AUTORITÉ
DE SÛRETÉ
NUCLÉAIRE

ABSTRACTS

ASN REPORT

on the state of nuclear safety and radiation protection in France in 2021

The French Nuclear Safety Authority presents its report on the state of nuclear safety and radiation protection in France in 2021.

This report is required by Article L. 592-31 of the Environment Code.

It was submitted to the President of the Republic, the Prime Minister and the Presidents of the Senate and the National Assembly and transmitted to the Parliamentary Office for the Evaluation of Scientific and Technological Choices, pursuant to the above-mentioned Article.

THE FRENCH NUCLEAR SAFETY AUTHORITY

ROLES
OPERATIONS
KEY FIGURES
ASN ORGANISATION CHART

ASN was created by the 13 June 2006 Nuclear Security and Transparency Act. It is an independent administrative Authority responsible for regulating civil nuclear activities in France.

On behalf of the State, ASN ensures the oversight of nuclear safety and radiation protection to protect people and the environment. It informs the public and contributes to enlightened societal choices.

ASN decides and acts with rigour and discernment: its aim is to exercise oversight that is recognised by the citizens and regarded internationally as a benchmark for good practice.

2006 15 2021
YEARS

REGULATING

ASN contributes to drafting regulations, by submitting its opinion to the Government on draft Decrees and Ministerial Orders, and by issuing technical regulations. It ensures that the regulations are clear, accessible and proportionate to the safety issues.

AUTHORISING

ASN examines all individual authorisation applications for nuclear facilities. It can grant all licenses and authorisations, with the exception of major authorisations for Basic Nuclear Installations (BNIs), such as creation and decommissioning. ASN also issues the licenses provided for in the Public Health Code concerning small-scale nuclear activities and issues licenses or approvals for radioactive substances transport operations.

MONITORING

ASN is responsible for ensuring compliance with the rules and requirements applicable to the facilities and activities within its field of competence. Since the Energy Transition for Green Growth Act of 17 August 2015, ASN's roles now include protecting ionising radioactive sources against malicious acts. Inspection is ASN's primary monitoring activity. More than 1,900 inspections were thus performed in 2021 in the fields of nuclear safety and radiation protection.

ASN has graded enforcement and penalty powers (formal notice, administrative fines, daily fines, ability to carry out seizure, take samples or require payment of a guarantee, etc.). The administrative fine is the competence of the ASN Administrative Enforcement Committee, which complies with the principle of the separation of the examination and sentencing functions.

INFORMING

ASN reports on its activities to Parliament. It informs the public and the stakeholders (environmental protection associations, Local Information Committees, media, etc.) about its activities and the state of nuclear safety and radiation protection in France.

ASN enables all members of the public to take part in the drafting of its decisions with an impact on the environment. It supports the actions of the Local Information Committees of the nuclear facilities.

The *asn.fr* website is ASN's main information channel.

IN EMERGENCY SITUATIONS

ASN monitors the steps taken by the licensee to make the facility safe. It informs the public and its foreign counterparts of the situation. ASN assists the Government. More particularly, it sends the competent Authorities its recommendations regarding the civil security measures to be taken.

REGULATION AND MONITORING OF DIVERSIFIED ACTIVITIES AND FACILITIES

Nuclear power plants, radioactive waste management, fabrication and reprocessing of nuclear fuel, packages of radioactive substances, medical facilities, research laboratories, industrial activities, etc. ASN monitors and regulates an extremely varied range of activities and facilities.

This regulation covers:

- 56 nuclear reactors producing 70% of the electricity consumed in France, as well as the Flamanville EPR reactor under construction;
- about 80 other facilities participating in civil research activities, radioactive waste management activities or "fuel cycle" activities;
- 35 facilities which have been finally shut down or are being decommissioned;
- several thousand facilities or activities using sources of ionising radiation for medical, industrial or research purposes;
- several hundred thousand shipments of radioactive substances performed annually in France.

EXPERT SUPPORT

When drawing up its decisions and regulations, ASN calls on outside technical expertise, in particular that of the French Institute for Radiation Protection and Nuclear Safety (IRSN). The ASN Chairman is a member of the IRSN Board. ASN also calls on the opinions and recommendations of its eight Advisory Committees of Experts, who come from a variety of scientific and technical backgrounds.

THE COMMISSION

The Commission defines ASN's general policy regarding nuclear safety and radiation protection. It consists of five Commissioners, including the ASN Chairman, appointed for a term of 6 years(*).

Bernard DOROSZCZUK Chairman	Sylvie CADET-MERCIER (*) Commissioner	Géraldine PINA JOMIR Commissioner	Laure TOURJANSKY (*)(**) Commissioner	Jean-Luc LACHAUME (*) Commissioner
from 13 November 2018 to 12 November 2024	from 21 December 2016 to 9 December 2023	from 15 December 2020 to 9 December 2026	from 21 April 2021 to 9 December 2023	from 21 December 2018 to 9 December 2026
APPOINTED BY the President of the Republic			APPOINTED BY the President of the Senate	APPOINTED BY the President of the National Assembly

(*) The Environment Code, modified by Act 2017-55 of 20 January 2017, introducing the general status of the independent administrative Authorities and the independent public Authorities, provides for the renewal of half of the ASN Commission, other than its Chairman, every three years. Decree 2019-190 of 14 March 2019 (codifying the provisions applicable to BNIs, the transport of radioactive substances and transparency in the nuclear field) sets out the relevant interim provisions and modifies the duration of the mandates of three Commissioners.

(**) By Decree of the President of the Republic dated 21 April 2021, Laure Tourjansky was appointed Commissioner for the remainder of the mandate of Lydie Évrard, called to other duties.

Impartiality

The Commissioners perform their duties in complete impartiality and receive no instructions from either the Government or any other person or institution.

Independence

The Commissioners perform their duties on a full-time basis. Their mandate is for a six-year term. It is not renewable. The duties of a Commissioner can only be terminated in the case of impediment or resignation duly confirmed by a majority of the Commissioners. The President of the Republic may also terminate the duties of any member of the Commission in the event of serious breach of his or her obligations.

Competencies

The Commission takes decisions and issues opinions, which are published in ASN's *Official Bulletin*. The Commission defines ASN's oversight policy. The Chairman appoints the ASN inspectors. The Commission decides whether to open an inquiry following an incident or accident.

Every year, it presents Parliament with the *ASN Report on the state of nuclear safety and radiation protection in France*. Its Chairman reports on ASN activities to the competent committees of the National Assembly and of the Senate and to the Parliamentary Office for the Evaluation of Scientific and Technological Choices. The Commission defines ASN's external relations policy at national and international level.

THE DEPARTMENTS

ASN comprises departments placed under the authority of its Chairman. The departments are headed by a Director General, appointed by the ASN Chairman. They carry out ASN's day-to-day duties and prepare draft opinions and decisions for the ASN Commission. They comprise:

- **head office departments organised according to topics,** which oversee their field of activity at a national level, for both technical and transverse matters (international action, preparedness for emergency situations, information of the public, legal affairs, human resources and other support functions). They more specifically prepare draft doctrines and texts of a general scope, examine the more complex technical files and the "generic" files, in other words those which concern several similar facilities;
- **11 regional divisions,** with competence for one or more administrative regions, covering the entire country and the overseas territories. The regional divisions conduct most of the oversight in the field of nuclear facilities, radioactive substances transport operations and small-scale nuclear activities. They represent ASN in the regions and contribute to public information within their geographical area. In emergency situations, the regional divisions assist the Prefect of the *département*(***) who is responsible for the protection of the population, and oversee the operations to safeguard the facility affected by the accident.

(***) Administrative region headed by a Prefect.

PERSONNEL

519
staff members

85%
management

48%
women

317
inspectors

BUDGET

€67.15 M
budget for ASN (programme 181)

€83 M
IRSN budget devoted to expert assessment work on behalf of ASN

ASN ACTIONS

1,881
inspections of which 5% were carried out remotely

26,733
inspection follow-up letters available on *asn.fr* as at 31 December 2021

393
technical opinions sent to ASN by IRSN

1,917
individual licensing and registration resolutions issued

8
plenary meetings of the Advisory Committees

INFORMATION

550
replies to queries from the public and stakeholders

63
information notices

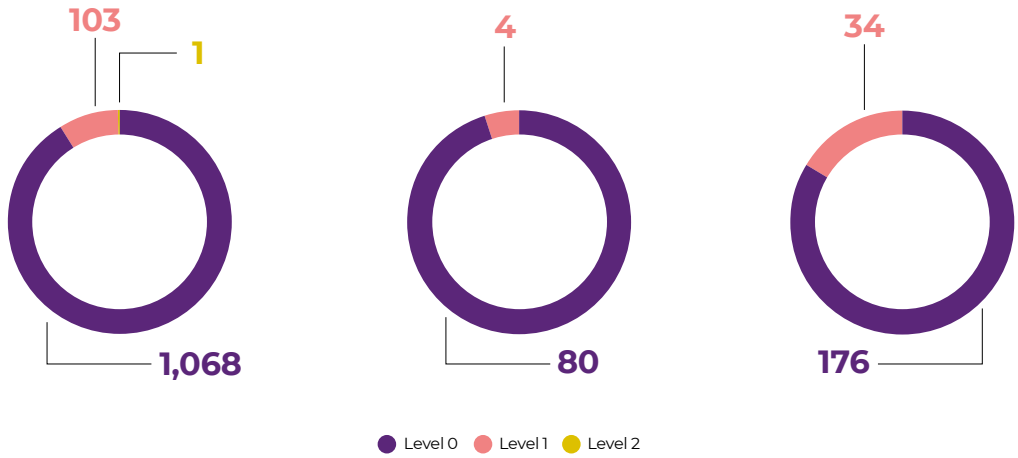
11
press conferences

NUMBER OF SIGNIFICANT EVENTS RATED ON THE INES SCALE(*)

1,172
events in the Basic Nuclear Installations

84
events in the transport of radioactive substances

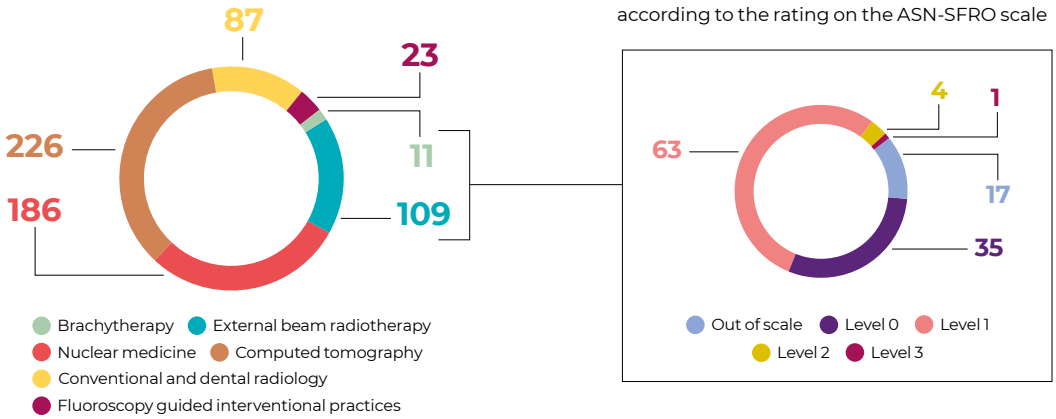
210
events in small-scale nuclear facilities (medical and industrial)



NUMBER OF SIGNIFICANT EVENTS IN THE MEDICAL FIELD(*)

642
significant events per area of exposure

120
significant events in external beam radiotherapy and brachytherapy
according to the rating on the ASN-SFRO scale



(*) The INES scale (International Nuclear and Radiological Event Scale) was developed by IAEA to explain to the public the importance of an event in terms of safety or radiation protection. This scale applies to events occurring in BNIs and events with potential or actual consequences for the radiation protection of the public and workers. It does not apply to events with an impact on the radiation protection of patients, and the criteria normally used to rate events (notably the dose received) are not applicable in this case.

As it was pertinent to be able to inform the public of radiotherapy events, ASN –in close collaboration with the French Society for Radiotherapy and Oncology– developed a scale specific to radiotherapy events (ASN-SFRO scale).

These two scales cover a relatively wide range of radiation protection events, with the exception of imaging events.

