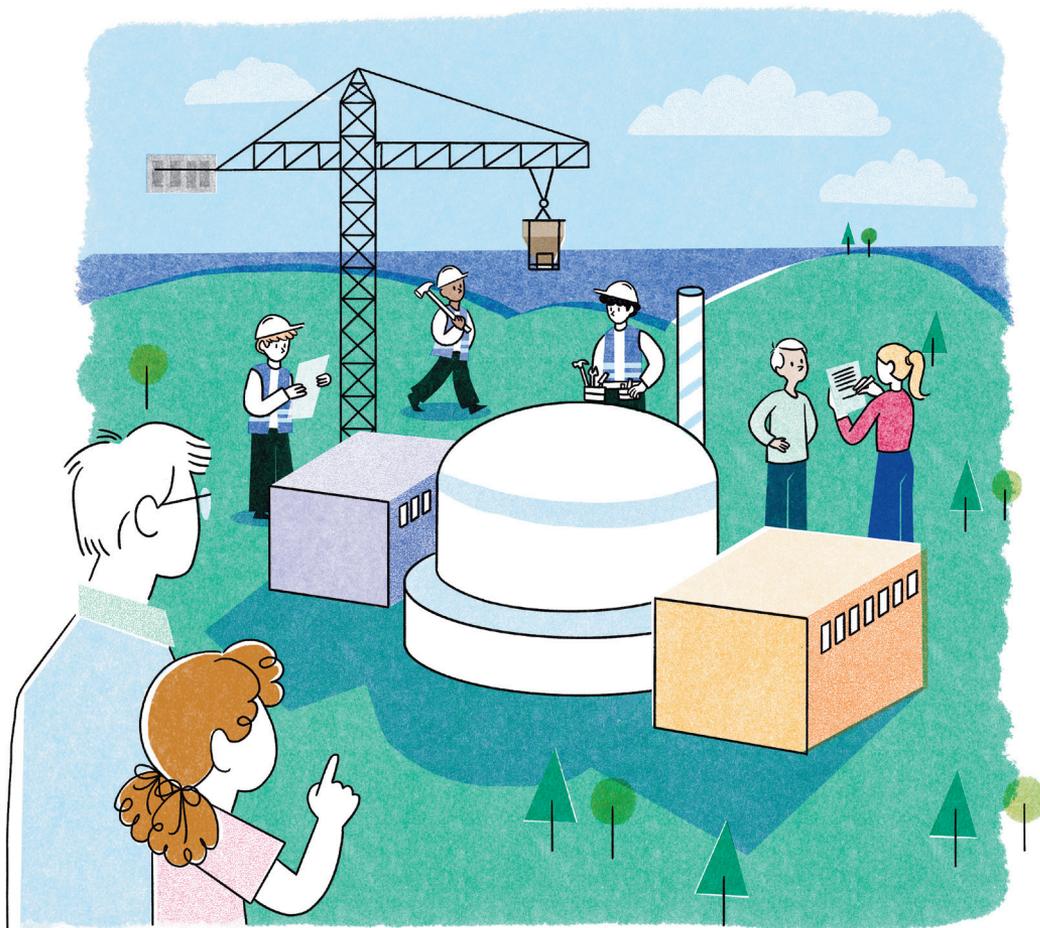


# 1,300 MWE NUCLEAR REACTORS

## Conditions for the continued operation of reactors beyond 40 years



The 4th periodic  
safety review

ASNR's decision and  
requirements

Involvement of  
the public

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## THE FOURTH PERIODIC SAFETY REVIEW

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*Words marked with an asterisk can be found in the glossary on page 34.*

**NOTE TO READERS:** the French Authority for Nuclear Safety and Radiation Protection (ASN), created by the law on the organisation of the governance of nuclear safety and radiation protection of 21 May 2024, came into operation on 1 January 2025. It brings together the duties, activities and teams of the French Nuclear Safety Authority (ASN) and, for the most part, those of the French Institute for Radiation Protection and Nuclear Safety (IRSN) within a single organisation.

The twenty nuclear reactors with a capacity of 1,300 MWe in service today in France are approaching their 40th year of operation. Following extensive analysis and expert assessment, as well as broad public involvement in the review process, ASN<sup>R</sup>\* has reached a decision on the conditions necessary for the continued operation of the reactors, and on the safety improvements that EDF will have to implement during the periodic safety review.

**As the licensee\***, EDF is required to carry out a periodic safety review\* of each of its reactors every ten years.

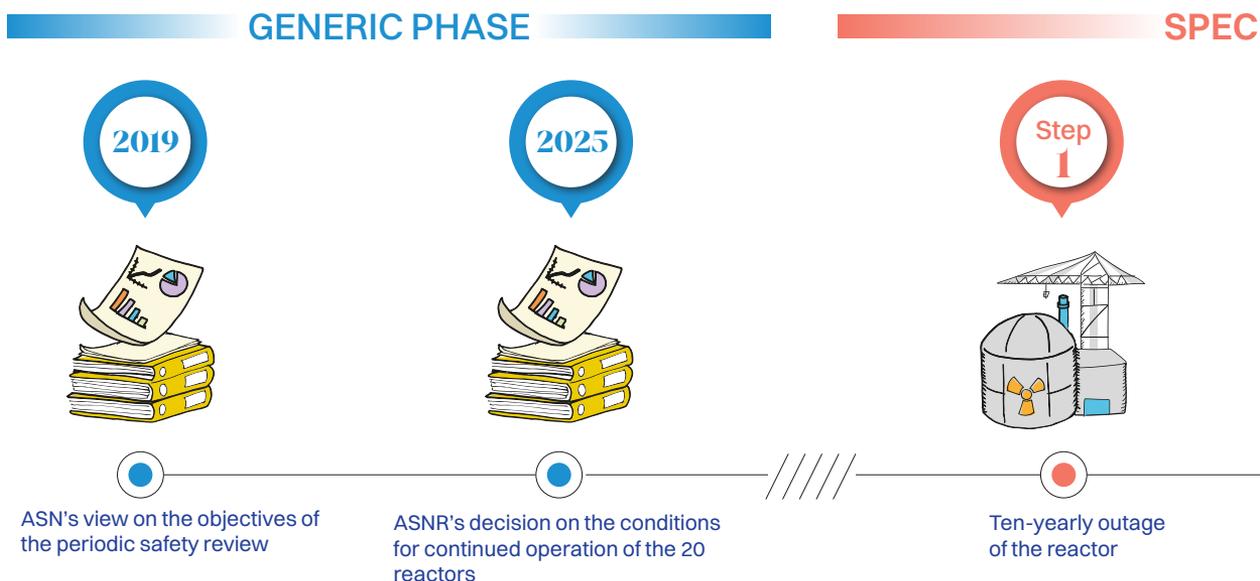
During each periodic safety review, the condition of the facility is checked, its compliance with applicable rules is verified, and safety improvements are implemented, taking into account the requirements that apply to the most recent facilities in France and abroad.

**As the independent authority** tasked with monitoring nuclear safety, ASN<sup>R</sup> is responsible for analysing the studies carried out by the licensee and for defining the conditions for continued operation of the reactors. This “Cahier de l’ASN<sup>R</sup>” brochure presents ASN<sup>R</sup>’s conclusions on the fourth periodic safety review of the 1,300 MWe reactors with regard to areas such as component ageing, resistance to natural hazards (earthquakes, floods and fires), and safety enhancements to the spent fuel pools.

## What is the purpose of a periodic safety review?

In France, the authorisation to create a nuclear facility is issued by the government after consulting ASN. This authorisation is granted for an unlimited period. However, an in-depth examination of the facility, known as a «periodic safety review», must be carried out every ten years in order to assess the conditions for continued operation of the facility for a further ten years.

During such periodic safety reviews, the licensee must ensure that the facility is operated in compliance with the applicable safety rules, and that equipment ageing phenomena are managed appropriately. It must also improve the safety of the facility by bringing it closer in line with the levels achieved by the most recent facilities.



# 1

**Analysis phase common to all twenty 1,300 MWe reactors**

## Generic phase

In 2019, the French Nuclear Safety Authority (ASN\*) determined that the general objectives set by EDF for the generic phase of the periodic safety review of the 1,300 MWe reactors were acceptable subject to additional information being provided on certain baseline requirements to be taken into consideration, and the inclusion of additional topics of study.

Between 2021 and 2024, ASN analysed the generic studies carried out by EDF on all of the 1,300 MWe reactors, with expert input from IRSN\* and the involvement of its Advisory Committees of Experts\*.

Following this analysis, ASN issued a position statement on EDF's generic studies. This is based, in particular, on the requirements setting out the conditions for the continued operation of reactors beyond 40 years. In 2025, these requirements were the subject of an opinion by the Advisory Committee for Nuclear Reactors as well as a public consultation on ASN's website.

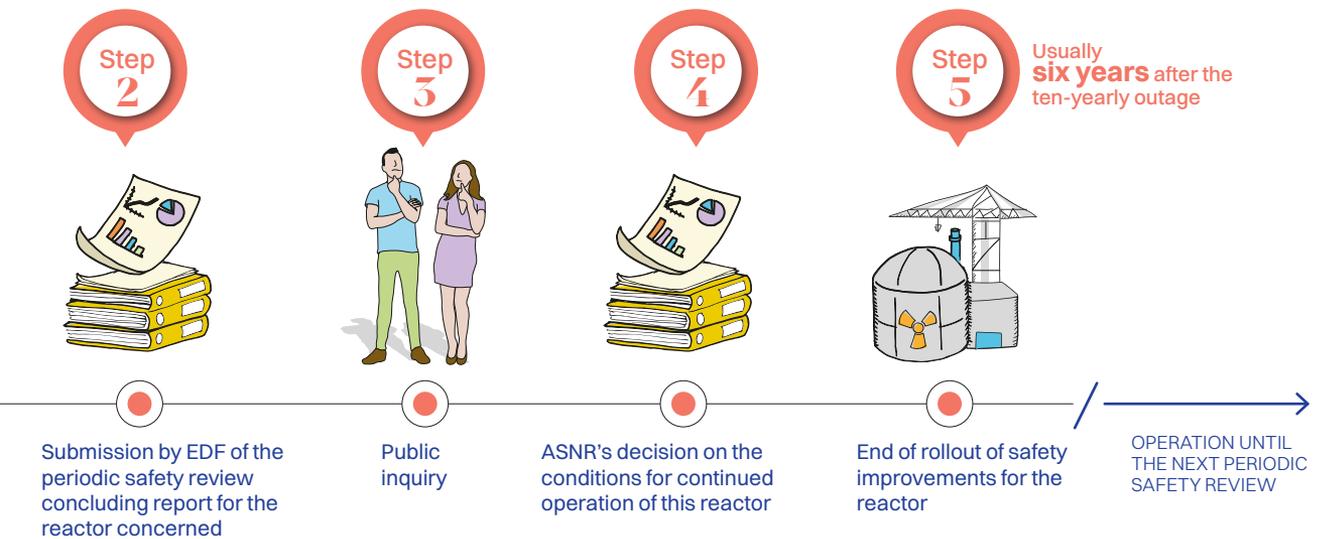
The fourth periodic safety review of the 1,300 MWe reactors follows on from the fourth periodic safety review of the 900 MWe reactors. Therefore, it benefits from feedback from the review of the latter.

