

OSART Good Practices

LONG TERM OPERATION

Review of ageing management and ageing management programmes, and revalidation of time limited ageing analyses

Mühleberg, Switzerland

Mission Date; 8-25 Oct., 2012

The KKM plant has developed a comprehensive strategy to manage the core shroud cracking issue and allow long term operation. The strategy includes chemical treatment of the reactor water, improved ultrasonic inspection tooling, analytical modelling, and the future optimization of the tie-rod design.

- The plant is an industry leader for on-line noble metal chemical addition (OLNC). Previously, the plant added the noble metal annually and injected a low rate of hydrogen in the reactor water continuously. However, evidence suggests the on-line OLNC process, in conjunction with the same low rate of hydrogen addition, better protects the shroud and other core internals. Pool side inspections of fuel and careful monitoring of this chemical addition has confirmed there is not a detrimental impact on fuel performance. In addition, reduced injection rates of hydrogen reduce plant dose during power operation.
- Plant personnel have worked with industry experts to refine inspections on the core shroud welds. For example, while ultrasonic testing (UT) inspections on the shroud welds have been performed for years, improved tooling allows for better weld coverage and accuracy. The UT data on the crack growth in welds is very comprehensive.
- Detailed three dimensional finite element analytical models of the shroud and supporting reactor structures are used to provide a structural assessment of the cracked core shroud. The modelling, coupled with conservative input assumptions and accurate crack measurements, quantify available structural margin. The results of the assessment verify the shroud has adequate design margins, even for extremely unlikely accident scenarios.
- The utility plans to add further design margin in the future to support long term operation. In the mid-1990's, the shroud was strengthened by adding four stabilizers or "tie rods" to the original design. The new design will replace the four existing tie rods with six tie rods of an improved design.

The actions completed to date, in combination with a future design change, provide a comprehensive short and long-term strategy for the KKM core shroud. Plant personnel will continue on-line OLNC, visual and ultrasonic inspections, and detailed analytical fracture mechanics modelling. These actions ensure current operation is safe and adequate margin exists for unlikely postulated accidents. The new tie-rod design, after installation, will increase design margin further and possibly allow reductions in the scope of visual and ultrasonic inspections.

PAMS - Piping and Component analysis and monitoring system

Revalidation of time limited ageing analyses (TLAAs) for LTO is a challenging issue for all NPPs. Fatigue analyses of mechanical components are very important for safety aspects, and are related to such activities as in-service inspection of pipelines. They are however very resource demanding activities, concerning input data, visualization and modelling, and fatigue and crack growth analyses. Data management of the inputs and results are the basis for maintaining TLAA validity. The PAMS system supports all activities of Class1 piping fatigue analyses revalidation in an effective manner, giving the possibility to renew and maintain the validity of all requested fatigue TLAAs of Class1 piping.

The PAMS system consists of:

- Linked databases with the geometry of piping and supporting structures, sections, boundary conditions, material properties and loading. Loading means basic load cases (thermal, pressure, hydraulic, spectra, transients and time histories), loading combinations, transients and number of fatigue cycles.
- A document database with source references linked to nearly all of the above information.
- Input, editing, visualization and animation modules.
- User configurable interface modules to generate input files with automatically incorporated source references for application programs and to return data into the result database. Both the data in the original database and the results database can be used as input for application programs, e.g. loading analysis with Relap5, Piping and support analysis with FPIPE, fatigue analysis with the NB3650M program, crack growth analysis, RI-ISI analysis etc.
- A report generator that automatically generates nearly complete reports.

The final aim of the work is to perform sequentially coupled analyses using appropriate application programs. For special purposes more programs are developed.

Using purpose-developed modules, the system has been used to visually and logically check the transient piping load applied in a large project. Input data was made for analysis of stand-alone piping, piping-inclusive support structures and combined into a dynamic building analysis. A large deterministic RI-ISI project was performed with a purpose-made integrated software module.

As results are read back into the results database and automatically linked to the original database contents, they can be used for subsequent analysis and/or documentation.

The PAMS system has now been taken into use with both commercial software and special purpose tailor-made programs. As the same data is used for different projects and with different sub-suppliers, the reliability of the data increases continuously.

Almaraz 2, Spain

Mission Date; 5-22 Feb., 2018

Action for resolution issues identified during the review of Ageing Management Programmes (AMPs) and Time Limited Ageing Analyses (TLAAs)

The environmental qualification (EQ) programme has been implemented since the start-up of the plant. The requirements for maintaining the environmental qualification of components are addressed and the documentation is complete and traceable. Maintenance work orders have been monitored for EQ compliance and performance has steadily improved over the years. The plant is currently sustaining the initial qualification, and has also begun to work on life time extension, since the plant is approaching 40 years of operation. All EQ equipment was assessed generically to EQ bounding conditions. In addition, results from Time Limited Ageing Analysis (TLAA) revalidation, the plant implemented an environmental monitoring programme, this involved the installation of temperature monitors where needed to record the actual temperatures in locations associated with EQ equipment. This will provide supplemental location-specific data to demonstrate EQ compliance.

Benefit

This action continues to provide to the plant the input data for recalculating the remaining life of the EQ components ensuring the safety function is not jeopardized.