COMMISSION

CHAIRMAN
Bernard DOROSZCZUK

COMMISSIONERS
Sylvie CADET-MERCIER
Géraldine PINA JOMIR
Jean-Luc LACHAUME
Laure TOURJANSKY

HEAD OF PRIVATE OFFICE
Sylvie RODDE

ADMINISTRATIVE ENFORCEMENT COMMITTEE
CHAIRMAN
Maurice MÉDA

GENERAL DIRECTORATE

DIRECTOR GENERAL
Olivier GUPTA

ETHICS OFFICER
Alain DORISON

DEPUTY DIRECTORS GENERAL
Julien COLLET
Daniel DELALANDE
Anne-Cécile RIGAIL

CHIEF INSPECTOR
Christophe QUINTIN

DIRECTOR OF PRIVATE OFFICE
Vincent CLOÎTRE

MANAGEMENT AND EXPERTISE OFFICE
Adeline CLOS

REGULATION AND OVERSIGHT SUPPORT MISSION
Julien HUSSE

GENERAL SECRETARIAT
Brigitte ROUÈDE

DEPARTMENTS

NUCLEAR POWER PLANTS
Rémy CATTEAU

NUCLEAR PRESSURE EQUIPMENT
Corinne SILVESTRI

WASTE, RESEARCH, FACILITIES AND FUEL CYCLE
Cédric MESSIER

TRANSPORT AND SOURCES
Fabien FÉRON

IONISING RADIATION AND HEALTH
Carole ROUSSE

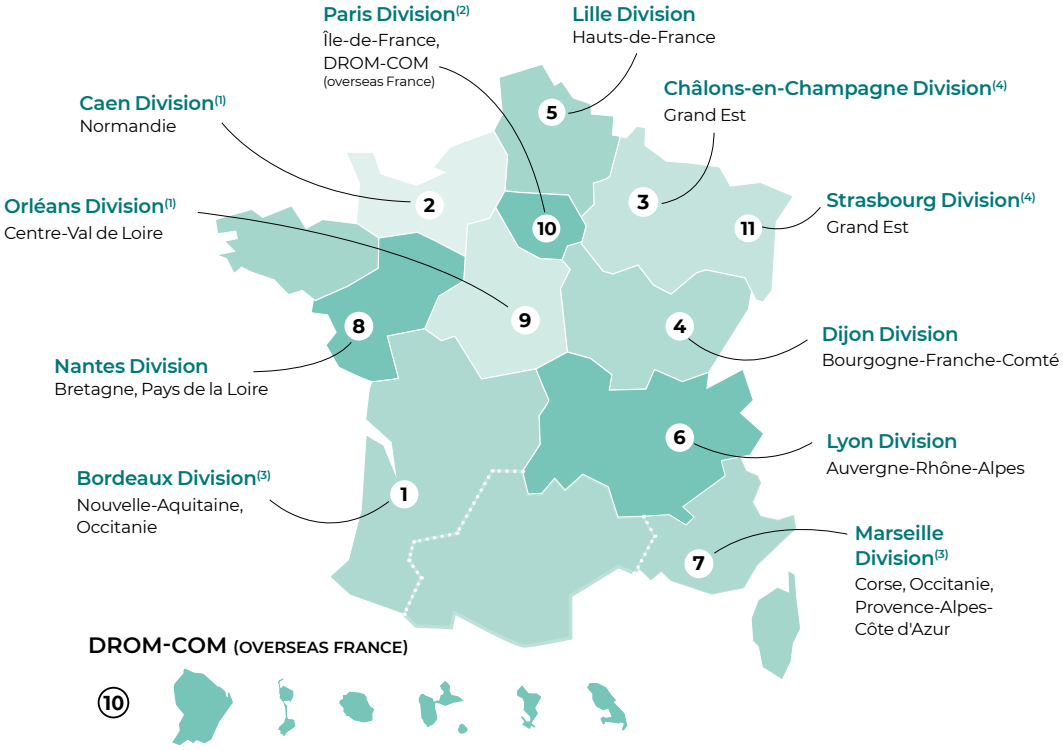
ENVIRONMENT AND EMERGENCY SITUATIONS
Olivier RIVIÈRE

INTERNATIONAL RELATIONS
Luc CHANIAL

LEGAL AFFAIRS
Olivia LAHAYE

INFORMATION, COMMUNICATION AND DIGITAL USAGES
Céline ACHARIAN

ORGANISATION CHART(*)



(1) For BNIs oversight only, the Caen and Orléans divisions hold responsibility for the Bretagne and Île-de-France regions respectively.

(2) The Paris division is responsible for Martinique, Guadeloupe, Guyane, Mayotte, La Réunion, Saint-Pierre-et-Miquelon.

(3) The Bordeaux and Marseille divisions jointly regulate nuclear safety, radiation protection and the transport of radioactive substances in the Occitanie region.

(4) The Châlons-en-Champagne and Strasbourg divisions jointly regulate nuclear safety, radiation protection and the transport of radioactive substances in the Grand Est region.

REGIONAL DIVISIONS

1 BORDEAUX
REGIONAL REPRESENTATIVE
Alice-Anne MÉDARD
REGIONAL HEAD
Simon GARNIER

2 CAEN
REGIONAL REPRESENTATIVE
Olivier MORZELLE
REGIONAL HEAD
Adrien MANCHON

3 CHÂLONS-EN-CHAMPAGNE
REGIONAL REPRESENTATIVE
Hervé VANLAER
REGIONAL HEAD
Mathieu RIQUART

4 DIJON
REGIONAL REPRESENTATIVE
Jean-Pierre LESTOILLE
REGIONAL HEAD
Marc CHAMPION

5 LILLE
REGIONAL REPRESENTATIVE
Laurent TAPADINHAS
REGIONAL HEAD
Rémy ZMYSLONY

6 LYON
REGIONAL REPRESENTATIVE
Jean-Phlippe DENEUVY
REGIONAL HEAD
Nour KHATER

7 MARSEILLE
REGIONAL REPRESENTATIVE
Corinne TOURASSE
REGIONAL HEAD
Bastien LAURAS

8 NANTES
REGIONAL REPRESENTATIVE
Anne BEAUVAL
REGIONAL HEAD
Émilie JAMBU

9 ORLÉANS
REGIONAL REPRESENTATIVE
Hervé BRÛLÉ
REGIONAL HEAD
Arthur NEVEU

10 PARIS
REGIONAL REPRESENTATIVE
Emmanuelle GAY
REGIONAL HEAD
Agathe BALTZER

11 STRASBOURG
REGIONAL REPRESENTATIVE
Hervé VANLAER
REGIONAL HEAD
Pierre BOIS

(*) As at 1 March 2022.

Competence
Independence
Rigour
Transparency

asn.fr

info@asn.fr

You can also follow ASN on social media

SUMMARY

ADVICE TO THE READER

- FIND THE FULL ASN REPORT on the state of nuclear safety and radiation protection in France in 2021 on ***asn.fr***.
- Only regulatory news for the year 2021 is present in this report. All the regulations can be consulted on ***asn.fr***, under the heading “L’ASN réglemente”.

EDITORIAL BY THE COMMISSION

Nuclear safety concerns must lie at the heart of energy policy decisions

From left to right: **Jean-Luc LACHAUME,** Commissioner; **Laure TOURJANSKY,** Commissioner; **Bernard DOROSZCZUK,** Chairman; **Géraldine PINA JOMIR,** Commissioner; **Sylvie CADET-MERCIER,** Commissioner.

Montrouge, 1 March 2022

In 2021, the safety of nuclear facilities and radiation protection in the medical, industrial and radioactive substances transport sectors remained at a satisfactory level, in line with the level observed in 2020.

What are most striking about 2021, in particular its second part, are the industrial vulnerabilities affecting all nuclear facilities and the debate concerning energy policy choices and the position of nuclear power in these choices.

On these subjects, ASN has four key messages:

1. The French electricity system today faces an unprecedented two-fold vulnerability in availability, affecting both the "fuel cycle" facilities and the fleet of nuclear power reactors. This vulnerability is compounded by the unexpected discovery of a stress corrosion phenomenon on several EDF reactors, which is a serious event from the viewpoint of safety.

These situations and vulnerabilities, most of which stem from the lack of margins and inadequate anticipation, must serve as lessons for the entire nuclear sector and the public authorities.

2. Nuclear safety concerns must lie at the heart of energy policy decisions, in the same way as concerns regarding the decarbonisation of electricity production by 2050.

In the coming 5 years, EDF will have to examine and individually justify the ability of the older reactors to continue to operate beyond 50, or even 60 years, so that lessons can be learned as soon as possible regarding any provision to be made for additional production capacity.

At the same time, given the foreseeable growth in the electrification of usages, and given the need to maintain margins in the electricity system, the public authorities will have to carefully weigh its decision to shut down an additional 12 reactors by 2035, except of course for safety reasons.

Finally, by the end of the decade at the latest, the Government will have to decide on whether or not to continue with the reprocessing of spent fuel after the 2040 time-frame, in order to anticipate the consequences, with regard either to the refurbishment of the existing facilities, or alternative solutions to be adopted for spent fuel management.

3. The prospect of an energy policy comprising a long-term nuclear component must be accompanied by an exemplary policy for the management of waste and legacy nuclear facilities.

A policy such as this implies that decisions be taken before the end of the next National Radioactive Materials and Waste Management Plan (PNGMDR), so that operational management solutions are available for all types of waste within the coming 15 to 20 years, and so that the nuclear licensees are more committed to meeting the specified deadlines for legacy nuclear waste retrieval and conditioning projects for which they are responsible.

4. ASN reaffirms that the new energy policies perspectives, whatever they are, imply a considerable industrial effort, in order to tackle the industrial and safety challenges.

If nuclear power is among the choices made to ensure a decarbonised energy mix by the 2050 time-frame, the nuclear sector will have to implement its own "Marshall Plan" to make this perspective industrially sustainable and have the skills it needs to tackle the scale and duration of the projects concerned.

Quality and rigour in the design, manufacture and oversight of nuclear facilities, which were not up to the required level in the latest major nuclear projects conducted in France, constitute the first level of "Defence in Depth" in terms of safety.

A weakened fuel chain, putting pressure on the electricity system

The "fuel cycle" industry consists of all the facilities contributing to the production of fresh fuel, the reprocessing of spent fuels and the reuse of products from reprocessing. These non-redundant facilities are the links in a chain, the operation of which can be disrupted if one of them experiences a long-term failure.

A series of events is currently weakening the entire "fuel cycle" chain and is a major strategic concern for ASN requiring particularly close attention, in that an unanticipated build-up of radioactive materials or waste could lead to storage conditions that are unsatisfactory from the safety standpoint.

Construction of the centralised spent fuel storage pool being planned by EDF to address the risk of saturation of the existing pools by 2030, the need for which was identified as of 2010, has not yet begun. This pool will not be available before 2034 at best. This delay will require interim measures to increase existing storage capacity. The solution chosen by Orano, which consists in increasing the storage density in the existing pools at the La Hague facility, cannot be considered a long-term one, given the required storage periods of about a hundred years, and in the light of the most recent safety standards.

Furthermore, the operating issues experienced by the Orano Melox plant in recent years, which worsened in 2021, are leading to the saturation of plutonium-bearing materials storage capacity as of 2022, owing to the production of a large quantity of manufacturing scrap. These issues are already leading to the "demoxing" of some of the 900 MWe reactors, which used MOX as fuel. They could also lead to saturation of the spent fuel pools at the La Hague facility earlier than 2028-2029.

Finally, the detection of corrosion in the existing evaporators in Orano's La Hague facility earlier than expected in the design has reduced reprocessing capacity until new fission product evaporators-concentrators are commissioned and could further degrade the saturation margins of the pools at La Hague.

Overall, these situations reflect a lack of anticipation and precaution owing to the absence of margins, which is weakening the entire "fuel cycle" chain and which could, in turn, have consequences on the operation of the Nuclear Power Plants (NPPs).

Pressure on the availability of the NPP fleet, underscoring the need to maintain margins for safety

The winter of 2021-2022 was marked by a lower than anticipated availability of the NPP fleet.

This was for a number of reasons, some of which could be foreseen, others less so.

The postponed commissioning of the Flamanville EPR, the 2020 shutdown of the two Fessenheim reactors and the schedule of heavy maintenance operations ("major overhaul"), as of 2018, were known.

In addition to this lower availability –which was predictable as of 2018, there was the unexpected impact of the Covid-19 pandemic– notably the first lockdown, identified as of mid-2020. This lockdown led to reactor maintenance and refuelling operations being spread out over a longer period, with the consequence of reducing production capacity margins over several consecutive winters.

Finally, this winter, the four N4 series reactors of Civaux and Chooz, plus one reactor at Penly were either shut down or kept shut down, for in-depth inspections and repairs, following the detection of stress corrosion anomalies on welds on the reactors' safety injection system. An inspection program for the reactors of the NPP fleet likely to be the most severely affected, extending over several months, has been proposed by EDF.

This build-up of events illustrates the absolute need –as ASN has pointed out to the public authorities and nuclear sector stakeholders numerous times– to maintain design-basis margins for the electricity system and the installations, in order to deal with unexpected events and avoid having to resort to a trade-off between the safety of installations and the availability of electricity supply.

New energy policy prospects which must address safety concerns at once

Five of the six scenarios presented in the *Réseau de transport d'électricité* (RTE) report, produced at the request of the Government, on "Energies of the future", aiming to achieve a decarbonised economy by 2050, are based on continued operation of the existing NPP fleet.