## What does it involve?

The fourth periodic safety review of the 1,300 MWe reactors consists of two complementary phases: **an initial analysis phase, common to all reactors, known as the «generic» phase** (all of the reactors having been designed according to a similar model); **and a second, «specific» phase**, which takes into account the characteristics specific to each facility - in particular its geographical location (coastal or riverside site, industrial environment, etc.).

The associated safety improvements are implemented on the reactors during two maintenance outages. The first of these, the ten-yearly outage\*, is the most important..

## IFIC PHASE for each of the 20 reactors



## 2

### Rollout phase for safety improvements on each reactor

### Specific phase

Starting in 2027, EDF will submit a periodic safety review concluding report\* for each 1,300 MWe reactor, based on the studies from the generic phase, and taking the specific features of the reactor into account.

This concluding report will describe the works selected for review, and, in particular, those already carried out during the ten-yearly outage.

It will be the subject of a public inquiry\* and an analysis by ASNR.

Finally, ASNR will issue additional requirements for the continued operation of each reactor, following a public consultation on its website.

# Substantial work carried out according to a set schedule

### PROVISIONAL SCHEDULE OF THE TEN-YEARLY OUTAGES

#### 2026

- Paluel 1

#### 2027

- Cattenom 1
- Paluel 2 and 3
- Saint-Alban 1

#### 2028

- Cattenom 2
- Flamanville 1
- Saint-Alban 2

#### 2029

- Belleville 2
- Flamanville 2
- Nogent 1
- Paluel 4

#### 2030

- Belleville 1
- Nogent 2

#### 2031

- Cattenom 3
- Penly 1

#### 2032

- Golfech 1

#### 2033

- Cattenom 4

#### 2034

- Golfech 2
- Penly 2

The fourth ten-yearly outages for the 1,300 MWe reactors have been scheduled by EDF to take place between 2026 and 2034, with the associated periodic safety review concluding reports to be submitted between 2027 and 2035.

The schedule for the fourth periodic safety reviews of the 1,300 MWe reactors is based on the date of the previous periodic safety review of each reactor.

Reactors 1 and 2 at Paluel nuclear power plant and reactor 1 at Cattenom nuclear power plant were the first to undergo their third periodic safety review. Therefore, they will be the first to undergo the fourth periodic safety review, ten years later.

### A substantial programme of industrial activity from 2026 onwards

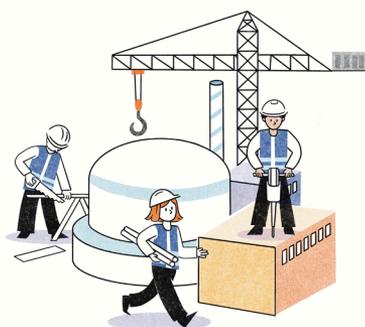
A large proportion of the works planned within the scope of the periodic safety review will be carried out by EDF during the ten-yearly outages prior to the submission of the periodic safety review concluding reports. Three 1,300 MWe reactors will submit their periodic safety review concluding reports in 2027. Consequently, a significant number of ten-yearly outage inspections will be carried out on the 1,300 MWe reactors at the start of the specific

phase. This situation requires EDF to be very well prepared right from the start of this phase.

### Works schedule validated by ASN in 2023

Owing to their scale, it will not be possible to implement all of the works during these ten-yearly outage inspections. Therefore, as was the case with the 900 MWe reactors, the improvements will be spread over time by splitting them into two phases of modifications. This means that some of the work will be carried out several years after the ten-yearly outage inspections.

In order to ensure that the improvements most important for safety are made as early as possible, ASN issued a position statement in 2023 regarding the work to be done during the ten-yearly outage inspections. This works schedule will be the same for all 1,300 MWe reactors and as such constitutes a guarantee of success for their implementation. It takes account of the ability of industrial providers to carry out the work to the expected level of quality, as well as the related training required for operators to become familiar with these modifications.



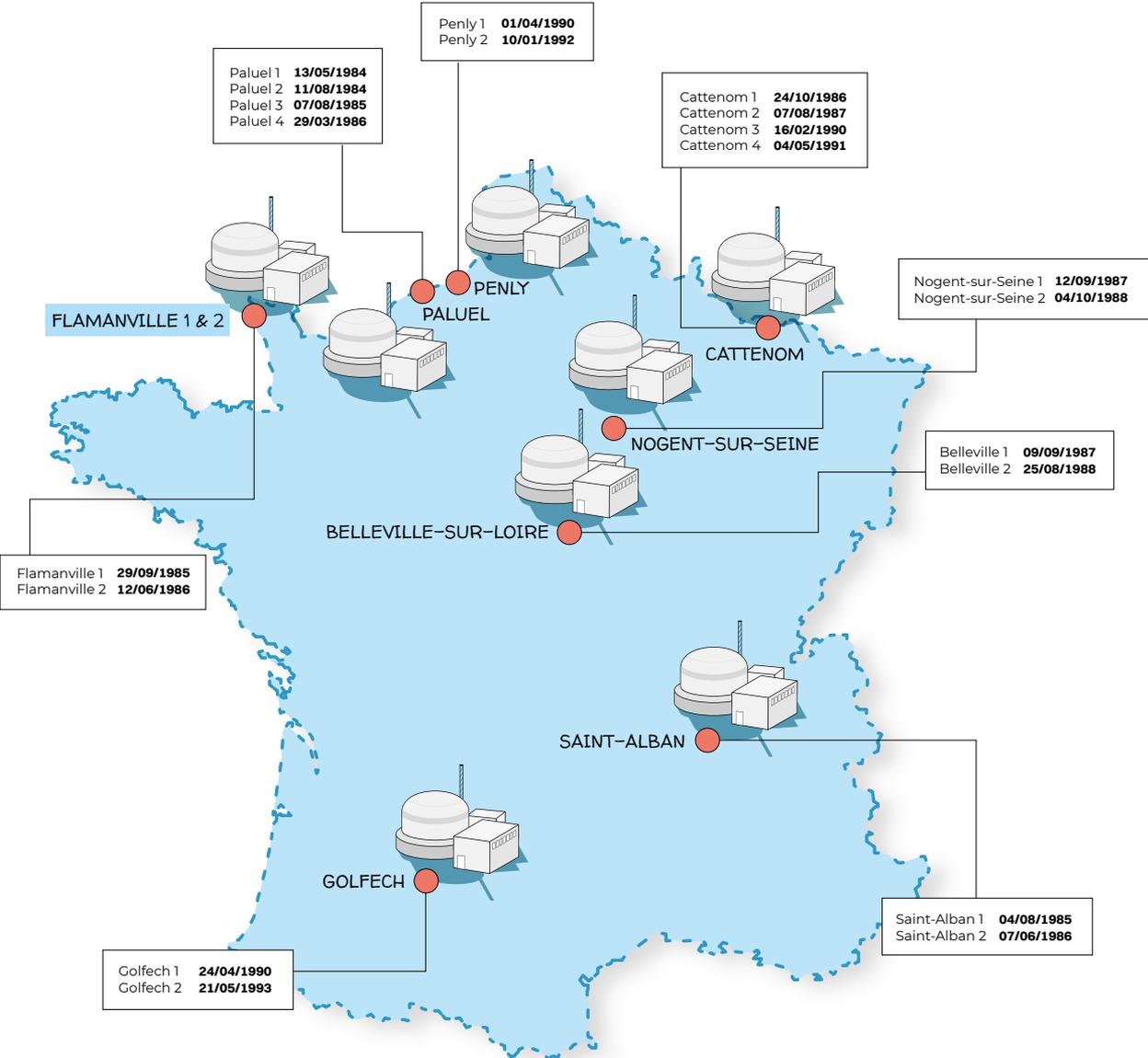
## SUBSTANTIAL WORK ASSOCIATED WITH THE PERIODIC SAFETY REVIEW

As part of the fourth periodic safety review, EDF plans to carry out substantial work aimed at improving accident management and making reactors more resilient to hazards. New safety systems will be installed, in particular the following :

- An ultimate containment cooling system, to remove heat from the reactor building in the event of a core melt accident;
- A system for distributing water from the ultimate water source to supply the steam generators and the spent fuel pool.
- A corium\* stabilisation device designed to prevent melt-through of the bottom of the reactor containment in the event of a core meltdown accident.

**20**  
reactors  
concerned

**START-UP DATES  
OF THE 1,300 MWE REACTORS**



# A vigorous expert assessment process to support ASNR's decision

ASNR relies on a proven assessment process which draws on significant resources, including, first and foremost, high-level expertise to enable precise analysis of the different aspects of the proposed measures. The conclusions of this assessment fuelled the discussions of the Advisory Committees of Experts, whose opinions enabled ASNR to formulate its decision.

## IRSN's expertise<sup>(1)</sup>

Between 2019 and 2024, at ASN's request, the teams at IRSN assessed the significant volume of studies submitted by EDF for the fourth periodic safety review of the 1,300 MWe reactors.

IRSN submitted around 40 expert opinions to ASN regarding the studies with the greatest safety implications. These opinions concern hazards, accidents, ageing of facilities and containment of radioactive materials.

In preparation for the meetings of the Advisory Committees of Experts, IRSN also drafted four assessment reports on the following topics :

- **consideration of internal and external hazards**
- **re-assessment of accident studies**
- **control of core meltdown accidents**
- **in-service behaviour of nuclear pressure equipment, and in particular reactor pressure vessels**

The fourth periodic safety review of the twenty 1,300 MWe nuclear reactors involved almost 160 engineers and researchers over a five-year period. Together, these individuals devoted over 180,000 hours of work to producing the technical conclusions that informed ASNR's decision.

**160**  
engineers and  
researchers



<sup>(1)</sup> IRSN and ASN became ASNR on 1 January 2025

## Advisory Committees of Experts

The Advisory Committees of Experts are made up of members appointed on the basis of their skills. They come from expert bodies, nuclear industry companies, foreign safety authorities and associations.

