
Project Title: Development of a Nondestructive Evaluation Technique for Automatic Inspection of Welds in DOE Standard Canisters

PI:

Dr. Salvatore Salamone, The University of Texas at Austin

Collaborators:

Dr. Mitch Pryor, The University of Texas at Austin
Dr. Elmar Eidelpe, INL

Program: Fuel Cycle

ABSTRACT:

The U.S. Department of Energy (DOE) created the National Spent Nuclear Fuel Program (NSNFP) to manage DOE's spent nuclear fuel (SNF). Packaging SNF usually is a three-step process: canister loading, closure welding, and closure weld verification. The prototype apparatus to perform these functions is currently under development at the Idaho National Laboratory (INL). After loading SNF into the canisters, the canisters must be seal welded and the welds verified using a combination of nondestructive testing (NDT) techniques, including visual, eddy current (EC), and phased array ultrasonic testing (PAUT). Typically, these techniques are time-consuming, since a point-by-point scan is needed to obtain information from a structure, because they only cover the localised area below or adjacent to the transducer. In addition, the interpretation of EC and PAUT results is very operator dependent largely due to the inherent uncertainties in measurements. In this project it is proposed a technology based on low-cost, low-profile piezoelectric transducers attached to the canister upper head assembly and body. These transducers are capable of transmitting and receiving helical guided ultrasonic waves (HG UW) across the circumferential weld joint. The crux of this proposal is to generate helical waves into the external surface of the canister, and detect their multiple echoes, generated from its cylindrical geometry, at a receiving transducer. Therefore, instead of monitoring only the direct path connecting two transducers (i.e., first echo arrival), multiple paths taken by each helical wave (i.e., late echo arrivals) can be monitored. The key advantages of the proposed HG UW-based monitoring technology include: (1) the ability to inspect the circumferential weld from only a few monitoring points, thus increasing the inspection cost effectiveness, (2) the ability to monitor simultaneously the entire circumferential area of the canister, (3) the increased sensitivity to many defects (e.g.: surface defects or volumetric defects such as lack of fusion) owing to the wave structure choice, (4) the capability to operate in a dual monitoring mode: i) quality assurance (i.e., inspect welds in real-time as they are being made), and ii) long-term monitoring (i.e., in-situ routine periodic inspections). The transducers will be left in place to provide continuous long-term monitoring of the canister