At this stage, no conclusion on the continued operation of all these reactors beyond 50 years can be drawn from the information available to ASN during the generic examination of the fourth periodic safety review of the 900 MWe reactors, for which it issued its decision in February 2021. Due to the specific features of some reactors, it might not be possible, with the current methods, to demonstrate their ability to operate up to 60 years.

Furthermore, over the longer term, one of the scenarios envisaged by RTE presents an electricity mix with a nuclear electricity share close to 50% in 2050. Consultation with industry revealed that the rate of construction of new nuclear reactors in order to achieve such a level would be hard to sustain, which led RTE also to base this scenario on the operation of some reactors beyond 60 years and the continued operation of the others until 60 years.

This scenario, which is based on fundamental hypotheses of an operating lifetime which cannot at present be confirmed with regard to safety, also entails the risk of leading the electricity system into a dead-end, if the number of reactors able to operate until or indeed beyond 60 years proves to be insufficient, and if this were only known belatedly. Moreover, the shutdown in a few years of a large number of reactors built during a short period of time in the 80s, could have "cliff-edge" consequences for electricity production capacity.

ASN considers that the energy policy choices for the 2050 time-frame must be based on hypotheses that are robust and which can be justified in terms of safety.

The choice of operating the current NPP fleet beyond 50 years and up to 60 years should include a step to justify this possibility, with sufficient margins for dealing with major or generic unexpected scenarios.

In any case, if the hypothesis of continued operation of certain reactors beyond 60 years were to be an option, this should involve an examination, in advance, so that there is enough time –at least 15 years– to be able to adjust the energy policy choices in the light of its conclusions and avoid a situation in which the lack of forward planning leads to continued operation of the nuclear reactors based on a decision dictated purely by electricity needs or which is hazardous in terms of safety.

The strong mobilisation of EDF must continue with a view to commissioning of the Flamanville EPR reactor

The activities concerning weld repairs on the secondary systems (main steamlines and steam generator feedwater lines) of the Flamanville EPR, involved considerable efforts of EDF. Because of the deviations observed, about a hundred secondary system welds needed to be repaired. EDF produced specific mock-ups and tests to qualify the repair processes. ASN carried out reinforced oversight of these worksites to ensure the quality of the new welds. According to the EDF schedule, repair of the welds on the secondary systems will continue until August 2022. Other work to correct deviations still has to be carried out ahead of commissioning, in particular concerning the primary system set-in nozzles.

Moreover, ahead of the reactor commissioning authorisation, considerable work is still to be done on numerous topics with major safety implications, already identified several years ago. In particular, EDF must carry out numerous analyses, including tests, to justify the design of certain equipment, notably the reliability of the pressuriser valves and the performance of the filters for the water reinjected from the bottom of the reactor building in an accident situation. In some cases, this could require modifications being made ahead of commissioning.

EDF must also complete the required test programme for reactor commissioning and supplement it, in order to carry out requalification of the installation after the modifications and repairs.

Finally, ASN is paying close attention to how EDF learns the lessons gained from the EPRs commissioned in Finland and China. In particular and in addition to the in-depth technical dialogue initiated with EDF, anomalies on fuel, in particular those affecting the Taishan reactor core, are the subject of experience feedback exchanges between ASN and its Chinese counterpart.

Management of waste and materials which must, more than ever, be exemplary

Following the public debate in 2019, a draft PNGMDR covering the period 2021-2025 has been produced. Further to its opinions on each of the waste management routes, ASN issued an opinion on this draft. It considers that on the whole it meets the main goal: to allow the necessary decisions to be taken before its end, so that safe management routes are operational within the coming 15 to 20 years, for all types of radioactive waste. Within the framework of the oversight committee which it jointly chairs, ASN will pay particular attention to compliance with the strategic milestones.

ASN underlines the simultaneous occurrence of short-term safety issues, related to the malfunctions observed in certain "cycle" facilities, and longer-term issues. At this stage, the multi-year energy plan has not determined that reprocessing policy will continue beyond 2040. Whatever the option chosen, either cessation or continued reprocessing of spent fuels, the design and examination of the resulting facilities requires extensive forward planning.

At ASN's request, CEA and Orano have drawn up strategies to conduct several major decommissioning projects on old facilities. These are part of a prioritisation effort to address the safety issues. ASN therefore underlined the need to prioritise retrieval of waste and decommissioning of the facilities representing the greatest risk for people and the environment, and to comply with the defined scheduled. The retrieval and conditioning of legacy waste are preliminary but complex steps, because they require that appropriate techniques be developed. They more specifically entail a risk of delay. When the feasibility of final conditioning cannot be demonstrated within the planned time-frame, ASN requests that an alternative solution be developed, with safe retrieval of the waste, regardless of its conditioning.

With the possibility of a new nuclear future, the entire sector must be mobilised in order to implement concrete solutions to manage the situations inherited from the past, as rapidly as possible.

In the medical field, the level of radiation protection is maintained despite the Covid-19 pandemic

In 2021, medical exposure still represents the first cause of exposure to artificial ionising radiation, with the particularity of providing benefits for the patient, provided that prescription of the procedure is justified. Justification is thus a fundamental principle of radiation protection, hence the importance of implementing and overseeing it. When, for example, a new technique or procedure emerges, good collaboration is needed between the various medical and institutional actors.

When a long-duration, unexpected crisis appears and exerts pressure on the health care structures, as was the case during the Covid-19 pandemic, mastering the fundamentals of radiation protection culture becomes the best guarantee of the high level of radiation protection expected in the medical field. With this in mind, ASN's decisions and inspections aim to implement a quality management system increasing the accountability of each individual, from decision-maker to actor, that is proportionate to the radiation protection issues for all the diagnostic, interventional and therapeutic fields. Eventually, this system should incorporate the methods for performing external peer reviews and, for radiotherapy, if a new technology or new type of practice is used, the recording and analysis of data concerning the expected benefits to the patient and the corresponding risks. ASN stresses the importance of learning lessons from undesirable events (Significant Radiation protection Events –ESR), which enhance the study of potential risks and contributes to continuous improvement of the safety of practices by looking for the root causes of the ESRs, regardless of origin (material, human, organisational, etc.).

Faced with growing technical complexity in a field where innovations are major and rapid, compliance with the principle of optimisation in radiation protection constitutes a major concern. ASN recalls the importance of forward planning for change and compliance with the learning curve when new equipment arrives or when new techniques are adopted. In therapeutic nuclear medicine, the growth of internal targeted radiotherapy requires anticipation of the arrival of new molecules and the increase in the number of patients treated.

Preparation for post-accident management based on innovative partnership-based approaches

The work done in 2021 by the the Steering Committee for the management of the post-accident phase (Codirpa), under the mandate given to ASN by the Prime Minister on 18 June 2020, led to a number of tangible advances, built around listening to and involving the stakeholders concerned.

The "Q&A for health professionals" regarding the consequences of an accident was prepared with the health professionals, both locally and nationally, as they were identified as trusted third parties in the event of an emergency. This method ensures that the questions dealt with are pertinent and the answers given are of high quality, thus fostering a good level of assimilation.

Along the same lines, the drafting of guidelines regarding foodstuffs in a post-accident situation relied on the work done by a pluralistic expert group, followed by a debate with four panels of citizens living near the NPPs. This was an initial trial to test the understanding of the subjects and the pertinence of the areas of work, and to collect the opinions of the populations concerned.

Finally, the work done on the necessary information and awareness-raising in order to reinforce the safety and radiation protection culture focused on target public. Given the extensive work already done, an inventory of good practices will form the basis of the Codirpa report. It will enable to identify how to mobilise the various actors to implement the most effective measures in each area.

These partnership-based approaches will help to inform decisions and adopt a pragmatic approach to the essential development of the safety and radiation protection culture. The Codirpa recommendations to the Prime Minister will be based on all of this feedback collection and expert work. ■

EDITORIAL BY THE DIRECTOR GENERAL

Responsible oversight, combining consistency with adaptability

Montrouge, 1 March 2022

The last decade has been marked by the follow-up to the Fukushima Daiichi accident and the problems experienced by the french nuclear industry. During this period, the stakeholders asked that safety and inspections be reinforced. Today, the security of electricity supply is the focus of everyone's attention, raising questions about the cost of safety or the potentially excessive nature of the regulations.

Over and above the cycles in which nuclear power falls into or out of favour and regardless of those who say that there is too much or too little safety, ASN has always sought to adapt its oversight to the challenges of the moment, without ever deviating from its fundamental principles.

These fundamental principles are unwavering, because they correspond to convictions about how to exercise oversight and because nuclear power, in which time-scales are very long, requires a stable framework: stop and go and a lack of visibility are hardly the best guarantors of safety.

Adaptability is needed because the installations, licensees and network of subcontractors change, whether in technical, human resources, financial or industrial terms. In 2017, ASN therefore defined a strategic plan to exercise oversight that was as efficient as possible in a context where the nuclear industry was faced with colossal investments, at a time when the licensees were also faced with budgetary or financial difficulties.

Five years later, as ASN is drafting a new strategic plan, what changes have been made in the field of oversight? What are the new challenges?

ASN has consolidated the fundamental principles of its oversight

Oversight promoting more accountability

ASN's conviction has always been that a good level of nuclear safety and radiation protection can only be achieved if the nuclear licensees fully assume their prime responsibility for it. ASN's action aims to ensure that they do so effectively.

Before issuing a ruling on the restart of nuclear reactors following maintenance outages, ASN used to examine numerous documents in which EDF justified maintaining the equipment as-is, despite the anomalies observed. In recent years, ASN made changes to its oversight of reactor outages by replacing this systematic documentary review with targeted on-site inspections, while at the same time, EDF has placed emphasis on rectifying the anomalies as early as possible, rather than justifying their acceptability. This approach illustrates a more responsible attitude on the part of the licensee, as encouraged by ASN's oversight, with safety being the winner.

Oversight that is more proportionate to the stakes

The internationally recognised principle of the proportionality of the resources to the issues means that licensees and professionals are focusing their resources, which are by definition finite, on subjects with the greatest nuclear safety or radiation protection implications. Application of this principle is a constant concern in that ASN directs the allocation of the licensee's resources through the requests it makes or the questions it poses.

ASN has ramped up its efforts in favour of a "graded approach" to oversight. In the field of small-scale nuclear activities, the overhaul of the administrative regimes carried out in recent years has thus reduced the burden in terms of the files requested and the examinations carried out for those activities with lower radiation protection implications. Similarly, ASN has

Olivier GUPTA

> “Without ever deviating from its fundamental principles, ASN has always sought to adapt its oversight to the challenges of the moment.”

refocused its inspections on the activities with greater implications.

This necessary proportionality with the stakes is not always understood with respect to the large nuclear installations, as any subject concerning a Nuclear Power Plant (NPP) could be seen as being important: this sometimes creates a distortion between the actual issues and the media coverage. However, in the interests of safety, realism and pragmatism dictate that the proportionate approach should continue to be used and that it should even be taken further in the coming years.

Reinforced technical dialogue

Contrary to popular belief, french nuclear safety regulations are not particularly voluminous and are focused on the objectives to be achieved: only rarely do they specify means requirements. They have the advantage of allowing each licensee to define the most appropriate provisions and do not stand in the way of innovation.

Nuclear safety is not therefore built around the regulations, but more on an in-depth technical dialogue between the licensee and ASN, with the support of its Advisory Committees of Experts and the Institute for Radiation Protection and Nuclear Safety (IRSN). Between 2018 and 2022, ASN deployed a plan to reinforce its control of technical examinations and its involvement in this dialogue, placing technical considerations at the heart of its decisions and resolutions.

However, it is clear that over the years, the way in which the regulations are applied has become more complex, and the technical dialogue has led to a multiplication of the internal rules drafted by the licensees, to the extent that they have become hard to apply or have even lost part of their meaning for the operatives in the field. One of the challenges for the coming years will be to control this inflation in the number of rules.

Public participation in the drafting of decisions

Public involvement in the process of drafting decisions and resolutions opens up an area for dialogue, not only on the protection objectives but also on how they are to be technically achieved by the licensee. This involvement must lead to a lasting improvement in the understanding of the issues, increase trust in the decision-making process and, whenever possible, enhance it by making it possible to comprehend the questions considered to be priorities by the stakeholders and provide answers to them. Together with IRSN, ASN thus set up technical dialogue and consultation sessions on key subjects such as the fourth periodic safety reviews for the NPPs, or the densification project for the spent fuel storage pools at La Hague.

ASN has deployed new means of oversight

Experience feedback from the Creusot affair

Following the discovery – starting in 2016 – of irregularities in the manufacturing files (sometimes dating back some time) for certain nuclear reactor parts at Framatome's Le Creusot plant, ASN implemented a system for the prevention, detection and handling of fraud and falsification, in line with its undertaking to Parliament: creation of an on-line form to facilitate whistle-blowing; creation of a unit for systematic analysis of these reports, leading to investigations whenever necessary; performance of inspections targeted on fraud, with a specific investigation methodology enabling information to be cross-checked.

