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COMMISSION STAFF WORKING PAPER

Technical Summary of the national progress reports on the implementation of comprehensive risk and safety assessments of the EU nuclear power plants

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT
on the interim report on the comprehensive risks and safety assessments ("stress tests") of nuclear power plants in the European Union

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1. PROGRESS REPORTS RECEIVED

All 14 EU Member States currently operating NPPs sent their progress reports[1], as well as Lithuania[2]. From neighboring countries, Switzerland and Ukraine sent progress reports. All Member State reports were received by the given deadline (15.9.). With the exception of the Ukrainian report, all national progress reports are published integrally on the internet[3].

The reports are different in scope, format, length and level of detail. Despite these differences in the approaches chosen by Member States and participating neighbouring countries, it was possible to make a basic comparison, summarise the country-specific situations and extract some first cross-country findings.

2. SUMMARIES OF MEMBER STATE REPORTS

On the basis of the national progress reports submitted, the following country-specific short summaries can be made:

2.1. BELGIUM

Context: Belgium has 7 reactors (all PWRs) on 2 sites (Doel, Tihange), generating more than half of its electricity.

Scope of Stress Tests: Stress tests are also foreseen for nuclear facilities other than operating NPPs (fuel fabrication plant, waste treatment and storage facilities, radioisotope production facility, research centres), and include man-made events (terrorist attacks, aircraft crash, cyber attack, toxic and explosive gases, blast waves).

Short Summary: Limited amount of technical details, but work to be performed is defined, seems to correspond to the required scope, and to progress as planned. Overall, the regulator considers that the process engaged by the licensee to prepare its stress tests report is appropriate and efficient. Working groups set up are considered well suited and sufficiently staffed. Planned tasks are performed on schedule and a substantial amount of technical data is now available for synthesis in the final reports. The regulator considers the effort mobilized so far by the licensee well suited to successfully complete the task. The report mentions several improvements already implemented in the areas of additional cooling water supplies for the SFPs during SBO and the reinforcement of the seismic resistance of some parts of the facilities. The inspections conducted by the regulator showed that some of the improvements are already operational and the formal implementation of the other improvements is still ongoing.

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1 Belgium, Bulgaria, Czech Republic, Finland, France, Germany, Hungary, Netherlands, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom.

2 Despite closure of the last NPP unit in Ignalina in 2009 in fulfillment of the Lithuanian EU Accession obligations, there are still site-specific operating licenses in place as well as significant amounts of spent fuel stored on-site.

3 www.ensreg.eu

2.2. BULGARIA

Context: Bulgaria has 2 reactors (all VVER-1000) on 1 site (Kozloduy) generating about 35% of its electricity. Construction of a new plant in Belene is planned.

Scope of Stress Tests: In addition to the two operating units in Kozloduy, the report covers also Unit 3 and 4 (permanently shut down with fuel still stored in SFPs).

Short Summary: Limited amount of technical details and limited amount of information on actions taken or preliminary results. Progress report covers mostly existing design features. However, work to be performed is defined, seems to correspond to the required scope, and to progress globally as planned even though in some areas there seems to be some delay at this stage (still ongoing work for the licensee to submit the progress report to the regulator for some areas). Review of licensee's report is ongoing, both with regard to design basis events and evaluation of safety margins.

2.3. CZECH REPUBLIC

Context: The Czech Republic has 6 reactors (4 VVER-440, 2 VVER-1000) at 2 sites (Dukovany, Temelín) generating about one-third of its electricity. In August 2009 a public tender for contractors to build 2 new reactors in Temelín was opened, planning to bring them online in 2020.

Short Summary: Very limited amount of technical details, but work to be performed is defined, seems to correspond to the required scope, and to progress as planned. So far, no immediate actions have been identified or taken.

Specific Issues: The licensee's reports on NPP stress tests at the two sites include evaluations based on BDBA analyses carried out in the past, covering specified accidents caused by natural disasters and their potential impact on the operability of important safety systems, such as LOOP, SBO and LUHS. According to the report, even first evaluations clearly confirm that the sites are not exposed to extreme natural hazards which could pose a significant risk to a NPP. It is mentioned that risk of LOOP is a relevant issue in the Czech Republic, especially with respect to the installed output of renewable power sources.

