ASN Resolution 2014-DC-0403 of 21th January 2014 instructing Electricité de France - Société Anonyme (EDF-SA) to comply with additional prescriptions applicable to the Flamanville (Manche) NPP further to the examination of the file presented by the licensee in compliance with prescription (ECS-1) of ASN resolution 2012-DC-0283 of 26th June 2012

The Nuclear Safety Authority (ASN - Autorité de Sûreté Nucléaire),

Having regard to the Environment Code, in particular its articles L. 592-20, L. 593-10 and L. 593-20;
Having regard to the decree of 21st December 1979 authorising Electricité de France to create two units at the Flamanville NPP, in the Manche département;
Having regard to decree 2007-534 of 10th April 2007 authorising the creation of the BNI referred to as Flamanville 3, comprising an EPR type nuclear reactor, on the Flamanville site (Manche département);
Having regard to decree 2007-1557 of 2nd November 2007 amended, relative to BNIs and to the regulation of the transport of radioactive substances in terms of nuclear safety, and its articles 18 and 25 in particular;
Having regard to the order of 7th February 2012 setting out the general rules for BNIs;
Having regard to ASN (French Nuclear Safety Authority) Resolution 2011-DC-0213 of 5th May 2011 instructing Electricité de France (EDF) to carry out stress tests on certain of its basic nuclear installations in the light of the accident which occurred in the Fukushima Daiichi nuclear power plant;
Having regard to ASN resolution 2012-DC-0283 of 26th June 2012 instructing Electricité de France – Société Anonyme (EDF-SA) to comply with additional requirements applicable to the Flamanville NPP (Manche département) in the light of the conclusions of the stress tests on BNIs 108, 109 and 167;
Having regard to the opinion of the Advisory Committee for Reactors of 13th and 20th December 2012 concerning the deployment of a post-Fukushima hardened safety core in EDF's PWR reactors under construction or in operation, transmitted by letter CODEP-MEA-2012-066279 of 21st December 2012;
Having regard to EDF file ECESN120385 revision B of 29th April 2013 "content of post-Fukushima hardened safety core –Flamanville 3 EPR";
Having regard to EDF file EMESN120777 revision B of 3rd May 2013 "content of post-Fukushima "SSC" hardened safety core for the NPPs in operation";
Having regard to EDF letter ENGSDS130199 of 12th June 2013 "seismic design/verification of the post-Fukushima hardened safety core";
Having regard to EDF letter DPI/DIN/EM/MRC/PC-13/015 of 1st July 2013;
Having regard to the observations from Électricité de France on the draft resolution transmitted in letters reference DPI/DIN/EM/MRC/PC-13/020 of 19th September 2013 and DPI/DIN/EM/MRC/PC-13 of 18th September 2013;
Having regard to the observations collected during the public consultation on the draft resolution, opened from 18th November to 9th December 2013;

Whereas ASN prescribed the deployment of a hardened safety core of robust material and organisational measures designed, for the extreme situations studied in the stress tests, to:
- prevent an accident with fuel melt, or limit its progression,
- limit large-scale radioactive releases,

- enable the licensee to perform its emergency management duties;

Whereas the construction of BNI 167 is today extensively advanced and that commissioning will be the subject of the next authorisation to be obtained for this BNI;

Whereas certain situations called "hardened safety core situations" in this present resolution were already taken into account in the initial design of BNI 167 (RRC-A situations);

Whereas the objective of limiting large-scale radioactive releases applies to all phases of an accident;

Whereas, in order to attain this objective, the licensee must, as far as is reasonably achievable, implement the best available techniques for the design and creation of the hardened safety core;

Whereas the review of the above-mentioned files of 29th April 2013 and 3rd May 2013 proposed by EDF indicates the need to prescribe certain additional requirements for creation of the hardened safety core;

Whereas the seismic justification methods proposed by EDF to justify the functionality of the existing systems, structures and components are similar to those used for the safety reviews and are thus acceptable,

Issues the following resolution:

Article 1

Following analysis of the above-mentioned files of 29th April 2013 and 3rd May 2013, this resolution sets additional requirements to be met by Électricité de France – Société Anonyme (EDF-SA), hereinafter referred to as the licensee, for operation of BNIs 108, 109 and 167 on the Flamanville NPP site (Manche département). These requirements are defined in the appendix.

