# Nuclear Safety Authority (ASN) opinion n° 2012-AV-0139 of 3rd January 2012 concerning the complementary safety assessments of the priority nuclear facilities in the light of the accident that occurred on the nuclear power plant at Fukushima Daiichi

The French Nuclear Safety Authority (ASN);

Having regard to Act n°2006-686 of 13th June 2006 as amended, concerning transparency and security in the nuclear field, in particular its articles 8 and 29;

Having regard to decree 2007-1557 of 2nd November 2007 as amended, concerning basic nuclear installations and the regulation of the nuclear safety of the transport of radioactive materials, in particular its articles 18, 24 and 25;

Having regard to the letter from the Prime Minister, dated 23rd March 2011;

Having regard to the European Council conclusions of 24th and 25th March 2011;

Having regard to ASN decisions n°2011-DC-0213 to n°2011-DC-0224 of 5th May 2011 requiring that Electricité de France (EDF), the Alternative Energies and Atomic Energy Commission (CEA), licensees of the Areva group and the Laue Langevin Institute conduct a complementary safety assessment of their basic nuclear installations in the light of the accident that occurred on the Fukushima Daiichi nuclear power plant;

Having regard to the conclusions of the campaign of targeted inspections on the priority nuclear installations performed by ASN on topics related to the Fukushima accident;

Having regard to the complementary safety assessment reports on the high-priority nuclear facilities submitted to ASN on 15th September 2011 by EDF, CEA, the licensees of the Areva group and the Laue Langevin Institute;

Having regard to the IRSN report evaluating the licensee reports, submitted on 4th November 2011;

Having regard to the opinion dated 10th November 2011 from the ASN advisory committees for reactors and for laboratories and plants on all these reports;

Having regard to opinion n°6 from the French High Committee for Transparency and Information on Nuclear Security (HCTISN) dated 8th December 2011;

Having regard to the elements transmitted by the National Association of CLIs (ANCCLI) as well as by the CLIs of Chinon, Civaux, Dampierre, Fessenheim, Golfech, Gravelines, Saint-Laurent and the three CLIs of the Cotentin peninsula;

Having regard to the elements forwarded by the experts mandated by the Grand Duchy of Luxembourg and the German states of Saarland and Rhineland-Palatinate and by the CGT trade union national mines-energy federation;

Having regard to the ASN report of December 2011 on the complementary safety assessments;

Issues the following opinion:

1. The disaster that struck the Fukushima Daiichi nuclear power plant confirms that, despite the precautions taken in the design, construction and operation of nuclear facilities, an accident can never be completely ruled out.

2. The licensee has prime responsibility for the safety of its facilities. On behalf of the State, ASN is responsible for the regulation of nuclear safety, with the technical support of IRSN and its advisory committees of experts. Pursuant to the law, it aims to ensure continuous improvement in the safety of French civil nuclear facilities, especially through the process of periodic safety reviews and the integration of operating experience feedback.

   In this context, ASN considered that a complementary safety assessment (CSA) of the facilities with regard to the type of events that led to the Fukushima disaster should be initiated without delay. This approach, which complies with the request from the Prime Minister dated 23rd March 2011 and with the European Council conclusions of 24th and 25th March 2011, is presented in appendix I to this opinion. It also enables some of the situations arising from a malevolent act to be taken into account.

   This approach, initiated first of all for the 59 nuclear power generating reactors in service or under construction and the other 20 nuclear facilities felt to be high-priority, is the first step in the experience feedback process from the Fukushima accident, which could take a decade. It complements the permanent safety approach based on the applicable safety requirements.

