Decree No. 2007-534 of 10 April 2007

Decree Authorising the Creation of the “Flamanville 3”, Basic Nuclear Installation Including an EPR Nuclear Power Plant at Flamanville (Manche Department)

Published in the *Journal officiel de la République française* (Official Gazette), 11 April 2007

NOR: INDI0700460D Consolidated version: **11 April 2007**

The Prime Minister,

On the report of the Minister of Economy, Finance and Industry and the Minister of Ecology and Sustainable Development,

Having regard to the *Environmental Code*, in particular Titles I and IV of Book V;

Having regard to the *Public Health Code,* in particular Chapter III of Title III of Book III;

Having regard to the *Labour Code,* in particular Title III of Book II;

Having regard to *Law No. 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field*, in particular Article 29;

Having regard to *Planning Act No. 2006-739 of 28 June 2006 Concerning the Sustainable Development of Radioactive Materials and Waste;*

Having regard to Decree No. 63-1228 of 11 December 1963, amended, on nuclear installations;

Having regard to Decree No. 95-540 of 4 May 1995, amended, on discharges of liquid and gas effluents on water intakes in basic nuclear installations;

Having regard to the Order of 10 August 1984 concerning the design, construction and operation quality of basic nuclear installations;

Having regard to the Order of 31 December 1999, amended, setting forth general technical regulations for the prevention and limitation of external nuisances and risks in the operation of basic nuclear installations;

Having regard to the application submitted on 9 May 2006 by *Électricité de France* and to its supporting documentation;

Having regard to the proceedings and the conclusions of the public debate held from 19 October 2005 to 18 February 2006;

Having regard to the results of the public inquiry held from 15 June to 31 July 2006;

Having regard to the opinion of 8 December 2006 by the Interministerial Committee on Basic Nuclear Installations;

Having regard to the opinion of 16 February 2007 by the Nuclear Safety Authority (*Autorité de sûreté nucléaire*);

Having regard to the formal opinion of 20 March 2007 by the Minister for Health,

Hereby orders:

Article 1

Électricité de France shall be authorised, in accordance with the conditions set forth in this decree, to create on the territory of the commune of Flamanville, located in the Manche Department, a basic nuclear installation, including a pressurised-water reactor with a design thermal power of 4,500 MW in order to generate electricity.

The perimeter of that basic nuclear installation shall be delineated according to the plan attached to this decree[1].

Article 2

I. Characteristics of the nuclear steam supply system

I-1. Operating thermal power

Within the limit of the design thermal power referred to Article I, the Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN) shall determine the level of the maximum operating thermal power of the nuclear steam supply system, especially on the basis of the results of the reactor's start-up tests.

I-2. Nuclear fuel

The nuclear steam supply system shall be designed in order to use fuel containing a fissile material consisting of either uranium oxide with low-enriched uranium 235 or a mixture of uranium and plutonium oxides.

II. Accident prevention

The reactor shall be designed, built and operated in order to avoid the following situations:

II-1. any break in the components of the primary cooling system and of specific piping under pressure;

Measures shall be taken in order to ensure the integrity of the following items throughout the lifetime of the installation:

- the reactor vessel, the containment envelope of the steam generators, as well as the pressuriser and casings of the reactor coolant pumps, and
- the main primary and secondary pipes for which the occurrence of a double-ended circumferential break has not been selected as a reference plant condition in the safety report.

Those measures shall cover the overall scope of the following aspects:

- the design quality and the corresponding verification;
- the manufacturing quality and the corresponding controls, and
- in-service monitoring ensuring a highly unlikely occurrence not only of alterations of the equipment that would compromise the prevention of different damage modes, but also of absence of timely detection of such alterations, if they occurred in any case.

II-2. accidents involving core meltdown and likely to lead to large early radioactive releases;

Accidents involving core meltdown and likely to lead to large early releases shall be the subject of preventive measures relying on the design provisions and completed, where appropriate, by operating measures, the performance and reliability of which shall allow for that type of situation to be excluded.

According to the most recent information, accidental situations shall include the following:

- any core meltdown occurring whilst the primary cooling system is at high pressure;
- any core meltdown in the spent fuel pool;

[1] The plan may be consulted at either of the following locations:

1. the Nuclear Safety Authority (*Autorité de sûreté nucléaire*): 6, place du Colonel-Bourgoin, 75572 Paris Cedex 12, or CITIS, Le Pentacle, avenue de Tsukuba,14209 Hérouville-Saint-Clair Cedex, or
2. the Prefecture of the Manche Department: place de la Préfecture, 50009 Saint-Lô Cedex.