The Advisory Committees of Experts are consulted on issues of nuclear safety and radiation protection at the request of ASNR's Director General. They issue an opinion, which may also include recommendations.



### Opinions issued by the Advisory Committees of Experts

22 MAY 2019	<b>Guidelines for the generic phase of the periodic safety review</b>
3-4 JULY 2024	<b>Internal and external hazards</b>
14-15 NOVEMBER 2024	<b>Management of core meltdown accidents</b>
4-5 DECEMBER 2024	<b>Accident studies</b>
17-18 DECEMBER 2024	<b>Nuclear pressure equipment</b>
29-30 APRIL 2025	<b>Results of the generic phase of the periodic safety review</b>

# ASNR's decision on the generic phase of the fourth periodic safety review

ASNR's decision of 1 July 2025 concludes the generic phase of the fourth periodic safety review of the 1,300 MWe reactors. The decision defines the conditions (common to all of the 1,300 MWe reactors) that EDF will be required to meet in order to continue operating the reactors beyond 40 years. It provides the framework for rolling out the modifications to the facilities, which will kick off in early 2026 with the fourth ten-yearly outage inspection of reactor 1 at the Paluel nuclear power plant.

## An ambitious review designed to improve reactor safety, modelled on the periodic safety review of the 900 MWe reactors

Ambitious objectives, similar to those adopted for the 900 MWe reactors, have been established for this fourth periodic safety review of the 1,300 MWe reactors, and ASNR wishes to underline the magnitude of the studies carried out by EDF during the generic phase.

These studies have enabled EDF to identify numerous modifications to the facilities that will be required to improve reactor safety.

## ASNR's requirements for rolling out the periodic safety review on each reactor

ASNR has set out the requirements governing the rollout of the most important modifications and the additional studies necessary to ensure that the objectives are met.

As was the case for the 900 MWe reactors, ASNR requires EDF to provide an annual report on the actions taken to meet the requirements and their associated deadlines, and on the industrial capacity of EDF and its nuclear industry partners to

implement the modifications to the facilities within the set timeframes. ASNR asks that this information be made public.

ASNR will perform inspections during EDF's checks on each of the reactors and during the rollout of the modifications, particularly during the ten-yearly outages.

ASNR considers that the conclusions from the generic phase of the periodic safety review will pave the way for the continued operation of the 1,300 MWe reactors for the ten years following their fourth periodic safety review.

ASNR considers that, alongside compliance with the requirements set out by ASNR, the measures planned by EDF will enable the objectives of the periodic safety review to be met, and will ensure that the safety level of the 1,300 MWe reactors is brought closer to the level achieved by the most recent reactors (third-generation reactors). As with the 900 MWe reactors, this will deliver the following notable outcomes:



**Verification on a large scale that the reactors comply** with the applicable safety rules  
*(see page 12)*



**Improved consideration of the risks of hazards** (such as flooding, explosion, fire, etc.,) and protection of the reactors against more severe natural hazards than those taken into account to date  
*(see page 14)*



**Improved arrangements for managing accident situations** in spent fuel pools  
*(see page 16)*



**Limitation of the consequences of core meltdown accidents,** in particular by reducing situations that would require the containment\* to be depressurised, and by implementing measures to significantly reduce releases into the environment during this type of accident  
*(see page 18)*



**Limitation of the radiological consequences of accidents not involving core melt.** This will make it possible to significantly reduce the occurrence of situations requiring measures to protect the general public to be taken (sheltering, evacuation, consumption of iodine tablets)  
*(see page 20)*



**Identification of improvements enabling each site to reduce its impact on the environment**  
*(see page 21)*



# Ageing and compliance of facilities

*How should the facilities be managed?*

Verification of facilities' compliance with applicable rules, and maintenance of that compliance over time, are based primarily on the following:

- verification of the compliance of equipment and structures and, where applicable, implementation of measures required to restore compliance
- management of equipment ageing and obsolescence.

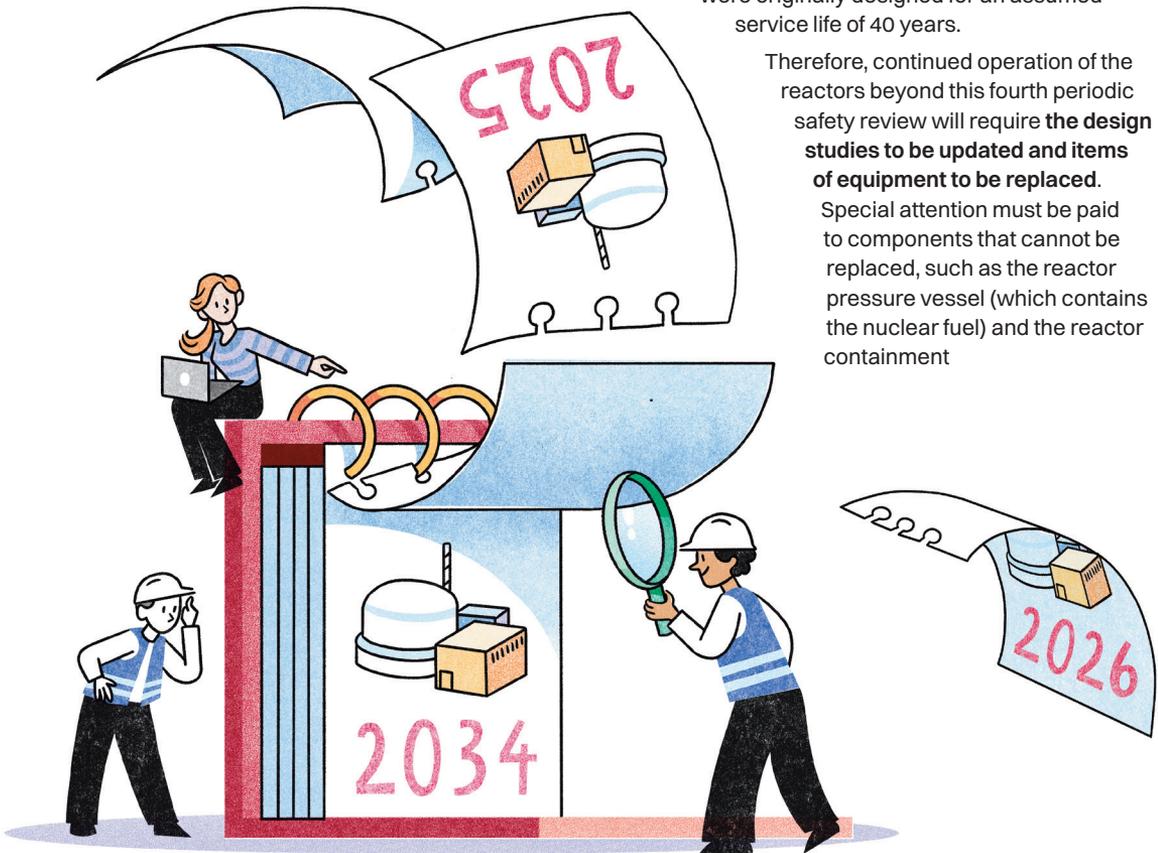
Daily actions are carried out to support ageing and compliance management (such as monitoring, maintenance, inspection, treatment of deviations, and replacement of equipment), and to ensure that the facilities comply with all **rules governing safe operation**.

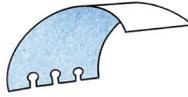
**The compliance of reactors is an essential prerequisite for their safety.**

Therefore, verification of compliance with baseline safety requirements is a key objective of the periodic safety reviews. Certain items of reactor equipment were originally designed for an assumed service life of 40 years.

Therefore, continued operation of the reactors beyond this fourth periodic safety review will require **the design studies to be updated and items of equipment to be replaced**.

Special attention must be paid to components that cannot be replaced, such as the reactor pressure vessel (which contains the nuclear fuel) and the reactor containment





## What new measures is EDF planning?

The fourth periodic safety review provides the ideal framework for re-assessing the compliance of certain items of equipment or systems, such as electric power sources and safety functions (e.g. containment of radioactive materials).

As was the case with the 900 MWe reactors, EDF plans to implement **a reactor compliance verification programme** to ensure that existing preventive maintenance programmes are being correctly applied. EDF has also supplemented its actions with extensive checks in the field. The scope of these checks takes

into account the specific features of the 1,300 MWe reactors.

**As part of its equipment ageing and obsolescence management approach**, EDF has implemented the following measures:

- a generic analysis of ageing and the associated consequences;
- a local analysis specific to each reactor, carried out during its ten-yearly outage inspection.

**In particular, EDF has justified the absence of a risk of sudden rupture of the 1,300 MWe reactor vessels** during the ten-year period following the fourth ten-yearly outage, subject

to the results of inspections to be carried out on each of the vessels.

Each reactor will also undergo pressure tests on the primary system and the reactor containment.

Lastly, **EDF has undertaken to resolve any deviation identified beforehand, particularly those with safety consequences**, during the fourth ten-yearly outage in each reactor at the latest. Any deviation detected during the ten-yearly outage itself will be corrected as soon as possible, taking account of their significance.

## The ASNR's *décision*

EDF's programme for managing ageing and verifying the compliance of its reactors, supplemented by compliance with ASNR's requirements, is satisfactory. It will enable the objectives of the periodic safety review to be achieved.

ASNR asks that EDF, in addition to the initially planned measures:

- provides justification of the behaviour of the seals on the reactor building equipment hatc,
- provides justification of the containment function provided by the reactor containment with respect to core melt accident situations.

These different points are subject to requirements in ASNR's decision.

EDF must pay special attention to the implementation of the programme for verifying reactor compliance. ASNR plans to **carry out specific inspections on each reactor with regard to this topic, particularly during the ten-yearly outages.**



## Fire, flood, earthquake, etc...

*How can hazards be addressed more effectively?*

Nuclear power plants are designed to withstand various hazards that can directly or indirectly affect equipment and structures important for safety.

The facilities must be able to withstand :

- **Hazards originating inside the facility** (fires, explosions, pressure equipment failures, falling loads, flooding caused by pipe ruptures, etc.
- **External hazards, which may be natural in origin** (earthquakes, lightning, floods, extreme weather conditions such as heat waves or tornadoes) or **caused by industrial activities and transport routes in the surrounding area** (explosions, releases of hazardous substances, accidental aircraft crashes.