3. **Following the complementary safety assessments performed on the priority nuclear facilities, ASN considers that the facilities examined offer a sufficient safety level to require no immediate shutdown of any of them. At the same time, ASN considers that their continued operation requires an increase in their robustness to extreme situations beyond their existing safety margins, as soon as possible.**

4. ASN will thus impose a range of measures on the licensees, presented in appendix II to this opinion. It in particular underlines the importance of the following measures:

   - Creation of a "hard-core" of material and organisational measures designed to ensure control of the basic safety functions in extreme situations; the licensees will propose ASN the content and specifications of this "hard-core" for each facility before 30th June 2012;

- For the nuclear power plants: as of this year, gradual creation of the "Nuclear rapid response force (FARN)" proposed by EDF, a national response system comprising specialist crews 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. The system will be fully operational by the end of 2014;

- For the spent fuel storage pools on the various nuclear facilities: implementation of complementary strengthened measures to reduce the risk of dewatering of the fuel;

- For the nuclear power plants and silos at La Hague: feasibility studies with a view to the implementation of technical measures, such as a geotechnical containment or system with equivalent effect, designed to protect the groundwater and surface water in the event of a severe accident.

5. Social, organisational and human factors, which are key aspects of safety, were the subject of particularly close attention during the complementary safety assessments, as shown in appendix III to this opinion. Following these assessments, ASN has identified the following priorities, to which it will be particularly attentive:

    - The renewal of the licensee workforces and skills, which is a fundamental point at a time when a new generation of staff is taking over a more experienced one, while extensive work is being required subsequent to the CSAs;

    - The organisation of the use of subcontracting, which is a major and difficult issue. Monitoring of the subcontractors working on nuclear facilities must be strengthened and must not be delegated by the licensee when the work undertaken is important for safety; ASN has made provision for this in the draft order setting out the general rules for basic nuclear installations;

    - Research on these topics, for which programmes are to be initiated at a national or European level.

    ASN proposes setting up a working group on these subjects, comprising the licensees, the trades union organisations, the HCTISN, the Ministry for Labour and the Ministries responsible for nuclear safety;

6. With regard to the current baseline safety requirements:

    - The licensees will be required to strengthen the nonconformity processing system and apply it in particular to the nonconformities found during the post-Fukushima targeted inspections;

    - The detailed operating experience feedback from the Fukushima accident will lead to reinforcement of the safety requirements for nuclear facilities, in particular with regard to the "earthquake", "flooding" and "risks linked to other industrial activities" aspects, as mentioned in appendix IV to this opinion.

7. ASN has prepared, together with Ministries responsible for nuclear safety, a draft order setting out the general rules for basic nuclear installations, which will make a significant contribution to improving safety. ASN emphasises the need for it to be signed as soon as possible.

8. ASN will focus on learning the lessons from the results of the European peer review process. It will continue to participate actively in all the analyses being conducted worldwide to gain a clearer understanding of the Fukushima accident and learn all relevant lessons.

9. ASN recalls that the reports from the licensees regarding lower-priority nuclear facilities shall be submitted before 15th September 2012.

10. Finally, ASN will be particularly vigilant with regard to monitoring the implementation of all the requirements it has issued, as well as the adoption of the new safety requirements it has approved. As of the summer of 2012, it will periodically present the progress of these actions as a whole.

Paris, 3rd January 2012.

The Nuclear Safety Authority Commission,

André-Claude LACOSTE Marie-Pierre COMETS

Michel BOURGUIGNON Jean-Jacques DUMONT Philippe JAMET

# APPENDIX I TO NUCLEAR SAFETY AUTHORITY OPINION N°2012-AV-0139 OF 3RD JANUARY 2012

## THE COMPLEMENTARY SAFETY ASSESSMENTS APPROACH

ASN considers that the accident which struck the Fukushima Daiichi nuclear power plant in Japan on 11th March 2011 is a major one, from which all relevant lessons must be learned. It made sure that a detailed experience feedback process from this accident was rapidly put into place. This process could take about ten years, as was the case following the Three Mile Island and Chernobyl accidents.

The Fukushima Daiichi nuclear power plant disaster confirms the fact that despite all the precautions taken in the design, construction and operation of nuclear facilities, an accident can never be completely ruled out.

The licensee has prime responsibility for the safety of its facilities. On behalf of the State, ASN is responsible for regulating nuclear safety, with the technical support of IRSN and its advisory committees of experts. Pursuant to the law, it ensures continuous improvement of the safety of French nuclear facilities, especially through the process of periodic safety reviews and the integration of operating experience feedback.