Oversight of the security of radioactive sources

An Ordinance of 2016 entrusted ASN with oversight of protection against malicious acts concerning the radioactive sources used outside the installations monitored by other authorities. An Order, published in 2019, defines the provisions to be followed by those in possession of sources and acts as a framework for inspections. On this basis, ASN was thus able to incorporate source security into the inspections it carries out in the small-scale nuclear activities. This oversight complies with the rules applicable to protection of the confidentiality of sensitive information.

Oversight of complex projects

ASN wished to overhaul its oversight of decommissioning and legacy waste retrieval projects, which suffer from repeated delays on the part of the licensees, partly owing to their complexity and the need to constantly adapt the operations to the new situations discovered. Rather than reinforce the level of technical detail of the inspections, and drawing inspiration from the practices of its british counterpart, ASN developed an inspection methodology for these projects designed to identify any potential drifts early on and to urge the licensees to take corrective measures in good time. Inspections were thus conducted at Orano and EDF accordingly. They will soon be extended to projects managed by CEA and the French National Radioactive Waste Management Agency (Andra).

ASN has changed how it works in-house

Skills reinforcement

ASN observes that, year after year, it is faced with increasingly complex subjects. This can be the analysis of physical phenomena not anticipated in the design, or the use by the licensees of increasingly sophisticated calculations to prove the safety of their facilities. At a different level, this can also concern ASN's ability to monitor the supply chain.

These issues require specific skills which take a long time to acquire, along with growth in the cumulative experience of ASN's personnel in the hazards and nuclear fields. In recent years, ASN thus developed its career paths, to ensure that it has personnel who have worked for a greater number of years in the oversight of nuclear safety and radiation protection. In addition to simply the question of numbers, it also devotes efforts to recruiting staff with more experience than previously for the "senior" positions. These approaches must be continued.

A well-advanced digital transformation

As early as 2017, ASN launched an ambitious digital transformation programme. It won a number of calls for project proposals from the State's Digital Division, which enabled it to benefit from support in developing data processing: for example, a data mining tool used for more than 26,000 follow-up letters now enables the inspection findings on a given topic to be collated, with identification of the early warning signs which were hitherto hard to detect.

The digital transformation also aims to simplify the procedures for the licensees: ASN has thus developed an online services portal to make it easier to submit notification or registration files for small-scale nuclear activities.

The Covid-19 pandemic crisis accelerated this process and led to the development of new practices, such as remote inspections, which do not aim to replace on-site inspection, but simply complement it.

ASN has begun to consider the future challenges and the changes for which it must begin to prepare

In conjunction with the internal analysis work, ASN conducted an "external consultation" to collect the viewpoints of its main interlocutors. Four main issues were identified by this preliminary work.

First of all, ASN will have to oversee a fleet of installations and nuclear activities undergoing a period of transition, given that many of them are faced with the question of their continued operation and consequently the need to plan ahead for their shutdown. Projects for new facilities to replace some of the older ones, in addition to the construction work already in progress, means that ASN will have to oversee a number of new facilities (under design or under construction) unlike anything that has been seen for some considerable time: the Jules Horowitz research reactor, ITER, the *Cigéo* waste disposal repository, the spent fuel centralised storage pool, and possibly a number of EPR2 reactors or Small Modular Reactors (SMRs). ASN must prepare for this, so that it can examine the corresponding requests without delay and without compromising on safety.

In the medical field, the major challenges are linked to questions of organisation and competence in a context of pressure in terms of staffing levels: as in the nuclear installations, social, organisational and human factors issues are predominant and ASN must further reinforce its skills and its oversight methods in this field.

A new challenge is the demand from our fellow citizens for the State to be more willing to listen and to explain. In the fields of risk management, it is clear that better results are obtained when the State encourages everyone to be a contributor to their own safety. This implies good understanding of the measures taken: strict policing alone is no longer sufficient and the activity managers, decision-makers and local players must truly take on board the nuclear safety and radiation protection issues.

At an international level, a key aspect of the coming period is geopolitical change. On the one hand, the nuclear centre of gravity is shifting towards Asia. On the other, some countries are preferring a national approach and the Covid-19 pandemic made international exchanges more difficult. ASN, together with its European partners, will have to redouble its efforts to ensure that there is an ambitious vision for nuclear safety internationally.

Finally, ASN must continue to adapt its operating methods in order to remain attractive, and acquire skills to address the new challenges.

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Many changes have been made in recent years to adapt both ASN and its oversight to the context, itself in a constant state of flux. The Covid-19 pandemic crisis, which weighed heavily on the ASN personnel in the same way as all our fellow citizens over the past two years, did not stop ASN from issuing the most urgent decisions in good time, nor from conducting examinations and inspections which attracted less media coverage, but which constitute the basis of its work and underpin the credibility of its oversight. I wish to thank all the ASN personnel for their commitment and indeed all the personnel of IRSN and the members of ASN's Advisory Committees of Experts, whose expertise is of valuable assistance during our examination work.

Preparing ASN for the oversight of new installations, ensuring that the nuclear safety and radiation protection challenges are addressed with sufficient forward planning and that all the actors involved take them on board, guaranteeing a high level of safety in Europe and worldwide, attracting the talents we need: the ASN teams will be capable of stepping up and tackling all these new challenges. ■

ASN **ASSESSMENTS**

ASN carries out its oversight role by using the regulatory framework and individual resolutions, inspections, and if necessary, enforcement measures and penalties, in a way that is complementary and tailored to each situation, to ensure optimal control of the risks nuclear activities represent for people and the environment. ASN reports on its duties and produces an assessment of the actions of each licensee, in each activity sector.

ASN assessments **per licensee**

EDF

The nuclear power plants in operation

For EDF, the year was particularly dense in terms of industrial activity, after a 2020 which was disrupted by the Covid-19 pandemic. ASN nonetheless considers that the quality of operation of the installations remained at a satisfactory level. However, the safety performance of some of the Nuclear Power Plants (NPPs) appears to be falling short continually. Progress was observed with regard to radiation protection, after two years of regression; this should be confirmed in 2022. The end of 2021 was marked by the discovery of cracks on systems connected to the main lines of the primary system of several reactors.

OPERATION

The quality of the monitoring of operating parameters in the control room remained at a satisfactory level in 2021. The improvements observed in 2020 continued, despite an increase in the industrial activity of the NPPs. However, there was a rise in the number of situations in which the reactor was operated outside the planned limits, with their number in 2021 being equivalent to that observed in 2019.

To control the fire risk, EDF must further improve management of equipment temporary storage sites and warehouses, which represent significant calorific potential, along with management of sectorisation in order to contain any outbreak of fire.

The organisation put into place to manage skills, qualifications and training remained on the whole satisfactory in 2021, despite the training difficulties owing to the Covid-19 pandemic.

In 2021, ASN observed good management of accident situation operating procedures. EDF took measures to remedy the errors and ambiguities contained in the operating documents used by the operating crews in these situations.

The ASN inspections focusing on the emergency organisation and resources confirmed that the organisation, preparedness and management principles for emergency situations covered by an On-site Emergency Plan (PUI) have been correctly assimilated. However, EDF needs to continue its efforts regarding response times in the event of an emergency situation.

The analyses conducted by the sites further to significant events are generally relevant and the identification of organisational causes continues to progress. ASN observes that the origin of many events lies in problems with the quality of the documentation placed at the disposal of the teams in charge of reactor operation or maintenance; problems are continuing with the creation and updating processes for this documentation.

THE CONFORMITY OF THE FACILITIES

For several years now, ASN has found that the management of deviations affecting the facilities has improved. More specifically, EDF is placing greater emphasis on remedying any deviations rapidly. The efforts must be continued so that the new process implemented can be a lasting one. However, as in previous years, ASN considers that the compliance of the facilities with the rules applicable to them needs to be significantly improved. EDF must continue the targeted inspection actions it has been gradually deploying over the last few years. More particularly, the specific inspections implemented during the fourth ten-yearly outages are enabling a large number of deviations to be detected. Some of these deviations date back to the construction of the reactors, while others arose when making modifications to the facilities.

At the end of 2021, EDF detected stress corrosion cracking on systems connected to the main lines of the primary system on several reactors. This subject will lead to a large-scale inspection and repair programme.

MAINTENANCE

Generally speaking, the organisation adopted by the NPPs for large-scale maintenance operations was relatively satisfactory in 2021. ASN finds that EDF is giving greater priority to ensuring a calm climate for maintenance and modification work during reactor outages, which contributes to safety.

However, in 2021, ASN still found areas for improvement with regard to reactor maintenance, such as the consideration of various hazards generated by the activities, their correct preparation, and the quality of technical oversight. With regard to the numerous maintenance activities resulting from the continued operation of the reactors and the major overhaul work, ASN considers that it is important for EDF to maintain the efforts started in order to remedy these difficulties and improve the quality of its maintenance activities.

Concerning EDF's monitoring of the subcontracted activities, the improvements observed in 2019 and 2020 were confirmed in 2021, even if weak points remain present on certain sites.

ENVIRONMENTAL PROTECTION

ASN considers that management of discharges from the various NPPs is on the whole handled satisfactorily.

In 2021, ASN's inspections with situational exercises showed that most of the NPPs are capable of ensuring the containment of a large volume of hazardous liquid substances in an accident situation. They also identified corrective measures to be taken. Inspections were also carried out by ASN on the prevention of leaks of sulphur hexafluoride, a gas with a significant greenhouse effect. The action plan defined by EDF to prevent, detect and reactively repair leaks is satisfactory and its implementation should continue.

ASN considers that corrective measures must be taken regarding waste management, notably in terms of signage, compliance with the baseline requirements for operation of outdoor areas and storage in unauthorised areas.

WORKER RADIATION PROTECTION AND OCCUPATIONAL SAFETY

In 2021, ASN found improvements in the handling of the issues related to worker radiation protection in several NPPs, after the deteriorations observed in 2019 and 2020. However, behavioural anomalies persist and the situation remains a subject of concern on certain sites. EDF must continue with the steps taken to improve the way in which radiation protection is handled.

The occupational health and safety situation degraded in the second half of 2021, as the number of accidents and events with potentially serious consequences actually increased. Progress is expected in 2022 to improve the management of situations that are hazardous for the workers, notably with regard to working equipment and lifting gear, explosion and fire hazards and electrical hazards in particular.

CONTINUED OPERATION OF THE REACTORS

The ambitious modifications EDF intends making to the facilities and the operational methods within the framework of the reactor periodic safety reviews are significantly improving the safety of the facilities and will enable their level of safety to be brought closer in line with that of the third generation reactors. EDF is deploying considerable engineering resources for these reviews.

ASN considers that all the provisions specified by EDF and those that it itself stipulates, open up the prospect of continued operation of the 900 Megawatts electric (MWe) reactors for the ten years following their fourth periodic safety review. Implementation of this review on each reactor includes specific examinations and will take account of the particularities of each installation.

The pace of the fourth ten-yearly outages of the 900 MWe reactors has accelerated: in 2021, EDF started four ten-yearly outages, which took place satisfactorily, and began preparatory work for the subsequent ones.

INDIVIDUAL NPP ASSESSMENTS

The ASN assessments of each NPP are detailed in the Regional Overview in this report.

With regard to safety, the NPPs of Saint-Alban and Civaux stood out favourably in 2021. The NPPs of Golfech, Gravelines and, to a lesser extent, Flamanville, under-performed by comparison with the other reactors operated by EDF.

With regard to radiation protection, the NPPs of Civaux, Paluel and Saint-Alban stood out positively. ASN considers that the NPPs of Dampierre-en-Burly, Gravelines and, to a lesser extent, Cruas-Meysse, under-performed.

With regard to environmental protection, the Saint-Laurent-des-Eaux NPP stood out positively. On the other hand, the NPPs of Dampierre-en-Burly and, to a lesser extent, Chinon and Cruas-Meysse, under-performed.

The Flamanville EPR reactor under construction

In 2021, EDF continued with work to complete the installation, to make modifications to certain equipment and to draw up the various documents needed for the future operation of the reactor. The repairs on the main secondary systems welds also continued in good conditions. EDF is devoting considerable resources to these repairs.

EDF has taken the necessary measures to protect the installed equipment up until commissioning. It also continued with the inspections forming part of the equipment quality review, initiated after the detection of anomalies in the main secondary systems welds. The organisation put into place by EDF for performance and monitoring of these activities is satisfactory.

Considerable works and examinations still remain before commissioning of the reactor. This in particular concerns the design and reliability of the primary system valves, repairs to the main secondary system welds, with anomalies on three nozzles of the main primary system and post-weld heat treatment of the nuclear pressure equipment, the performance of the filtration system on a containment internal water tank, and the various anomalies detected on the cores of the Taishan EPR reactors, including the fuel clad ruptures observed in 2021.

