

# **National Progress Report on**

**“Stress Tests”**

**NPP Dukovany and NPP Temelín  
Czech Republic**

**Evaluation of Safety and Safety Margins  
in light of the accident at  
NPP Fukushima**

**State Office for Nuclear Safety  
Czech Republic**

## **Background**

The accident at the nuclear power plant Fukushima in Japan created the need in the EU to evaluate and assess the resilience of European nuclear power plants against extreme and very unlikely events for which these power plants might not be sufficiently equipped, because they were not taken into consideration in the original project designs. The aim of the stress tests is to determine the extent of existing safety margins and time intervals after which accidents become “severe accidents” with damaged fuel rods and with a large radioactive release into the surroundings. The content requirements for the reports were defined by the European Nuclear Safety Regulators Group (ENSREG) and the EU sent the corresponding requests to the member states on May 2th 2011. The requirements were also elaborated in detail in the form of a recommendation of the Chairman of WENRA, J. Laaksonen on July 17, 2011.

## **Work carried out**

Based on the written requirement of SÚJB (State Office of Nuclear Safety, SONS) of May 25<sup>th</sup> 2011, the licensee – ČEZ a.s. - of both nuclear power plants, Dukovany and Temelín, commenced the preparation of the stress tests reports on June 1<sup>st</sup> 2011. A special group was created for this purpose within the ČEZ production division comprising of specialists from both power plants.

The reports were prepared in several stages:

- 1<sup>st</sup> stage; information was collected from all relevant documents related to safety (safety reports, PSA studies, PSR documentation, rules for abnormal situations and accidents – EOP, SAMG and more). At the same time on-site walk down and checks of important systems and facilities were initiated to verify the actual status and persons were appointed to be responsible for the different parts of the report. Subsequently, the first version of the report on stress tests was prepared and it was assessed in terms of its correctness, completeness and objectivity.

- 2<sup>nd</sup> stage; a detailed evaluation and a summary of the report were prepared by expert departments of both power plants and the report was discussed by the Safety Committee of ČEZ a.s. Additionally, during this stage, information and experiences were exchanged with other operators of nuclear power plants and VVER.
- 3<sup>rd</sup> stage; experts from ÚJV Řež for safety gave their comments with an emphasis on the evaluation of severe accidents, and corrective measures were formulated with the aim of compensating for the identified risks and existing problems.

On August 8<sup>th</sup> 2011 reports on stress tests of NPP Dukovany and NPP Temelín

- Stress tests of NPP – assessment of the safety and safety margins of NPP Dukovany, considering experiences from the accident at NPP Fukushima
- Stress tests of NPP – assessment of the safety and safety margins of NPP Temelín, considering experiences from the accident at NPP Fukushima.

were approved by the Safety Committee of ČEZ a.s. On August 15<sup>th</sup> 2011 both reports were made accessible to the State Office for Nuclear Safety (SÚJB) for evaluation.

In connection with this, the SÚJB requested that Centrum výzkumu Řež s.r.o. (Research Center Řež), as a TSO, to provide preliminary evaluations of both reports and comments, which will be taken into consideration during the preparation of final versions by the authors of both reports in ČEZ a.s.

### **Brief evaluation of the submitted reports by SÚJB**

ČEZ a.s., as the owner and operator of nuclear power plants in the CR, carried out, based on instructions from SÚJB and in the sense of the request from the EU, this first preliminary

evaluation of NPP Dukovany and NPP Temelín. The results of this evaluation are summarized in two separate reports. Both reports in principle meet the requirement – they represent a targeted assessment of safety margins of the nuclear power plants Dukovany and Temelín, with respect to the events observed at the NPP Fukushima: failure of safety functions due to extreme external effects leading to a severe accident. These reports assess the current ability of the power plants and their personnel to cope with the consequences of extreme external events, in particular earthquake, floods and other natural disasters, which could potentially lead to failure of the safety functions – shutting down the reactor and keeping it in a subcritical state (including spent fuel pool), the transfer of residual heat and the containment of radioactive substances inside the technological barriers. Where possible the assessment also specifies limiting parameters and time periods until irreversible degradation processes would occur in the core of the reactor (cliff-edge effect).

In content the reports are very similar, cross-disciplinary in nature and exceptional in that the discussion of severe accidents goes far beyond the scope of license requirements specified in the current legislation. Standard licensing process according to the Atomic Law No. 18/1997 Col. requires the demonstration of safety in the form of safety reports containing mostly analyses of deterministically specified project accidents. This method of assessing and proving the safety of NPP is a long-established worldwide standard. Assessment of nuclear safety in the Czech Republic is continuous process which includes among others Periodic Safety Reviews and regular international peer review missions as an OSART, WANO Peer Review etc.. Results from PSR and from international missions are regularly assessed by Regulatory Body and provide valuable tool for further improvement of safety. In general, the periodic review process organized every 10 years is major tool for thorough and systematic re-evaluation of safety of each of nuclear installations on territory of the Czech Republic, including site conditions and environmental risks.