2.4. FINLAND

Context: Finland has 4 reactors (2 VVER-440, 2 BWRs) on 2 sites (Loviisa, Olkiluoto) providing nearly 30% of its electricity. A fifth reactor (EPR) is now under construction and 2 more are planned.

Short Summary: Detailed and technically informative report, work to be performed is clearly defined, seems to correspond to the required scope, and to progress as planned. Based on evaluations carried out after Fukushima, it has been concluded that deficiencies demanding immediate plant modifications do not exist. However, some modifications to further improve safe plant operation are envisaged.

Specific Issues:

– *Earthquake:* The seismic PSA from 2010 resulted in introducing some safety improvements to further decrease the risk. The latest PSA shows that only about 2%

of the CDF is due to earthquakes. Additional studies on seismic robustness of the fuel pools and the fire water systems are being conducted.

– *Other:* Some areas for possible improvements are already identified in some plants, such as measures in relation to increasing the robustness:

  – against LOOP, SBO and LUHS (ongoing investigations namely related to the possible use of transportable AC power sources, additional diesel driven emergency feed water pumps, analysis of alternative heat transfer means to the atmosphere, injection of fire fighting water into reactor pressure vessel, water supply from independent sources), and

  – of SFPs (ongoing investigations namely related to the reliability increase of SFP inventory makeup using reliable electric power and permanent piping, SAM analysis and implementation of strategies for the SFPs including hydrogen management, enhancement of SFP water level and temperature measurements).

2.5. FRANCE

Context: France has 58 reactors (PWRs of 3 standard types) at 19 sites (Belleville, Blayais, Bugey, Cattenom, Chinon, Chooz, Civaux, Cruas, Dampierre, Fessenheim, Flamanville, Golfech, Gravelines, Nogent, Paluel, Penly, St. Alban, St. Laurent, Tricastin) generating over 75% of its electricity from nuclear energy. 1 EPR is under construction, another one is planned.

Scope of Stress Tests: The French stress tests concern virtually all the 150 nuclear installations and not just the power reactors, including for example the EPR reactor currently under construction and the La Hague fuel reprocessing plant. The final report will cover 80 priority installations, including all NPPs. On some topics (industrial hazards, nearby roads and railways) the report goes beyond ENSREG specifications.

Short Summary: No technical information included in the progress report, but work to be performed is defined, seems to correspond to the required scope, and to progress as planned. To ensure full transparency of the French stress tests, France is broadly involving stakeholders (non-governmental organizations, elected officials, union representatives, etc) in different steps of the process. Additionally, some foreign experts from Germany, Switzerland, Belgium and Luxembourg participated on their request. According to the report, a large number of analyses will apply generically to all reactors since the French nuclear fleet is largely standardized. Consideration of specific scenarios for given sites is requested by the French regulator. An initiative to establish a national "Rapid Action Force" in charge of bringing in a timely manner human and material support to the affected site in case of an accident is also under consideration.

2.6. GERMANY

Context: Germany until March 2011 obtained about one quarter of its electricity from nuclear energy, using 17 reactors (11 PWRs, 6 BWRs) at 12 sites (Brunsbüttel, Brokdorf, Krümmel, Unterweser, Emsland, Grohnde, Grafenrheinfeld, Biblis, Philippsburg, Neckarwestheim, Gundremmingen, Isar). The government formed after the 1998 federal elections had the phase-out of nuclear energy as an element of its policy. With a new government formed in

2009, the phase-out was pushed back by around 10 years in 2010, but confirmed for 2021–2022 in 2011 as a direct political consequence of Fukushima.

Scope of Stress Tests: German stress tests are broader than the ENSREG specification, covering also several man-induced events, such as aircraft crash, blast wave, toxic gases, terrorist and cyber attacks.

Short Summary: Detailed and technically informative report, work to be performed is clearly defined, seems to correspond to the required scope, and to progress as planned. Germany has launched a domestic safety review before the start of the EU stress tests, based on the German Reactor Safety Commission approach using the concept of robustness levels. To assess robustness, three levels have been proposed for all the topics to be analysed. These levels reflect the assurance of the required safety functions to prevent "cliff edge" effects. The report states that the stress tests are progressing according to the agreed schedule. According to the report, the current findings show a high level of robustness.