- reactivity accidents resulting from the fast introduction in the primary cooling system of cold water or of water with an insufficient level of soluble neutron absorber;
- any core meltdown with containment bypass either (1) through the steam generators or the systems connected to the primary cooling system and coming out of the containment reactor building or (2) when opening the containment reactor building under shutdown state, and
- global hydrogen detonations and steam explosions inside and outside the reactor vessel likely to affect the containment integrity of the reactor building.

III. Basic safety functions

III-1. Reactivity control

III-1.1. In the reactor vessel

III-1.1.1. Monitoring of the nuclear reaction

As long as any fuel assembly is present in the reactor vessel, the concentration of soluble neutron absorber in the water of the primary cooling system shall be monitored at all times.

As soon as the required fuel for the normal operation of the reactor is loaded in the reactor vessel, the nuclear reaction shall be monitored at all times. The capacity of all installed measurement means intended for monitoring purposes shall exceed the design thermal power of the reactor.

Those measurement means and the intensity of the associated counting sources shall be selected and maintained at a sufficient performance level in order to prevent the operator either from starting water circulation in the main primary cooling system or from reducing the concentration of soluble neutron absorber in that water without disposing of a significant neutron flux.

The follow-up of the power distribution in the core shall be ensured by various neutron-measurement systems scattered inside and outside the core.

III-1.1.2. Reactivity-control means

Irrespective of the power level, when the core is critical, the balance of neutron feedback shall ensure an intrinsically stable behaviour in case of power excursion.

More particularly:

- the temperature coefficient of the fuel shall be designed as negative;
- the void coefficient of the primary coolant shall be designed as negative, and
- the moderator temperature coefficient shall be negative from hot conditions and zero power up to the nominal-operation conditions; after each loading of nuclear fuel in the reactor, that temperature coefficient shall be systematically verified during physical restart tests and, where appropriate, a limited number of rod cluster control assembly may be inserted temporarily in the core in order to meet that criterion at the beginning of the cycle.

The reactivity of the core shall be controlled by two independent means, one containing a neutron absorber included in the rod cluster control assembly and the other a soluble neutron absorber in the cooling water of the core, with the understanding that at least one of those means shall be capable of maintaining the subcritical shutdown of the reactor.

Any potential deformation of fuel assemblies during normal operation or following a reference transient, incident or accident shall not impede the drop of the rod cluster control assembly, within the required timeframe, in order to shut down the reactor.

In addition to the system used during normal operation to regulate the concentration of neutron absorber in the water of the primary cooling system, the reactivity-control function shall be guaranteed, without having to open the safety valves of the pressuriser of the main primary cooling system, by another neutron-absorber injection system, consisting of two subsystems, each capable of shutting down the reactor following a reference transient, incident or accident other than a loss of primary coolant accident.

III-1.1.3. Reactor protection

In case of abnormal evolution of the physical reactivity-related parameters, automatic devices shall allow to shut down the reactor, notably in case of significant excess in the maximum operating thermal power of the reactor.

III-1.2. Under-water fuel storage racks

All under-water fuel-assembly storage racks shall be designed to exclude all criticality risk, not only under standard storage conditions, but also in case of a zero concentration of dissolved neutron absorber in the water.

III-2. Cooling of nuclear fuel

III-2.1. In the reactor vessel

III-2.1.1. Cooling under normal conditions

Under any normal operating conditions, suitable cooling systems shall ensure at all times the removal of thermal heat from the fuel assemblies, while ensuring their integrity within sufficient margins.

When reactor coolant pumps are in operation, the water circulation flow rate in the primary cooling system shall ensure a satisfactory removal of the heat produced within the fuel assemblies and the force exerted by the water circulation shall not compromise the stable position or the integrity of the fuel assemblies in the core.

Any situation requiring by design a reduction of the water level in the primary cooling system during shutdown states, when the core is in the reactor vessel, shall be defined and justified, as well as any implemented measure to counter associated risks, including design margins, instrumentation and adequate procedures.

III-2.1.2. Cooling monitoring

As long as any fuel assembly is still present in the reactor vessel, the water inventory in the primary cooling system and the actual cooling of the fuel shall be monitored at all times.

