



Lessons learnt from stress tests performed in France

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➤ **Post-Fukushima actions at French and European levels**

- Process and timeline
- Main conclusions and resulting actions

➤ **Conclusion and challenges**



Post Fukushima actions at French and European levels (1/2)

Immediately after the accident, ASN launched:

- A campaign of **targeted inspections**
- **“Stress tests” (i.e. complementary safety assessment)**
 - Respond to a request from the French Prime Minister (23rd March 2011) and from the European Council (24th and 25th March 2011)
 - Are a **complementary approach to the continuous improvement process** of safety pursuant to the law and overseen by ASN (periodic safety reviews (PSR) and integration of operating experience feedback)
 - Cover **French nuclear installations** (~120), including EPR reactor under construction, with priority given to the most important ones (NPPs, La Hague fuel reprocessing plant...)
- Stress tests aims at checking the **robustness of plants to beyond-design Fukushima-related situations**: extreme natural events, loss of safety systems (heat sink, electrical power), severe accident situations.
 - Stress tests specifications were drafted by WENRA, formally established by ENSREG (official group of EU nuclear regulators) and served for the stress tests of all European NPPs.
 - In addition, French stress tests also address human factors

Post Fukushima actions at French and European levels (2/2)

5th May 2011

ASN's resolutions to require licensees to perform stress tests according to **detailed stress test specifications**, consistent with WENRA proposal

3rd January 2012

ASN's formal report and ASN's opinion about stress tests

Jan. – April 2012

European peer review

26th June 2012

- **ASN issued legally binding requirements** (licence conditions) to EDF on improvements to be implemented:

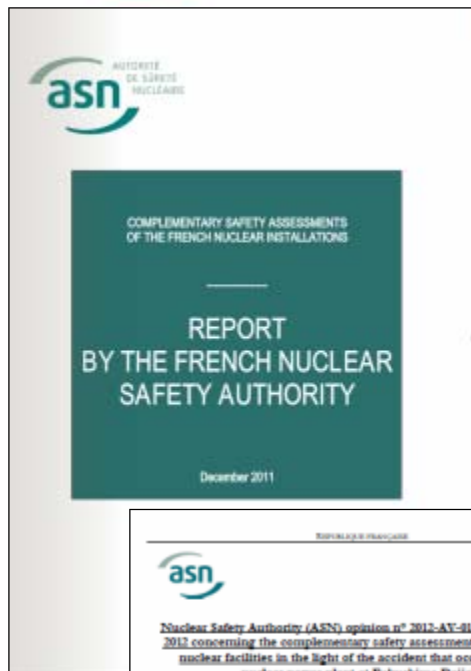
- 19 site specific resolutions with about **40 licence conditions in each of them**
- Compliance deadlines : from 2012 to 2018. Improvements are expected as soon as possible, without waiting the next periodic safety review (EU peer review recommendation)

- Letter signed by ASN's DG with **41 additional requests to EDF**



Conclusions in France (1/5)

No immediate shutdown but ...



ASN's position : *“the facilities examined offer a safety level that is sufficient for ASN not to request the immediate shutdown of any of them [...]. At the same time, ASN considers that continued operation of the facilities requires that their robustness to extreme situations be increased beyond the existing safety margins, as soon as possible.”* (3rd January 2012)

- EDF made proposals to enhance its NPP's safety
- For some other nuclear installations, some shutdowns were already decided

Conclusions in France (2/5)

Confirming PSR benefits

- Importance of the **periodic safety review (PSR)** process and significant operating experience feedback
 - Seismic improvements
 - 2001 Basic Safety Rule
 - Wide ranging set of hazards considered for flooding risk assessment
 - 1999 Blayais NPP event
 - Severe accident measures implemented on all the sites
- Importance of **maintaining skills and competences** in the organizations

