Dutch stress tests – National progress report

Table of content

1. Introduction

1.1 Context

After the accident at the Fukushima Nuclear Power Plant in Japan, the European Council of March 24th and 25th concluded (See Annex 1) that

> *the safety of all EU nuclear plants should be reviewed, on the basis of a comprehensive and transparent risk assessment ("stress tests"); the European Nuclear Safety Regulators Group (ENSREG) and the Commission are invited to develop as soon as possible the scope and modalities of these tests in a coordinated framework in the light of lessons learned from the accident in Japan and with the full involvement of Member States, making full use of available expertise (notably from the Western European Nuclear Regulators Association); the assessments will be conducted by independent national authorities and through peer review; their outcome and any necessary subsequent measures that will be taken should be shared with the Commission and within the ENSREG and should be made public; the European Council will assess initial findings by the end of 2011, on the basis of a report from the Commission;*

In the following months, ENSREG and WENRA developed the scope and the modalities for the "stress test" defined as a targeted reassessment of the safety margins of all European nuclear power plants. On May 24th the European Commission agreed with the proposed approach.

The agreed methodology consists of 2 tracks: track 1 on safety and track 2 on security.
Track 1 will focus on extreme natural events like earthquake and flooding but will also look into the consequences of loss of safety functions as a consequence of any other initiating event. These events include man-made and other accidental impacts (for instance large disturbance from the electrical power grid, airplane crash, etc.) in so far as they are not covered under track 2 on security, which falls under the responsibility of the national security authorities.

The licensee is primarily responsible for safety of the nuclear installation. Hence, it is up to the licensee to perform the reassessments, and to the regulatory bodies to independently review them.

The reassessment will consist on the one side of an evaluation of the response of a nuclear power plant when facing a set of extreme situations and on the other hand of a verification of the preventive and mitigation measures that have to ensure the safety of the plant.

1.2 Concerned nuclear facilities and licensees

The Dutch government endorsed the European stress test specifications. The lessons learned from the nuclear accident in Fukushima, and more specifically from the European stress test, will be implemented in The Netherlands. If necessary, actions will be taken to further increase safety of the existing Borssele nuclear power plant and of the new nuclear plants eventually to be built.
In The Netherlands there is only 1 nuclear power plant, in Borssele. Licensee is N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland (EPZ).
According to the European agreements, by June 1st (annex 2) the Minister of Economic Affairs, Agriculture and Innovation, responsible for the nuclear safety policy and for the licensing of nuclear power plants in the Netherlands, sent a letter to EPZ requesting to perform the stress test[1].

[1] Following a political decision in the Parliament, a stress test has been requested also from the licensees of the research reactors in Petten and Delft. Besides, a similar request will shortly also be sent to the URENCO enrichment plant in Almelo and the COVRA, radioactive waste storage facility in Vlissingen. The stress test

1.3 Scope of the document

The "stress test" follows a deterministic approach and leads to insight into how Borssele NPP reacts when exposed to ever more serious threats and in case emergency measures fail. Evaluation of the results, and in particular decisions about possible measures to increase the safety margins, will take into account also the likelihood that such an event occurs. This information will also be reported.

The "stress test" will lead to insight into:

- how Borssele NPP and the safety management system react in ever more serious accidents and which protective measures are progressively defeated
- weak points of the installation and the safety management system
- any potential for modifications to improve the weak points.