III-2.1.3. Reactor protection and emergency cooling systems

Suitable automatic devices shall shut down the reactor in case of any abnormal evolution of the physical parameters relating to the water inventory or to the actual cooling of the core.

In case of any reference incident or accident and under any operating conditions with multiple failures mentioned in the safety report, suitable emergency cooling systems shall ensure a sufficient water inventory in the primary cooling system and remove the residual power of the core.

Although adequate measures shall be taken in order to prevent any double-ended circumferential break in any main primary pipe, one of the emergency cooling systems shall be able to assume its functions in case of a break which mass flow of water loss is equivalent to the one resulting from such break.

In addition, an emergency water supply system for steam generators shall be able:

- in the case of any reference transient, to ensure the cooling of the primary cooling system, then the removal of the residual power of the core, and
- in the case of any reference incident or accident and under any plant conditions with multiple failures without a total loss of coolant by the secondary cooling system to ensure the cooling of the primary cooling system up to the operating conditions of an emergency core-cooling system.

III-2.2. In the under-water fuel storage racks

III-2.2.1. Cooling control

Throughout the operation of the under-water fuel storage rack, the water inventory of the rack pool and its actual cooling shall be monitored at all times.

III-2.2.2. Cooling means

Suitable systems for managing the water inventory in the rack pool and its actual cooling shall ensure that any residual power of the stored fuel is removed at all times.

Cooling systems shall have a sufficient design exchange capability in order to remove any residual power of the fuel at all times by maintaining the temperature of the pool water under its boiling point.

Cooling systems shall also be designed in order to be able to start and operate under boiling-water situations in the rack pool.

Any leak or break occurring in a system likely to transport any water from the rack pool:

- shall either be considered as excluded by a set a measures covering the same aspects as those mentioned in II-1 of this article, and
- shall not lead to a direct uncovering of the fuel assemblies during handling or already stored on the rack.

For stored assemblies, the non-uncovering of fuel assemblies shall be guaranteed even in the absence of any isolation action.

In the case of any accidental partial drainage stopping the cooling systems from pumping the water of the rack pool, a suitable emergency system shall be able:

- to prevent the deferred uncovering of the fuel assemblies stored on the rack due to boiling, and
- to re-establish a sufficient water level in order to restart the cooling system.

III-3. Containment of radioactive substances

III-3.1. Containment guaranteed by the fuel rod cladding

The containment of the radioactive material of the nuclear fuel by the fuel rod cladding shall be monitored. Such monitoring shall be adapted to the different storage, handling and operating phases of the fuel assemblies on the site.

Only fuel assemblies with a cladding designed and manufactured to remain intact under normal operating conditions and during the most likely incidental transients may be loaded in the nuclear reactor.

The storage conditions for fuel assemblies in the spent fuel pool shall prevent and protect all fuel rod claddings against any damage risk.

III-3.2. Containment guaranteed by the primary cooling system

As soon as the primary cooling system is closed, its activity and its leaks shall be monitored at all times and a corresponding report shall be prepared periodically.

In the case of operating situations where the removal of the heat from the primary cooling system relies on steam generators, adapted instruments shall monitor more particularly and at all times that the integrity of the primary cooling system is maintained at the level of the tube bundle of every steam generator.

In order to reduce any risk of water release from the primary cooling system into the environment, in case of break of one or several steam-generator tubes, the discharge pressure of the emergency cooling system ensuring the injection of water in the primary cooling system during such situations shall be lower than the set pressure the safety valves of the secondary cooling system.

III-3.3. Containment guaranteed by the buildings

The reactor vessel shall be placed within a containment system including:

- an internal wall made of pre-stressed concrete and covered internally with a leaktightness skin (liner);
- an annular space maintained at a lower pressure than external pressure, and
- an external protective wall made of reinforced concrete.

The internal wall of the containment system shall be designed and built in order to withstand especially any temperature and pressure conditions likely to result from the complete break of main primary piping. In addition, it shall be designed and built in order for its leaktightness to be ensured:

- without requiring any removal of the residual power outside the containment reactor building over the short term, including after an accident involving core meltdown, and
- if a total deflagration occurs, involving the maximum quantity of hydrogen that may be present in the containment system during an accident with core meltdown at low pressure.

Any leak through the internal wall of the containment system shall be collected. The activity of any collected and filtered releases shall be monitored at all times and recorded.

