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Charles Ross WGISC EDF Energy

Pressuriser Replacement Heaters (New Design)

Following on from the Sizewell B forced outage last year, when the plant was off for 197 days as a result of primary coolant leakage from one of the Pressuriser Heater Well Inserts (HWI), all but 4 of the 78 pressuriser heaters were replaced with new Thermocoax heaters during the 2011 September/October outage. The 4 heater locations which have not been re-used and as such plugged, are those which have damaged HWI's (2 off) or the support plate has been cut during heater removal, meaning it can no longer accommodate new heaters (2 off). The new heaters were installed and welded with an automated Gas Tungsten Arc Welding system supplied by the repair vendor to minimise operator dose. All welding was satisfactorily carried out with no repair welding required.

The aforementioned leakage was caused by stress corrosion cracking (SCC) of the heater sheath with the resultant water causing swelling of the Magnesium Oxide (MgO) insulation. This resulted in deformation of the heater sheath and subsequent deformation and rupture of the HWI below the pressuriser. The leakage issue is discussed in the Westinghouse Technical Bulletin: "Pressuriser Heater Structural Failures" TB-11-8, Dated 28th July 2011.

The new heaters are based on a design which has been in use for many years, particularly in French PWRs. Improvements to address heater sheath SCC have been developed by EDF in collaboration with the manufacturers Thermocoax and a programme to install them in the French fleet is due to commence shortly. The key features of the new design, is that the heater sheath is heat treated after swaging in order to reduce high hardness and tensile residual stresses and modify the cold worked microstructure on the outer surface of the sheath. In addition there is a double stainless steel barrier around the heater element and MgO insulation, with a resultant large reduction in the amount of MgO required.

Risk-Informed ISI

It is widely recognised that operating experience has shown that degradation is typically not a random occurrence and the designed high stress locations may not be the same location as the failure event. With this operational experience, the industry has discovered locations susceptible to new degradation mechanisms and developed augmented programmes to supplement the deterministic ASME XI requirements. In short, Risk-Informed ISI has been an unquestionable success by targeting inspections to critical locations, whilst allowing utilities to decrease resources expended on "non risk" significant locations.

Despite the above benefits of Risk Informed ISI, Sizewell B continues to be outside industry best practice by not going down the risk informed route. This will be raised as a "significant issue" in the 20-year Periodic Safety Review.

European Project Development and Validation NDE of HDPE Pipework

In response to Regulatory concerns (on both sides of the Atlantic) on the lack of performance demonstration and capability of volumetric inspection techniques etc. EDF Energy joined a European Project on the development of an automated system for the NDE of HDPE pipework welds. In summary the objectives of the project are as below:

- To develop ultrasonic phased array NDE techniques for the inspection of welded joints (electro & butt fusion) in a range of HDPE pipe sizes NPS90 - NPS1000 mm.
- To determine the limits of detection for the above NDE techniques/pipe sizes.

- To determine critical defect sizes and contamination levels for the above pipe sizes and joint configurations
- To develop defect recognition and automatic defect sentencing software to allow the equipment to provide a pass/fail indication
- To assess the prototype NDT equipment in the field

The anticipated Project key deliverables will include:

- A new compact flaw detector with the ability to drive phased array probes in a harsh compact environment.
- An integrated scanner and phased array probes providing a mechanically rugged system.
- Novel data analysis and processing enabling the system to be used rapidly in the field by pipe laying technicians.
- Inspection procedure including flaw reporting criteria and flaw acceptance levels.
- Rugged phased array probe design that is adaptable for different pipe sizes and fitting geometries.
- Guidelines for application and operator training and certification leading to future standards.
- Training programmes in phased array inspection technology.

The Project has been split into 8 Work Packages (WP), these being:

WP1 - Project Specification

- Survey of needs in the plastic pipe industry based on range of pipe sizes, weld types, joint configurations, fittings etc.
- Preparation of functional specification for UT system – drive unit, transducers, manipulator & software.