## What new measures is EDF planning ?

The general approach to reviewing the risks associated with hazards comprises the following steps:

- Re-assessment of the levels of hazard to be considered, in light of experience gained and advancements in knowledge, particularly with regard to climate change;
- Examination of the suitability of existing protection measures to handle such levels of hazard and, where applicable, identification of improvements to be made to the facilities;

EDF has re-assessed the safety of its reactors with

respect to the risks associated with the different types of hazards likely to affect the facilities.

**The studies carried out have enabled numerous modifications to be identified that will enhance the safety of the reactors.**

**The climate-related hazards taken into account include the consequences of climate change in light of available knowledge. In addition, EDF is setting up a monitoring system to track the development of these risks, and to collect data on heatwaves and rising sea levels in particular.**

This periodic safety review also provides the opportunity to **complete the rollout of the “hardened safety core”\* in line with the safety provisions prescribed by ASN in 2012** following the accident at the Fukushima nuclear power plant. These provisions will make it possible to withstand certain extreme events (earthquakes, floods, etc.) of a higher level of intensity than those experienced to date.

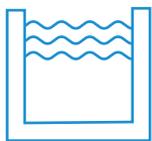
### The ASNR's decision

ASNR wishes to underline the substantial work carried out by EDF to update all of the internal and external hazard studies. The methods used by EDF to define the hazard levels are acceptable. The modifications resulting from these studies constitute a significant improvement in the management of risks associated with hazards, and will enable the objectives of the periodic safety review to be achieved.

ASNR has issued requirements governing the rollout of certain modifications in view of the associated implications which are particularly significant.

These requirements relate in particular to:

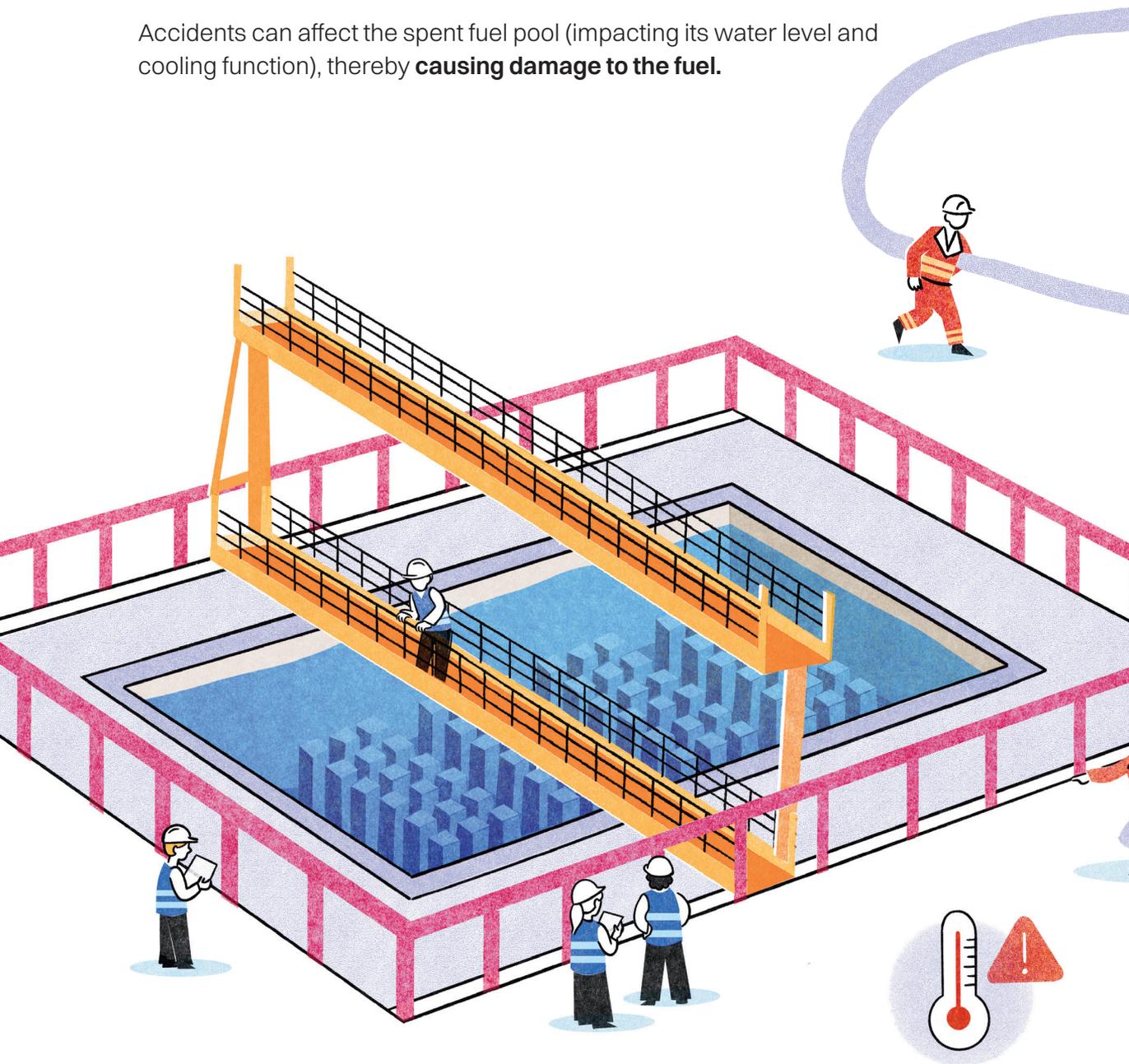
- **temperature levels to be taken into account for heatwaves,**
- **modifications required to limit fire-related risks,**
- **identification of key valves for managing internal flooding situations,**
- **the level of extreme earthquakes that the «hardened safety core» must be able to withstand.**



## Spent fuel pool

*How can safety be improved?*

Accidents can affect the spent fuel pool (impacting its water level and cooling function), thereby **causing damage to the fuel**.



## What new measures is EDF planning?

EDF plans to install **a water make-up system** via a diversified ultimate water source, as well as a supplementary cooling system to improve the safety of the spent fuel pool.

EDF has extended the scope of accident situations analysed with respect to the spent fuel pool.

**As result of these analyses, it has defined a new operational strategy for cooling the fuel assemblies in certain situations.**

Finally, EDF has provided justification that cooling of the fuel assemblies in the spent fuel pool **would not be jeopardised by an accidental crash involving a light aircraft.**

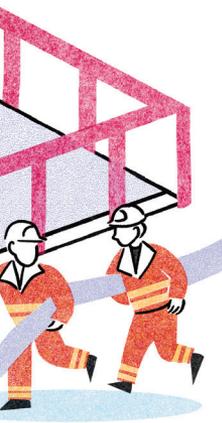
### The ASNR's decision

The additional measures planned by EDF will constitute major improvements to the safety of the spent fuel pools.

These new measures, most of which relate to the «hardened safety core», will significantly reduce the risk of fuel assemblies no longer being cooled under water and, in the majority of the situations considered, will enable a final post-accident state to be reached without pool boiling.

For situations in which it would not be possible to achieve such a state using the cooling system or the supplementary cooling system, **EDF must define measures to improve prevention of the associated accidents**, as well as post-accident management measures.

These different points are subject to requirements in ASNR's decision. The results of the studies conducted by EDF, and the planned modifications, supplemented by compliance with the requirements set out by ASNR, will enable the objectives of this periodic safety review to be met.



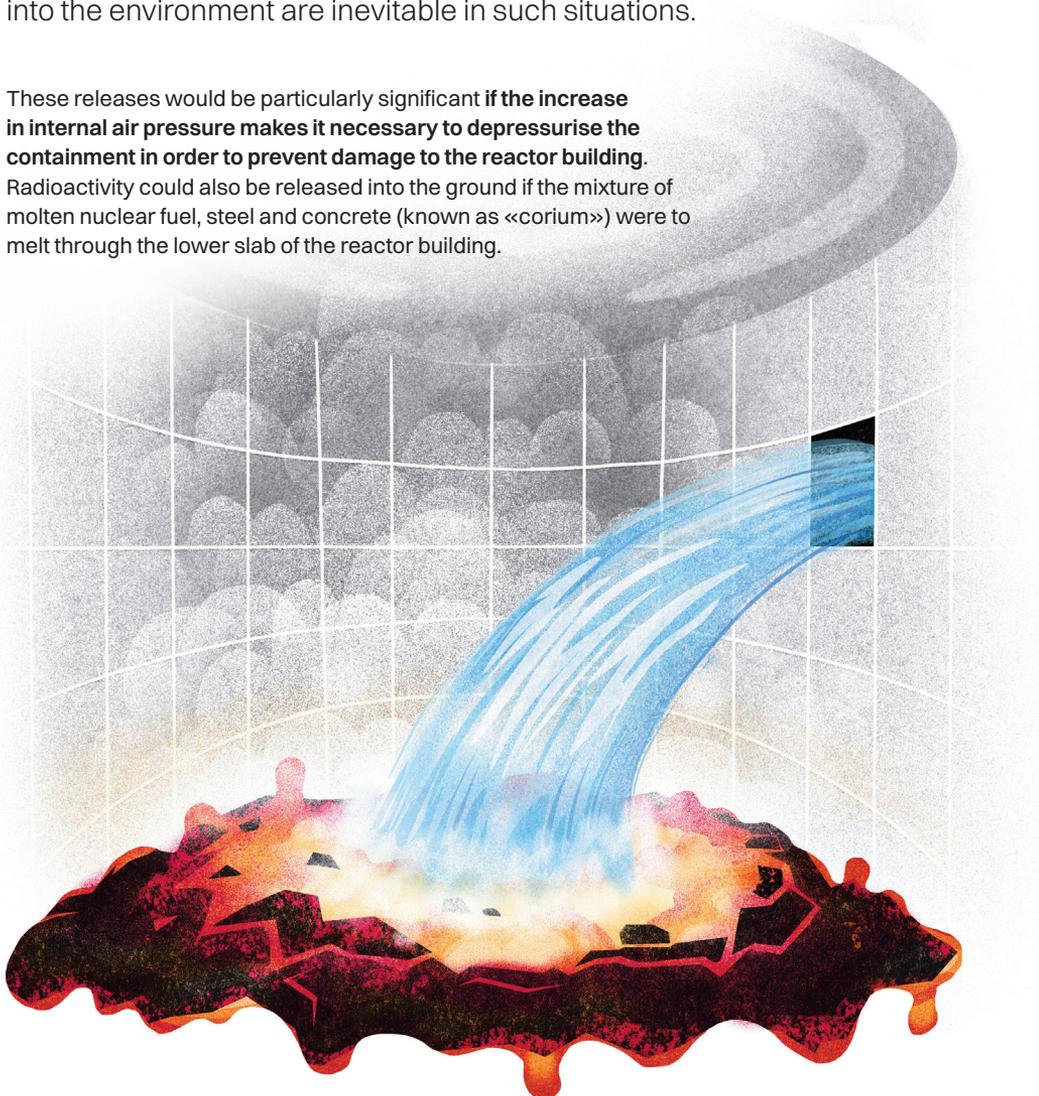


## Severe accidents involving core melt

*How can the effects be limited?*

**Core meltdown is the most serious accident that can occur in a nuclear reactor.** It manifests itself by melting of the nuclear fuel which can then breach the reactor vessel, leading to a very substantial release of radioactivity (in the form of aerosols, gas and radioactive water) into the concrete containment. Releases of radioactivity into the environment are inevitable in such situations.