Except for water and steam-line penetrations of the secondary cooling system, all penetrations and openings in the containment system shall lead to peripheral buildings with adequate containment capabilities.

Any penetration in the containment system transporting fluids shall be equipped with suitable isolating devices in order to limit any radioactive release in peripheral buildings. Except for those that are placed on prescribed systems for accident management, such isolating devices shall either be equipped with an automatic-shutdown device in case of accident or remain in the shutdown position as long as nuclear fuel is present in the reactor vessel.

In order to prevent the basemat of the containment system to be perforated in case of accident involving core meltdown, a suitable long-term system shall be implemented in order to collect and to cool any molten radioactive material resulting from the nuclear reactor.

Throughout the lifetime of his installation, the operator shall ensure the reliability of the active elements and the general sound performance of the containment devices, which are designed:

- in case of accident without core meltdown, to prevent the implementation of protective measures for the population living in the vicinity of the nuclear power plant, and
- in case of accident with core meltdown at low pressure, to rely only on very limited measures in scope and time to protect the population.

For that purpose, the leaktightness of each wall of the containment system and of their penetrations shall be tested before any fuel is loaded in the reactor vessel and controlled periodically. All leaktightness controls of the internal wall shall notably be conducted by tests at design pressure.

The building hosting the under-water fuel-storage rack shall be equipped with:

- ventilation systems ensuring its dynamic containment under normal operating conditions and in case of accident during the handling of any fuel assembly, and
- a suitable mechanism in order to detect any leaks resulting from any potential loss of leaktightness of the liner of the rack pool.

In addition, the building shall be designed in order to collect any potential leaks from the rack pool and from any piping connected to the pool.

IV. Protection of the installation against internal hazards or hazards induced by its environment

IV-1. Internal hazards

All safety systems located outside the containment reactor building shall be distributed in divisional areas specifically designed to prevent that any total loss of one divisional area following an internal hazard, notably in case of fire or flood, may compromise the fulfilment of the three basic safety functions referred to in III, assuming the application of a single failure on the systems of the other divisional areas consistently with the safety-demonstration rules for reference transients, incidents and accidents.

IV-2. Risks induced by the environment of the installation

The design of the installation shall ensure that any equipment failure and any structure damage likely to result either from natural events, external human activities to the installation or from any likely combination of those events, shall not impede the fulfilment of the three basic safety functions referred to in III.

Beyond the loading cases selected during the design stage, any hazard induced by the environment of the installation shall not represent, at the commissioning time of the installation, a predominating share of the core-meltdown risk, notably due to design margins.

The operator shall keep abreast of any project that may lead to any modification in the environment of his installation in relation to the description contained in the supporting documents of his aforementioned creation-licence application, that has or may have consequences on the fulfilment of the provisions of this decree. He shall inform the Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN) of such projects as quickly as possible and specify the identified impact with due account of predictable normal and accidental situations.

IV-2.1. Risk of accidental aircraft crash

The capability of the installation to ensure the three basic safety functions in case of an accidental aircraft crash shall be ensured either by the geographical segregation of the redundant systems or the physical protection of the buildings against the direct and indirect impact of such event.

All buildings likely to contain nuclear fuel or to include two divisional areas hosting redundant systems ensuring the fulfilment of the three basic safety functions referred to in III, the main control room or the remote shutdown station shall be protected physically by an external wall made of reinforced concrete.

The loading charges to be selected for the design of the above-mentioned external wall shall be determined by considering not only the overall air traffic and its predictable evolution, but also, by convention, the accidental crash of a military aircraft.

IV-2.2. Earthquakes

The operator shall identify in detail which equipment that is not required for the performance of the basic safety functions referred to in III, but, in case of earthquake up to the selected design level, may lead to the failure of required equipment. Depending on the identified aggression risks, measures shall be taken in order either to prevent such risks or to ensure the protection of the required equipment.

In order to counter the possibility of a long-term loss of external electrical supply, all emergency electrical sources shall be designed and qualified at the design earthquake level.

IV-3. Risk of unavailability of the main control room

Special measures relating to the protection of the main control room and to its habitability shall limit its unavailability as much as possible due to internal hazards or hazards induced by the environment of the installation.

In the case of situations where the main control room is likely to be unavailable, an accessible, operational and habitable remote shutdown station shall ensure:

- the shutdown of the reactor, and
- the ongoing fulfilment and monitoring of the three safety functions referred to in III.