- ❑ PSR process is in addition to routine safety assessment
- ❑ 2 steps in the PSR process:
 - 1) **Extensive compliance check** with the (latest) applicable licensing basis
 - 2) **Safety re-evaluation:** revisiting licensing basis (especially design basis) taking into account current (i.e. latest) safety standards, to identify the reasonably practicable improvements to be implemented and to upgrade the licensing basis

Conclusions in France (3/5)

Improvements expected

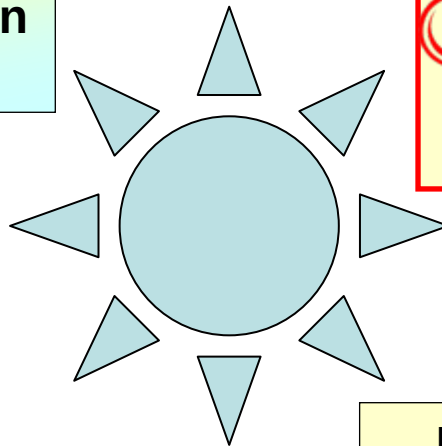


Need for a « **hardened safety core** »
(technical and organizational measures)
which remains operational under conditions considered in the stress tests

Strengthening of the **deviation processing system**

Organizational & human Factors are essential to nuclear safety

- Renewal of the licensee workforces and skills
- Organisation of the use of subcontracting
- Research on these topics



Establish a « **Nuclear rapid response force** » for NPPs
(specialist crew and equipment
within 24 h to the site)

Reinforced measures to reduce the risk of dewatering of the spent **fuel stored in pools**

Feasibility studies to **protect the groundwater and surface waters** in case of severe accident

Targeted **strengthening of the regulatory safety requirements/guidance**

- Conformity of the facilities
- Earthquake, Flooding
- Risks linked to other industrial activities

- **3 objectives, for the situations studied in the stress tests**
 1. prevent or mitigate the progress of an accident with fuel melt,
 2. mitigate large-scale radioactive releases,
 3. enable the licensee to perform its emergency management duties.

- **Limited number of strengthened equipment including**
 - ✓ an **additional ultimate electricity generating set** for each reactor;
 - ✓ a **diverse emergency cool-down water supply** for each reactor;
 - ✓ **new emergency management premises**, offering greater resistance to hazards and remaining accessible and habitable at all times and during long-duration emergencies
 - ✓ **mobile devices** and **means of communication** essential to emergency management
 - ✓ technical and environmental **instrumentation**

- **Systems, Structures and Components (SSCs) included in the hardened safety core shall be maintained in a functional state, in particular for the extreme situations studied in the stress tests. **SSCs shall be designed with significant fixed margins in relation to the requirements currently applicable.****

- For the nuclear power plants, ASN required the progressive creation of the "Nuclear rapid response force" (FARN) proposed by EDF.
 - The FARN is a national response system including **specialist crew and equipment**, able to take over from the personnel of a site affected by an accident and deploy additional emergency response resources **in less than 24 hours**.
- ① EDF submitted its specific organization regarding the nuclear rapid response force in June 2012
- ① Gradual creation until end of 2014



Conclusions in Europe (1/3)

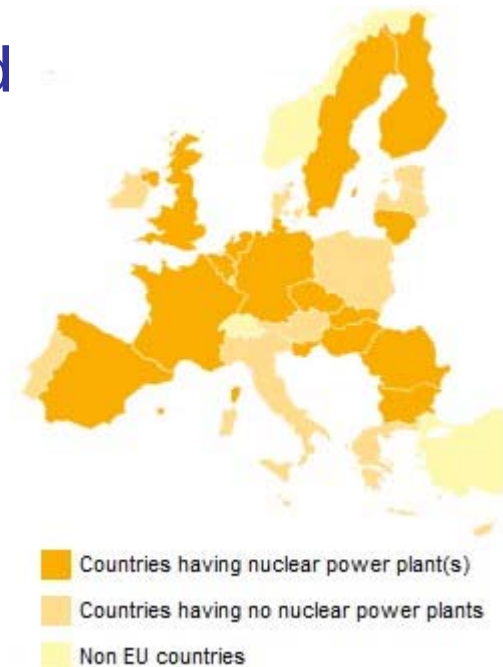
European peer review

➤ European stress test process (limited NPPs) involved

- **Countries with NPPs:** 15 EU countries + Switzerland + Ukraine
- **5 EU countries without NPPs**
- **European Commission and observers** (IAEA, USA, Canada, Japan, UAE, Croatia)

