



Equipment Qualification for Harsh Environmental Conditions at Ukrainian NPPs

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Overview of the Nuclear Energy Sector in Ukraine

- All nuclear power is operated by SE NNEGC Energoatom, which also operates pumped storage and hydro power plants at the South Ukraine Power Complex
- Nuclear fleet total installed capacity is 13,835 MW(e), comprised of 15 VVERs
- In August 2017 a new Energy Strategy for the period until 2035 was approved by the Government of Ukraine. It provides for the further development of nuclear power with nuclear share to be kept at least at 50% of the total domestic electricity generation.

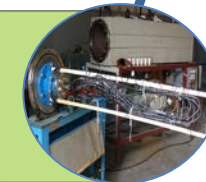


Regulatory documents governing equipment qualification in Ukraine:

NP 306.2.208-2016 establishing “Requirements for seismic design and assessment of seismic hazards of nuclear power units” developed by the regulatory body of Ukraine with account of the IAEA recommendations and put into effect in 2016.



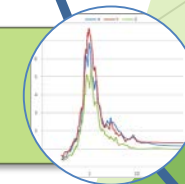
Program of activities on equipment qualification of NPPs issued by NNEGC "Energoatom" and agreed with the regulatory body of Ukraine



Operator`s Standard “Equipment qualification of safety important systems for environmental conditions”



Operator`s Standard “Equipment qualification of safety important systems for seismic effects”



The main tasks of activities on equipment qualification for harsh environmental conditions at Ukrainian NPPs are as follows:

- ▶ preparation of design input data for EQ;
- ▶ assessment of the qualification status of operated equipment;
- ▶ extension of qualification of operated equipment (i.e. increasing maximum values of harsh environmental conditions or seismic loads for which equipment should keep operating as long as needed)
- ▶ development of compensating measures and recommendations aimed at preservation of qualifications carried out in the framework of operational activities after achieving the required level of EQ;
- ▶ setting up qualification requirements for equipment supplied for modernization and retrofitting of NPP safety important systems.

Qualification is performed for equipment providing the following safety functions:

- ▶ Safe reactor shutdown and maintaining reactor in such state as long as needed;
- ▶ Residual heat removal from the core and the cooling pool as long as needed;
- ▶ Mitigating the consequences of accidents by keeping radioactive substances released (during failure of localizing safety systems elements) due to seismic impact (DE, SSE) and / or in harsh environmental conditions resulting from initiating events.

* DE - design earthquake

SSE - safe shutdown earthquake

List of initiating events

- ▶ For all power units of Ukrainian NPPs NNEGC Energoatom has developed lists of initiating events resulting in harsh environmental conditions and defined parameters of harsh environmental conditions :

- ▶ **For VVER-1000:**

- ▶ Temperature 150,0 °C;
- ▶ Pressure - 4,41 MPa;
- ▶ Humidity - 100%;
- ▶ Dose rate - $4,5 \times 10^3$ R/h;
- ▶ Medium - steam - water mixture.

- ▶ **For VVER - 440:**

- ▶ Temperature 124,0 °C;
- ▶ Pressure - 0,226 MPa;
- ▶ Humidity - 100%;
- ▶ Dose rate - $4,85 \times 10^4$ R/h;
- ▶ Medium - steam - water mixture.

Qualification for harsh environmental conditions by testing

Placement of cables for thermal aging



LOKA camera - facility for qualification in harsh environment



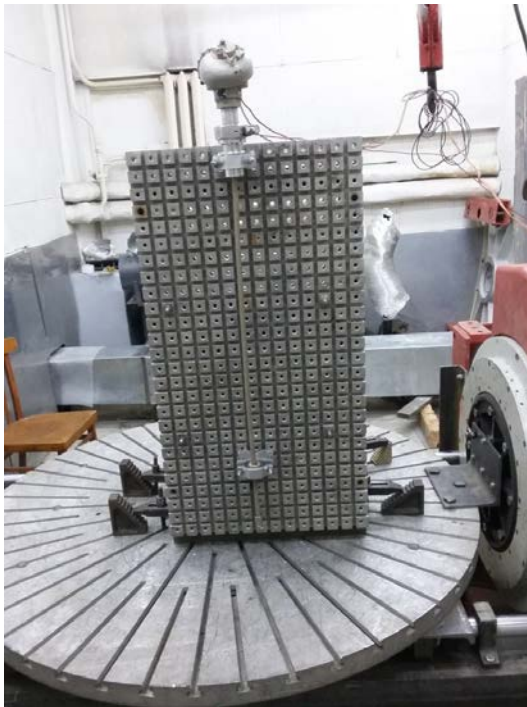
Qualification for seismic loads

As of today, the following works have been performed:

- ▶ - completed reassessment of seismic resistance of operating power units of ZNPP (except for ZNPP-5, 6), SUNPP, RNPP and KhNPP.
- ▶ - put into operation site seismic monitoring systems.
- ▶ - performed seismic resistance reassessment based on the results of seismic resistance assessment of equipment, pipelines, buildings and structures with account of site ground accelerations:
 - ▶ RNPP - 0,1g; KhNPP - 0,1g;
 - ▶ SUNPP - 0,12g; ZNPP - 0,17g.

Qualifications performed for seismic loads by testing

Qualification of the level sensor for seismic effects



Qualification of the ventilation unit for seismic effects



Thank you for your attention