Nuclear power plants being decommissioned and waste management facilities

ASN considers that the decommissioning and waste management operations were carried out in safety conditions there were on the whole satisfactory in 2021.

EDF gave priority to risk reduction in its installations that had been definitively shut down. 2021 was notably marked by the removal of all the fuel from Fessenheim reactor 1, which had been shut down in February 2020. The fuel from reactor 2 should for its part be removed before the end of 2023. The other reactors (Brennilis, Superphénix, Gas-Cooled Reactors –GCRs) no longer contain any fuel. The main safety issues therefore concern the containment of radioactive substances and radiation protection. Some installations also present an additional risk linked to the presence of asbestos, sometimes combined with the presence of radiological contamination, which makes the intervention conditions more complex.

2021 was marked by the resumption of most of the decommissioning worksites, which had been partially interrupted in 2020 owing to the Covid-19 pandemic.

The "outside pressure vessel" decommissioning work on the Saint-Laurent A, Bugey 1 and Chinon A3 sites is continuing in satisfactory conditions of safety. For these operations, EDF will have to be vigilant in meeting the deadlines stipulated in the resolution of 3 March 2020[1]. ASN asked EDF to continue with its reactor pressure vessel diagnostic and monitoring programme, in order to monitor the ageing of the civil engineering structures and ensure their long-term integrity. The first results of these investigations should be presented in the decommissioning files to be submitted at the end of 2022. In these files, EDF will also be required to demonstrate that the GCRs are being decommissioned "as rapidly as possible, in economically acceptable conditions".

With regard to worker radiation protection, the "alpha" action plan implemented on the Chooz A installation in 2020 is resulting in a positive trend in the number of contaminations detected. Efforts in this field must however be continued on all the decommissioning worksites, in order to confirm this trend over the course of 2022.

A few worksites requiring the use of remote-operated cutting systems were interrupted owing to equipment unavailability problems. EDF will need to ensure correct maintenance of this equipment to avoid delaying the progress of the decommissioning operations. The decommissioning of the reactor pressure vessels of Superphénix and Chooz A is continuing with the stipulated deadlines, notably with the removal of the first R73 packages containing waste –resulting from cutting up of the Chooz A vessel internals– to Iceda, where the first packages were conditioned and stored at the end of 2021. The Iceda restart completion file, expected in 2022, will provide feedback regarding these initial conditioning operations.

EDF is required to improve the periodic safety review process for definitively shut down installations, in particular regarding the approach for evaluating the conformity of the installations.

ASN notes EDF's involvement in the public inquiry on the Brennilis decommissioning file and, more generally, its efforts regarding transparency and communication.

1. ASN Chairman's resolution CODEP-CLG-2020-021253 of 3 March 2020, setting binding requirements concerning the preparation fosr decommissioning of reactors Chinon A1 and A2 and the next steps in the decommissioning of reactors Bugey 1, Chinon A3, Saint-Laurent A1 and A2.

ORANO

ASN considers that the safety level of the facilities operated by Orano remained overall at a satisfactory level in 2021. ASN however notes that malfunctions in the Melox plant are leading to a faster than anticipated saturation of storage capacity for plutonium-bearing materials, requiring urgent action by the industry in 2022. ASN notes progress in the management of complex projects, such as radioactive waste retrieval and conditioning operations. It however considers that Orano must analyse the causes of delays to the priority projects and ensure the adequacy of the resources devoted to these projects.

The facilities operated by Orano are located on the sites of La Hague, Marcoule and Tricastin. They present significant implications for safety but of different types, both chemical and radiological.

The organisation of the Orano group changed on 1 January 2021. Three group subsidiaries were thus created:

- *Orano Chimie-Enrichissement*, operating nuclear facilities for the production of enriched uranium;
- *Orano Recyclage*, operating nuclear facilities for the reuse of materials derived from spent fuel;
- *Orano Démantèlement*, subsidiary specialising in the decommissioning of nuclear facilities, which does not operate any nuclear facility.

This organisational change came on top of other organisational modifications ongoing within the Orano facilities at La Hague ("Convergence" Project) and Tricastin ("Single licensee" Project). ASN considers that maintaining a high level of safety in the facilities in parallel with the implementation of these organisational changes is a major challenge for Orano.

INSTALLATIONS IN OPERATION

Orano's management of the safety of the nuclear installations in operation is on the whole satisfactory.

The measures designed to combat ageing phenomena in the equipment of the installations, some of which were commissioned more than 30 years ago, or its replacement by new equipment, represent a major challenge for their continued safe operation.

These reviews are an opportunity for Orano to propose improvements, notably concerning management of the fire risks and the safe storage of materials and waste.

ASN considers that Orano must demonstrate greater rigorousness in operation and in compliance with the binding requirements and undertakings made further to the reviews of the installations.

LEGACY WASTE RETRIEVAL AND CONDITIONING, DECOMMISSIONING AND WASTE MANAGEMENT

Large quantities of legacy waste at La Hague are not stored in accordance with current safety requirements and present major safety risks. The Retrieval and Conditioning of this Legacy Waste (RCD) determines the progress of decommissioning in the definitively shut down plants.

With regard to the organisation of complex project management, ASN notes progress, such as assimilation of the objectives of immediate dismantling, the creation of the major projects department, the use of project maturity evaluations, or the development of project progress oversight tools. This progress must however be made more widespread and be consolidated for all the decommissioning and RCD projects. ASN observes that the complexity of the RCD operations had led Orano on several occasions to revise the retrieval and processing scenarios and announce significant postponements, sometimes of several decades.

STORAGE CAPACITY

In 2021, problems at the Melox plant led to faster than anticipated saturation of the storage capacity for plutonium-bearing materials at La Hague.

ASN considers that the deterioration of the available margins in the storage facilities at La Hague is all the more worrying as, were these difficulties to persist, it would be impossible to rule out saturation of the spent fuel storage pools far faster than expected.

OUTSIDE CONTRACTORS

ASN considers that the licensee must continue with its efforts to improve the monitoring of outside contractors, by ensuring that in-house technical skills are maintained in order to guarantee the quality of the services provided. Orano must also ensure that appropriate monitoring is maintained on operation of the workshops placed under the responsibility of industrial operators.

PERSONNEL RADIATION PROTECTION

Radiation protection issues are taken seriously by Orano. Particular vigilance is however required with regard to the Melox facility, owing to the increase in the number of preventive and corrective maintenance operations carried out on the facility's equipment, against a backdrop of significant production difficulties. This situation is leading to significant exposure, although within the regulation limits, of a large number of personnel in this facility.

The significant radiation protection events reported for the Orano group sites are primarily linked to the radiological cleanliness of the premises.

RISK MANAGEMENT

With respect to fire, ASN notes significant progress in the work done to reinforce fire detection and protection. However, considerable inadequacies remain in the facilities. Furthermore, the safety analyses presented are sometimes incomplete, or insufficient from the technical standpoint, and ASN has therefore asked that they be extensively revised. The licensee must improve and more regularly update its incident response instructions, so that they are more appropriate and operational, and carry out periodic exercises to test them.

ENVIRONMENTAL PROTECTION

For the year 2021, control of the detrimental effects and impact of the Orano sites on the environment is on the whole satisfactory.

The measures to prevent spillage/leaks and the environmental dispersal of radioactive or hazardous liquid substances, including those liable to result from actions taken to combat a possible incident, must still be improved.

With regard to protection of the ozone layer, ASN took enforcement measures against Orano in 2021, owing to the lack of forward planning in the replacement of certain automatic fire extinguishing installations containing halon.

INDIVIDUAL FACILITY ASSESSMENTS

The ASN assessments of each nuclear facility are detailed in the Regional Overview in this report.

CEA

ASN considers that the safety of the facilities operated by the Alternative Energies and Atomic Energy Commission (CEA) remains on the whole satisfactory. CEA must nonetheless clarify its vision regarding the continued operation of some of the older facilities. It must also reinforce its project management, notably for those projects concerning the decommissioning of definitively shut down facilities, or the retrieval and conditioning of legacy waste. The emergency situation management organisation also needs to be improved.

MANAGEMENT OF NUCLEAR SAFETY AND RADIATION PROTECTION

ASN considers that CEA must remain vigilant in ensuring that all the nuclear safety and radiation protection aspects are correctly taken into account at all levels of the organisation and are led by people who have the necessary resources, skills and authority.

ASN asked CEA to propose a strategic vision for the management of nuclear safety and radiation protection. This roadmap must be based on an analysis of feedback from the numerous organisational changes made in recent years, present an evaluation of the policy to protect CEA's interests, describe its strategy for guaranteeing the availability of rare and critical skills in the light of the safety issues and draw on the observations made by its internal general inspectorate.

ASN considers that the implementation of "major safety commitments", managed at the highest level and enabling the most important nuclear safety and radiation protection issues to be monitored, is on the whole satisfactory. It will be necessary to ensure that the reduction in resources allocated to CEA has no impact on its ability to meet other commitments.

FACILITIES IN OPERATION

Faced with the ageing of the facilities in operation and the uncertainty surrounding the projects to replace some of them, CEA developed a medium/long-term strategy in 2019 concerning the utilisation of its experimental civil nuclear research facilities and its waste and materials management facilities. ASN finds that uncertainties remain regarding the continued operation of some of the older facilities. ASN considers that CEA must precisely clarify the options adopted (abandon or optimise operation, works to be carried out, etc.).

FACILITIES UNDERGOING DECOMMISSIONING

ASN finds that, despite CEA's clear intention to carry out facilities decommissioning and RCD operations, this licensee is experiencing major difficulties in handling all these complex projects at the same time.

ASN notes that CEA's annual budget to finance provisions for nuclear costs is limited. If it wishes to finance unexpected spending for priority projects, this budgetary constraint could cause CEA to smooth the budget for lower priority projects, thus delaying their performance schedules.

In 2021, ASN found that certain deadlines were thus pushed back by several decades, even though they concern ordinary decommissioning projects, based on sound operating experience feedback (notably the decommissioning of the research reactors). ASN also notes substantial changes to the priority projects, with numerous postponements, scope reductions or even some projects being abandoned.

RADIOACTIVE WASTE MANAGEMENT

ASN finds that the management of radioactive waste in the CEA facilities is satisfactory, even though the situation differs from one facility to another. Although progress was observed on certain facilities, notably with regard to the updating of procedures and waste inventories, the situation in other facilities is more contrasted.

CEA must remain vigilant with respect to the storage conditions for its waste (operation of collection areas, demarcation and signage), the pertinence of and compliance with waste zoning and tracking of the radioactive waste produced in the facilities.

In 2020, ASN noted that the provisions of the protocol between the National Radioactive Waste Management Agency (Andra) and CEA regarding Andra's monitoring of CEA waste packages liable to be disposed of in *Cigéo* were overly restrictive of Andra's scope of action and therefore failed to fully meet the provisions of ASN resolution 2017-DC-0587. Even though progress was observed in 2021, ASN will remain attentive to this subject in 2022.

THE CONFORMITY OF THE FACILITIES

ASN recognised the efforts made by CEA to improve the conformity of the facilities on the occasion of the periodic safety reviews. This trend must be maintained in the coming years, so that CEA is able to comply with the schedule for implementation of the actions it has identified.

MANAGEMENT OF DEVIATIONS

ASN finds that progress in the management of deviations is required in certain facilities, notably with regard to analysis of causes or of trends concerning repeated deviations of a similar nature.

In 2021, CEA informed ASN of the fall of a "medium activity" waste package into a storage pit of the Cedra facility (BNI 164) as well as the fall of a basket containing sections of fuel rods during placement in a storage pit in the STAR BNI. ASN hopes that CEA will learn the lessons from these handling problems, so that they do not occur in other facilities.

CHANGE MANAGEMENT

ASN considers that the quality of the safety analyses sent to ASN when CEA submits an authorisation application for a noteworthy modification is on the whole satisfactory. ASN also observes that the changes made in the field do effectively correspond to the information provided by CEA in its authorisation applications.

MAINTENANCE AND THE SCHEDULING OF PERIODIC INSPECTIONS AND TESTS

Maintenance work and the scheduling of the periodic inspections and tests, their performance and their monitoring within the CEA facilities are on the whole satisfactory. As these operations are generally subcontracted, CEA must however remain attentive to the level of technical competence. Moreover, ASN still observes disparities between the facilities. In addition, the traceability of the inspections performed must be further improved. CEA must also implement a harmonised materials ageing and obsolescence management strategy for all its facilities. The new methodology developed by CEA to manage the ageing of the Cabri reactor (BNI 24) represents a step forward.