➤ Peer review :

- 80 experts from all over Europe for 4 months
- **First-of-a-kind opportunity to share results and compare practices between European countries**
- This peer review delivered **clear conclusions** to the stress test process of European NPPs, which were endorsed by ENSREG (the official group of nuclear regulators) and the European Commission



Conclusions in Europe (2/3)

European level recommendations

<http://www.ensreg.eu/EU-Stress-Tests/EU-level-Reports>

- **Periodic safety review (PSR)** are extremely beneficial to the continuous improvement of safety
 - Necessity to re-evaluate natural hazards at least every 10 years
- Need for European guidance on **assessment of natural hazards and margins**
 - WENRA task group to be established
- Need to **strengthen the robustness of NPPs to beyond design situations**, as a way to prevent accidents resulting from unforeseen/extreme natural hazards and to limit their consequences
 - Bunkered equipment,
 - Mobile equipment and off-site rescue teams to assist a crippled site...
- Need to maintain **containment integrity**
 - Urgent implementation of recognized measures (H2 explosion prevention...), for NPPs where they are not yet implemented



- **Full understanding of the TEPCO Fukushima accident will be a long term process extending over several years, possibly a decade.**
- **One of the important results of the public interaction is a strong demand for a European initiative on off-site emergency preparedness.**
 - This subject was not part of the mandate of the peer review.
 - Crisis management preparedness and post-accidental planning ⇒ work at both national and international levels, both for the licensees and the emergency response organizations

➤ Following up the stress tests

- **France:**

- Completing the stress test for nuclear installations that were not in priority 1
- **Checking implementation** of the new licence conditions
- Review and revision of **regulatory requirements/guidance** related to natural hazards (earthquake and flooding) and risks linked to other industrial activities located in the vicinity of nuclear installations
- **Human and organizational factors** aspects (ASN established a specific Committee on Social, Organisational and Human factors, involving licensees and stakeholders),
- **Avoiding stress tests being a one-shot exercise**
- Continuing work on **post accident management issues** (CODIRPA)

- **EU stress test:** Follow up national action plan established by each regulatory body, published by end 2012 and peer-reviewed by ENSREG during the first quarter of 2013.

- The accident at Fukushima confirmed that, **despite all the precautions that are taken for safety, an accident is always possible.**
- It now appears clearly, and has been endorsed in the conclusions of the extraordinary meeting of the Contracting Parties to the CNS, that *“nuclear power plants should be designed, constructed and operated with the objectives of preventing accidents and, should an accident occur, mitigating its effects and **avoiding (long-term) off-site contamination.** The Contracting Parties also noted that regulatory authorities should ensure that these objectives are applied in order to identify and implement appropriate safety improvements at existing plants.”*

- This objective now needs to be actually implemented.
 - For new NPPs
 - It is consistent with WENRA safety objectives for new NPPs (November 2010)
 - For existing NPPs. **PSR of the existing reactors should be guided by this objective of avoiding (long-term) off-site contamination:** improvements should be implemented on the plants and those which cannot meet the expectations should be shut down.

- The actual improvement of safety according to these principles relies, in part, on the action of the **regulators**, for example by having the licensing basis updated.
 - ↳ The independence, the transparency and the rigorous action of the regulators are a necessary key to this process.
 - ↳ By helping the IAEA in updating its safety standards
- But first of all, the **licensees**, which have the primary responsibility for safety, must take their share and be active in the process of improvement.
 - ↳ This is to be done at an **individual level**, but also at a **collective level**, through organizations such as WNA, WANO or Reactor Owner groups.