In this context, ASN considered that a complementary safety assessment of the facilities with regard to the type of events that led to the Fukushima disaster should be initiated without delay. This approach complies with the request from the Prime Minister dated 23rd March 2011 and with the European Council conclusions of 24th and 25th March 2011. It also enables some of the situations arising from a malevolent act to be taken into account.

To regulate this approach, ASN issued twelve decisions on 5th May 2011, requiring the various nuclear facility licensees to perform these complementary safety assessments in accordance with precise specifications. The complementary safety assessments concern the robustness of the facilities to exceptional situations such as those which led to the Fukushima accident. They complement the permanent safety approach that applies to the facilities.

ASN also initiated a campaign of targeted inspections on topics related to the Fukushima accident. These inspections comprised field checks on the conformity of the licensee's equipment and organisation with the existing safety requirements.

The complementary safety assessments concern virtually all of the 150 French nuclear facilities (58 nuclear power generating reactors, the EPR reactor under construction, research facilities, fuel cycle plants, etc.). Excluded are fewer than about ten facilities for which decommissioning is nearing completion.

These facilities were split into three categories depending on their vulnerability to the phenomena which led to the Fukushima accident and the importance and scale of any consequences of an accident affecting them. For the 79 facilities considered to be of high-priority, including the 59 nuclear power generating reactors in operation or under construction, the licensees (EDF, CEA, Areva and the Laue Langevin Institute) submitted their reports to ASN on 15th September 2011. For the lower-priority facilities, the licensees are required to submit their reports before 15th September 2012. Finally, the other facilities will be covered by appropriate requests from ASN, mainly on the occasion of their next ten-year periodic safety review.

To analyse the reports submitted by the licensees on 15th September 2011, ASN called on the expertise of its technical support organisation, IRSN, which submitted its report in early November. On 8th, 9th and 10th November 2011, ASN also convened two of the seven advisory committees it consults on the most important subjects: the advisory committee for reactors and the advisory committee for laboratories and plants. These advisory committees, made up of French and foreign experts, submitted their opinion to ASN, dated 10th November 2011.

ASN attached the greatest importance to this approach being conducted openly and transparently: the French High Committee for Transparency and Information on Nuclear Security (HCTISN), the local information committees (CLI) and several foreign Regulatory Bodies were invited to take part in the targeted inspections carried out by ASN, subject to the approval of the licensee, and to attend the meetings of the advisory committees; these various stakeholders also received copies of the reports transmitted by the licensees.

On its website (www.asn.fr) ASN also posted the licensee reports, the IRSN report, the opinions of the advisory committees and the follow-up letters to the inspections it carried out. Finally, ASN published a number of information memos and held three press conferences devoted to the CSAs.

On 3rd May 2011, the HCTISN issued a favourable opinion on the specifications for the complementary safety assessments. On 8th December 2011, it also issued an opinion on the complementary safety assessment process. This opinion stressed the fact that the general public was satisfactorily made aware of information concerning the Fukushima accident and the resulting process initiated.

At the same time, the National Association of CLIs (ANCCLI) mandated experts to review the reports submitted by the licensees to ASN. Several CLIs also carried out their own analyses: the Fessenheim CLIS sent ASN a study on the risk of flooding of the Fessenheim nuclear power plant in June; the CLIs of Chinon, Civaux, Dampierre, Golfech, Gravelines, Saint-Laurent and the three CLIs of the Cotentin Peninsula sent in their observations on the licensees' reports. Finally, experts mandated by the Grand Duchy of Luxembourg and the German states of Saarland and Rhineland-Palatinate sent ASN their analysis of these reports, as did the CGT trade union national mines-energy federation.

The complementary safety assessments thus led to exceptional mobilisation on the part of the licensees, experts, stakeholders and ASN.

ASN's initial conclusions concerning the complementary safety assessments on the priority nuclear facilities are based on a review of all of this work and the results of its regulatory action.