Article 2

The commissioning application file for BNI 167 provided for in Article 20 of the above-mentioned decree of 2nd November 2007 shall describe and substantiate the provisions concerning it and designed to ensure compliance with the prescriptions set out in appendix 2 to this present resolution.

Article 3

Until completion of the actions designed to ensure compliance with the prescriptions appended to this resolution, and no later than 30th June of each year, the licensee shall present to ASN and make public the actions taken during the course of the previous year to comply with the prescriptions and deadlines contained in the appendix to this resolution along with the measures still to be taken. This presentation can be made in the annual public information report stipulated in Article L.125.15 of the Environment Code.

The licensee notifies ASN of any difficulty which could compromise compliance with the deadlines associated with the above-mentioned actions.

Article 4

The ASN Director General is tasked with implementation of this resolution, which will be published in the ASN *Official Bulletin*.

Signed in Montrouge on 21th January 2014.

The ASN Commission,

Pierre-Franck CHEVET

Michel BOURGUIGNON	**Jean-Jacques DUMONT**	**Philippe JAMET**

Appendix 1 to ASN resolution 2014-DC-0403 of 21th January 2014 instructing Electricité de France – Société Anonyme (EDF-SA) to comply with additional prescriptions applicable to the FLAMANVILLE (Manche) NPP further to the examination of the file presented by the licensee in compliance with prescription (ECS-1) of ASN resolution 2012-DC-0283 of 26th June 2012

Requirements applicable to BNIs 108 (reactor 1 of the FLAMANVILLE NPP) and 109 (reactor 2 of the FLAMANVILLE NPP)

Title III: Management of accident risks

Chapter 1: General

The *hardened safety core* mentioned in I of prescription [ECS 1] in the above-mentioned resolution of 26th June 2012, aimed at:

a) preventing an accident with fuel melt, or limit its progression,
b) limiting large-scale radioactive releases,
c) enabling the licensee to perform its emergency management duties;

is hereinafter referred to as "*hardened safety core"*.

The external natural hazards adopted for the design of the *hardened safety core,* the severity of which exceeds those considered in the installation's baseline safety requirements, are earthquake, flooding (including heavy rain), extreme winds, lightning, hail and tornados. They are hereinafter referred to as "*external hazards considered for the hardened safety core"*.

The following situations, as well as the situations resulting from their combination, are hereinafter referred to as *"hardened safety core situations"*:

- total loss of electrical power supplies not belonging to the *hardened safety core*;
- total loss of heat sink not belonging to the hardened safety core;
- *external hazards considered for the hardened safety core;*
- situations resulting from the condition of the facility, the site and its environment after one or more *external hazards considered for the hardened safety core.*

[INB108-] [ECS-ND1] and [INB109-] [ECS-ND1]

I. The *hardened safety core* aims to prevent core melt during *hardened safety core situations*. For core cooling and residual heat removal from the reactor building containment when the reactor coolant system is pressurisable, the *hardened safety core* allows control strategies giving priority to cooling by the secondary systems, while maintaining the integrity of the main primary system.

II. To limit large-scale radioactive releases in *hardened safety core situations,* the *hardened safety core* allows isolation of the containment and prevention of third barrier bypass situations. The *hardened safety core* aims to preserve the integrity of this barrier without opening the containment venting system.

The provisions of the *hardened safety core* adopted by the licensee to limit radioactive releases take account of the case of total core melt and reactor vessel melt-through following *hardened safety core situations*.