OUTSIDE CONTRACTORS

Although the monitoring of outside contractors has been reinforced in recent years, ASN still notes the need for the CEA to reinforce the monitoring of the entire chain of outside contractors, particularly its contractors' subcontractors. Lastly, there are still disparities in the quality of this monitoring between the various facilities operated by CEA, and harmoni–sation is thus required.

RISK CONTROL AND EMERGENCY MANAGEMENT

ASN considers that CEA must continue its efforts to improve protection against the fire risk. Management of the technical devices (fire doors and dampers, detection systems, etc.), must be improved and fire loads limited, particularly on worksites.

CEA's emergency organisation and resources still need to be significantly improved, in order to make up the delay in meeting the current requirements. The national organisation in particular needs to be reinforced, paying very close attention to the coordination between the national level, the sites and the facilities. ASN noted that the teams in the field, notably the local safety force, are engaged and motivated in the performance of emergency exercises. Coordination between the local safety force and the facilities in the CEA centres however still needs to be improved with regard to the management of permanent resources (retention areas, automatic shut-off devices, etc.), as the priority of the local safety force is to extinguish fires.

ASN also observes significant delays in the construction of the emergency management buildings for the Cadarache and Saclay centres, designed to take account of the lessons learned from the Fukushima Daiichi NPP accident.

PERSONNEL RADIATION PROTECTION

Within the various CEA centres, radiation protection is on the whole dealt with satisfactorily. ASN remains vigilant with regard to the identification of items and activities important for protection, management of measuring instrument ageing and monitoring of outside contractors (handling of deviations, traceability and application of the "As Low As Reasonably Achievable" –ALARA approach).

Most of the significant radiation protection events reported by CEA are linked to failure to wear a passive dosimeter and problems with the radiological cleanliness of the premises. Of these events, only one was rated level 1 on the International Nuclear and Radiological Event Scale (INES) and concerned the failure by an outside contractor to wear personal protection equipment.

In 2022, ASN will ensure that CEA reinforces the worker radiation protection provisions, monitoring of their application, and of the outside contractors in its facilities.

ENVIRONMENTAL PROTECTION

For the year 2021, control of the detrimental effects and impact of the CEA facilities on the environment is on the whole satisfactory. The number of deviations in 2021 is approximately the same as in previous years. ASN considers that CEA must continue to implement measures on a number of subjects relating to environmental protection, management of the ageing of liquid effluent networks and repair of the network of piezometers, all of which will require long-term action.

INDIVIDUAL FACILITY ASSESSMENTS

The ASN assessments of each centre and each nuclear facility are detailed in the Regional Overview in this report.

ANDRA

Andra is continuing with the design of the *Cigéo* deep geological disposal project. ASN notes that Andra is firmly committed to public information and consultation. ASN also considers that the operation of the disposal BNIs by Andra, which is the sole licensee of this type of BNI in France, is satisfactory.

ANDRA'S PREPARATION FOR SUBMISSION OF THE *CIGÉO* CREATION AUTHORISATION APPLICATION

ASN notes that Andra has changed its organisation in order to ensure successful completion of the *Cigéo* deep geological disposal project. Owing to the scale of this project, adapting the organisation of the Agency is a very real challenge.

In the same way as the exploratory approaches to monitoring the progress of complex projects at EDF and Orano, ASN entered into discussions with Andra at the end of 2021 in order to gain a clearer understanding of the licensee's baseline requirements for the project, with a view to a subsequent inspection on the *Cigéo* project.

ASN considers that dialogue between ASN, Andra and the Institute for Radiation Protection and Nuclear Safety (IRSN) on the technical subjects identified following examination of the *Cigéo* safety options is fruitful.

In order to prepare for and facilitate the creation authorisation application examination process, ASN also urges Andra to submit all the documents providing additional justifications or presenting optimisations of the facility's concept, as early as possible.

Finally, ASN underlines the efforts made by Andra to conduct consultations around the *Cigéo* project, notably concerning the governance of the project and the pilot industrial phase.

PROGRESS OF THE STUDIES FOR THE LLW-LL WASTE DISPOSAL FACILITIES PROJECT

Discussions between ASN and Andra concerning the project for a low-level, long-lived waste (LLW-LL) disposal facility continued in 2021. ASN considers that this positive trend must be maintained in order to meet the deadlines that will be defined by the fifth National Radioactive Materials and Waste Management Plan (PNGMDR).

OPERATION OF ANDRA'S EXISTING FACILITIES

ASN considers that operating conditions in Andra's facilities are satisfactory in the areas of nuclear safety, radiation protection and environmental protection. It also notes the quality of the safety analyses produced by Andra and the fact that the performance of the periodic safety reviews on the disposal facilities is satisfactory. ASN nonetheless points out that the evaluation of the long-term impacts of the radiological and chemical substances in the disposal facilities on the flora and fauna must be consolidated.

ASN assessments **by activity sector**

THE MEDICAL SECTOR

On the basis of the inspections carried out in 2021 and despite the impact of the Covid-19 pandemic on the working of the health services, ASN considers that the state of radiation protection in the medical sector is comparable to that of the years 2019 and 2020, reflecting the fact that the departments were able to adapt and maintain a good level of radiation protection. No major deficiency was therefore detected in the areas of radiation protection of medical professionals, patients, the public or the environment. However, owing to the impact of the pandemic, delays were observed in the radiation protection technical checks for Fluoroscopy-guided Interventional Practices (FGIPs), leading to a failure to comply with the regulation frequencies of these checks, designed to ensure the radiation protection of the workers. In addition, coordination of the prevention measures during external interventions, in particular by private practitioners, must be reinforced in the field of nuclear medicine and FGIPs. Finally, the awareness of the operating theatre personnel, who are non-specialist users of ionising radiation –such as surgeons, must be raised to ensure a clearer perception of the issues and the adoption of radiation protection measures in this sector where, moreover, the premises are being brought into conformity far too slowly. The events reported to ASN underline that the formalisation of practices, the explanation of validations, the management of maintenance services, the notification and analysis of malfunctions, and the evaluation of the impact of degraded situations, are all essential to ensuring that practices are safe.

In radiotherapy, the inspections carried out in 2021 in nearly one-quarter of the radiotherapy departments confirmed that the safety fundamentals are in place: organisation of medical physics, equipment checks, training in patient radiation protection, deployment of quality assurance procedures, collection and analysis of events and production of preliminary risk analyses. However, there is as yet little widespread use of the evaluation of the effectiveness of the corrective measures and the preliminary risk analysis still remain relatively incomplete and insufficiently updated before any organisational or technical change, or following experience feedback from events. The occurrence of events such as laterality or patient identification

errors, reveals persistent organisational weaknesses and the need to assess practices regularly. The lessons learned from these events also illustrate the fact that calibration of medical devices is a critical step in health care safety.

In brachytherapy, the radiation protection of professionals and the management of high-level sealed sources are considered on the whole satisfactory. The training effort for professionals in possession of a high-level source must be maintained and reinforced for certain centres. ASN finds that new requirements concerning secure access to high-level sources are being deployed gradually, in particular measures preventing unauthorised access to these sources. The events reported underline the importance of event registration systems in order to identify malfunctions early on, as well as the need to evaluate the risks in a degraded situation (insufficient staffing levels) and to formalise and record equipment quality controls.

In nuclear medicine, the inspections reveal that radiation protection is correctly taken into account in the vast majority of departments. However, improvements are needed in effluent management, in order to control discharges into the sewage networks, in formalising the coordination of prevention measures with outside contractors (for maintenance, upkeep of premises, intervention by private practitioners, etc.) and in training of professionals. ASN observes a significant commitment on the part of the nuclear medicine departments to deploy high-quality management systems and underlines the good culture of undesirable events reporting in most of the departments inspected in 2021. The events reported however underline the fact that the drugs administration process needs to be regularly evaluated, in particular for therapeutic procedures, owing to the potentially serious consequences of any administration error.

In the field of fluoroscopy-guided interventional practices, ASN is still observing delays in premises being brought into conformity in order to comply with the technical design rules, more particularly in operating theatres, and recalls that these modifications are fundamental to preventing occupational hazards. Breaches of the regulations are still frequently observed, with unsatisfactory situations involving the radiation protection training of workers and patients, and preventive measures during concomitant activities, in particular with private practitioners. Non-conformities were found in 2021 in relation to non-compliance with radiation protection technical verification frequencies, as the departments had been unable to perform them in 2020 owing to the Covid-19 pandemic. Even if the deployment of medical physicists and the formalisation of the medical physics organisation plan would appear to be under way, progress is needed in the implementation of the optimisation approach, in particular in the operating theatres, where there is still insufficient analysis of the doses received by the patients.

However, a reporting culture is spreading, with the adoption of event registration systems. The reporting of significant radiation protection events underlines the fact that maintenance operations, which can have repercussions on the doses delivered, must be correctly managed and that practitioner training in the use of medical devices is essential to dose control. Extensive work to raise the awareness of all the medical and paramedical professionals in the centres is still necessary to give them a clearer perception of the issues, especially for operating theatre staff. This is why recommendations to improve radiation protection in the operating theatres, issued in 2020, are still valid.

In computed tomography, during its 2021 inspections, ASN still observes a lack of traceability of justification for the examinations and of the difficulties medical professionals encounter in implementing it. The lack of training of the referring practitioners, and of the use of the guide to good medical imaging practices, and the lack of justification protocols for the most common procedures partly explains the fact that the justification principle is not always applied. Furthermore, the lack of availability of other diagnostic methods (Magnetic Resonance Imaging –MRI, ultrasonography) and of health professionals limit the replacement of irradiating procedures by non-irradiating procedures. Elsewhere, ASN finds that examination protocols are optimised, quality controls of medical devices are performed at the required regulation frequency and the medical physics resources are appropriate to the tasks to be performed.

THE INDUSTRIAL, VETERINARY AND RESEARCH SECTOR

Among the nuclear activities in the **industrial sector, industrial radiography** and more particularly gamma radiography, are priority sectors for ASN oversight owing to their radiation protection implications. ASN considers that the risks are addressed to varying extents depending on the companies, even though worker dosimetric monitoring is generally carried out correctly. If the risk of incidents and the doses received by the workers are on the whole well managed by the licensee when this activity is performed in a bunker in accordance with the applicable regulations, ASN is still concerned by the observed shortcomings in terms of the signage of the operations area during site work. In 2021, in order to raise licensee awareness, ASN drew their attention –in a letter sent out to each company performing industrial radiography– to the deviations most commonly identified during inspections and urged them to exercise greater vigilance in signage of the operations area. ASN also recalls the need for regular maintenance and periodic checks on the correct working of the safety devices built into the bunkers, so that the line of defence they represent in preventing inadvertent exposure remains effective. More generally, ASN considers that the ordering parties should give priority to industrial radiography services in bunkers and not on the worksite.

In the other priority sectors for ASN oversight in the industrial sector (**industrial irradiators, particle accelerators including cyclotrons, suppliers of radioactive sources and devices containing them**) the state of radiation protection is considered to be on the whole satisfactory. However, two cyclotron licensees informed ASN that their annual radioactive gas discharge limits had been exceeded, although the resulting impact remains very small. With regard to suppliers, ASN considers that the areas in which practices still need to be improved are advance preparations for the expiry of the sources administrative recovery period (which by default is ten years), information for the purchasers regarding future source recovery procedures, and the checks prior to delivery of a source to a customer.

The actions carried out by the licensees in recent years are continuing to improve radiation protection within the **research laboratories**. The conditions for the storage and elimination of waste and effluent remain the primary difficulties encountered by the research units, including with regard to the performance and traceability of checks prior to elimination or the recovery of “legacy” unused sealed radioactive sources. Finally, the licensees must be more attentive, notably in the event of modifications to research projects or experimental procedures, to compliance with certain requirements in their authorisations, notably those regarding the premises in which sources of ionising radiation are allowed to be kept or used.

With regard to the **veterinary uses of ionising radiation**, ASN can see the result of the efforts made by veterinary bodies over the past few years to comply with the regulations, notably in conventional radiology activities on pets.

For practices concerning large animals such as horses, or performed outside veterinary facilities, ASN considers that the implementation of radiological zoning and the radiation protection of persons from outside the veterinary facility who take part in the radiographic procedure, are points requiring particular attention.

With regard to the **protection of sources of radiation against malicious acts**, more particularly when high-level radioactive sources or batches of equivalent sources are used, the inspections conducted by ASN show that the licensees are beginning to implement the measures needed to comply with the requirements set out in the Order of 29 November 2019. Thus, the categorisation of sources, an essential step in identifying the applicable requirements and in implementing an approach proportionate to the risks, has been done by nearly 75% of the facilities concerned. Similarly, the issue of nominative permits for access to sources is progressing, even if it still needs to be implemented in nearly half the industrial facilities and the vast majority of health facilities. ASN therefore considers that significant progress is still needed, in particular because in mid-2022, the requirements regarding the presence of physical systems to prevent unauthorised access to sources will become applicable, offering intrusion resistance compliant with that stipulated by the Order. In 2022, ASN will continue its actions to raise licensee awareness on these subjects.