V. Qualification of equipment for safety-demonstration purposes

A demonstration shall be made that all equipment installed in the installation meets their assigned functional requirements in relation to their roles in the safety demonstration and under the environmental conditions associated with the situations for which they are required.

Although special measures shall be taken in order to prevent any double-ended circumferential break of any main primary piping, the qualification of any equipment located within the containment reactor building and involved in the safety demonstration shall integrate the environmental conditions resulting from such break.

Specific study, testing, control and maintenance measures shall be established and implemented in order to ensure the durability of the qualification of the equipment at accidental situations.

VI. Impact control of the operation of the installation on populations and the environment

VI-1. Water intakes and releases

All suitable measures shall be taken in the design and operation of the installation, particularly for the use of the best available industrial technologies at an economically acceptable cost, in order to limit fresh-water intakes and the impact of releases on the populations and the environment.

The operator shall ensure that environmental controls are conducted periodically.

VI-2. Waste

All suitable measures shall be taken in the design and operation of the installation, particularly for the use of the best available industrial technologies at an economically acceptable cost, in order to limit the volume and activity of resulting radioactive waste.

No radioactive waste shall be stored permanently within the delineated perimeter shown on the plan attached to this decree.

VII. Technical 'information of the Institute for Radiation Protection and Nuclear Safety

As soon as the on-sitel emergency plan of the installation is launched, a reliable and secured connection shall be able to transmit on a continuous basis to the Institute for Radiation Protection and Nuclear Safety (*Institut de radioprotection et de sûreté nucléaire* – IRSN) any information resulting directly from the the instrumentation and control and concerning the state of the installation, as well as the nature and level of potential releases to the environment.

Any information transmitted through the aforementioned channel shall help the Institute for Radiation Protection and Nuclear Safety to establish its own diagnosis on behalf of public authorities, notably the Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN).

Article 3

I. The introduction in the perimeter of the installation of any nuclear fuel intended for the first loading into the reactor shall be submitted to the approval of the Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN).

To that end, the operator shall submit, no later than 6 months prior to the expected date for the introduction of nuclear fuel in the perimeter of the installation, an application file containing the relevant elements listed in II for such applications, except if they have already been submitted to the Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN) for the loading operation referred to in II.

II. The regulatory timeframe for performing the first loading of nuclear fuel in the reactor shall be 10 years after the publication of this decree in the *Journal officiel de la République française* (Official Gazette). Such timeframe shall constitute the commissioning timescale referred to in Article 29 of the aforementioned *Law of 13 June 2006*.

In order to obtain the authorisation referred to in the previous paragraph, the operator shall submit to the Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN) the following documents, no later than 12 months prior to the expected date for the first loading of nuclear fuel in the reactor, in addition to the other documents prescribed by the regulatory provisions applicable to basic nuclear installations:

- a safety report containing the updates to the preliminary safety report;
- the general operating rules that the operator intends to implement in order to protect the interests mentioned in I of Article 28 the aforementioned *Law of 13 June 2006*, and
- an on-site emergency plan.

Article 4

The Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN) shall be informed of any modifications brought to the installation or to the operating conditions in the cases and in accordance with the modalities specified in the aforementioned *Law of 13 June 2006* and its enforcement instruments.

Provided that they do not call for the delivery of a new authorisation taken in application of II of Article 29 of the said Law, those modifications may be submitted to the prior approval of the Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN) in the cases and in accordance with the modalities specified in the said Law and its enforcement instruments.

Article 5

The final shutdown and dismantling of any installation shall be subject to prior authorisation. The corresponding application shall contain the elements listed in V of Article 29 of the aforementioned *Law of 13 June 2006* and its enforcement instruments.

Article 6

With regard to Article L. 1333-4 of the *Public Health Code*, this decree shall be considered as an equivalent authorisation for importing, exporting and holding any required radioactive source and device emitting ionising radiation for the operation of the installation.

Article 7

The Minister of Economy, Finance and Industry, the Minister for Ecology and Sustainable Development and the Minister for Industry shall be responsible, each in his or her own jurisdiction, for the enforcement of this decree to be published in the *Journal officiel de la République française* (Official Gazette).

By the Prime Minister:

Dominique de Villepin

Minister of Economy, Finance and Industry,

Thierry Breton

Minister of Ecology and Sustainable Development,

Nelly Olin

Minister for Industry,

François Loos