These releases would be particularly significant **if the increase in internal air pressure makes it necessary to depressurise the containment in order to prevent damage to the reactor building.** Radioactivity could also be released into the ground if the mixture of molten nuclear fuel, steel and concrete (known as «corium») were to melt through the lower slab of the reactor building.



## What new measures is EDF planning?

EDF has set the goal of avoiding lasting effects on the environment in the event of a core melt accident. As a result, EDF plans to modify its facilities in order to:

- **be able to remove the heat produced by the core from the containment** without having to depressurise this enclosure. This will significantly limit releases of radioactivity into the air;
- **limit the risk of corium melting through the lower slab of the reactor building.**

The measures planned by EDF for **managing such accidents more effectively** will include the installation, during the ten-yearly outage, of new systems (including new pumps, new piping and new heat exchangers) forming part of the «hardened safety core», as well as modifications to the reactor pit and certain adjacent areas.

Mobile equipment will also be deployed by EDF's Nuclear Rapid Intervention Force (FARN) in the event of a core meltdown accident.

Finally, EDF plans to **implement measures to limit leaks of contaminated water** outside the reactor building and the safeguard auxiliary building in the event of a core meltdown accident, and to reduce the contamination level of the water in the reactor building

### The ASNR's decision

ASNR underlines the very substantial work carried out by EDF with regard to limiting the consequences of core meltdown accidents, and the ambitious nature of the related modification programme. This programme will enable major advances to be made in safety, and will meet the objectives of this periodic safety review.

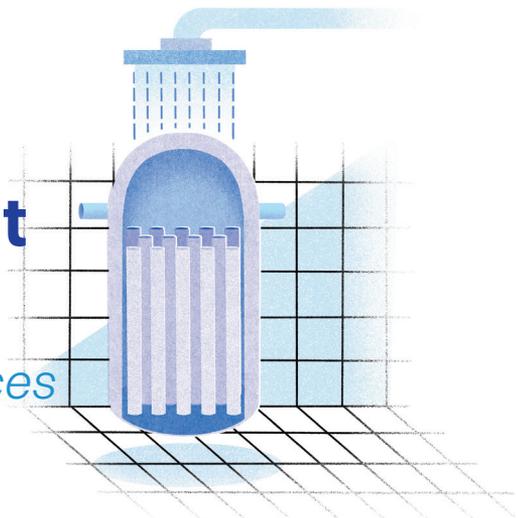
However, having completed its assessment, ASNR considers that EDF must supplement the measures planned to manage a core meltdown accident, in particular by **increasing the thickness of the concrete of the lower slab of the reactor building** to ensure containment of corium.

These different points are subject to requirements in ASNR's decision.



## Accidents without core meltdown

*How can the consequences be reduced?*



In an accident not involving core melt, little or no damage occurs to the nuclear fuel. Such accidents can, however, lead to radioactivity being released into the environment. **Controlling such accidents can prevent core meltdown.**

The safety case for reactors covers both accidents resulting from a single failure (for example, a small break in the primary cooling system) and accidents resulting from multiple and cumulative failures (for example, loss of on-site and off-site power).

### **What new measures is EDF planning?**

*EDF plans to update its safety case in light of developments in knowledge and the conclusions of investigations carried out prior to the periodic safety review. Its aim is to work towards levels of radioactive releases into the environment that do not require population protection measures (sheltering, evacuation, consumption of iodine tablets).*

*During the generic phase of the periodic safety review, EDF reviewed all the studies associated with various accidents.*

*In particular, EDF assessed the effects of physical phenomena not previously taken into account in the safety case, such as deformation of the nuclear fuel assemblies.*

*EDF is also planning to modify its facilities, in particular by adding four shutdown control rods\* to the reactor cores, and replacing the pump used to inject borated water into the reactor coolant pump seals.*

### **The ASNR's decision**

The modifications planned by EDF will improve the management of incident and accident situations not involving core melt, and will therefore also improve the prevention of core meltdown accidents.

They will limit the radiological consequences of the accidents analysed in the safety case. This will significantly reduce the occurrence of situations requiring population protection measures.

**The results of these studies and the modifications planned by EDF will enable the objectives of the periodic safety review to be met.**



# Protection of the environment

*How can environmental protection be improved?*

The normal operation of nuclear power plants has an impact on the environment. This includes, in particular, water intakes, effluent discharge and harmful effects such as noise, vibrations, dust emissions, odours, the dispersion of pathogenic microorganisms and the production of waste.

Environmental impacts are specific to each site.

## *What measures are planned by EDF?*

*As with the 900 MWe reactors, the generic phase of the review made it possible to define the actions to be implemented for each reactor in order to review the management of environmental impacts. EDF has thus defined the scope of the checks and studies to be carried out, for example with respect to the chemical and radiological condition of the soil at each reactor.*

## The ASNR's decision

ASNR considers that the analysis and verification programme planned by EDF needs to be supplemented. In particular, EDF must:

- **Carry out an in-depth diagnosis of the performance of its reactor systems designed to reduce water intake as well as discharges of chemical and radioactive effluent into the environment.** Where applicable, EDF must identify the actions needed to restore expected system performance and maintain it over time.
- **Analyse its operating practices in terms of water intake and discharges,** taking into account, in particular, the latest available data on hydro-climatic changes and specific water resource issues. EDF must specify the improvements that it plans to make to help reduce the environmental impact of its facilities in light of the conclusions of this analysis and the best available techniques.

In addition, ASNR asks EDF to consolidate the environmental impact assessment in the form currently provided for in the French Environment Code.

These different points are subject to requirements in ASNR's decision.



# Priority improvements to be carried out during the ten-yearly outages and beyond

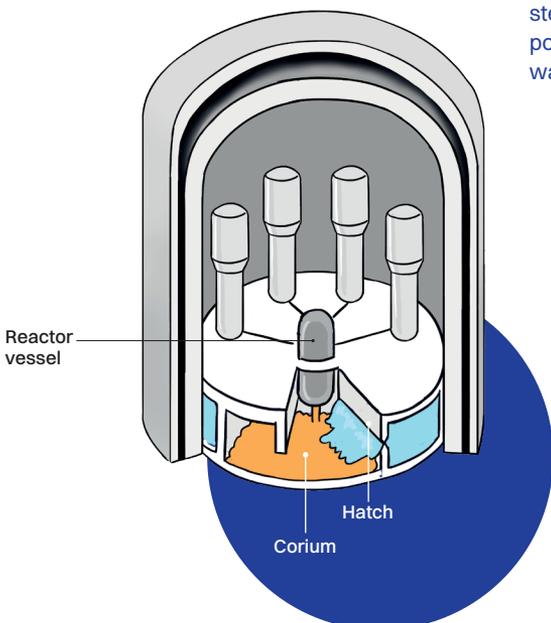
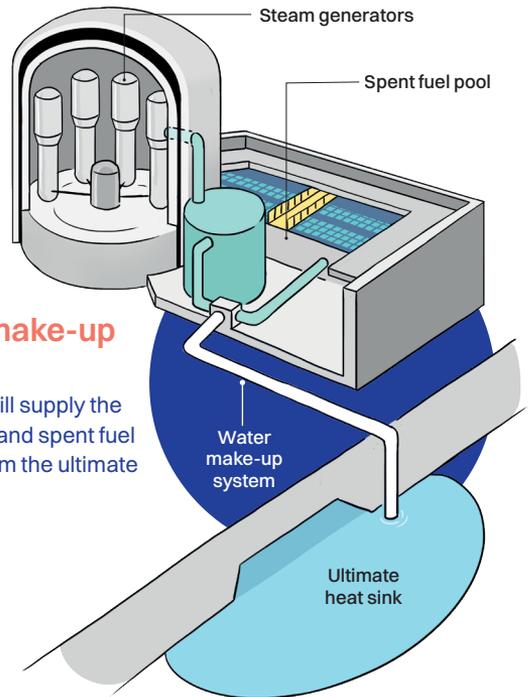
The periodic safety review will lead to the implementation of a very large number of modifications (several hundred in total). It will not be possible to implement all of these modifications during the ten-yearly outages. Therefore, ASNR's decision draws a distinction between modifications that are considered a priority and must be implemented during the ten-yearly outages, and those that it will be possible to implement at a later date.

## Reinforced protection against hazards

EDF plans, in particular, to reinforce ventilation and air conditioning systems to mitigate the risk of heatwaves, and to protect equipment and integrate new fire extinguishing systems to mitigate the risk of fire.

## New water make-up system

The new system will supply the steam generators and spent fuel pool with water from the ultimate water source.



## Corium stabilisation device

In the event of a core meltdown accident, the corium stabilisation device is designed to prevent melt-through of the lower slab of the reactor building by flooding the corium with water after spreading. EDF also plans to increase the thickness of this lower slab.

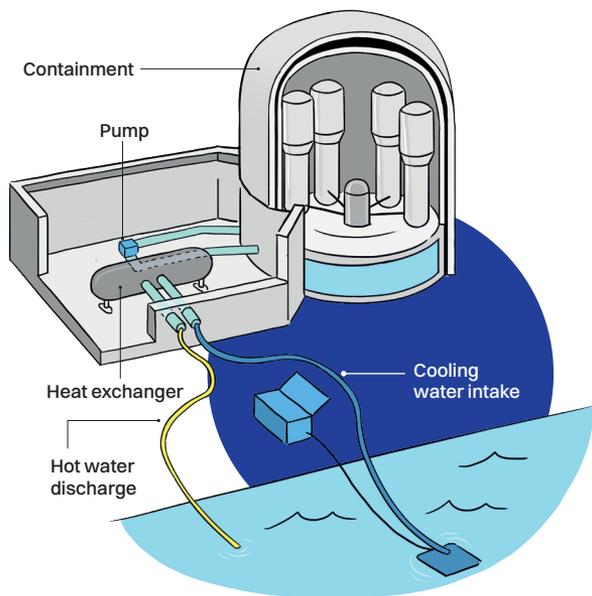
# carried out and beyond

## Improved reactivity management

EDF plans to install a new high-pressure boroated water injection pump in the primary system and to add four shutdown control rods to the reactor core.

