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Regulatory Challenges: Unique Approaches

The nuclear power plant periodic safety reviews

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Break out session T 11: Regulatory Challenges: Unique Approaches

The nuclear power plant periodic safety reviews

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The safety of a nuclear facility depends on a safety analysis performed at the outset, which demonstrates that the facility meets the safety requirements fixed for it. This initial safety analysis does however need to be periodically reviewed, for two main reasons. The first is that the facility evolves: it can be modified, deviations can occur at construction, and the effects of ageing can lead to deterioration. The second is that the safety requirements themselves change, as the ASN considers that safety requirements must keep pace with technical change and accumulated experience, and that what may have been felt to be acceptable at a given time may no longer be acceptable later on.

The purpose of the periodic safety reviews is therefore to reconsider the original safety demonstration and on the one hand to check that the installations are still in conformity with the initial requirements fixed for them and on the other to raise and improve their level of safety. The periodic safety reviews are thus of prime importance, both to detect any conformity deviations and ensure that ageing phenomena are controlled, and to improve the safety of the installations, through a realistic risk reduction approach. The periodic safety review takes place over several years and demands considerable resources on the part of the operator, but also on the part of the ASN and its technical support organisation, the IRSN.

For the power reactors, for which the safety review is to a large extent conducted simultaneously on all the reactors in the same series, several major milestones were reached in 2002: the conclusion of the periodic safety review of the 900 MW reactors after 20 years of operation, definition of the safety reference system and objectives for the periodic safety review of the 1300 MW reactors, and the beginning of the periodic safety review for the 900 MW reactors, with a view to their third ten-yearly inspection.

The periodic safety review process

The general process for the periodic safety reviews involves a two-fold comparison.

- Comparison of the condition of the installations with their design reference, taking account of any changes made since they were built: this is the **conformity check**.

The conformity check, as carried out in France on the power reactors, is of a scale unique in the world. The conformity check performed on the 900 and 1300 MW reactors includes inter alia a check on the conformity of the measures to protect against external hazards, including extreme weather conditions and seismic activity, and against internal hazards such as high energy pipe breaks, or a check on the ability of the equipment to function in degraded conditions (known as qualification for accident conditions). A "program of additional investigations" was also defined, to check those parts of the installation which are not covered by maintenance programs, such as certain portions of piping or tanks which are inaccessible during normal operation.

Each reactor is thus subject to in-depth review and any anomalies are recorded, with the aim of ensuring that the reactors are in conformity with their design, no later than during the ten-yearly inspection. For anomalies with a strong safety stake, the ASN can nonetheless set shorter times to restore conformity.

- Comparison of the level of installation safety with that required for the latest reactors, examination of the consequences of retroactive application of the most recent safety rules, comparison with best international practices and taking account of the lessons learned from reactor operation: this is the **safety reassessment**.

The ASN asks the operator to examine the consequences of implementing stricter safety requirements and, whenever feasible, to propose modifying the plants. These modifications are generally made during the reactor ten-yearly inspections which, for a given plant series, can extend over about ten years.

To this must be added measures which strictly speaking in France are not within the remit of the periodic safety review, but which are guided by the same determination to verify conformity and bolster requirements: this in particular concerns the current revision to the plant effluent discharge authorisations and application of the ministerial order of 31 December 1999 concerning protection of the environment.

After the periodic safety review, the ASN decides on whether or not reactor operations can continue until the next ten-yearly inspection.

Conclusion of the 20 year periodic safety review on the 900 MW reactors

This review was begun in 1987 for the Fessenheim and Bugey reactors and in 1990 for the other 900 MW reactors. Initially, until 1995, the aim was to ensure a uniform level of safety for all the 900 MW reactors: a number of design changes were defined for the older plants, those of Fessenheim and Bugey, so that they can now be considered as having the same level of safety as the other 900 MW reactors.

A broad-ranging conformity check led to the detection and correction of non-conformities, in particular concerning the seismic resistance of components and their qualification for accident conditions.

The reassessment approach was based on a comparison between the 900 MW reactors and the 1300 MW reactors and the more recent N4 plant series. Probabilistic safety assessments were used to highlight failure scenarios the importance of which had hitherto been underestimated. Several modifications designed to improve safety were felt to be necessary by the ASN: for example, the addition of heating to guarantee equipment operation in particularly cold weather, or improved reliability of certain safety-related systems, such as the steam generator auxiliary feedwater system, the ventilation systems or the back-up turbine generator.

This review led to a significant improvement in the level of safety of the reactors concerned. After the exercise was completed, the ASN approved a new standard safety analysis report for these reactors and gave a green light for continued operation until the third ten-yearly inspection.

The 20 year periodic safety review for the 1300 MW reactors

This review began in 1997. The conformity check, for which the program includes all checks performed on the 900 MW reactors, is currently being carried out on these reactors.

The safety reassessment is conducted with reference to current requirements for the N4 plant series reactors. In 2002, the ASN consulted its Advisory Committee for nuclear reactors concerning the validity of the engineering studies conducted by EDF, and in particular considered that the new method for calculating the radiological consequences of the design-basis accidents proposed by EDF could not be accepted as they stood.

A large part of the modifications resulting from the reassessment has already been defined. They will be implemented on the 1300 MW reactors as of 2005.

Initiation of the 30-year periodic safety review for the 900 MW reactors

Initial technical discussions began in the autumn of 2002, between the ASN, IRSN and EDF to define the content of the 900 MW reactor periodic safety review for the third ten-yearly inspection, scheduled as of 2008.

As compared with the previous reassessments, this one will comprise a larger part devoted to ageing and it is during the third ten-yearly inspections that the ASN will look particularly closely at EDF's ability to manage the effects of ageing, both technically and in terms of maintaining skills. The ASN thus asked EDF to submit a program of work, but delays in forwarding the relevant documents mean that the ASN is concerned as to whether the resources committed to this work by EDF are commensurate with the targets EDF has set for itself, that is, a life of at least 40 years for the reactors as a whole, and sometimes more for all or part of them.

In terms of re-assessment, the ASN considers that ambitious goals must be set, given that the new safety requirements to be defined will remain valid until the most recent of the 900 MW reactors, Chinon B4, undergoes its fourth ten-yearly inspection in 2027. Consequently, the ASN feels that it is necessary, as part of this reassessment, to examine the possibility and indeed the benefits of transposing to the 900 MW reactors some of the improvements proposed for the EPR future reactor project. The ASN decided to consult its Advisory Committee for nuclear reactors in mid-2003 to obtain their opinion on the technical scope to be covered, and the level of requirements to be adopted, topic by topic, for the safety reassessment. The ASN will pay particular attention to ensuring that the best international practices are taken into consideration.