III. The licensee produces the following and sends them to ASN:

- before 31st January 2014, a study of the provisions which, when the reactor coolant system is pressurisable, allow core cooling by the secondary systems, while maintaining the integrity of the main primary system during *hardened safety core situations*;
- before 31st December 2014, a study of provisions allowing residual heat removal from the containment without opening of the containment venting system in *hardened safety core situations*.

[INB108-] [ECS-ND2] and [INB109-] [ECS-ND2]

The *hardened safety core* avoids exposure of the fuel assemblies in the spent fuel pits and fuel assembly handling compartments, in *hardened safety core situations*.

[INB108-] [ECS-ND3] and [INB109-] [ECS-ND3]

The material and organisational measures, including the instrumentation employed in the *hardened safety core,* enable the *hardened safety core* to be activated and the installation to be operated in the *hardened safety core situations,* in particular:

- measurement of the status parameters of the NSSS and the pools necessary for management of *hardened safety core situations* by diagnosing the condition of the containment barriers, including the third containment barrier extension systems, which need to be monitored;
- identify the availability of the functions necessary for management of the *hardened safety core*;
- determine the conditions for intervention by the workers in the facility.

Within a time-frame compatible with the emergency management requirements, these provisions must also allow the provision of data able to characterise the radioactive releases and the environmental consequences.

[INB108-] [ECS-ND4] and [INB109-] [ECS-ND4]

The *hardened safety core* comprises an I&C system and electrical distribution system that are as independent as possible from the existing means at the date the stress tests required by the above-mentioned resolution of 5th May 2011 were initiated, except in cases where such independence would degrade the reliability of the *hardened safety core*.

The licensee justifies the reliability of the electrical power supply, electrical distribution and I&C system in *hardened safety core situations*.

[INB108-] [ECS-ND5] and [INB109-] [ECS-ND5]

Before 30th June 2014, the licensee informs ASN of the functions performed by the *hardened safety core* and sends it a list of the systems, structures and components (SSC) which perform these functions. In this list, the licensee makes a distinction between the new SSC and the existing SSC.

The SSC constituting this *hardened safety core* are elements important for protection (EIP). The *hardened safety core* functions are performed by SSC which were qualified as described in II of Article 2.5.1 of the above-mentioned order of 7th February 2012 for *hardened safety core situations*.

The SSC for which the operation or integrity is required for the *hardened safety core* functions meet the requirements applicable to the *hardened safety core* SSC, for the situations in which they are needed.

The connection points on the installation's fixed SSC for the mobile resources specified for management of *hardened safety core situations,* remain or can be made accessible and functional following *external hazards considered for the hardened safety core.*

[INB108-] [ECS-ND7] and [INB109-] [ECS-ND7]

The seismic hazard to be considered for the *hardened safety core* SSC, defined by a response spectrum, must:

- encompass the site's safe shutdown earthquake (SMS), plus 50%;
- encompass the probabilistic site spectra with a return period of 20,000 years;
- take account of the particular site effects, in particular the nature of the soil, in its definition.

For the new *hardened safety core* SSC*,* the licensee adopts a spectrum higher than the response spectrum defined above.

[INB108-] [ECS-ND8] and [INB109-] [ECS-ND8]

I. Before 30th June 2014, for *external hazards considered for the hardened safety core* other than earthquake and flooding, as well as for other external hazards including extreme temperatures and precipitations, the licensee sends ASN the hypotheses and procedures considered for the design of the new SSC and verification of the *hardened safety core's* existing SSC. For the new SSC, these hypotheses comprise increased margins.

II. Before 30th June 2014, the licensee sends ASN the methodology and its justification for processing of the risk of effects induced on the *hardened safety core* by the failure of SSC which do not belong to the *hardened safety core,* following *external hazards considered for the hardened safety core.*

[INB108-] [ECS-ND9] and [INB109-] [ECS-ND9]

For the design of new *hardened safety core* SSC, the licensee uses codified design and construction rules or, failing which, rules which are compliant with the state of the art. It demonstrates the integrity and functionality of these SSC with respect to the situation considered.

