ABSTRACT

The Code Case N-722 will be implemented at the Spanish PWR plants during 2009. The objective of this paper is to describe the methodology and equipment that Tecnatom is preparing for the implementation of the examinations in the Spanish RPV affected and the possible schedule for this implementation.

There are different solutions for the implementation of the Code Case:

- To perform the visual examinations according the Code Case.
- To perform ultrasonic examination of the affected area.
- To apply any kind of mitigative measures, such as weld overlay processes or stress improvement.

Depending on the different configuration of each reactor vessel, TECNATOM is preparing different equipment and technologies of inspection that affect as less as possible the duration of the outage:

- Visual examinations methodology that impact as less as possible in time and dose during the outages. These visual examinations should help to improve the information for future ultrasonic examinations and/or mitigations.
- Mechanical equipment that could be used for UT, ET or VT examinations from inside the vessel, with low impact in the normal refuelling tasks: TENIS equipment for nozzle to pipe weld inspections and PIV equipment for BMIP inspections. Both equipment could be used for inspections with the lower internals in vessel (only access to the hot nozzles). These equipment and techniques must be ready for use, during the plants normal outages, for the case of detection of possible indications of leakages during the visual inspections.

TENIS system is a compact and light-weight tool (0 Kg. underwater) that can be introduced in the nozzles using poles from the refuelling bridge, it can support up to 16 probes (UT and ET) and includes a set of cameras for VT. It was used with success in the inspection of three outlet nozzles in Vandellós 2 NPP in 2002.

PIV system is a device with an external geometry similar to one fuel element, it can be introduced through the core plate (lower internals in place) and has the inspection end-effectors motorised for doing the different scans needed to cover the inspection area from inside the penetrations. It was used with success in the inspection of BMI in Jose Cabrera NPP in 1997.

INTRODUCTION

At present, the obligatory document for the Spanish NPP’s is Code Case N-722, which establishes the need to visually inspect the areas involved under bare metal conditions. It is expected that these requirements might be modified in the future (e.g. Code Case N-770 to be published by the ASME) and that it will be necessary to carry out also ultrasonic inspections whose frequency will depend on whether or not mitigation activities, similar to those that are already being performed at similar plants in the USA, are implemented. In Spain the inspection techniques are being developed through the GRUVAL project.

TECNATOM and the affected Spanish Plants have carried out a study of possible equipment needs, in order to address these possible changes in requirements in a planned manner, as described below.
DESCRIPTION

First step

The first step is to use the visual inspections to be performed during forthcoming outages to obtain data for future interventions using the equipment required for inspections by means of ultrasonic techniques. With this aim in mind, permanent records of the visual inspections will be drawn up and measurements will be made of the profiles and spaces available for the assembly of the automatic equipment for future ultrasonic inspections. The dose rate in the areas in question is another important issue for these future inspections.

Remote operated vehicles will be used for these visual inspections (see examples in Figure 1).

Second step

The second step is to modify and/or fine tune the equipment available for the performance of automatic inspections in the affected areas.

TECNATOM currently has equipment that has been used in similar inspections in the affected areas and that, with slight modifications, will be available in the short term:

1.- Inspection of welds at vessel nozzle connections (from the ID): TENIS equipment, used for the first time for inspection of the hot leg nozzles at Vandellòs 2 NPP in 2002. The modification to be made to this equipment would consist of adapting it for cold leg nozzle inspections (see Figure 2).
TENIS system is a compact and light-weight tool (0 Kg, underwater) that can be introduced in the nozzles using poles from the refuelling bridge, it can support up to 16 probes (UT and ET) and includes a set of cameras for VT.

The inspection of RPV hot legs has a low impact in the outage: less than 9 hours in vessel time with lower internals in place.

The inspection of RPV cold legs needs to be appropriated scheduled: lower internals should be removed.

2.- Inspection of welds at vessel nozzle connections (from the OD): pipe scanner equipment, standard item of equipment for the inspection of the OD of similar sized piping (see Figure 3). The modification to be made to this equipment would consist of adapting it to each of the different exterior geometries of the nozzle welds.

Inspections with this equipment have no impact in the in-vessel tasks, but have the following disadvantages:

- Dose rate has to be taking into account.
- No good accesses to the areas at some plants.
- Limitations for complete coverage in some plants (see Figure 4).
3.- Inspection of vessel bottom penetration welds: PIV equipment used for the first time for BMI inspections at José Cabrera NPP in 1997. The modification to be made to this equipment is adaptation of the inspection header for the different configurations of the vessel bottom penetrations.

PIV system is a device with a external geometry similar to one fuel element, it can be introduced through the core plate (lower internals in place) and has the inspection end-effectors motorised for doing the different scans needed to cover the inspection area from inside the penetrations (see Figure 5).
The third step consists of planning the inspections to be performed, taking into account the specific situation of the standard ASME inspections scheduled for period in question, in order to cause the least possible impact during refuelling outages.

CONCLUSIONS

In order to reduce the impact of future more restricted examinations at the affected areas, it should be considered the different possibilities at each plant&RPV:

- When access from OD to the welds is feasible: use the performed visual examinations, ALARA topics, examination coverage issues.
- For plants with limited accessibility from OD: schedule the ID inspections during specific outages where the impact should be the less; as stated before, low impact for hot legs and BMI, significant for cold legs.