Some areas for possible improvements are already identified, such as measures in relation to increasing the robustness of NPPs against SBO and LUHS, and improving plant-specific SAM and implementing SAMG. Quantitative assessment criteria and their consistency for beyond design basis events and postulated unavailabilities of safety systems are still under development.

2.7. HUNGARY

Context: Hungary has 4 reactors (all VVER-440) at 1 site (Paks) generating more than one-third of its electricity. New nuclear capacity is under consideration, and 2 new units for Paks are proposed.

Short Summary: Detailed and technically informative report, work to be performed is clearly defined, seems to correspond to the required scope, and to progress as planned. Some areas for possible improvements are already identified, such as measures in relation to increasing the robustness of NPPs against BDBE, dynamic effects of flooding and SBO, increasing the robustness of the SFPs, and introducing plant-specific SAMG.

Specific Issues:

– *Earthquake:* Regarding the ongoing BDBA investigations, some findings which require detailed safety assessment and possibly corrective actions were already identified.

– *Severe accident management & emergency management:* In Unit 1, technical modifications have already been completed, and the introduction of SAMGs will begin at the end of 2011. Technical modifications and introduction of SAMGs regarding the other units will be completed by 2014. The report highlights some areas for improvement under evaluation, mainly concerning the containment integrity through:

  – Installation of passive autocatalytic recombiners by end of 2011 at all 4 units;

  – Installation of a containment filtered venting system;

– Analyses of hydrogen generation and distribution when a nuclear accident involves several reactors and/or SFPs simultaneously;

– Analysis of possible mitigation measures after a severe accident in the SFP.

2.8. LITHUANIA

Context: As part of its EU Accession commitments, Lithuania closed the last of its 2 reactors (all RBMK) at the Ignalina site at the end of 2009. Despite closure of Ignalina, there are still several site-specific valid licenses, for example to operate the storage facility for the significant amounts of spent fuel. Plans for a new plant with or without involving neighbouring countries are in place.

Short Summary: Limited amount of technical details and reference to the final report, but work to be performed is defined, seems to correspond to the required scope, and to progress as planned. Some areas for possible improvements are already identified, such as measures in relation to increasing the robustness of the SFPs against BDBE.

Several potential corrective measures are identified, such as the provision of alternative means to makeup water inventory to Unit 2 reactor core and the SFPs, means to supply neutron absorbers to the SFPs, and alternative power supply in case of SBO. A number of preliminary conclusions and recommendations identified for the new interim spent fuel storage include the analysis of BDBE, scenarios of cask turnover and tightness failure during transportation, cask blockage by debris after collapse of the storage hall, and cracks or collapse of the hot cell while spent fuel is being handled. The possible installation of new mobile diesel generators has been identified as a preliminary recommendation.

2.9. NETHERLANDS

Context: The Netherlands has 1 reactor (PWR) at 1 site (Borssele) generating about 4% of its electricity. A large new unit is proposed.

Scope of Stress Tests: The scope of the Dutch stress tests has been broadened to cover also other nuclear facilities in addition to the NPP. Research reactors in Petten and Delft, the URENCO enrichment plant in Almelo, and the COVRA radioactive waste storage facility in Vlissingen will be covered as well. However, the results on these facilities will not be presented in the final report. The implementation of the stress test is also enhanced by bilateral collaboration with the Belgian regulator. The scope of the stress tests has also been extended to include additional initiating events, such as large grid disturbances, airplane crash, explosion pressure wave, electromagnetic pulse, toxic gasses, running aground of a ship, cyber attack and biological phenomena.

Short Summary: Limited amount of technical details, no details about the preliminary results, but work to be performed is defined, and seems to progress. The regulator informed the licensee that the progress report contains too little information and requested complementary information about the adopted scenarios and methodologies, the progress so far and the quality assurance. Further, it was noted that the licensee's progress report only considers the NPP as it is built and operated on 30.6.2011, i.e. with only U-fuel. Since a license has already been given for the use of MOX-fuel, regulator informed licensee that also MOX-fuel should be included in the analysis. Further, it is stated that actions will follow-up on the short term measures undertaken by the licensee immediately after Fukushima, including verification of

the NPP's capability to cope with BDBA, SBO, internal and external flooding, as well as its capability to mitigate fire and flooding after a seismic event.

