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PWR Individual Fuel Rod NDE Inspection – ALFRED

Progressive Technology to Meet Changing Industry Guidelines

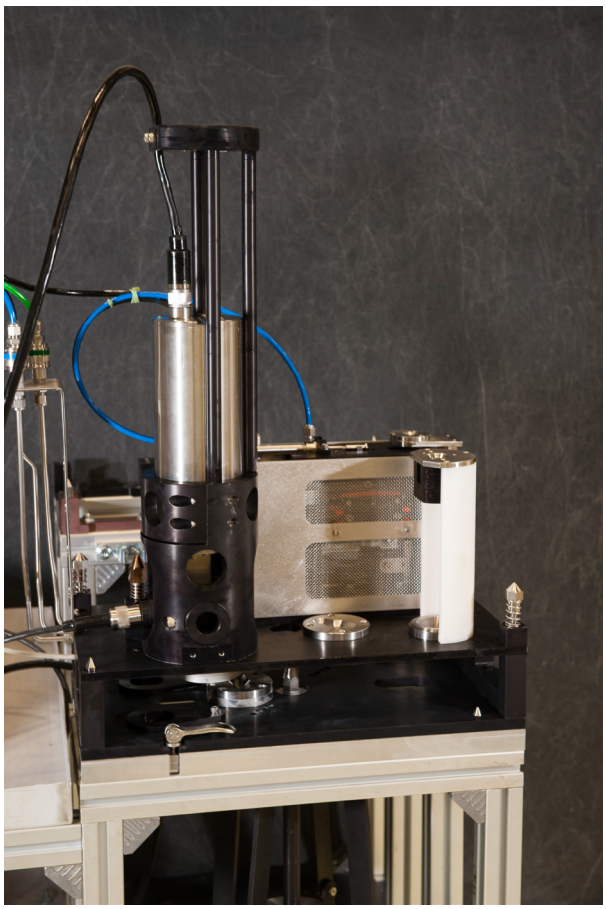
Nuclear fuel product performance monitoring is a key attribute to understanding operating reliability and safe operation. Monitoring tools for fuel performance cover a varying selection for the fuel structure, fuel rods and control components. The ALFRED system was developed to compile individual non-destructive fuel rod inspections into one station. This single point station comprises multiple inspection capabilities (visual, rod diameter, rod liftoff, encircling eddy current and crud sampling). This measurement package is used in parallel with the fuel disassembly/reassembly and fuel rod handling equipment systems to extract targeted fuel rods from the fuel assembly, safely manipulate the rods into ALFRED, and reposition back into the fuel assembly.

Multiple Inspection Measurement in a Single Station

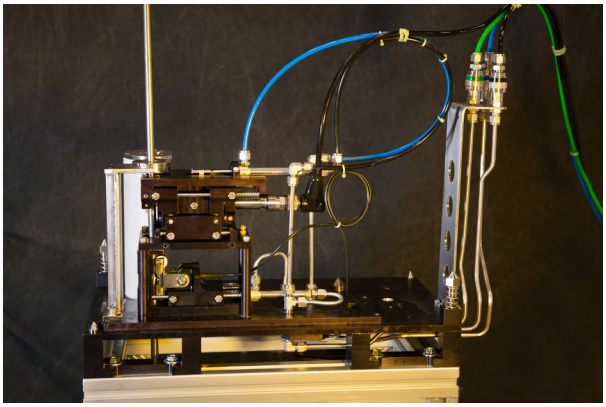
The visual inspection station is supported with, multi-focus high-radiation-tolerant color camera systems coupled to an axial-position monitoring instrument. These camera systems provide feedback of surface anomalies or regions of interest related to position in the fuel assembly or of neighboring operating structures that could interact with the fuel rod during operation. These systems are also electronically tied to digital recording systems that incorporate annotation capability to capture and document the individual fuel rod information and compile complete performance inspections onto redundant solid state hard drives.