2. Conclusion

2.1 Main achievements to date (summary)

June 1st request from the Ministry to the licensee to perform the stress test according to the European agreements
August 15th EPZ progress report to the national authorities (according to time schedule)
August 17th EPZ progress report sent to the Parliament and published on internet

2.2 Overall evaluation of the licensee's progress by the regulatory body

The licensee has set up a project group and is investing resources and effort in performing the requested stress test.
The licensee Progress Report provides a table of contents of the Final Report (the same as proposed by ENREG/WENRA on July 17th), a description of the plant and of the safety policy. It does not contain information about the analysis performed so far.
The regulator informed the licensee that the progress report contains too little information about the work performed and therefore it is not possible for the regulator to evaluate it. The regulator urged the licensee to provide more information about the adopted scenario's and methodology, the progress so far and the quality assurance. Further it was noted that the licensee progress report only considers the Borssele plant as it is built and operated on June 30th, that is with only U fuel. Since a license has already been given for the use of MOX fuel, the regulator informed the licensee that also MOX fuel should be included in the analysis, in conformity with the ENSREG specifications.
After submission of the progress report on August 15th, details about scope and methodology were discussed with the regulatory body. On the basis of such discussions and of preliminary results of the assessment, expected by the end of September, further decisions about the following steps will be made.

2.3 Perspectives (short term and medium term)

We expect that the licensee will be able to perform the requested analysis, in accordance to the agreed methodology and that the finale licensee report with the results of the stress test will be delivered in time.
In de coming weeks the licensee and the regulatory body will regularly meet (every two weeks) and discuss the progress of the project. This allows also for timely identification and solution of problems and challenges.

---

for these installations are outside the scope of the European agreements and specifications, and there will be no reporting to the European Commission; however, these stress tests will follow (as far as possible and meaningful) the same approach as agreed for nuclear power plants.

3. Chronology and milestones

Date	Regulator	Licensee
May	development of a communication plan and start communication to the public about the stress test.	
May 31st	webpage dedicated to the stress test opened on the website of the Ministry of EL&I (http://www.rijksoverheid.nl/onderwerpen/kernenergie/europese-stresstest-kerncentrales).	
June 1st	letter from the Ministry of EL&I to the licensee of the Borssele Nuclear power plant with the formal request to perform the stress test.	
June	start meetings between regulators and licensee; meetings still in progress on a regular basis.	
June		start collaboration with Electrabel
June 6th		start project Complementary Safety margin Assessment (CSA)
June 16th	start collaboration between Dutch regulator and the Belgian Federal Agency for Nuclear Control	
July 17th		adoption of “Post-Fukushima “Stress tests” of European nuclear power plants – content and format of complementary safety assessment report” by ENSREG
August 15th		release of Progress Report to the Dutch authorities
Augustus 17th	communication of the progress report to the public (via internet) and to the Parliament	
September 12th		details about scope and methodology agreed with the regulator
September 26th		final report revision 0 ready for review
October 21th		release of final report for internal use
October 31th		release of final report to the Dutch authorities - end of project

4. Main achievements

4.1 Regulatory body

4.1.1 Project organization and resources

A project team has been set up at the Ministry of Economic Affairs, Agriculture and Innovation, including 5 people from the Department for Nuclear Energy and Radiation Protection[2] at the Ministry of Economic Affairs, Agriculture and Innovation (EL&I), and 5 from the Department for Nuclear Safety, Security, Safeguards & Radiation Protection (KFD)[3].
A group of independent experts in the field of (non nuclear) hazard control, earthquakes and flooding has also been asked to join the project team, as advisors.
A budget of € 120000 has been made available for the stress test project.

4.1.2 International collaboration

The stress test project is a national project set within an international (European) context comprising, in particular, the European Commission, ENSREG/ WENRA and the IAEA.
International contacts go through the Ministry of EL&I, which also coordinates and organizes participation to international meetings.
The KFD will be involved and the asked for advice whenever necessary and useful, in particular for judgment and advice on technical issues.

Bilateral contact has also started set with the regulators in Belgium (Federal Agency for Nuclear Control). EL&I and KFD will on a regular basis meet FANC (and its subsidiary inspection organization Bel V) and discuss progress and approach of the stress test in the respective countries.

Also contacts have started with the authorities in Germany, but not on a regular basis.