2.10. ROMANIA

Context: Romania has 2 reactors (CANDU 6) at 1 site (Cernavoda) generating almost 20% of its electricity. Plans are advanced for completing 2 more units at Cernavoda. The regulator agreed that any potential design changes resulting from the stress tests will be implemented in the designs of Cernavoda Units 3 and 4. More plants are proposed at different sites.

Short Summary: The report shows good progress, provides preliminary results and technical design information, and mentions possible safety improvements. Several concrete areas for improvement are identified in order to increase the robustness of the plant, such as measures against hydrogen build up and slow containment over-pressurisation. Installations of passive autocatalytic hydrogen re-combiners and containment emergency filtered venting systems are planned. The report highlights also technical improvements in the field of SAM that are already in place, such as the procurement of mobile diesel generators and specific EOP to cope with SBO and loss of SFP cooling events. Special attention has been paid to improve the existing SAM communication systems. Improvements are also planned for the survivability of key instrumentation in BDBA conditions.

Specific Issues:

– *Earthquake:* First, a seismic design basis review was performed, and both the level of earthquake against which the NPP is designed and the methodology used to evaluate the DBE have been found adequate. Preliminary seismic margin assessment showed that in comparison with the original DBE of 0.2 g (at 10^{-3} per year), all SSCs which are part of the safe shutdown path after an earthquake would continue to perform their safety function up to 0.4 g (at 5×10^{-5} per year). This margin is considered adequate by the regulator.

– *Severe accident management & emergency management:* The main challenges identified are due to hydrogen build up, slow containment over-pressurization and molten core–concrete interaction. Safety improvement measures already planned comprise, among other, hydrogen re-combiners, containment emergency filtered venting systems and mobile diesel generators.

2.11. SLOVAKIA

Context: Slovakia has 4 reactors (all VVER-440) on 2 sites (Bohunice, Mochovce) generating about half of its electricity and 2 more under construction in Mochovce. The 2008 national Energy Security Strategy aims to maintain the proportion of electricity generated by NPPs at around 50% by means of power uprates and construction of a new reactor at Bohunice in addition to completing Mochovce 3-4.

Short Summary: Limited amount of technical details, but work to be performed is defined, seems to correspond to the required scope, and to progress as planned. Although the report does not identify any needs for immediate actions, additional safety upgrades are being studied to increase the existing safety margins against beyond design basis events. Although with a focus on the two units currently under construction in Mochovce, some areas for improvement possibly relevant also for other units have already been identified, such as measures to increase the robustness of plants against BDBE and external flooding.

Specific Issues:

– *Earthquake:* Earthquakes are relevant safety issues considered in the plant design at both sites (max. horizontal acceleration in Mochovce is 0.143 g and 0.344 g in Bohunice at 10^{-4} per year). Seismic margin assessment is ongoing and will be summarized in the final national report.

– *Severe accident management & emergency management:* The progress report highlights that some improvements have already been implemented in the last few years to extend the capabilities of the NPPs to cope with severe accidents. Additional safety improvement measures are currently under evaluation, such as:

  – Adoption of measures to flood the reactor cavity in order to ensure the outside cooling of the reactor pressure vessel;

  – Protection of the containment against uncontrollable hydrogen burning by means of passive autocatalytic recombiners and igniters;

  – Protection of the containment against overpressure and high temperature by containment spray using a dedicated borated water tank;

  – Setting up an offsite plant control center for SAM.

2.12. SLOVENIA

Context: Slovenia has 1 reactor (PWR) at 1 site (Krško) generating about 40% of its electricity. New nuclear capacity is under consideration.

Short Summary: The report is very comprehensive, well-structured and provides valuable technical details. It indicates that the stress test is well ahead of schedule, as most of the specified requirements have already been dealt with. The work to be performed is clearly defined and seems to correspond to the required scope. Some areas for possible improvements are already identified, such as measures in relation to increasing the robustness of the NPP against BDBE, flooding, LOOP and LUHS. Several safety improvements are already implemented as result of the stress tests. Critical disruption of plant supplies due to infrastructure destruction has been considered.

Specific Issues:

– *Earthquake - NPP:* According to the report, a number of measures have already been implemented at the plant to increase its seismic robustness – no need for further work/measures mentioned.