The new *hardened safety core* SSC which cannot be replaced by other means are the subject of reinforced design and manufacturing requirements to ensure a high level of reliability enabling them to perform their safety functions in all phases of an accident, for as long as they are needed.

For the existing SSC, which can only be justified in *hardened safety core situations* on the basis of codified design and construction rules or, failing which, rules which are compliant with the state of the art, the licensee justifies these SSC on the basis of realistic deterministic methods; in any case it uses criteria that guarantee the functionality of the SSC for the roles they are required to perform in *hardened safety core situations*. If justification cannot be provided on the basis of these methods, the licensee examines the replacement or reinforcement of these SSC.

[INB108-] [ECS-ND10] and [INB109-] [ECS-ND10]

Before 30th June 2014, the licensee sends ASN a file summarising the design, verification, manufacturing, inspection, testing, qualification and in-service monitoring options it has adopted to ensure a high level of availability of the *hardened safety core* functions in *hardened safety core situations* with a high degree of confidence.

[INB108-] [ECS-ND11] and [INB109-] [ECS-ND11]

I. The licensee defines the mission duration of the new *hardened safety core* SSC.

II. Before 30th June 2014, the licensee defines, justifies and sends ASN the requirements it adopts for management of *hardened safety core situations* going beyond the mission duration considered for the *hardened safety core*.

Before 30th June 2015, the licensee defines, justifies and sends ASN the provisions it adopts for management of *hardened safety core situations* going beyond the mission duration considered for the *hardened safety core*.

[INB108-] [ECS-ND12] and [INB109-] [ECS-ND12]

Before 30th June 2015, the licensee identifies the situations that the *hardened safety core* and the associated operating modes, including support for the teams mentioned in prescription [ECS-36] of the above-mentioned resolution of 26th June 2012, are able to cover beyond the *hardened safety core situations,* in the case of extreme external or on-site hazards or their induced effects.

First of all and before 30th June 2014, the licensee shall propose an approach accordingly.

[INB108-] [ECS-ND13] and [INB109-] [ECS-ND13]

Before 30th June 2014, the licensee shall communicate its programme of work concerning the provisions specific to ensuring dropping of the control rod clusters to control reactivity following the *external hazards considered for the hardened safety core* and a summary of the progress made by this programme.

Before 31st December 2014, the licensee shall send ASN a description of the provisions designed to ensure dropping of the control rod clusters following the *external hazards considered for the hardened safety core* specifying the SSC to be included in the *hardened safety core*.

[INB108-] [ECS-ND14] and [INB109-] [ECS-ND14]

Before 31st December 2015, the licensee shall send ASN a study of the structural strength of the spent fuel pits and the fuel assembly handling compartments with respect to the *external hazards considered for the hardened safety core*.

Within the same time-frame, it shall submit a description of any changes required to guarantee their strength.

[INB108-] [ECS-ND15] and [INB109-] [ECS-ND15]

Before 31st December 2015, the licensee shall send ASN a study of the consequences on the fuel storage area in the spent fuel pool of a fall by a transport container caused by a *hardened safety core* level earthquake.

Within the same time-frame, it shall submit a description of any changes required to guarantee the strength of the spent fuel pits.

[INB108-] [ECS-ND16] and [INB109-] [ECS-ND16]

Before 31st December 2014, the licensee shall send ASN a study of the feasibility of the provisions designed to prevent melt-through of the basemat in the event of partial or total core melt in *hardened safety core situations*, as well as an evaluation of the industrial time-frame for deployment as necessary.