## Ultimate containment cooling system

This system will remove the heat from the reactor building in the event of a core meltdown accident using a heat exchanger and a pump.

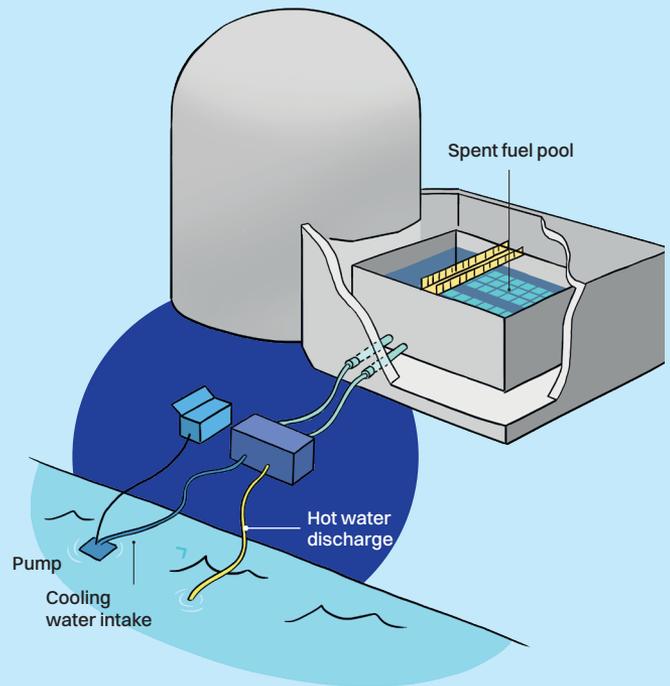


## Second phase of the works

Usually takes place six years after the ten-yearly outage.

### Supplementary cooling system for the spent fuel pool

This system will be made up of fixed parts and mobile parts, the latter being deployed by EDF's Nuclear Rapid Intervention Force (FARN).



### Contaminated water treatment unit

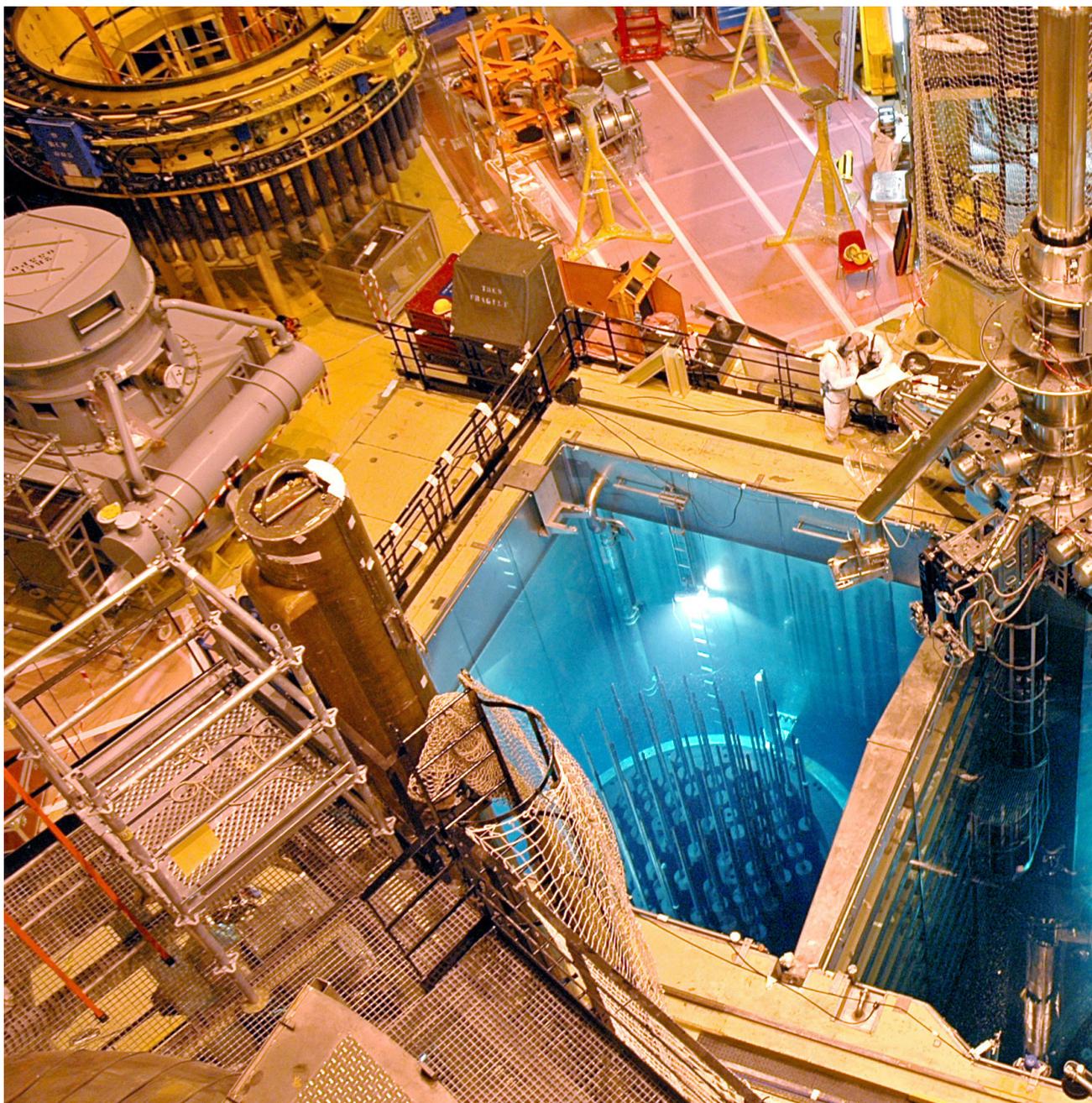
This unit will reduce the contamination of water in the reactor building following a core meltdown accident. It will be deployed by EDF's Nuclear Rapid Intervention Force (FARN).

### Completion of the implementation of the « hardened safety core »

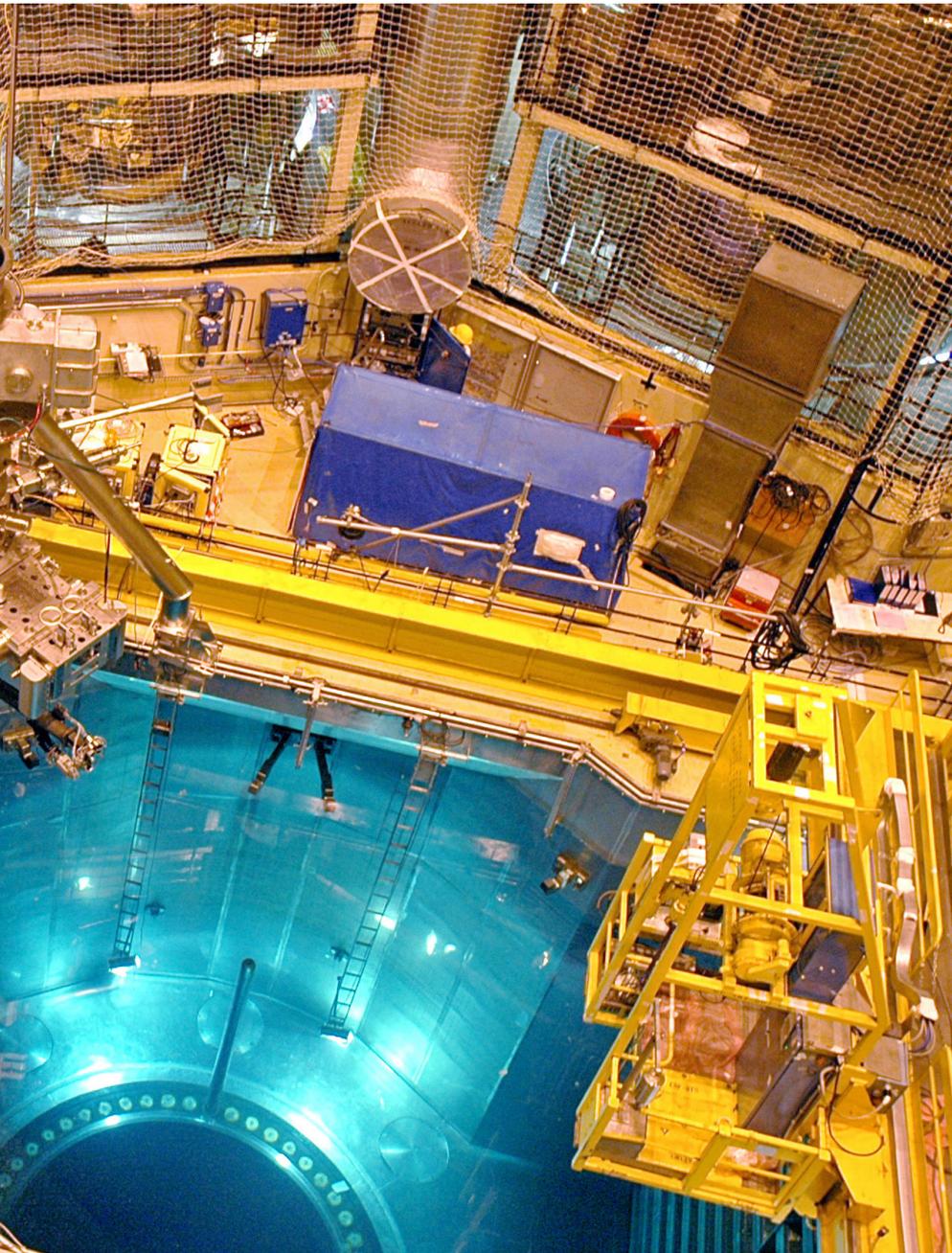
These additional works will complete the implementation of the «hardened safety core» which will then be fully operational. In an extreme event, it will allow functions to be performed that are vital to ensuring the safety of the facilities and on-site emergency management.