## APPENDIX II TO NUCLEAR SAFETY AUTHORITY OPINION N°2012-AV-0139 OF 3RD JANUARY 2012

## PROVISIONS TO IMPROVE THE ROBUSTNESS OF THE FACILITIES TO EXTREME SITUATIONS

ASN considers that the reports submitted by the licensees of the priority nuclear facilities on 15th September 2011 represent a significant amount of work and on the whole meet the requirements set out in its decisions dated 5th May 2011, even if further work remains necessary. It in particular underlines the quality of the work done and the proposals presented by the Laue-Langevin Institute and EDF.

Following the complementary safety assessments on the priority nuclear facilities, ASN considers that the facilities examined offer a safety level that is sufficient for it not to request the immediate shutdown of any of them, taking into account the shutdowns already decided on, such as that of the plutonium technology facility in Cadarache (ATPu), the Phenix and Osiris reactors, some old units on Areva's La Hague site, the Comurhex nuclear facility in Pierrelatte and the Eurodif plant and the retrieval of fissile materials from the storage building of Masurca in Cadarache. 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.

These facilities must therefore be given the means of dealing with:

- a combination of natural phenomena of an exceptional scale and exceeding the phenomena used in the design or the periodic safety review of the facilities,
- severe accident situations following a prolonged loss of electrical power or cooling and capable of affecting all the facilities on a given site.

ASN thus notes with interest the emergence of the "hard-core" concept defined by IRSN.

**ASN will therefore be asking the licensees to propose a "hard-core" of material and organisational measures for each facility, specifications and procedures by 30th June 2012, for implementing these measures, such as to allow control of the basic safety functions in exceptional situations.**

These measures will thus ensure ultimate protection of the facilities, with the following three objectives:

- prevent a severe accident or limit its progression,
- limit large-scale releases in the event of an accident which it was not possible to control,
- enable the licensee to perform its emergency management duties.

The "hard-core" will in particular comprise:

- crisis management premises and equipment,
- means of communication and alert,
- technical and environmental monitoring instrumentation,
- operational dosimetry resources for workers,
- strengthened equipment including, for the nuclear power plants, an electricity generating set and an emergency cooldown water supply for each reactor.

The design of the EPR reactor, which already offers improved protection against severe accidents, should make it easier to create its "hard-core". EDF will be identifying the existing or

additional systems to be included in the "hard-core", in particular to control the pressure in the containment in the event of a severe accident.

**For the nuclear power plants, ASN will require that, as of this year, EDF gradually deploy its proposed national "Nuclear rapid response force (FARN)", comprising specialist crews and equipment able to take over from the personnel on a site affected by an accident and to deploy additional emergency response resources in less than 24 hours, with operations beginning on the site within 12 hours. The system shall be deployable to any site by the end of 2012 and have a capacity for simultaneous intervention on all the reactors of a site by the end of 2014.**

**For the spent fuel storage pools of the various nuclear facilities, ASN will be requiring reinforced measures to reduce the risk of dewatering of the fuel.**

**Finally, a range of other measures to reinforce the robustness of the facilities to extreme situations shall be taken by the nuclear licensees**.

Among these measures, ASN considers the following to be particularly noteworthy.

For the La Hague site, ASN will be asking Areva to implement additional robust measures to resupply the water to the pools and units housing storage tanks containing concentrated solutions of fission products, as well as means for restoring cooling of the pools and storage tanks as rapidly as possible.

For the silos storing the legacy waste and effluents on the La Hague site (silos 130, STE2 and HAO), ASN will be asking Areva to submit a schedule for recovery of these waste and effluents as soon as possible. ASN will also be asking Areva to carry out feasibility studies concerning the use of technical measures such as a geotechnical containment, or system with equivalent effect, designed to protect the groundwater and surface waters in the event of a leak from these silos.

For the Tricastin and Romans sites operated by Areva, ASN will be asking the licensee to study and implement additional means to mitigate the consequences of a leak of toxic products (hydrogen fluoride gas, uranium hexafluoride, chlorine, chlorine trifluoride, etc.).

For the Masurca facility on the Cadarache site, ASN will be asking CEA to relocate the fissile materials as soon as possible to a facility designed to withstand an earthquake.