Appendix 2 to ASN resolution 2014-DC-0403 of 21th January 2014 instructing Electricité de France – Société Anonyme (EDF-SA) to comply with additional prescriptions applicable to the Flamanville (Manche) NPP further to the examination of the file presented by the licensee in compliance with prescription (ECS-1) of ASN resolution 2012-DC-0283 of 26th June 2012

Prescriptions applicable to BNI 167 (reactor 3 of the Flamanville NPP)

Title III: Management of accident risks

Chapter 1: General

The *hardened safety core* mentioned in I of prescription [ECS 1] in the above-mentioned resolution of 26th June 2012, aimed at:

a) preventing an accident with fuel melt, or limit its progression,
b) limiting large-scale radioactive releases,
c) enabling the licensee to perform its emergency management duties;

is hereinafter referred to as the "*hardened safety core*".

The external natural hazards adopted for the design of the hardened safety core, the severity of which exceeds those considered in the installation's baseline safety requirements, are earthquake, flooding (including heavy rain), extreme winds, lightning, hail and tornados. They are hereinafter referred to as "*external hazards considered for the hardened safety core*".

The following situations, as well as the situations resulting from their combination, are hereinafter referred to as "*hardened safety core situations*":

- total loss of electrical power supplies not belonging to the *hardened safety core*;
- total loss of heat sink not belonging to the *hardened safety core*;
- *external hazards considered for the hardened safety core*;
- situations resulting from the condition of the facility, the site and its environment after one or more *external hazards considered for the hardened safety core*.

The existing SSC is taken to mean all SSC which were the subject of a specification for the nuclear safety demonstration presented in the preliminary safety report submitted with a view to obtaining the above-mentioned decree of 10th April 2007.

[INB167-70] [ECS-ND1]

I. The *hardened safety core* aims to prevent core melt during *hardened safety core situations*. For core cooling and residual heat removal from the reactor building containment when the reactor coolant system is pressurisable, the hardened safety core allows control strategies giving priority to cooling by the secondary systems, while maintaining the integrity of the main primary system.

II. To limit large-scale radioactive releases in *hardened safety core situations*, the *hardened safety core* allows the integrity of the third containment barrier to be maintained and third barrier bypass situations to be prevented.

The provisions of the *hardened safety core* adopted by the licensee to limit radioactive releases take account of the case of total core melt and reactor vessel melt-through following *hardened safety core situations*.

[INB167-71] [ECS-ND2]

The *hardened safety core* avoids exposure of the fuel assemblies in the spent fuel pits and fuel assembly handling compartments, *in hardened safety core situations*.

[INB167-72] [ECS-ND3]

The material and organisational measures, including the instrumentation employed in the *hardened safety core*, enable the *hardened safety core* to be activated and the installation to be operated in the *hardened safety core situations*, in particular:

- measure the status parameters of the NSSS and the pools necessary for management of *hardened safety core situations* by diagnosing the condition of the containment barriers, including the third containment barrier extension systems, which need to be monitored;
- identify the status of the functions necessary for management of the *hardened safety core*;
- determine the conditions for intervention by the workers in the facility.

Within a time-frame compatible with the emergency management requirements, these provisions must also allow the provision of data able to characterise the radioactive releases and the environmental consequences.

[INB167-73] [ECS-ND4]

In the facility commissioning application file provided for in Article 20 of the above-mentioned decree of 2nd November 2007, the licensee justifies the level of reliability of the electrical power supply, the electrical distribution and the I&C system in *hardened safety core situations*.

[INB167-74] [ECS-ND5]

Before 30th June 2014, the licensee sends ASN the functions performed by the *hardened safety core* along with a list of the systems, structures and components (SSC) which enable these functions to be performed. In this list, the licensee makes a distinction between the new SSC and the existing SSC.

The SSC constituting this *hardened safety core* are elements important for protection (EIP). The *hardened safety core* functions are performed by SSC which were qualified as described in II of Article 2.5.1 of the above-mentioned order of 7th February 2012 for *hardened safety core situations*.

The SSC for which operation or integrity is required for the *hardened safety core* functions meet the requirements applicable to the *hardened safety core* SSC, for the situations in which they are needed.

The connection points on the installation's fixed SSC for the mobile resources specified for management of *hardened safety core* situations, remain or can be made accessible and functional following *external hazards considered for the hardened safety core*.