4.1.3 Licensee's progress report – reaction of the regulator

The regulator informed the licensee that the progress report contains too little information about the work performed and therefore it is not possible for the regulator to evaluate it. The regulator urged the licensee to provide more information about the adopted scenario's and methodology, the progress so far and the quality assurance. Further it was noted that the licensee progress report only considers the Borssele plant as it is built and operated on June 30th, that is with only U fuel. Since a license has already been given for the use of MOX fuel, the regulator informed the licensee that also MOX fuel should be included in the analysis, in conformity with the ENSREG specifications.

4.1.4 Communication plan and release of the reports

A communication plan has been developed aiming at maximum transparency.
Both the licensees reports and the national reports will be published and made available to the public as soon as possible. The licensees' reports (containing technical details) will be provided in English but an extended 'public friendly' summary in Dutch will also be provided which will be used in the communication to the public.
The national reports will be written both in English (for communication to the European Commission) and in Dutch (for communication within The Netherlands).

---

[2] The Department for Nuclear Energy and Radiation Protection at the Ministry of Economic Affairs, Agriculture and Innovation (EL&I) is responsible for policy, legislation, regulation & licensing under the Nuclear Energy Act;

[3] The Department for Nuclear Safety, Security, Safeguards & Radiation Protection is responsible for supervision, assessment, inspection, enforcement, technical advising & support. KFD is part of the organization of the ministry of Infrastructure and the Environment (I&M) and carries out its activities independently under the political responsibility of the Minister of EL&I.

The progress report of the licensee has been published on the internet both by the licensee[4] and the regulator[5] and sent to the Parliament by the regulator direct after receiving it.

Communication about the stress test will make use of several different instruments:
1) the website of the central government www.Rijksoverheid.nl (a dedicated webpage is already available)
2) public hearings (organized by the licensee and/or by the regulator)
3) letters to the Parliament
etc.

Public documents shall not contain any information which potentially can be useful for malevolent acts against nuclear power plants. The restrictions shall be justified and as limited as possible. Which information will or will not be published is subject to discussion both at international and national level.

4.2. Licensee

4.2.1 Project organization and resources

The basis for the execution of the stress tests program (named by EPZ as the Complementary Safety margin Assessment project (CSA)) is the letter of the Dutch Ministry of Economic Affairs, Agriculture and Innovation (EL&I) of June 1st which refers to the ENSREG declaration and Annex I "EU Stress tests" specifications issued by European Nuclear Safety Regulatory Group (ENSREG).

The ENSREG document stipulates that a number of issues should be evaluated. Based on these issues the work has been divided into modules by EPZ and made up the basis for the initial Work Breakdown Structure of the project. For the selected modules a report will be generated. The information gained within the modules will be integrated in the Licensee's Final Report.

The project is divided into two phases. In the first phase the basic analyses of the main issues should be finished, comprising all the three prescribed elements: design base, evaluation of the margin in the design base and assessment of the margins "beyond design". With the release of the Licencee's Progress Report, Phase 1 has been finished mid August, according to the planning.

Mid august Phase 2 of the CSA project started with the following main activities:

- systematically reviewing of the reports of the separate modules that have been produced in the first phase
- discussing and evaluating of possible (combination of) issues that have not been evaluated in the first phase
- execution of complementary evaluations and analyses, especially on "beyond design" margin data which were generated in phase 1
- systematically reviewing the total report to assure interrelated style and consistency of the modules
- if necessary execution of complementary "second opinion" on specific issues
- final editing of the Final Report.

EPZ established an experienced project team, lead by a project manager and supervised by a Steering Committee. In the Steering Committee members from outside the nuclear environment

[4] http://www.kerncentrale.nl/media/downloads/Progress-report-CSA.pdf
[5] http://www.rijksoverheid.nl/onderwerpen/kernenergie/documenten-en-publicaties/kamerstukken/2011/08/17/voortgangsrapportage-stresstest-kerncentrale-borssele.html

and members from outside EPZ ensure the independency of the assessment. The EPZ Technology Department is responsible for the analyses, the reviews, the results and in general for the technical quality of the Final Report.

