

**Report of the  
stress test peer review follow-up fact finding site visit  
to Sizewell B, United Kingdom, 11-12 September 2012**

## **1 INTRODUCTION**

In accordance with the action plan set out by ENSREG following the peer review of the stress tests, the fact finding team of four international experts visited the single-unit Sizewell B (SZB) nuclear power plant in UK. The objective being to exchange information with respect to measures to improve safety and to identify any lessons learned from implementation of these measures. Three representatives of the regulatory body (ONR) joined the team for the site visit. Sizewell B is a 1200 MWe PWR, based upon 4-loop Westinghouse design, placed in a large (90 000 m<sup>3</sup>) double dry containment. The plant was connected to the grid in 1995. The current plant licensee is EDF Nuclear Generation Ltd.

EDF in response to Fukushima and following ONR requirements shortly after the accident performed an assessment of the plant capabilities, established a dedicated Japan Event Response (JER) team and developed an action plan for safety enhancement of all their nuclear facilities in UK, including SZB.

The visit consisted of presentations delivered by ONR and EDF/SZB, describing the current status of the action plan for this site, followed by a site tour. The presentations were focused on site specific actions already implemented, planned or considered. The overall EDF approach concerning safety improvements of all their plants was also briefly discussed. A site tour was performed of those plant areas where modifications are being implemented or planned, in particular: containment water injection; filtered containment venting (FCV) including the intended location for the filter and the stack; the auxiliary shutdown room; the battery charging diesel generators (BCDGs); flood protection plans; tie-in points for back-up equipment connection to the refuelling water and condensate storage tanks and spent fuel storage pond dry riser; the emergency diesel generator (EDG) flood protection plans; and, the reserve ultimate heat sink flood protection plans.

## **2 ASSESSMENT RELATIVE TO EARTHQUAKES, FLOODING AND OTHER EXTREME WEATHER CONDITIONS**

The UK country report included several findings related to enhancement of plant resistance against extreme natural hazards. These findings are adequately addressed in the JER programme, in which 6 out of 9 major sets of actions (called “capabilities”) are devoted to external hazards, further subdivided into “withstand” and “recovery” capabilities.

Flooding and seismic issues are explicitly addressed in the capabilities, while remaining natural hazards are taken into account as “unknown beyond design events”. These “unknown” events should also cover extreme meteorological conditions (wind, extreme temperature) and the team suggests that more specific attention be devoted to these issues.

Flooding is taken into account through the consideration of a postulated 1 meter high site flooding to identify improvements, such as resilience to flooding of: the 4 emergency DGs; the reserve ultimate heat sink; the BCDGs; the auxiliary shutdown building; and, the steam driven steam generator auxiliary feed pumps. Earthquakes are addressed mainly through the seismic qualification of the new BCDGs and enhancing seismic protection of the fire station and fixed fire systems. In addition, new equipment for mitigation of severe accidents will be seismically resistant.

The consequential hazards from seismically induced flood or fire are recognized and under review. Possible updating of methodologies for assessment of seismic, flooding and extreme meteorological hazards, with evaluation of margins beyond the design basis and identification

of cliff edge effects is considered by ONR as a medium or long term action. Further consideration will be given to this in the next periodic safety review as appropriate.

The team noted active involvement of ONR in the development of the European guidance on natural hazards assessment by chairing WENRA T1 Group, as well as ONR's participation in all other WENRA groups in the post Fukushima task force.

### **3 ASSESSMENT RELATIVE TO LOSS OF ELECTRICAL POWER AND LOSS OF ULTIMATE HEAT SINK**

Although the UK peer review report identified several strong points relevant to this topic (availability of 4 EDGs, two steam driven emergency feedwater pumps, an alternate ultimate heat sink using forced air cooled heat exchangers for residual heat removal), there were also several potential improvements identified. These improvements were mainly devoted to strengthening of DC power supply, increasing stock of fuel for BCDGs, availability of hardened storage facilities for back-up equipment, and extra connection points for mobile equipment for power and water supply. The team noted that significant progress is being made to address the identified issues as part of the "capabilities", (in addition to already introduced enhanced resistance of certain essential equipment against earthquakes and flooding). Relevant measures include:

- Purchasing a range of mobile DGs
- Providing external connection points to electrical systems, including battery charging
- Replacing existing BCDGs with new units qualified against external hazards
- Providing easy connection points from water tanks to connect back-up equipment, and for injecting water into containment
- Installation of a feed line allowing high pressure feed of water to the steam generators from an external pump
- Consideration of improvements to gravity feed of the reactor vessel in case of station black-out during refuelling
- Spent fuel cooling during black-out by rise pipe from outside of the spent fuel building
- Installation of gas feed line to the exterior of the building to enable actuation of key valves controlling flow of coolant
- Constructing a new off-site seismically resistant emergency response centre as a central facility for coordinating and controlling emergency response activities, with large storage of emergency and back-up equipment (completion in December 2013)
- In addition to the SZB off-site emergency centre, establishment of three UK-wide regional storage facilities with additional back-up equipment, with locations selected based on calculated response time.

The plant recognizes the challenges associated with maintenance, coordination of use of mobile equipment during emergencies, and complexity of training programmes for the new equipment, and relevant procedures are under development.

### **4 ASSESSMENT RELATIVE TO SEVERE ACCIDENT MANAGEMENT**

In the area of accident management, the main issues identified for SZB in the peer review report were insufficient hardware provisions for protecting the containment integrity in case of a severe accident. During this plant visit very good progress was observed in all items addressing the issues, including

- Enhancement of reliability of the reactor coolant system depressurization capability
- Implementation of passive autocatalytic recombiners (PARs) to minimise the hydrogen risk (installation scheduled for the next outage in Spring 2013)

- Installation of FCV (completion in 3<sup>rd</sup> Q 2014)
- Enhancement of the corium cooling capability by adding a line for injecting water to the containment thus reducing risk of containment damage by molten corium
- Constructing a new off-site seismically resistant emergency response centre and of three UK-wide regional storage facilities
- Enhancement of plant monitoring capabilities for key parameters needed in case of beyond design basis accidents
- Enhancement of logistics for recovery from emergencies.

The plant is aware of the fact, that after implementation of the above listed hardware measures, it will be necessary to implement corresponding “software provisions” such as: updating of SAMGs for new plant configuration; considering accidents during shutdown regimes and in the spent fuel pool; validation, staff training and exercises of SAMGs; and, demonstrating the feasibility of SAMGs under harsh radiological situations and severely damaged infrastructure. Studies on the potential migration of hydrogen beyond where it is generated and the treatment of large volumes of contaminated water should be also considered.

## **5 CONCLUSIONS**

The follow-up plant visit observed that SZB has made good progress in the implementation of post-Fukushima improvements. Most recommendations of the stress test main report and UK country report are addressed or are in the process of being implemented. Several actions taken by the plant deserve the attention of other plants as good practices, in particular the hardened emergency response centre and prompt implementation of severe accident mitigation capabilities. ONR closely oversees the development of the action plan and its implementation. ONR is also active in implementation of the European level ENSREG recommendations by involvement in all working groups established by WENRA.

The SZB programme is already in an advanced stage of implementation with envisaged completion of all measures by 2014. All European level recommendations are adequately addressed as far as applicable for SZB. The procurement process for back-up equipment and vehicles is near completion. An ambitious programme of installation of hardware provisions has been established and its satisfactory progress was noted during the plant visit based on the SZB and ONR presentations, site tour and discussions.

It was also positively noted, that SZB is one of few plants with a comprehensive PSA Level 3 available and that EDF performs extensive independent safety analyses in support of the improvements as an essential component for demonstration of its prime responsibility for safety.

A major challenge for timely completion of planned works is availability of adequate plant internal manpower to implement the programme of modifications.

EDF and ONR should ensure that the ambitious JER programme is implemented in accordance with the established schedule. In addition, the team suggest that the plant should review its action plan by taking into account the ENSREG Compilation of Recommendations and Suggestions.