WP2 – Manufacture of Welded Joints

- Development of flaw insertion procedures – planar flaws, particulate contamination, cold fusion (kissing bond) & under penetration.
- Manufacture of welded pipe samples for pipe sizes, weld types and joint configurations defined in WP1.
- Welded samples will contain known position, sizes, type and quantity to enable NDE assessment and development of acceptance criteria. A total of 180 weld samples will be required in order to cover weld types, pipe sizes, flaw types etc.
- Welded samples to include planar flaws, simulating fingerprints, oil, grease and rain droplets; fine particulates, simulating airborne dust; course particulates, simulating sand & dirt; by varying heat input cold fusion and under penetration.

WP3 – Development of NDE Techniques

- Measurement of basic ultrasonic material properties (to overcome very slow acoustic velocity and highly attenuative nature of materials)
- Development of inspection procedures for each weld geometry
- Inspection of welded samples produced under WP2.
- Design and manufacture of probe wedges
- Manufacture of probes
- Develop data analysis algorithms and software

WP4 – Develop Flaw Acceptance Criteria

- Mechanical testing of welded samples inspected under WP3. Results from these tests will be analysed for each different flaw type and compared with the results from tests on welds containing no deliberate flaws.
- The actual size of the flaws in the joints, as opposed to the size of flaw inserted into the joint prior to welding will be determined by sectioning a set of test samples.
- Graphs of flaw size/particulate contamination level against time-to-failure will be generated in order to calculate the critical sizes/level of defects for each pipe material, pipe size and joint type, that reduces long-term integrity of the weld. This information will be compared with the flaws detected using the prototype NDE equipment to enable the inspected weld to be accepted or rejected.

WP5 – Development of NDE Instrument (flaw detector)

- Design and development of “miniaturised” ultrasonic phased array NDE data acquisition and analysis system.
- The flaw detector to be robust enough to withstand dust, water etc.
- For larger pipes the flaw detector to be incorporated into the scanning system and for smaller pipes Ethernet connection to flaw detector outside of trench.
- Wi-Fi communication between flaw detector and remote computer to monitor the data acquisition and display data.

WP6 – Develop Scanning System

- Design & development of a modular system for scanning phased array probe (s) over the surface of welded joints allowing full 360 deg rotation around joint whilst providing detailed positional data and accommodating a wide range of pipe sizes and joint geometries.
- Robust system that can be used in trench
- System capable of carrying probes, wedges

WP7 – Assembly & Testing of Prototype Inspection System

- Complete NDE system, including flaw detector, probe (s) and scanning system will be assembled and assessed in the field by the end users in the project and other interested members of industry to evaluate the sensitivity, reproducibility and ease-of-use of the system.
- Validation of the system for the range of pipe sizes specified in WP1.
- Produce finalised inspection procedures for the range of pipe sizes specified in WP1
- For validation purposes, a series of pipe weld samples will be produced where the location and number of flaws are withheld, enabling their use for NDE operator blind trials. .

WP8 – Training & Dissemination

- Development of training guidelines
- Awareness events – seminars, conferences, workshops etc.
- Promotion – website, publications, newsletters etc.

Hinkley C (EPR) New Nuclear Build

The 31st October marked a key milestone in our nuclear new build plans, after EDF Energy delivered a Development Consent Order to the Infrastructure Planning Commission (IPC) to build and operate a new nuclear plant at Hinkley Point and to construct various associated developments in the surrounding area. The IPC is a Government body set up to look at large infrastructure projects e.g. airports, tunnels, nuclear power stations etc.

The IPC now has up to 28 days to decide whether or not to accept the submission. If accepted, the submission then becomes a live application. Until then, EDF Energy remains available to provide the IPC with any clarification that might be necessary.

The IPC will only publish the application documents after the application has been formally accepted. Acceptance of the application would signal the start of the IPC's examination process when people and organisations will have an opportunity to view the documentation, register their interest and make representations.

Also if the application is accepted by the IPC, EDF Energy would embark on a public information exercise, highlighting its proposals and explaining how to access the documentation and the next steps in the IPC process.

In parallel with the above, EDF Energy are progressing with the production of the site specific Pre-Construction Safety Report (PCSR) which should be issued in March/April 2012 and will support the issuance of the site licence, hopefully by the middle of 2012.