The rod diameter inspection device incorporates a linear variable differential transformer (LVDT) coupled to two sapphire contact rods on floating arms that the fuel rod is passed through to acquire in either individual point measurements or axial scan measurements. Reference standards with a series of diameters are utilized to verify equipment in-performance operation. Multiple axial measurements can be acquired to evaluate the fuel rod performance as well as ovality at discrete locations.

The rod liftoff measurement device is utilized to measure cladding oxide and tenacious crud deposits on the fuel rod clad surface. A surface eddy current coil mounted in a spherical tip probe is utilized to measure the total liftoff of the probe from peripheral base metal clad surface. Measurements can be obtained in individual point measurement or axial scans over the fuel length of the fuel rod.



In-pool Measurement Station – shown on pool-side preparation stand



FME cover removed to display rod liftoff and rod diameter measurement heads

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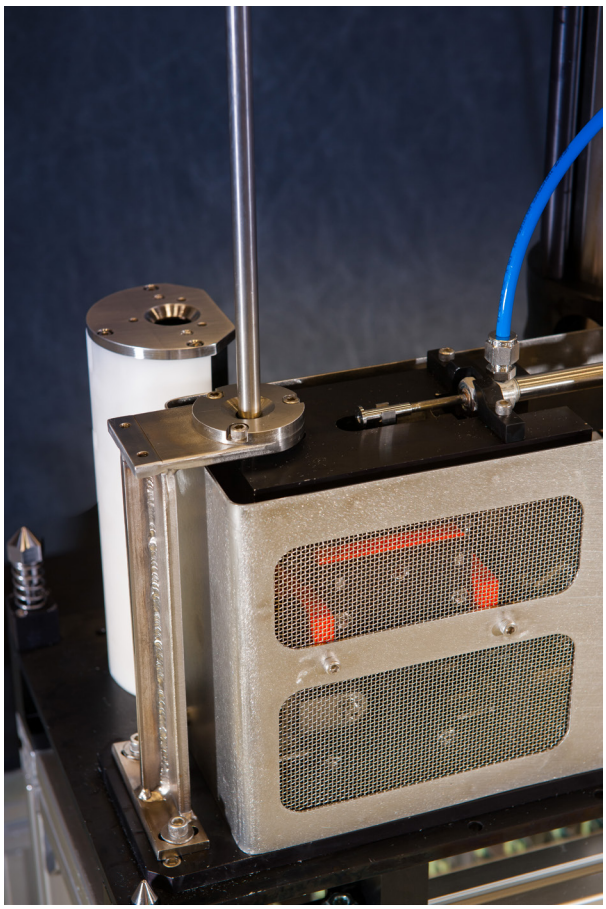
The encircling eddy current device is utilized to measure fuel rod clad thinning, cracking or inclusions initiating from the internal or external clad surfaces. This technique is used primarily during examinations where incore operating chemistry conditions challenge fuel performance or a fuel failure defect has been identified and a cause of failure inspection is required to locate the defect for investigation.

The crud sampling device is utilized to acquire crud deposit sampled from the clad surface in a controlled manner over a specified surface area. Crud samples are acquired to evaluate the effects of reactor chemistry operation and management on the fuel performance. The crud sample device is attached to the fuel rod via pneumatic fingers to isolate the sample area. The scraper device (blade, stone or brush) is extended and articulated over a controlled surface area. Displaced particulate is channeled to filter housing to a micron filter paper located poolside via control unit. The control unit manages the cycle time for sampling and controls the sample water through the filter media and back to the pool water inventory. At the completion of the control sample cycle, the sample filter media is removed and isolated into a sealed container, identified for tracking and placed into a poolside transport cask. Multiple samples can be accommodated in the cask for shipment to a lab for processing and analysis.



Fuel rod guides provide precise alignment with the fuel rod handling tools

Features and Benefits

- Innovative technology
- Single station for multiple rod exams
- Single station minimizes on-site interface
- Safety features to protect fuel rod integrity
- Measurement head encasement is foreign maternal exclusion (FME) compliant
- Centralized multi-measurement capability minimizes fuel rod handling

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