The aim of the assessment under “stress tests” was not to revise or repeat this safety evaluation. Therefore it was not an objective to include in these reports information contained in a number of existing documents (regulations, safety reports etc.) or in international documents, such as the “National Report of the CR for the Convention on Nuclear Safety”, IAEA documents related to solutions of “safety issues” for VVER reactors, selected safety missions of the IAEA, etc.

The evaluation and conclusions contained in both reports are based on a number of quantitative analyses of beyond design basis accidents carried out in the past. In areas where the results of these quantitative analyses fail to provide an estimate of safety margins the reports contain engineering judgment. The reports describe in sufficient detail specified accidents caused by natural disasters (earthquake, flood etc.) and their potential impact on the operability of important safety systems in NPP, such as loss of external power supply (loss of offsite power – LOOP), complete loss of power (station black-out – SBO) and loss of heat transfer capacity (ultimate heat sink – UHS). The risk of loss of offsite power is very real in the CR, especially with respect to the installed output of renewable power sources. This puts more weight and significance on this assessment.

The focus of both reports is in the chapters on “severe accidents”, describing the processes and strategies designed to cope with such events in various phases. Strategic manuals for coping with or reducing the severity of severe accidents (Severe Accident Management Guidelines - SAMG) were implemented in both of our NPPs since 2000. The reports are honest in that they critically evaluate the present capacity of all six power reactors from the view of their capability to withstand loadings analogical to those in Fukushima event. These include indication of missing or not up-to-date analysis and/or procedures or insufficient capacity of some facilities or systems. The real value of both documents is in the fact that they identify the potential risks and weaknesses with respect to beyond design basis accidents (technical or organizational in nature) and are preparing proposals for measures for their reduction. The proposal of these measures, however preliminary, can be seen as a conservative approach going beyond legislative requirements by the license holder (ČEZ a.s.). This list might not be final or complete. All proposed measures (short term, long term) will be in the continuing process of evaluation subject to further analysis, and priorities will be set in terms of urgency, complexity of implementation, benefits and costs.

Even at this preliminary stage it can be stated that evaluations of external risks and analysis of safety margins for these risks confirmed in most scenarios that the design of both power plants provides sufficient margins in parameters and in time periods available for the personnel to react and prevent severe accidents. Strengths of both power plants in terms of robustness to external risks include:

- sites with minimal seismic risk
- sites with practically zero risk of floods

- two large water reservoirs (dams) with raw water for both power plants
- large amounts of cooling water inside the power plants
- compact spent fuel pools ensuring that the fuel remains in subcritical state even when flooded with clean water
- in Dukovany NPP a large hermetic zone and relatively smaller source term
- In Temelin NPP the spent fuel pool is located inside the full-pressured containment.

With respect to the logic and objectives of the stress tests even first evaluation clearly confirms that the region of the Czech Republic is not exposed to extreme natural events, such as earthquakes, floods etc., which could have posed a threat to the safety of a nuclear power plant. Of course, this is also true for the specific sites of nuclear power plants Dukovany and Temelín, which were selected in compliance with official criteria for the selection of sites for nuclear power plants based on recommendations of the IAEA and applied in the Czech Republic since the 1970s.

Another important aspect is the fact that the licensing process for nuclear power plants in the Czech Republic has got three stages (approval of the site, construction permit, permit to operate). A detailed evaluation of the selected site is carried out in the first step of the licensing process and is included in the pre-construction safety analysis report. This report is evaluated by the regulatory authority, which then approves the site of the NPP. This approval may depend on a number of specific conditions to be considered in the design and construction process. In the past the designer of the NPP took part in the selection of the NPP site and its evaluation, which guaranteed that the already very low risk for the nuclear power plant from the characteristics of the selected site was further reduced by additional technical solutions in the NPP design.

With respect to the inland location of the Czech Republic and the absence of sufficiently large rivers in the vicinity of the Czech NPP sites, the final heat-transfer medium is the atmosphere – via cooling towers. Water reservoirs were built near both NPPs to provide raw water and regulate rivers. These water reservoirs are located much lower than the NPPs, therefore damage to these reservoirs, even when combined with earthquake, cannot lead to flooding of the site of the nuclear power plants.

**The evaluation of the “stress tests” by the licensee must be perceived as an assessment of the risks of external events, based on existing analyses, knowledge and engineering estimates.**

**In final revision of the National Report on Stress Tests two attachments (1 and 2) will contain summary of the main points and conclusions both for Temelín and Dukovany site. Summary will be organized according to the outline recommended by the Chairman of WENRA, J. Laaksonen.**

**At this moment, there are no findings from already performed assessments that would require immediate actions by licensee or temporary shut down of any of NPP Temelín or NPP Dukovany units.**