The Head of Nuclear Power Station Borssele (HKCB) will, in his responsibility for nuclear safety, execute an independent review on the report.

To ensure the necessary expertise and resources to generate the CSA report, experienced external parties from the beginning take part in the project. In phase 1 they are generally involved in the execution of the analyses of the different issues, whereas EPZ employees are responsible for supervision and reviewing. In phase 2 EPZ employees will be in the lead for complementary analysis and writing the final report.

Quality control on the project execution is assured by the Nuclear Safety and Quality Assurance Department of EPZ, which is reporting directly to the CEO of EPZ.

4.2.2 Short term actions undertaken after Fukushima accident

As a first response on the Fukushima accident, EPZ has drawn up the WANO Significant Operating Experience Report (SOER) 2011-2 titled Fukushima Daiichi Nuclear Station Fuel Damage Caused by Earthquake and Tsunami.
The short term actions distinguished in this report are given in Appendix.

4.2.3 Licensee's stress tests methodology

According to the letter of the Dutch Ministry of EL&I a targeted reassessment of the safety margins of the Borssele NPP will be carried out.

This reassessment will consist on the one hand of an evaluation of the response of the plant when facing a set of extreme situations and on the other hand of a verification of the preventive and mitigative measures that have to ensure the safety of the plant.

The reassessment will consider three elements:

- provisions taken in the design basis and plant conformance to its design requirements
- evaluation of the available margins in the design basis
- assessment of the margins "beyond design"; how far the beyond design envelope can be stretched until accident management provisions (design and operation) cannot prevent a radioactive release to the environment that requires mitigative actions to protect the general public.

The reassessment will lead to insight into severe accident conditions and how NPP Borssele reacts, also if the emergency measures provided for that situation, will fail. This means that for the determination of the safety margins a deterministic approach is chosen. The intention is that an ever more serious threat (for example, an increasingly higher tidal wave or heavier earthquake[6]) is assumed, and that will be determined how NPP Borssele and safety management system respond to that and to what level of threat the safety systems work adequately. For further evaluation and taking any measures it is of course important to know how likely it is that such an event occurs. This information will also be reported.

At the end the reassessment will deliver insight in:

[6] The methodology for assessing the effects of an increasingly heavier earthquake is still subject to discussion because of the extensive calculations needed for assessing these effects

- how NPP Borssele and the safety management system react in ever more serious accidents in which protective measures are supposed to be progressively defeated
- indication of the weak points of the installation and the safety management system
- any potential for modifications to improve the weak points.

4.2.4 Licensee's progress report - general structure and features

At August 15th EPZ released the licensee's progress report to the national authorities (according to time schedule).

The general structure and features of the report are given below.

1. Executive summary
2. Introduction
3. Nuclear safety Nuclear Power Station Borssele
   - 3.1 General safety policy
   - 3.2 Periodic safety review
4. Complementary Safety margin Assessment NPP Borssele
   - 4.1 ENSREG EU "Stress tests" specifications (See Annex 2)
   - 4.2 The approach of the CSA project
   - 4.3 Content Licensee Final Report
5. General data about site/plant
   - 5.1 Brief description of the site characteristics
   - 5.2 Main characteristics of the unit
   - 5.3 Significant differences between units
   - 5.4 Scope and main results of Probabilistic Safety assessments

ANNEX 1 Letter to EPZ from the Ministry of Economic Affairs, Agriculture and Innovation (June 1, 2011)

ANNEX 2 ENSREG Safety Annex I EU "Stress tests" specifications

Preliminary proposal of the stress tests reports table of content

Based on the letter to EPZ from the Ministry of Economic Affairs, Agriculture and Innovation of June 1, 2011 and ENSREG Safety Annex I EU "Stress tests" specifications, EPZ has the intention to consider the following issues (discussion with the regulator is still ongoing):

Initiating events:

1. Earthquake and consequent fire, explosion, LOOP, extensive destruction of infrastructure or flooding
2. Flooding and consequent LOOP and extensive destruction of infrastructure
3. Extreme weather conditions, including
   a. Extreme high or low water temperatures of the Westerschelde river (icing up)
   b. High speed winds
   c. Heavy rainfall and/or hail.
   d. Extreme high or low air temperatures
   e. Stroke of lightning
   f. Realistic combinations of above mentioned events
4. Large grid disturbances (loss of grid, overvoltage, frequency variation)
5. External fire (in particular fire in the adjacent coal-fired plant and consequent high temperatures and dust)
6. Airplane crash

7. Explosion pressure wave (including shipwreck in the Westerschelde river and consequent explosion and tidal wave)
8. EMP (electromagnetic pulse)
9. Toxic gasses
10. Running aground of a ship
11. Cyber attack
12. Biological phenomena (jellyfish, etc.).

Consequence of loss of safety functions from the initiating events mentioned above:

- Loss of electrical power (LOOP), including station black out (SBO)
- Loss of the ultimate heat sink (UHS)
- Combination of both

Severe accident management issues:

- Means to protect from and to manage loss of core cooling function
- Means to protect from and to manage loss of cooling function in the fuel storage pool
- Means to protect from and to manage loss of containment integrity

Appendix:
Licencee's short term actions undertaken after Fukushima accident

WANO SOER 2011-2 Fukushima Daiichi Nuclear Station Fuel Damage Caused by Earthquake and Tsunami

Recommendation

1. Verify the capability to mitigate conditions that result from beyond design basis events. Include, but do not limit, the verification to the following:

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
a. Verify through test or inspection that equipment designed for severe accident mitigation is available and functional. Active equipment shall be tested and passive equipment shall be walkeddown and inspected.	April 5, 2011	Bunkered HP ECCS pumps are not routinely tested, based on surveillance program requirements, for the case where the highest pressure is needed (ATWS).	End 2011
a.	April 5, 2011	Availability of required key to unlock chains (used to lock safety related valves in the required position for the actual plant status) is not guaranteed.	Aug 2011
a.	April 5, 2011	Equipment for alternative water supply to the component cooling system is available. However, usefulness of some alternatives is challenged by users.	End 2011
a.	April 6, 2011	H_3BO_3 stock (in bags), related to refilling the bunkered ECCS tanks, could be lost after flooding.	End 2011

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
a.	April 6, 2011	Radiation shielding materials to be used outside the nuclear island are stocked near ground level and could therefore be lost after flooding.	Aug 2011
a.	April 6, 2011	On-site transportable diesel generator could be lost, based on storage location	Aug 2011
b. Verify through walkdowns or demonstration that procedures to implement severe accident mitigation strategies are in place and are executable.	April 6, 2011	One remark in the power recovery procedure must be removed or changed to reflect the current plant design status. The remark directs users to order and install a 6 kV diesel generator to supply the main plant busbar, however in reality a direct connecting is not available.	May 5, 2011
b.	April 6, 2011	Accumulator injection valves are automatically closed to prevent N2 injection into the primary system. A step by step work instruction to bypass this automatic interlocks (in case N2 is required for inertisation) is not available.	End 2011
c. Verify the qualifications of operators and the support staff needed to implement the procedures and work instructions are current.	April 6, 2011	No gaps found	

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
d. Verify that any applicable agreements and contracts designed as contingencies to support severe accident mitigation are in place and are capable of meeting the conditions needed to mitigate the consequences of these events.	April 6, 2011	Status of agreements, mainly with local and regional governmental organizations, is not up to date. Exact capabilities are not known. Support is available based on mutual agreement, but not formally guaranteed and documented.	End 2011
d.	April 6, 2011	No contract for support by a commercial supplier does exist. Support is available based on mutual agreement, but not guaranteed and documented.	Sept 2011
e. Complete this action by 8 April 2011.			

2. Verify that the capability to mitigate station blackout (SBO) conditions required by station design is functional and valid.