Finally, for the nuclear power plants, ASN will be asking EDF to submit feasibility studies before 31st December 2012 with a view to implementing technical measures such as a geotechnical containment or system with equivalent effect, designed to protect groundwater and surface waters in the event of a severe accident. ASN will also be asking EDF to examine strengthening the venting-filtration device on the reactor containments in order to improve both its robustness and its effectiveness.

**ASN will in the coming weeks be issuing a range of stipulations requiring that the licensees comply with these steps and measures.**

## APPENDIX III TO NUCLEAR SAFETY AUTHORITY OPINION N°2012-AV-0139 OF 3RD JANUARY 2012

## SOCIAL, ORGANISATIONAL AND HUMAN FACTORS

Managing the organisation of labour and human resources, and the interaction between humans and their working environment constitute what are commonly called social, organisational and human factors. These factors play a key role in the prevention and management of incidents and accidents. They are thus essential aspects of nuclear safety and were given particularly close attention during the complementary safety assessments.

ASN identifies the following three priorities, to which it will be especially attentive:

- The renewal of the licensee workforces and skills, which is a fundamental point at a time when a new generation of staff is taking over a more experienced one, while extensive work is being required subsequent to the CSAs;

- Organisation of the use of subcontracting, which is a major and difficult subject, two aspects of which were examined in particular:

  - first of all, this organisation is a key factor in accident prevention, facility maintenance and the quality of facility operation. The conditions governing the use of subcontracting must thus enable the licensee to maintain full responsibility and complete control over the safety of its facility. On the basis of the complementary safety assessment reports, ASN considers that subcontractor monitoring needs to be strengthened and that it must not be delegated by the licensee when dealing with work that is important for safety. ASN has made provision for this accordingly in the draft order setting down the general rules for basic nuclear installations. The proposal by EDF, Areva and CEA to limit to three the number of subcontracting tiers is interesting and worthy of further study. ASN also aims to pursue the steps already taken with regard to subcontracting, based on the evaluations carried out at its request by IRSN and the advisory committee, as well as on the conclusions of its targeted inspections.

  - secondly, the Fukushima accident showed that the ability of the licensee and, as applicable, its contractors, to organise and work together in severe accident conditions is a key factor in managing such a situation. Subcontractors can have a major role to play in crisis management in a facility owing to their expertise and the scale of the work that could prove necessary. ASN will thus be requiring the licensees to prove that their organisation guarantees the availability of the necessary skills in the event of an emergency, especially should outside contractors need to be called on.

- Research on these topics, for which programmes are to be initiated at a national or European level.

**ASN proposes setting up a working group on these subjects, comprising the licensees, the trades union organisations, the HCTISN, the Ministry for Labour and the Ministries responsible for nuclear safety.**

**Finally, the complementary safety assessments and the targeted inspections showed the importance of the new regulations contained in the draft order prepared by ASN, together with**

**the Ministries responsible for nuclear safety, and setting out the general rules for basic nuclear installations, designed in particular to tighten up the requirements concerning contractor monitoring. ASN underlines that this draft order should be signed as rapidly as possible.**

## APPENDIX IV TO NUCLEAR SAFETY AUTHORITY OPINION N°2012-AV-0139 OF 3RD JANUARY 2012

## PROVISIONS CONCERNING THE BASELINE SAFETY REQUIREMENTS

French nuclear safety regulations stipulate that nuclear facilities are designed, built and operated to deal with a certain level of risk, without safety being compromised. These risks include natural hazards such as earthquake and flooding. It also requires the implementation of a system of "defence in depth", consisting of a range of redundant and diversified measures (automation, systems or procedures) able to prevent accidents, manage them if they cannot be avoided or, failing which, minimise the consequences. These arrangements are regularly checked and systematically reassessed on the occasion of the ten-year periodic safety reviews which have been made mandatory by the article 29 of the Act of 13th June 2006.

- Conformity of the facilities

The conformity of the nuclear facilities with the safety requirements applicable to them is an essential component in their safety and their robustness to accident initiators or hazards. ASN will therefore be requiring that the licensees reinforce the detection and processing of nonconformities, especially with regard to the combined impact of various anomalies. ASN will be particularly attentive to the steps taken for the fuel cycle facilities operated by Areva, where the situation needs to be improved.