## Substantial work to improve safety

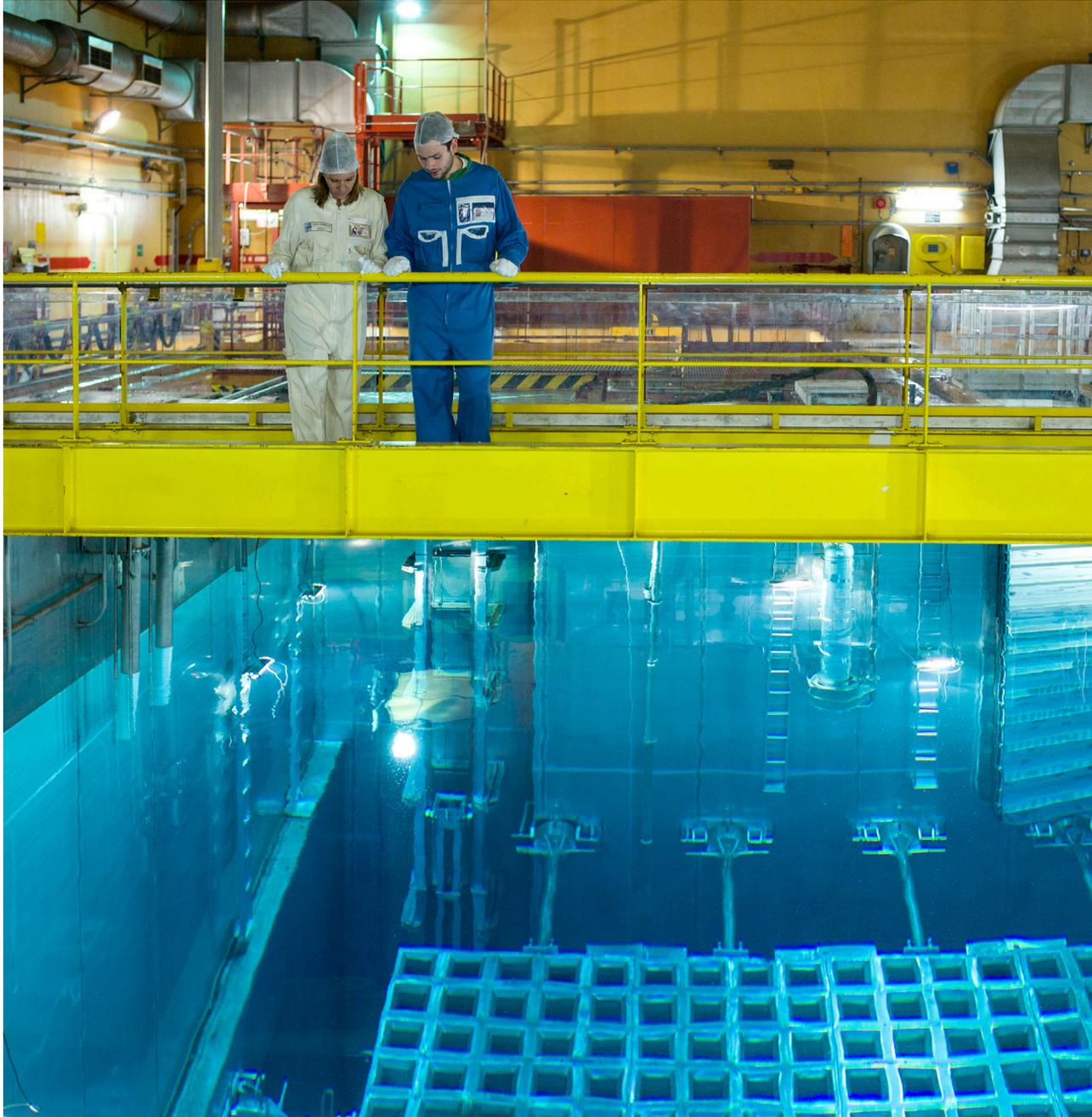


As part of the fourth periodic safety review of the 1,300 MWe reactors, EDF will carry out in-depth inspections of its facilities and modify them to improve safety.



*Inside the reactor building at Paluel nuclear power plant (Seine-Maritime) during installation of the machine used to inspect the reactor vessel.*

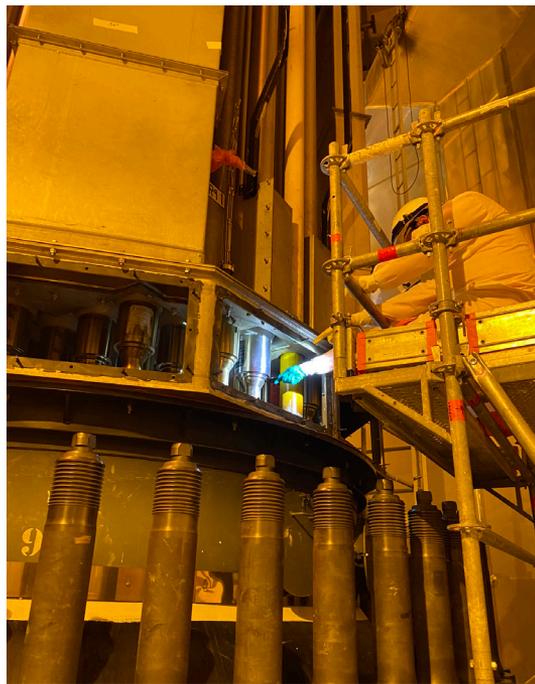
## ASNR'S DECISION AND REQUIREMENTS



*The spent fuel pool (photo shows Saint-Alban nuclear power plant (Isère), for which a new water make-up system and a supplementary cooling system will be installed.*



*New heat exchanger for heat removal in the event of a core meltdown accident - reactor 1 at Paluel nuclear power plant (Seine-Maritime).*



*Checking a reactor vessel head during a hydraulic test\* at Cattenom nuclear power plant (Moselle).*



## Involvement of the general public *throughout the periodic safety review*

Since 2019, ASN has implemented various public involvement initiatives in order to provide information, facilitate understanding of safety issues, explain its requirements linked to the periodic safety review, and identify the expectations, questions and positions of various stakeholders.

The great number of interactions enabled ASN to guide the work involved in the periodic safety review, and to check that the concerns of the public were properly examined.

### TIMELINE OF PUBLIC INVOLVEMENT INITIATIVES

**October to November 2019**  
Consultation organised by ASN on the guidelines of the periodic safety review

**December 2022 to October 2023**  
Technical meetings hosted by IRSN, ASN and Anccli

**January to September 2024**  
Public consultation organised by the HCTISN\*

**May to June 2025**  
Consultation organised by ASN on its draft decision



December 2022 to October 2023

### Technical dialogue meetings

Between December 2022 and October 2023, IRSN, ASN and Anccli\* organised four «technical dialogue» days for local information committees (CLI\*), associations and non-institutional experts. This «technical dialogue» also involved members of EDF's teams.

The aim of this approach was to facilitate access to IRSN's expertise, to further enrich that expertise by feeding in the expectations of the public, and to involve stakeholders in the areas concerned as early as possible, in order to prepare them for the national consultation in 2024 and for the local public inquiries relating to each reactor to be held in the next few years.

Around 250 questions were asked at these meetings, addressing issues such as the double-walled containment in the 1,300 MWe reactors, and the consideration of external hazards, particularly with regard to climate change. The concerns raised at the meetings were taken into account in IRSN's expert assessments

4

public meetings in  
2022 and 2023

250

questions from participants  
at «technical dialogue»  
meetings





January 2024 to September 2024

## Public consultation



Between January and September 2024, ASN and IRSN held discussions with members of the general public located close to the nuclear power plants concerned, at public meetings and topic-based workshops.

This voluntary consultation, conducted at the initiative of the High Committee for Transparency and Information on Nuclear Security (HCTISN), also involved webinars on topics such as climate change, accident management, ageing, etc.

In addition to EDF, ASN and IRSN, local information committees (CLIs) were also involved in this initiative.

Internet users were also able to ask their questions via the [dedicated Internet platform](#) where the answers provided are published in full

During the consultation, the public expressed concerns regarding the following topics in particular :

- ageing of facilities;
- lessons learned from the Fukushima nuclear accident;
- the consequences of climate change on the operation of reactors;
- EDF's ability to implement the planned programme, and the human and organisational factors involved;
- management of hazards;
- assessment of the level of safety of the 1,300 MWe reactors in comparison with the EPR\* reactor at Flamanville.

ASNR has satisfied itself that the issues raised during the consultation process were thoroughly examined during its assessment where they related to the periodic safety review.

8

public meetings

5

webinars between January and September 2024

3

topic-based workshops



May 2025 to June 2025

## On-line consultation

As a final step, ASNR organised an online consultation from 16 May to 15 June 2025 to gauge public opinion on the draft decision.

ASNR has published [a summary](#) of this consultation on its website.

The online consultation confirmed the points requiring particular attention that had been expressed during the previous steps, and had already been taken into account by ASNR.

ASNR has satisfied itself that the new issues relating to the periodic safety review were thoroughly examined during the assessment, and updated its decision as well as the accompanying documents accordingly.

ASNR will continue its dialogue with the public, in particular via the different CLIs, at the time of the public inquiry for each reactor



131

comments gathered on [asn.fr](#)



## Your questions, our answers

To keep the public informed, ASN has published a summary of the consultation, which ran from 16 May to 15 June 2025, on its website, together with a report explaining the conclusions of its assessment.

ASN provides answers to some frequently asked questions below.



The licensee of France's nuclear power plants faces major challenges, including transfer and maintenance of skills, training, management of subcontractors, quality of workers, etc. Is it reasonable to demand so much of EDF?

The rollout of the fourth periodic safety review of the twenty 1,300 MWe reactors represents a major challenge for EDF. **For the company and its subcontractors, it will require a human investment on a scale that has not been seen since the reactors were built.**

**ASN has examined the specific measures adopted by EDF** to take account of human and organisational factors during the design and implementation of the associated modifications.

**ASN also requires the works on each reactor to be carried out in two phases**, to take account of the ability of industrial providers to carry out the works to the expected level of quality, and to enable operators to make the significant modifications to facilities on a step-by-step basis.

The modifications that are the most important in terms of safety will be carried out first



Why is the fourth periodic safety review not carried out in certain reactors during their fortieth year of operation?

**It's true that the fourth periodic safety review does not always take place after exactly 40 years of reactor operation.** Scheduling depends on the differences in timing of the first periodic safety reviews. In any case, however, the fourth periodic safety review of each reactor takes place ten years at the latest after the third periodic safety review. This means that the safety of each reactor is re-assessed every ten years.



**Will the periodic safety review lead to improvements in the nuclear power plants' protection against serious disruptions (floods, storms, severe hot weather, etc.) caused by climate change?**

EDF periodically assesses possible changes in hazards resulting from climate change, and makes sure that such changes do not call into question the protection of the power plants.

