

**Taking into account Fukushima Daiichi nuclear accident experience feedback:
contribution from IRSN**

Benjamin Richard¹, Naoelle Matahari², Patrick Lejuste³

Context

The Fukushima Daiichi nuclear accident occurred on the 11th of March 2011 in Japan. It is now recognized it was the consequence from the combination of the Tohoku mega earthquake (magnitude $M_w = 9.0$) with the tsunami. In addition, it was classified as a major accident with a grade of 7 on the INES scale. In October 2011, the European commission asked the member states to carry out complementary safety studies (also called “stress tests”) to re-assess the nuclear safety of existing plants in case of extreme hazards. In December 2011, the French Authority for nuclear safety (ASN) produced guidelines to apply the principles stipulated by the European commission to the French nuclear fleet under operation. Early in 2012, IRSN raised up the concept of post-Fukushima hardened safety core in order to prevent nuclear accident in case of beyond designed loadings associated with extreme hazards, such as long return period earthquakes and to mitigate the consequences of a potential core fusion. The choice to put a given structure, system or component (SSC) within the hardened safety core was approved by the ASN after technical exchanges between EDF and IRSN, based upon a licensee’s proposal. Safety assessment of SSC being in the hardened safety core required a dedicated work and led to on site modifications, some of them not being fully implemented at the moment in all the sites but being associated to licensee’s commitments or ASN prescriptions.

The main objective of this presentation is to give an overview of the work done since 2011 in order to reassess and maintain nuclear safety of the EDF reactors. To reach this objective, the presentation will be outlined as follows. First, the EDF 4th periodic safety review (PSR) of 900 MWe pressurized water reactors (PWR) in France will be presented. The attention will be paid to both generic and specific phases of the 4th 900 MWe PSR. Second, on site modifications on the 900 MWe PWR fleet will be highlighted, some of them being the consequences of the stress tests. The experience feedback from the 4th 900 MWe PSR and from the stress tests showed that scientific locks appeared in a clear way and sometimes, may lead to difficulties to conclude on specific safety issues. As an example, because issues related to the management of ageing effects were not fully taken into account at the design stage, numerous international research and development (R&D) programs were started to improve knowledge related to various

scientific locks. This is why the presentation will end by some focuses on R&D programs in order to highlight ongoing and future works planned to maintain the highest safety level in the future.

¹ Head of the Structural Performance Modelling and Analysis Lab, IRSN, Fontenay-aux-Roses, France benjamin.richard@irsn.fr

² 4th 900 MWe periodic safety review project leader, IRSN, Fontenay-aux-Roses, France naoelle.mathari@irsn.fr

³ Post Fukushima project leader, IRSN, Fontenay-aux-Roses, France patrick.lejuste@irsn.fr