**The complementary safety assessments and the targeted inspections showed the importance of the new regulations contained in the draft order prepared by ASN, together with the Ministries responsible for nuclear safety, and setting out the general rules for basic nuclear installations, designed in particular to tighten up the requirements concerning the processing of nonconformities. ASN underlines that this draft order should be signed as rapidly as possible.**

- Earthquake

With regard to earthquakes, the complementary safety assessments showed that the seismic margins on the nuclear reactors and the more recent fuel cycle facilities are sufficient to prevent cliff-edge effects from occurring in the event of a limited overshoot of the current baseline safety requirements. These assessments confirmed the benefits of examining the seismic risk on the occasion of each ten-year periodic safety review. However, ASN identified several areas in which safety could be improved, related to the robustness of the facilities to earthquakes and it will be asking for:

- the necessary reinforcements to at least ensure resistance to the safe shutdown earthquake (SSE) for certain of the older fuel cycle facilities. Concerning those units for which closure is already scheduled, the licensee may take compensatory measures proportional to the risk. These compensatory measures concern the facilities on the Tricastin platform (TU5/W, Comurhex and Eurodif), FBFC Romans and the facilities in the former Areva plants at La Hague.
- For the nuclear power plants, protection of equipment able to perform the basic safety functions in the event of a fire caused by an earthquake. The main fire protection measures for the facilities are not currently designed to withstand an SSE.

- Greater awareness and assimilation of the seismic risk by the operators in the day-to-day operation of the facilities, by strengthening operator training, improving the awareness of the "event-earthquake[1]", ensuring compliance with the basic safety rule concerning seismic instrumentation (maintenance, operator familiarity with the equipment, calibration).

- Flooding

With regard to flooding, the complementary safety assessments show that the requirements resulting from the comprehensive review conducted following the flood on the Le Blayais nuclear power plant in 1999 offer NPPs a high level of protection against the flood risk. ASN however recalls that the action plan designed to implement the measures to meet these requirements is still in progress. In these conditions:

- ASN will ensure that the licensees complete the work and measures to protect the nuclear facilities within the allotted time, particularly for the nuclear power plants of Le Blayais, Bugey, Cruas, Gravelines, Saint-Alban and on the Tricastin platform;
- ASN will be requiring reinforced protection of the nuclear power plants against the risk of flooding beyond the current baseline safety requirements, for example by raising NPP volumetric protection[2]. The complementary safety assessments revealed the existence of "cliff-edge effects" (total loss of electrical power) for levels close to those adopted in the baseline safety requirements.

ASN and IRSN have begun work on updating a new guide for the protection of nuclear facilities against the risk of flooding, incorporating operating experience feedback from France and abroad, along with the most recent knowledge and data available. ASN aims to release this new guide in 2012. ASN will focus on verifying implementation of this guide by the nuclear facilities, especially those of the fuel cycle, for which it will specify the relevant requirements.

**Furthermore, to take account of experience feedback from the Fukushima accident, the most recent data and the best international practices, ASN has decided to review the methodology for assessing the effects of earthquake and flooding on nuclear facilities.**

- Risks linked to other industrial activities

Finally, **ASN considers that the risks induced by other industrial activities present in the vicinity of nuclear facilities need to be reassessed**. When faced with extreme natural phenomena such as those of Fukushima, these activities could constitute major sources of hazards for the neighbouring nuclear facilities, or their releases could complicate access by the emergency services. ASN will be requiring the licensees of nuclear facilities to enhance their existing studies by including the effects on their installations of high-risk activities located nearby, in the event of natural hazards on an exceptional scale, jointly with those responsible for these activities.

[1] The purpose of the "event-earthquake" approach is to prevent damage to a necessary equipment item in the event of an earthquake by an item or structure that is not seismic-classified, in particular equipment installed temporarily for maintenance work.

[2] Volumetric protection concerns all the measures taken to ensure the watertightness of the premises in the event of flooding on the site.