In addition, within the scope of the fourth periodic safety review, **EDF will take steps to ensure that its power plants are more resilient**, and capable of withstanding natural hazards of greater intensity than before (for example, severe hot weather or tornadoes).



**Could ASNR demand the shutting down of the reactors if EDF is unable to carry out the work set out in the requirements?**

**ASNR can suspend the operation of a reactor at any time in the event of serious and imminent danger.** This is part of its duty to permanently monitor nuclear facilities. However, the definitive shutdown of a nuclear reactor for energy policy reasons is decided on by the government, not by ASNR.

**In addition, EDF must report annually to ASNR on its industrial capacity to implement the expected safety improvements within the specified timeframe.** ASNR expects EDF to anticipate the risks, particularly industrial risks, which could prevent certain work from being carried out, and to remedy any difficulties that are identified. If EDF considers that, for technical or economic reasons, it is not able to implement ASNR's requirements, the reactor concerned must be shut down.



**How will the creation of a new authority (ASNR), which brings together capabilities in research, expert assessment, decision-making and oversight, affect the implementation and monitoring of the modifications within the scope of the fourth periodic safety review?**

The law of 21 May 2024 on the organisation of the governance of nuclear safety and radiation protection to meet the challenge of relaunching the nuclear industry led to the creation, from 1 January 2025, of a new authority which brings together the majority of the activities of IRSN (ASN's historical technical support body) with those of ASN.

**From the point of view of nuclear safety, the remit of the new authority has been extended** to include research, regulation, expert assessment and oversight tasks. Monitoring of the implementation of modifications required by the regulations within the scope of the fourth periodic safety reviews of nuclear reactors remains unchanged. **ASNR carries out all its tasks with the combined workforces from the relevant IRSN and ASN departments.**



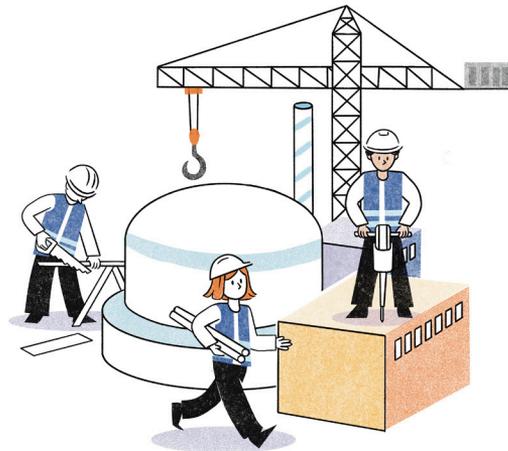
Following their fourth periodic safety review, will the 1,300 MWe reactors be as safe as the new-generation reactors?

The safety objectives for the new-generation reactors, such as the EPR reactor at Flamanville, have been used as a benchmark for the continued operation of the 1,300 MWe reactors beyond 40 years. **The fourth periodic safety review will therefore bring the safety level of the 1,300 MWe reactors closer in line with that of the third-generation reactors.** The periodic safety review will enable the radiological consequences of accidents to be reduced, for example.

In particular, EDF plans to reinforce the electric power and cooling water sources, and to boost the protection of the reactors against extreme hazards.

**As part of the periodic safety review, EDF will also implement safety improvements which are directly inspired by the new-generation reactors** such as the function for stabilising and cooling the corium inside the reactor containment.

**However, at the end of the periodic safety review, there will still be disparities between the safety level of the EPR reactor and that of the 1,300 MWe reactors.** This is due to design differences that are difficult to change, such as the more favourable layout of the different buildings of an EPR reactor, the protection of its spent fuel pool building, and the number of safety systems for dealing with an accident in an EPR.



Why aren't the modifications identified by ASN in its decision implemented in one go during the ten-yearly outage inspections?



A particularly large volume of modifications will be carried out on the reactors within the framework of the fourth periodic safety review. Given the scale of these modifications, it is not advisable to implement all of them during the ten-yearly outages. **Consequently, EDF submitted a request to ASN in 2023, asking if it could implement the modifications in two phases.** ASN agreed on condition that the modifications with the greatest safety implications would be carried out during the ten-yearly outages. The other modifications will be carried out no later than six years after the ten-yearly outages.



**Will the safety of the building in which the fuel is stored after it has been used in the reactor be improved by the modifications to be carried out within the scope of the fourth periodic safety review?**

**EDF plans to carry out various modifications within the scope of the fourth periodic safety review that will enhance the safety of the fuel building both with respect to the accidents that could occur in the building and to the hazards that could affect it.**

In particular, EDF plans to install a new water make-up system for the spent fuel pool and a complementary mobile cooling system in case of loss of existing cooling systems.



**Will the public (local information committees, local residents, and people living further away from the reactors) be kept informed of the progress of the work?**

**ASNR asks EDF to report annually on the actions it is taking in order to comply with requirements, and to make this report public, and send it to local information committees.**

# Glossary

**Advisory Committee of Experts (GPE):** created and convened by ASNR, the GPEs issue an opinion, at ASNR's request, on certain technical files with particularly high potential consequences prior to decisions being taken. The GPEs consist of experts appointed individually for their skills, and are open to civil society. Their members come from industrial and university backgrounds, associations, and from expert assessment and research bodies.

**Anccli:** National Association of Local Information Committees and Commissions. Anccli comprises the 35 Local Information Committees (CLIs) in France. By ensuring regular monitoring and issuing clarifications and information that can be readily understood by the general public, Anccli helps give the CLIs the means to fulfill their public information duties. It is also heavily involved in the discussion and exchange bodies set up by its partners (HCTISN, ASNR, etc.).

**ASN:** the French Nuclear Safety Authority Created by the law of 13 June 2006 on transparency and security in the nuclear field, ASN was the independent administrative authority responsible for overseeing civil nuclear activities in France.

**ASNR:** the French Authority for Nuclear Safety and Radiation Protection. Created by the law on the organisation of the governance of nuclear safety and radiation protection of 21 May 2024, ASNR is an independent administrative authority formed from the merger of ASN and IRSN. Since 1 January 2025, it has been responsible for overseeing civil nuclear activities in France on behalf of the French government. It also carries out research, expert assessment, training and public information tasks in the fields of nuclear safety and radiation protection.

**CLI:** Local Information Committee. A CLI is set up for each nuclear power plant and brings together the licensee, ASNR, representatives of local authorities in the vicinity of the plant, local residents, government representatives and members of associations. The role of CLIs includes relaying information to local residents located close to these facilities about the activities of civil nuclear facilities and the monitoring of these facilities.

**Containment:** leaktight concrete shell containing the reactor vessel, the primary system, the steam generators and the main elements important for safety in a pressurised water reactor. The containment of 1,300 MWe reactors has two walls: the inner pre-stressed concrete wall and the outer reinforced concrete wall.

**Corium:** mass of molten fuels and nuclear reactor core structural elements mixed together, which could form in the event of a severe accident.

**EPR:** European Pressurised Reactor (now renamed as "Evolutionary Power Reactor"). A new type of reactor incorporating numerous safety improvements, developed by Framatome and EDF. In France, one EPR reactor was commissioned in Flamanville (Manche) in May 2024.

**Hardened safety core:** the concept of the "hardened safety core" is aimed at providing structures and equipment capable of withstanding extreme events and of performing key functions to ensure the safety of facilities and for on-site emergency management.

**HCTISN:** High Committee for Transparency and Information on Nuclear Security Information, consultation and debating body concerning the risks linked to nuclear activities.

**Hydraulic test:** required every 10 years by the regulations, the hydraulic test is an overall strength test which involves subjecting the system to pressure that is 20% higher than its design pressure.

**IRSN:** French Institute for Radiation Protection and Nuclear Safety. Until 31 December 2024, IRSN was the public expert body responsible for expert assessment and research into nuclear and radiological risks, and served the public authorities and the general public. ASNR, which has been operational since 1 January 2025, combines some of IRSN's tasks with those of ASN.

**Licensee (nuclear):** natural or legal person operating a Basic Nuclear Installation or having submitted a creation authorisation application with a view to operating such an installation. .

**Periodic safety review:** in-depth examination of a nuclear reactor, scheduled to take place every ten years in accordance with the regulations, designed to ensure the conformity of the facilities, management of the ageing of the facility's components (materials, equipment, systems, etc.) and to raise the level of safety. Periodic safety reviews may lead to major work in areas in which the regulatory requirements and technical requirements have changed significantly.

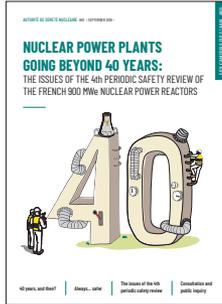
**Periodic safety review concluding report:** report sent by the licensee to ASNR at the end of the ten-yearly outage inspection. In this report, the licensee issues a position statement on the compliance of its facility, and on the modifications intended to correct any identified deviations or to improve the safety of the facility. ASNR sends its analysis of the report to the Minister responsible for nuclear safety, and may impose additional requirements on the licensee.

**Public inquiry:** participative procedure implemented and supervised by the French prefectures. A public inquiry enables the public, at a local level, to find out about a project that is likely to have consequences for the population and the environment, and to submit comments. For example, applications for authorisation to create or decommission a nuclear facility are subject to a public inquiry as are the conclusions of periodic safety reviews conducted after 35 years of operation of a nuclear reactor.

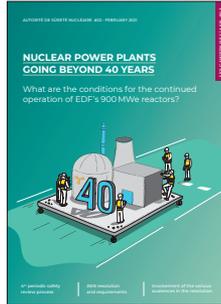
**Shutdown control rod:** control rods, made of neutron-absorbing material, are inserted into the reactor core to regulate the number of neutrons present and therefore the nuclear reaction. Some control rods are always kept raised out of the core during power operation, and are only inserted to shut the reactor down. They are known as shutdown control rods.

**Ten-yearly outage:** lengthy reactor outage (lasting around five months) during which the licensee carries out checks and modifications to improve the safety level. The ten-yearly outage is one step in the periodic safety review.

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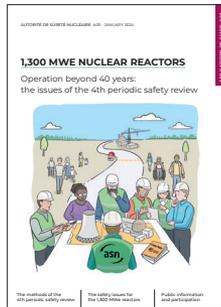
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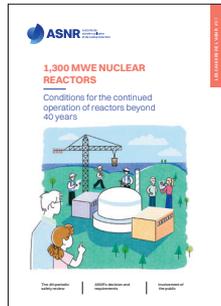
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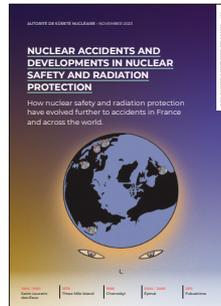
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