– *Earthquake - SFP:* SFP was not evaluated in the context of the Krško SPSA, only NPP. For earthquakes up to about 0.9 g, it is considered that SFP integrity would not be challenged. For earthquakes >0.9 g, gross structural failures of SFP cannot be excluded. It is considered likely that fuel uncovery would then occur (i.e. at $\leq 10^{-5}$ per year). No further work mentioned.

– *Severe accident management & emergency management:* SAM evaluations were performed (for NPP and SFP) as well as emergency management evaluations. Updated SAMG are in place. No further work/measures mentioned in the report.

2.13. SPAIN

Context: Spain gets about one fifth of its electricity from nuclear energy, using 8 reactors (6 PWRs, 2 BWRs) at 6 sites (Almaraz, Ascó, Cofrentes, Sta. Maria de Garoña, Trillo, Vandellós). By government decision Sta. Maria de Garoña has been granted a life extension of 2 years and will be shutdown in 2012, although the regulator had accepted the extension for 10 years as submitted by the operator.

Scope of Stress Tests: Stress tests are also foreseen for a nuclear fuel manufacturing facility.

Short Summary: Detailed and technically informative report, work to be performed is clearly defined, seems to correspond to the required scope, and to progress as planned. All sites have addressed almost all points of the stress test requirements, and the regulator considers the progress reports as complete and appropriate. Some areas for possible improvements are already identified, such as measures in relation to increasing the robustness of the NPPs against BDBE, flooding, LOOP and LUHS, as well as SAM.

Specific Issues:

– *Earthquake:* According to the report, the existing DBEs were re-assessed for all sites, and seismic margins are being reviewed for a horizontal acceleration of 0.3 g, from 1.5 to 3 times the design basis.

– *Severe accident management & emergency management:* The licensees propose to set up a common support centre for all the plants equipped with all necessary human and material resources to intervene in any plant within a maximum of 24 hours.

2.14. SWEDEN

Context: Sweden has 10 reactors (7 BWRs and 3 PWRs) at 3 sites (Oskarshamn, Forsmark, Ringhals) providing over 40% of its electricity. In June 2010, the abolishment of the act banning construction of new reactors was approved by Parliament, with construction being possible at existing sites and to replace the present 10 units. This is part of the government's climate program, which, among other targets, stipulates that the country should be carbon-neutral by 2050.

Short Summary: Detailed and technically informative report, work to be performed is clearly defined, seems to correspond to the required scope, and to progress as planned. Some areas for possible improvements are already identified, such as measures in relation to increasing the robustness of NPPs against BDBE and flooding, as well as to further improving some SAM measures. Assessment of hydrogen accumulation and combustion needs further studies.

Specific Issues:

– *Earthquake:* According to the report, assessments are proceeding according to schedule. Remaining work includes renewed verification of plant design against DBE and BDBE analysis. DBE characterized by a set of ground response spectra corresponding to an exceedance frequency of 10^{-5} per site and year. The 8 oldest NPPs were initially not analyzed and designed to withstand a specified earthquake and are thus not fully verified against DBE. Analyses will be limited to a seismic load level of 10^{-7} per site and year.

2.15. UNITED KINGDOM

Context: The UK has 18 reactors (MAGNOX, AGR, PWR) at 9 sites (Oldbury, Wylfa, Dungeness, Hartlepool, Heysham, Hinkley Point, Hunterston, Torness, Sizewell) generating about 15% of its electricity, and all but one will be shut down by 2023. The government assumes that there will be a requirement of 60 GWe of net new generating capacity by 2025, of which 35 GWe is to come from renewables and the expectation is for "a significant proportion" of the remaining 25 GWe to come from new nuclear.

Short Summary: Limited amount of technical details, but work to be performed is defined, seems to correspond to the required scope, and to progress as planned. The report describes the progress of the licensees' reassessments, the organization set up by those licensees and the works still to be done by both licensees and the regulator. The report provides only very little information about the contents and the preliminary results. Some areas for possible improvements are already identified, such as measures in relation to increasing robustness of NPPs against flooding and LUHS.

Specific Issues:

– *Earthquake:* Work is ongoing. The exact nature of modifications and additional equipment to further improve resilience where reasonably practicable has not yet been fully developed for any of the licensees or sites.

– *Flooding:* Work is ongoing. As an example, one licensee has indicated that resilience enhancements under consideration include provision of additional local flood protection to key equipment and provision of further emergency back-up equipment to provide cooling and power. Additional studies are being prepared to re-consider flood modelling for specific sites and to review recent climate change information.