TRANSPORT OF RADIOACTIVE SUBSTANCES

ASN considers that in 2021, the safety of transport of radioactive substances is on the whole satisfactory. Although a few transport operations –mainly by road– did suffer incidents, these must be put into perspective with the 770,000 transport operations carried out each year.

The number of significant events involving the transport of radioactive substances on the public highway (84 events reported to ASN in 2021) is slightly up on 2020, even if the number of events rated level 1 on the INES scale remained stable and the number of events concerning the transport of radiopharmaceutical products fell significantly. The events mainly comprise:

- material non-conformities affecting a package (notably damaged packaging) or its stowage on the conveyance, thereby weakening the strength of the package (whether or not an accident occurs). These cases do not concern transports of spent fuels or highly radioactive waste and primarily concern transports for small-scale nuclear activities;
- exceeding of the limits set by the regulations, usually by a small amount, for the dose rates or unfixed contamination of a package;
- errors or omissions in package labelling, mainly for transports concerning small-scale nuclear activities.

The inspections carried out by ASN also frequently identify such deviations. The consignors and carriers must therefore demonstrate greater rigorousness in day-to-day operations.

With regard to “fuel cycle” transports and, more generally, the BNIs, ASN finds that the licensees carry out numerous checks and are therefore better able to detect any deviations. It considers that the consignors must further improve how they demonstrate that the contents actually loaded into the packaging comply with the specifications of the package model approval certificates and the corresponding safety files. This more specifically concerns transports relating to research facilities or the removal of legacy radioactive waste.

More particularly with respect to transports concerning small-scale nuclear activities, the ASN inspections confirm significant disparities from one carrier to another. The deviations most frequently identified concern the quality management system, actual compliance with the procedures put into place and the content and actual implementation of the worker radiation protection programme.

At a time when the uses of radionuclides in the medical sector are generating a high volume of transport traffic, progress is still needed in familiarity with the regulations applicable to these transport operations and the arrangements made by certain hospitals or nuclear medicine centres for the shipment and reception of packages. ASN considers that the radiation protection of carriers of radiopharmaceutical products, who are significantly more exposed than the average worker, needs to be improved.

Finally, for transport operations involving packages that do not require ASN approval, progress is observed with respect to the previous years, along with better application of the recommendations given in ASN Guide No. 7 (volume 3). The improvements still to be made generally concern the description of the authorised contents by type of packaging, the demonstration that there is no loss or dispersion of the radioactive content under normal transport conditions, and that is impossible to exceed the applicable dose rate limits with the maximum authorised content.

NOTABLE EVENTS 2021

MANAGEMENT OF RADIOACTIVE MATERIALS AND WASTE

ASN opinion on the draft fifth plan

Planning Act 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste stipulated the periodic drafting of a National Radioactive Materials and Waste Management Plan (PNGMDR). This gives a detailed inventory of radioactive materials and waste management systems, whether operational or to be deployed, and then makes recommendations or sets targets to develop these systems.

Disposal of a concrete container in a cell at the Aube repository

For the first time, the drafting of the 5th edition of the PNGMDR was preceded by a public debate, the conclusions of which were published in November 2019. On 21 February 2020, the Ministry in charge of energy and ASN published a joint decision further to this public debate. The management of the plan also changed in the light of the conclusions of this debate. In particular, as the PNGMDR is a governmental policy document, ASN is therefore no longer jointly responsible for production of the work. It nonetheless remains involved and, with the Ministry for Ecological Transition, co-chairs the working group responsible for monitoring implementation of the plan. In 2020 and 2021, ASN also issued seven opinions on the management of radioactive materials and waste as contributions to the drafting of the fifth PNGMDR, covering the period 2021-2025.

The implementation of the orientations included in the 21 February 2020 decision was the subject of "guiding principles" established by the Ministry for Ecological Transition, which were debated at meetings of the pluralistic "Guidance Committee" chaired by an independent qualified personality. **This Committee issued 11 opinions summarising the debates concerning each management route and each subject on which it worked**. These "guiding principles" were also submitted to the public during the consultation following the public debate.

In September 2021, the Ministry for Ecological Transition asked the Environmental Authority for its opinion on the draft fifth PNGMDR. It submitted its opinion 2021-96 on the draft plan on 18 November 2021.

In addition, at the end of September 2021, the Ministry for Ecological Transition asked ASN for its opinion on this same draft plan. In response to this request, ASN's opinion 2021-AV-0390 of 9 November 2021 considers that **the PNGMDR 2021-2025 must, prior to its conclusion, enable the necessary decisions to be taken** so that operational solutions are available within the coming 15 to 20 years for all types of radioactive waste.

ASN considers that the draft PNGMDR 2021-2025 is in line with this approach, but that particular attention must be paid to compliance with the deadlines for each action it contains. It therefore issued a favourable opinion for the draft PNGMDR 2021-2025 with the following provisos:

• **given the malfunctions observed in 2021 in certain facilities vital to the working of the "fuel cycle",** the licensees will have to study worst-case operating scenarios for this "cycle" in terms of quantities of materials and waste produced, and as applicable propose appropriate remedies. They will also have to regularly report on the anticipated time-frames for saturation of the spent fuel storage capacities. In any case, the estimated prospects for saturation of spent fuel storage capacities produced pursuant to the draft plan must not be based on the hypothesis of any long-term densification of the storage pools envisaged by Orano on its La Hague site. This is not a technical solution that meets current safety standards;

• **given the forward planning needed for the actions involved in a decision to cease or continue with reprocessing of spent fuels after 2040**, studies of technical and safety options will have to be carried out by the industry with regard to the impact of such a decision on existing or future Basic Nuclear Installations;

• **with regard to actions concerning the safe management of high-level waste (HLW) and intermediate-level, long-lived (ILW-LL) waste**, the recommendations of the PNGMDR "Guidance Committee", formulated in its opinion of 19 March 2021, must now be incorporated into the PNGMDR 2021-2025. This more particularly entails:

- updating of the waste package delivery records at the very least at each new edition of the plan, with a first deadline for the end of 2023,
- provision of a preliminary version of the *Cigéo* acceptance specifications, no later than the deadline for submission of the creation authorisation application,
- explanation of the toxic, chemical and radiological substances inventories of the waste in the *Cigéo* reserve inventory, along with the conditioning methods adopted or, failing which, the ongoing or envisaged studies,
- by mid-2023, the transmission of a progress report on the studies carried out on the processing of bituminised waste, explaining the health and environmental impacts of each of the processes studied;

• **the work aiming to implement specific management solutions for certain waste, in the light of its properties, must be continued and supported by the PNGMDR 2021-2025**. This in particular concerns waste containing tritium, disused sealed sources, organic oils and liquids and activated waste from small producers. In this respect, ASN recalled the recommendations made in its opinion 2021-AV-0379 of 11 May 2021, aiming to improve the inventory of this waste and knowledge of its characteristics, as well as to identify and deploy appropriate management solutions.

ASN also considers that the ambition of that part of the draft plan requiring the development of recovery plans from the owners of radioactive materials is insufficient with regard to certain materials, such as depleted uranium, or the heavily depleted uranium which could result from the re-enrichment of depleted uranium, spent fuel from reactor EL4 (Brennilis' Nuclear Power Plant) and thorium-bearing substances. **ASN stresses the need to assess the recoverable nature of the radioactive materials**, taking account of the quantities concerned and the time-frames within which industrial solutions for using these materials will be available. In this respect, it recalls the analysis framework it proposed in its opinion 2020-AV-0363 of 8 October 2020, which includes the notion of a time-frame for the envisaged recovery.

In this opinion, ASN also makes a number of recommendations concerning the management of low-level, long-lived waste (LLW-LL) and ILW-LL waste, as well as on how to involve the public.

Following the submission of the above-mentioned opinions from the Environmental Authority and from ASN, the Ministry for Ecological Transition will submit an amended draft of the PNGMDR 2021-2025 for public consultation, along with draft regulatory texts issued pursuant to this plan, on which ASN will also issue an opinion.

NUCLEAR POWER PLANTS BEYOND 40 YEARS

Oversight of the fourth periodic safety reviews of EDF's 900 MWe reactors

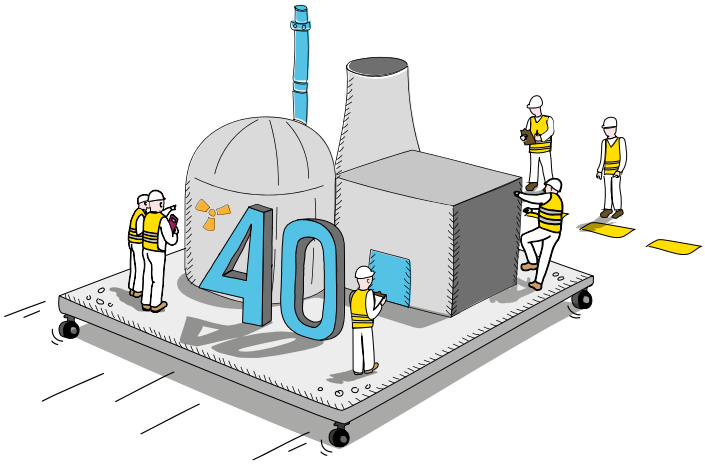
Aerial view of the Bugey Nuclear Power Plant

The fourth periodic safety review of the 900 Megawatts electric (MWe) reactors results in significant safety improvements, the deployment of which is mobilising the entire nuclear sector. ASN considers that so far, the fourth ten-yearly outages have been conducted relatively satisfactorily.

In France, the authorisation to create a nuclear facility is issued by the Government, after consulting ASN. This authorisation is issued without time limit. An in-depth examination, called the "periodic safety review", is performed every 10 years to evaluate the conditions for the continued operation of the installation for the next 10 years.

EDF's 900 MWe reactors are the oldest reactors in operation in France. Their fourth periodic safety review is of particular significance, because their design postulated an operating lifetime of 40 years. Their continued operation beyond this period requires the updating of design studies and equipment replacements.

"The generic phase of the periodic safety review concerns the 900 MWe reactors, the oldest reactors in operation in France."



The generic review phase, common to the 32 reactors of 900 MWe, enabled the safety improvements to be deployed on all the reactors to be determined

ASN considers that these safety improvements will make it possible to bring the level of safety of the 900 MWe reactors close to that of the most recent reactors (third generation), in particular:

- **by improving the way potential hazards** (earthquake, flooding, explosion, fire, etc.) are taken into account. The reactors will also be able to cope with more severe hazards than those hitherto considered;
- **by reducing the risk of accident with core melt** and mitigating any consequences of this type of accident. These provisions will thus lead to a significant reduction in environmental releases during this type of accident;
- **by mitigating the radiological consequences** of the accidents studied in the safety report. This will significantly reduce the occurrence of situations that involve implementing population protection measures (sheltering, evacuation, taking iodine tablets);
- **by improving the provisions for managing accident situations affecting spent fuel pools**.

In its resolution 2021-DC-0706 of 23 February 2021, ASN prescribed the implementation of the major safety improvements planned by EDF, along with additional measures it considers necessary to achieve the objectives of the safety review. ASN underlines the ambitious objectives of the fourth periodic safety review of the 900 MWe reactors and the substantial work carried out by EDF in the generic phase. It also underlines the scale of the modifications planned by EDF, the implementation of which will bring about significant safety improvements.

In 2019, EDF began to deploy these improvements during the fourth ten-yearly outages

The provisions determined during the generic stage of the safety review and those that will be defined in the studies specific to each site, will have to be applied on each reactor with a view to its continued operation. ASN asked EDF to carry out the majority of the safety improvements before submitting the safety review concluding report, and in practice during the ten-yearly outage of each reactor. At the end of 2021, EDF had carried out or initiated seven of these ten-yearly outages.

ASN is conducting reinforced oversight of these ten-yearly outages, with regard to both EDF's verification of the conformity of the installations with the safety rules, and deployment of the safety improvements. ASN considers that **these ten-yearly outages are being conducted relatively satisfactorily**. EDF is devoting considerable human resources to preparing and conducting them.

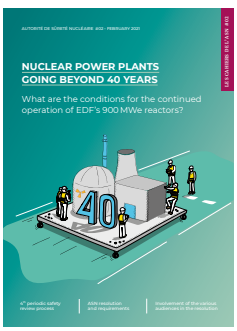
Considerable industrial capacity to be mobilised

Every year, EDF has to carry out the fourth ten-yearly outages for four to five 900 MWe reactors. This work entails a significant increase in the industrial workload in the sector. ASN asked EDF to report annually on the industrial capacity of both itself and its suppliers to complete the modifications to the facilities on schedule.

The public is involved throughout the review process

The measures set out by EDF during the generic phase of the review underwent public participation from September 2018 to March 2019, under the aegis of the High Committee for Transparency and Information on Nuclear Safety. ASN also consulted the public regarding the objectives of the review in 2016 and the conclusion of the generic phase at the end of 2020.

