

Evaluation and upgrading of the seismic safety of Paks NPP

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Abstract: In the design of Paks NPP the seismic loads have not been considered. During operation of the plant the site seismicity had to be re-evaluated by state-of-the-art methods and a new seismic design base has been established. A comprehensive programme has been implemented for analysis, upgrading and re-qualifying the seismic safety. The lessons learned from the programme will be presented in the paper.

Keywords: evaluation of site seismicity, seismic analysis of operating plant, design of seismic fixes, re-qualification of systems, structures and components of nuclear power plant

Experience of the March 11 2011 earthquake clearly demonstrated that the earthquakes and associated phenomena might be the dominating contributors to the overall risk of nuclear power plants. Operators of nuclear power plants worldwide performed seismic re-evaluation and upgrading programmes of nuclear power plants during last three decades. The lessons learned during these programmes are worth of consideration while the operators are reviewing and upgrading the plant seismic safety after the Fukushima accident.

Originally the Paks NPP has not been designed and qualified for the earthquake loads. Therefore, the scope of seismic safety programmes at VVER-440/213 plant of Paks included the re-evaluation of the hazard, establishing a new seismic design base, analysis and reinforcement of structures and components, qualification of the active equipment, installation of seismic instrumentation and development of appropriate procedures. The implementation of measures was completed in 2003.

The re-evaluation of site seismic hazard included all required geological, geophysical, seismological and geotechnical investigations. The seismic design basis had been newly defined. Formally the compliance with design basis requirements has to be ensured by design methods and standards. It was already recognised that a consequent and full scope re-design in line with design codes and standards and subsequent upgrading might be impossible at Paks NPP. On the other hand, it should be recognised that use of methodologies developed for the justification of the seismic safety of operating plants does not ensure the compliance with design basis requirements and cannot be directly applied for VVER plants. The qualification of the nuclear power plant have been executed for the newly defined design basis earthquake by applying procedures and criteria for the design, combined with the methods and techniques developed for seismic re-evaluation of operating nuclear power plants. The selection and use of methodologies has been graded in accordance with safety and seismic classification of the systems, structures and components.

After implementing the measures for design basis reconstitution, the achieved level of safety has been quantified via seismic PSA, which provides the core damage frequency.

Implementing the seismic safety programme, adequate level of safety has been achieved that has been justified during the targeted safety review (stress-test) performed in 2011.