3. SUMMARIES OF NEIGHBOURING COUNTRIES' REPORTS

Several neighbouring countries expressed an interest to participate in the stress tests. So far, Switzerland and Ukraine sent their progress reports.

3.1. SWITZERLAND

Context: Switzerland has 5 reactors (3 PWRs, 2 BWRs) on 4 sites (Beznau, Leibstadt, Gösgen, Mühleberg) generating about 40% of its electricity. Two large new units were planned. A national vote had recently confirmed nuclear energy as part of Switzerland's electricity mix. However, following Fukushima, in June 2011 parliament resolved not to replace any reactors, and hence to phase out nuclear power by 2034.

Short Summary: Detailed and technically informative report, work to be performed is clearly defined, seems to correspond to the required scope, and to progress as planned. Some areas for possible improvements are already identified, such as measures in relation to increasing the robustness of the NPPs against BDBE and flooding.

Specific Issues:

– *Earthquake:* Regarding seismic risk, in 1999 the operators were requested to perform re-evaluations in accordance with the most advanced methods, including comprehensive quantification of uncertainties. It was shown that in the past the seismic hazard had been underestimated. On the basis of this insight, the regulator required the PSAs of all NPPs to be reassessed. The new PSA results demonstrate that all Swiss plants satisfy the IAEA criterion on CDF.

– *Flooding:* It is stated that several hazard levels for external flooding are considered. Regarding analysis of safety margins, a need for harmonization of procedures for all operators has been identified. Furthermore, it is considered necessary that sensitivity studies on potential cliff-edge effects are undertaken.

– *Other:* In June 2011, an external storage facility for emergency equipment shared by all NPPs was set up as requested by the regulator.

3.2. UKRAINE

Context: Ukraine has 15 reactors (all VVER) in operation at 4 sites (Khmelnitski, Rovno, South Ukraine, Zaporozhe) generating about half of its electricity. Completion of 2 VVER units at Khmelnitski as well as construction of new nuclear capacity is planned.

Short Summary: Very limited amount of technical details, but work to be performed is defined, and seems to progress according to the agreed schedule. For the operating plants, preliminary results are available. Walkdowns in all plants performed. Ukraine, as a neighbouring country, has adopted a different timing for the stress tests, with progress reports to be presented by the licensees to the regulator by 15.10.2011.

Specific Issues:

– *External initiating events:* Based on the preliminary assessments, the NPPs must continue improving seismic qualification of SSCs important to safety. As for flooding, the implementation of technical and organizational measures to cope with possible damages of dams at the Dnieper, mostly for Zaporozhe site, is one of the priority actions. Regarding extreme weather conditions, the report states that specific measures have to be implemented to strengthen NPP resistance to tornadoes.

– *Severe accident management & emergency management:* The following areas for improvement have been identified at this stage: Absence of mobile devices to supply power to equipment and water, absence of design features for containment protection against overpressure, as well as absence of hydrogen concentration control features under severe accident conditions.

– *Other:* Priorities for safety enhancement defined. Shortcomings in electrical power supply identified. Evaluations on hydrogen hazards and containment overpressure performed, impact analysis ongoing.

- **GLOSSARY**
- AC Alternating Current
- AGR Advanced Gas Cooled Reactor
- BDBA Beyond Design Basis Accident
- BDBE Beyond Design Basis Earthquake
- BWR Boiling Water Reactor
- CANDU Canada Deuterium Uranium (Pressurised Heavy Water) Reactor
- CDF Core Damage Frequency
- DBE Design Basis Earthquake
- ENSREG European Nuclear Safety Regulators Group
- EOP Emergency Operating Procedure
- EPR Evolutionary Power Reactor
- LOOP Loss Of Offsite Power
- LUHS Loss of Ultimate Heat Sink
- NPP Nuclear Power Plant
- PSA Probabilistic Safety Assessment
- PWR Pressurised Water Reactor
- SAM Severe Accident Management
- SAMG Severe Accident Management Guidelines
- SBO Station Blackout
- SFP Spent Fuel Pool / Pit
- SPSA Seismic Probabilistic Safety Assessment
- SSC Structures, Systems and Components
- UHS Ultimate Heat Sink
- VVER (Russian) Water Water Energetic Reactor