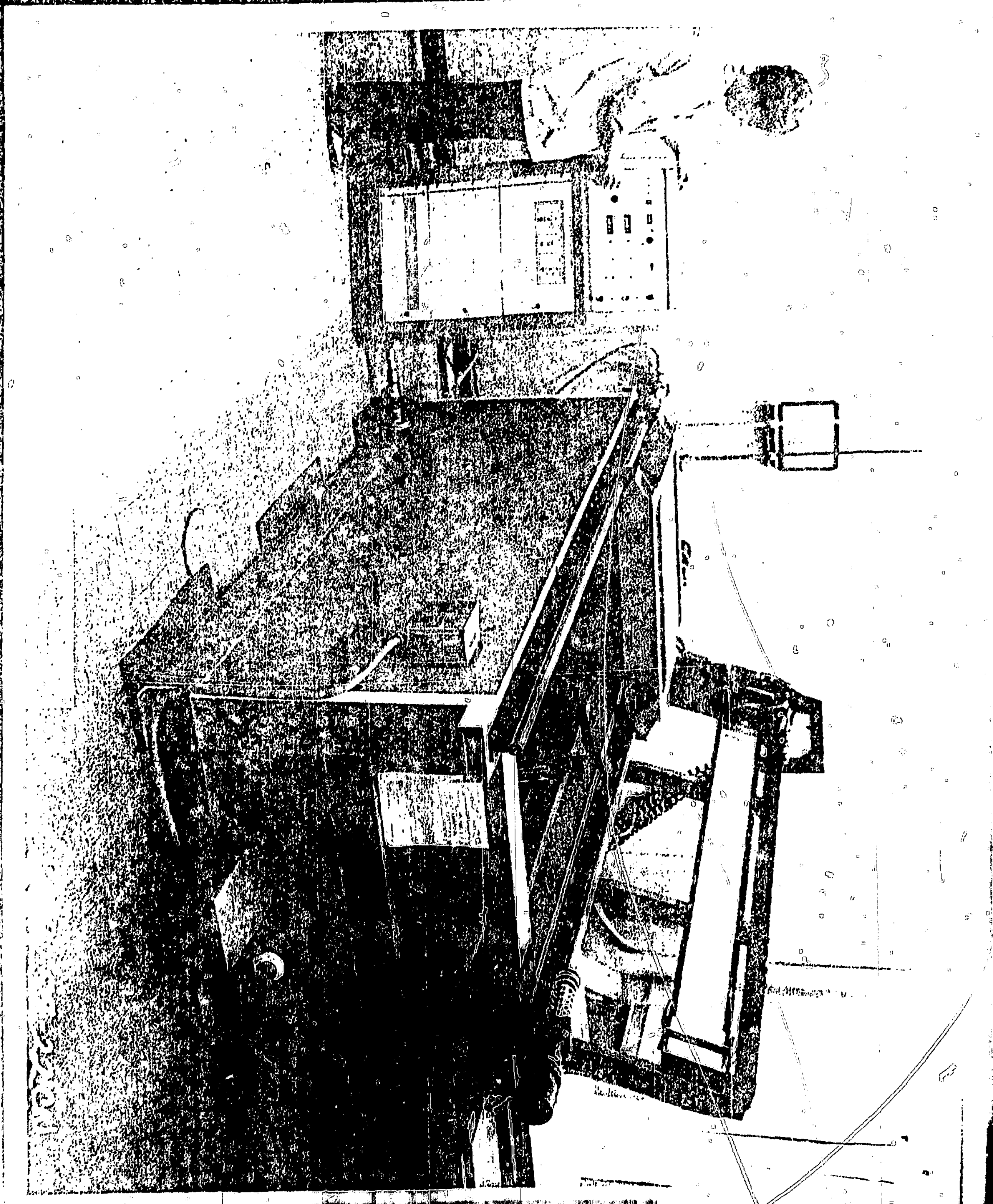
The entire system is configured for maximum through-put on the production line. Scanning speed is typically 1 meter per second with a constant velocity over 80% of the scan length. Inspection of the typical 7.6 cm by 127 cm fuel plate takes approximately 6 minutes. Data output is in C-scan format as well as a digital count of indications for the clad thickness measurement. The operator needs only to slide a fuel plate into the holding fixture, unroll fresh paper for the C-scan, and push a start button to initiate the inspection. Since the plate

is held on edge between two scanning heads the pulse-echo clad measurement is taken on both sides of the plate simultaneously so that each plate needs to be scanned only once. The combining of both clad and bond inspections into one operation represents a significant labor savings over the previous method requiring two separate inspections.

High reliability and modularity are important features of the system since down time affects the entire fuel production line. The majority of the electronics which represents the unusual instrumentation required for high resolution ultrasonics[2] [3] was configured from commercially available modules to allow most maintenance to be accomplished through replacement with spares. Modules are configured in a standard NIM or Tektronix TM-500 format for standardization.

This measurement system represent significant progress in high resolution ultrasonics in that fuel particles as small as 0.1 mm that are covered by as little as 0.15 mm of aluminum cladding can be reliably resolved in a high speed production environment. In addition the configuration of this equipment into a turn-key inspection system portends substantial labor savings.

1. C. R. Mikesell, Oral Presentation, ASNT Conference, Fall 1971
2. J. L. Rose and P. A. Meyer, Materials Evaluation, 12,249 (1974)
3. R. J. Botsco, Materials Evaluation, 4, 76 (1967)



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