[INB167-75] [ECS-ND7]

The seismic hazard to be considered for the *hardened safety core SSC, defined by a response spectrum*, must:

- encompass the site's safe shutdown earthquake (SMS), plus 50%;
- encompass the probabilistic site spectra with a return period of 20,000 years;
- take account of the particular site effects, in particular the nature of the soil, in its definition.

For the new *hardened safety core* SSC, the licensee adopts a spectrum higher than the response spectrum defined above.

[INB167-76] [ECS-ND8]

I. Before 30th June 2014, for *external hazards considered for the hardened safety core* other than earthquake and flooding, as well as for other external hazards including extreme temperatures and precipitations, the licensee sends ASN the hypotheses and procedures considered for the design of the new SSC and verification of the *hardened safety core's* existing SSC. For the new SSC, these hypotheses comprise increased margins.

II. Before 30th June 2014, the licensee sends ASN the methodology and its justification for processing of the risk of effects induced on the *hardened safety core* by the failure of SSC which do not belong to the *hardened safety core*, following *external hazards considered for the hardened safety core.*

[INB167-77] [ECS-ND9]

For the design of new *hardened safety core* SSC, the licensee uses codified design and construction rules or, failing which, rules which are compliant with the state of the art. It demonstrates the integrity and functionality of these SSC with respect to the situation considered.

The new *hardened safety core* SSC which cannot be replaced by other means are the subject of reinforced design and manufacturing requirements to ensure a high level of reliability enabling them to perform their safety functions in all phases of an accident, for as long as they are needed.

For the existing SSC, which can only be justified in *hardened safety core situations* on the basis of codified design and construction rules or, failing which, rules which are compliant with the state of the art, the licensee justifies these SSC on the basis of realistic deterministic methods; in any case it uses criteria that guarantee the functionality of the SSC for the roles they are required to perform in *hardened safety core situations*. If justification cannot be provided on the basis of these methods, the licensee examines the replacement or reinforcement of these SSC.

[INB167-78] [ECS-ND10]

Before 30th June 2014, the licensee sends ASN a file summarising the design, verification, manufacturing, inspection, testing, qualification and in-service monitoring options it has adopted to ensure a high level of availability of the *hardened safety core* functions in *hardened safety core situations* with a high degree of confidence.

[INB167-79] [ECS-ND11]

I. The licensee defines the operating duration of the new *hardened safety core* SSC.

II. Before 30th June 2014, the licensee defines, justifies and sends ASN the requirements it adopts for management of *hardened safety core situations* going beyond the mission duration considered for the *hardened safety core*.

Before 30th June 2015, the licensee defines, justifies and sends ASN the provisions it adopts for management of *hardened safety core situations* going beyond the mission duration considered for the hardened safety core.

[INB167-80] [ECS-ND12]

Before 30th June 2015, the licensee identifies the situations that the *hardened safety core* and the associated operating modes, including support for the teams mentioned in prescription [ECS-36] of the above-mentioned resolution of 26th June 2012, are able to cover beyond the *hardened safety core situations*, in the case of extreme external or on-site hazards or their induced effects.

First of all and before 30th June 2014, the licensee shall propose an approach accordingly.

[INB167-81] [ECS-ND13]

Before 30th June 2014, the licensee shall communicate its programme of work concerning the provisions specific to ensuring dropping of the control rod clusters to control reactivity following the *external hazards considered for the hardened safety core* and a summary of the progress made by this programme.

Before 31st December 2014, the licensee shall send ASN a description of the provisions designed to ensure dropping of the control rod clusters following the *external hazards considered for the hardened safety core* specifying the SSC to be included in the *hardened safety core*.

[INB167-82] [ECS-ND14]

Before 31st December 2015, the licensee shall send ASN a study of the structural strength of the spent fuel pit and the fuel assembly handling compartments with respect to the *external hazards considered for the hardened safety core*.

Within the same time-frame, it shall submit a description of any changes required to guarantee their strength.