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
a. Verify through walkdowns and inspection that all required materials are adequate and properly staged.	April 14, 2011	Refilling the spent fuel pool without entering the containment is feasible during SBO, however required materials and preferred methods are not defined.	No gap. Not required in current design base for SBO. Final evaluation in near future.
a.	April 14, 2011	Dedicated fuel depots are sufficient to run all (5) diesel generators for 72 hours. Other fuel depots are available close by, however detailed instructions to use these, don't exist.	No gap. Current design base 72 hours. Final evaluation in near future.
b. Demonstrate through walkdowns that procedures for response to an SBO are executable.	April 14, 2011	The corrected procedure for handling and connecting the transportable diesel generator is not authorized.	July 4, 2011

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
b.	April 14, 2011	No contracts for specific support related to SBO by a commercial or public supplier are in place. Support is available based on mutual agreement, but not guaranteed and documented.	No gap. Not required in current design base for SBO. Final evaluation in near future
c. Complete this action by 15 April 2011.			

3. Verify the capability to mitigate internal and external flooding events required by station design.

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
a. Verify through walkdowns and inspections that all required materials and equipment are adequate and properly staged. These walkdowns and inspections shall include verification that accessible doors, barriers, and penetration seals are functional.	May 3, 2011	Doors, barriers and seals are inspected under the surveillance programs. Therefore the review is focused on completeness of the surveillance and on unexpected results from plant modifications. .	N/A
a.	May 3, 2011	Flooding resistance of the electrical supply connections to the deep well (ground water) pumps, used for the alternative heat sink, is not verified under the surveillance program.	December 31, 2011
a.	May 3, 2011	Wall, part of the flooding barrier for the auxiliary reactor building, contains an undocumented and untagged seal, which is opened during outages. Flooding resistance is degraded during the time that this seal is opened or not correctly closed.	October 1, 2011

Recommendation	**Date Completed**	**Brief Description of Gaps Found**	**Date Gap Will Be Closed**
a.	April 21, 2011	Check valves used for the level protection of the cooling water intake building are not tested under the surveillance program.	October 1, 2011
b. Complete this action by 6 May 2011.			

4. Verify the capability to mitigate fire and flooding after a seismic event as required by station design.

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
a. Perform walkdowns and inspections of important equipment needed to mitigate fire and flood events to identify the potential that the equipment's function could be lost during seismic events appropriate for the site.	May 11, 2011	All installed fire suppression systems can fail as a result of seismic events. The same is true for the on site fire trucks and crash tender, as storage locations (buildings) and water tanks are not designed for these seismic events. Damage from fire after seismic events is limited by fire barriers and the redundant and independent design of the relevant buildings and safety systems. This functionality is secured by the surveillance programs.	N/A N/A

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
a. Perform walkdowns and inspections of important equipment needed to mitigate fire and flood events to identify the potential that the equipment's function could be lost during seismic events appropriate for the site.	May 11, 2011	Design specs, surveillance and walkdowns demonstrate that principal equipment designed to mitigate flooding will also withstand the design seismic event for the site. The plant water intake building is not designed to withstand seismic events, therefore only the alternative heat sink is taken into account. For one specific case, flooding resistance of the auxiliary reactor building, engineering judgment was used to show that the building seals will withstand the design seismic event. The flooding resistance of this building is not degraded by the seismic event.	N/A N/A

Recommendation	Date Completed	Brief Description of Gaps Found	Date Gap Will Be Closed
b. Develop mitigating strategies for identified vulnerabilities. b Complete this action by 13 May.	May 11, 2011	No specific mitigation strategies for fires after seismic events are in place today. Based on the design of the relevant buildings and systems, no immediate actions are deemed necessary. If all fire suppression systems fail, mitigation of fires will largely depend on external assistance, i.e. local and regional fire brigades. Fire brigade "attack plans" are available in each fire truck and at the local fire station. These plans should be well trained and kept up to date.	N/A N/A End of 2011