Finally, the measures set out by EDF in the periodic safety review concluding report for each reactor shall be subject to a public inquiry. That of Tricastin Nuclear Power Plant reactor 1 took place in early 2022.



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DECOMMISSIONING

Orano decommissioning and waste management strategy

Monitoring of decommissioning of the former Eurodif plant at Tricastin

The decommissioning of old nuclear facilities is a major challenge for Orano which –over the coming decades– will be required to carry out several large-scale decommissioning projects: the first generation fuel reprocessing plant at La Hague, called UP2-400, with its support facilities (STE2 Effluent Treatment Station and AT1 spent fuels reprocessing Unit, ELAN IIB radioactive sources fabrication unit and HAO "Oxide High Activity" unit), as well as the Tricastin uranium enrichment and conversion units.

The Legacy Waste Retrieval and Conditioning operations (referred to as RCD) are among the first steps in decommissioning. These are of particular importance given the inventory of radioactive substances present and the age of the facilities in which they are stored, which do not meet current safety standards. RCD projects are characterised by major safety and radiation protection challenges, as well as by considerable industrial complexity.

The general decommissioning of these facilities will also create a large quantity of waste, which will need to be safely managed.

Since 2005, ASN has been regularly evaluating Orano's decommissioning and waste management strategy for the La Hague and Tricastin sites. At ASN's request and given the complexity of these subjects, their interdependance and the delays observed in

"Despite progress observed in its decommissioning strategy, ASN asks Orano to improve certain points."

certain priority projects, the licensee updated its strategy in 2016. ASN examined this strategy and, following discussions with the licensee, observed progress in the assimilation of the objectives of immediate dismantling, monitoring the governance of complex projects[1], progress in the operations on several installations at Tricastin, and the definition of final waste conditioning processes for the La Hague site.

However, ASN asks Orano to improve its strategy in the following four areas:

1. The implementation of the decommissioning and waste management strategy must be prioritised according to the risks (existing pollution or high dispersible inventory[2]). The construction of new effluent and waste conditioning, storage, transport and treatment capacity will be needed to enable this strategy to be implemented, given the existing weak points (storage facilities that do not meet current safety standards, uncertainties regarding the medium-term saturation of certain storage facilities, etc.);

2. The implementation of the clean-up strategy must be based on sufficient knowledge of the current state of the facilities, and more particularly the civil engineering structures and soils. If complete clean-out is not possible, an appropriate clean-out strategy taken as far as is reasonably achievable, taking account of the technical and economic feasibility of the measures, shall be deployed;

3. The implementation of the RCD strategy must be better managed and the dispersible inventory must be reduced as early as possible. The characterisation of the waste and qualification of the processes envisaged must be actively pursued in order to define the required processes and demonstrate their feasibility within a time-frame compatible with implementation of the RCD projects. The waste currently stored in temporary facilities and for which there is no operational solution or which requires preliminary treatment, shall be transferred as rapidly as possible to storage facilities compliant with current safety requirements;

4. The oversight of complex projects must be improved by analysing the causes of delays to the priority projects and by examining the adequacy of the resources devoted to these projects.

ASN also underlines the need for the licensee to inform the public of the progress of its programmes.

It is up to Orano to ensure that this strategy is implemented and to report on it regularly to ASN. Given the safety and radiation protection issues encountered, ASN very regularly checks progress, by means of dedicated investigations, inspections, technical meetings and a project oversight approach.

Thanks to this heightened oversight, ASN adapts its methods for these high-stakes projects. Its intention is to transition from a "static" approach –in which the project completion deadline is set out in the regulations, often a long time in the future, and with calendar drift that is detected too belatedly– to a "dynamic" approach, focused on a precise analysis of the actions planned by the licensee over the coming 5 years.

In this new approach, having strengthened its RCD projects programming and oversight methods, the licensee submits detailed schedules to ASN, including milestones for which it makes a binding commitment to ASN. This may consist of safety studies or studies to develop certain aspects of the project, placing of industrial contracts or the completion of actual physical steps in the progress of the project, such as the beginning of construction of new equipment. On the basis of this detailed 5-year programme, ASN will specify key milestones for this period and will check that they are reached. This sliding process will continue until the final waste retrieval and conditioning result is achieved.

1. Creation of a major projects department, a procedure to evaluate project maturity and develop project progress monitoring tools.
2. Corresponds to the quantity of radiological activity that could be involved in an incident or accident.

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REGULATORY NEWS

2021 was a particular year for work in the field of standards, notably owing to several Ministerial Orders and ASN resolutions as a result of the Decrees transposing European Council Directive 2013/59/Euratom of 5 December 2013 setting out Basic Standards for Health Protection against the dangers arising from exposure to ionising radiation.

National news

1.1 Acts and Ordinances

▶ **Act 2021-401 of 8 April 2021 improving the effectiveness of local justice and the penal response**

The purpose of this text is to encourage the use of alternatives to prosecution and settlement, in order to provide a faster response to violations of lesser importance. It also aims to create more fluid use of sentences involving community service and improve the collection of fixed penalty fines.

Its goals are to reinforce the proximity of the penal response for minor misdemeanours, to bring the justice process closer to the citizens and to speed up the judicial procedures.

In order to reinforce the effectiveness of the penalties pronounced for violations and to facilitate collection of fixed-penalty fines, the text creates a reduction in the amount of the fine for fifth category fixed-penalty fines. Article 9 of the Act thus stipulates that when a violation is category five, or when the regulation so provides, the fixed-penalty fine is reduced if the offender pays the amount of the reduced fixed-penalty fine, either to the officer issuing the fine at the moment the violation is detected, or within fifteen days from detection of the violation or, if notification of the violation is sent subsequently to the party concerned, within fifteen days from this notification. The purpose of this procedure is to encourage voluntary payment of the fine (within 15 days).

▶ **Act 2021-1104 of 22 August 2021 combating climate change and reinforcing resilience to the effects thereof**

The 22 August 2021 Act comprises legislative provisions adopted by Parliament, contributing to implementation of the proposals of the "Citizens climate Convention", concerning the following question: "*By 2030, how to reduce greenhouse gas emissions by at least 40% in comparison with 1990, while protecting social justice?*"

Article 86 of this Act introduces a provision into the Energy Code (I bis of Article L. 100-4) which, notwithstanding the provisions taken to ensure nuclear security, requires that the State take account of the objectives of security of supply and reduction in greenhouse gas emissions when it decides to cease the operation of a nuclear reactor in order to achieve national energy policy objectives.

The purpose of Title VII of the Act is to "*reinforce the legal protection of the environment*" and it comprises provisions which, within the Environment Code, defines new violations, or aggravates existing violations within this same Code or in the Transport Code. The purpose of these provisions is to reinforce the criminal prosecution of environmental offences and thus contribute more effectively to protection of the environment. These provisions include the following:

Penalty for exposure to risk with the creation of an offence of endangerment of the environment

The Act introduces provisions into the Environment Code (new Article L. 173-3-1) and into the Transport Code (II of Article L. 1252-5) which aggravate the penalties applicable to the circumstances set out respectively in Articles L. 173-1 and L. 173-2 of the Environment Code and Article L. 1252-5 of the Transport Code, when these circumstances directly expose the fauna, flora, or water quality to an immediate, serious and lasting risk. The Act stipulates that lasting refers to damage liable to persist for at least 7 years.

The penalties incurred are three years of imprisonment and a fine of 250,000 euros, which could be raised to three times the benefit gained from the offence committed.

The same penalties are incurred in the event of a further offence, created in X of Article L. 541-46 of the Environment Code, for non-compliance with formal notice served regarding the regulations governing the dumping of waste or its management, when this failure to comply "*directly exposes the fauna, flora, or water quality to an immediate serious and lasting risk*".

Within their sphere of competence, the nuclear safety inspectors are authorised to investigate and record these new violations.

Penalty for damage and creation of an offence of ecocide
A general offence of pollution of the environment and an offence of ecocide for the more serious cases (new Articles L. 231-1 to L. 231-3 of the Environment Code) are created.

Article L. 231-1 punishes the fact –in clear and deliberate violation of a particular obligation of prudence or safety set out by law or the regulations– of emitting into the air or releasing into the water a substance leading to serious and lasting harmful effects on health, flora, fauna, or serious modifications to the normal water supply system. The scope of this Article excludes emissions into the air complying with the limit values set out in a decision by the competent administrative authority, authorised discharge operations and the use of authorised substances when the binding requirements set by the competent administrative authority are adhered to. It defines lasting effects as those liable to persist for at least 7 years. The offences set out in the new Article L. 231-1 are punishable by a penalty of 5 years of imprisonment and a fine of one million euros, which could be raised to five times the benefit gained from the offence committed.

The new Article L. 231-3 of the Environment Code states that intentionally committing an offence as defined in Article L. 231-1 and intentionally committing offences set out in Article L. 231-2, when they lead to serious and lasting harm to health, flora, fauna, or air, soil or water quality, are considered to be crimes of ecocide. This crime of ecocide is punishable by 10 years of imprisonment and a fine of 4.5 million euros, an amount which can raised to ten times the benefit gained from the violation. Article L. 231-3 specifies that lasting effects are those harmful effects on health, flora, fauna or the quality of soils or surface or groundwater, which are liable to persist for at least 7 years.

Pursuant to the new Article L. 231-5, the nuclear safety inspectors, within their sphere of competence, are authorised to investigate and record the offences thus created.

The Act creates a new technical investigation system (Articles L. 501-1 to L. 501-19 of the Environment Code) which can apply to any accident occurring in the installations, mines, networks and products and equipment listed in Article L. 501-1, at the initiative of the head of the industrial risks investigation and analysis office or at the request of the Minister in charge of the environment.

II of this Article L. 501-1 states that, by way of derogation, ASN's special policing installations and activities are exclusively subject to the technical inquiries set out in Articles L. 592-35 to L. 592-40 of the Environment Code.

▶ Act 2021-1109 of 24 August 2021 consolidating compliance with the principles of the Republic

Article 12 of the Act of 24 August 2021 consolidating compliance with the principles of the Republic inserts an Article 10-1 into Act 2020-321 of 12 April 2000 on the rights of the citizens in their relations with the administrations, stipulating that any association or foundation applying for a public subsidy must sign a contract of commitment to the values of the Republic. The obligations arising from this contract are to respect the principles of liberty, equality, fraternity and the dignity of the human person, as well as the symbols of the Republic as defined in Article 2 of the Constitution, that is the national emblem, the national anthem and the motto of the Republic; not to call into question the secular nature of the Republic and, finally, to abstain from any action prejudicing public order. As a result of work in Parliament, this latter obligation concerns actions liable to lead to serious threats to public peace and security.

In the event of any breach of this contract of commitment, the public subsidy shall be revoked, following an adversarial procedure, with a fully substantiated decision by the authority or organisation, and with the association being given a period of six months in which to return the funds paid to it.

1.2 Decrees and Orders

▶ Decree 2021-286 of 16 March 2021 designating the regional centres specialising in environmental prejudice pursuant to Articles 706-2-3 of the Code of Criminal Procedure and L. 211-20 of the Judicial Organisation Code and adapting the Code of Criminal Procedure to the creation of specialised environmental assistants

The Decree determines the seat and the jurisdiction of the judicial tribunals with competence to investigate the most complex environmental offences, as well as actions regarding ecological prejudice founded on Articles 1246 to 1252 of the Civil Code, civil liability suits stipulated by the Environment Code and civil liability suits founded on the special environmental liability conditions resulting from the European regulations, international Conventions and Acts passed to implement these conventions.

The Decree also adapts the provisions regarding the specialised environmental assistants in the regional and interregional centres, pursuant to Articles 706-2 and 706-2-3 of the Code of Criminal Procedure, in their drafting derived from Articles 15 and 20 of Act 2020-1672 of 24 December 2020 relative to the European Prosecutor's Office, environmental justice and specialised criminal justice.

▶ Decree 2021-759 of 14 June 2021 creating an interministerial Delegate to assist the regions with their energy transition

The Decree creates an interministerial Delegate to assist the regions with their energy transition. It specifies the missions within the scope of his or her competence, updates the missions of the Delegate for the future of the Fessenheim region and the regions in which coal-fired power plants are located and supplements them for the other regions undergoing energy transition. It repeals Decree 2019-67 of 1 February 2019 creating an interministerial Delegate for the future of the region of Fessenheim and the regions in which coal-fired power plants are located.

▶ Decree 2021-837 of 29 June 2021 constituting various reforms regarding environmental assessments and public participation in the environmental field

The Decree is an implementing Decree of Act 2018-148 of 2 March 2018 which ratifies the following two Ordinances:
- Ordinance 2016-1058 of 3 August 2016 relative to modification of the rules applicable to the environmental assessment of projects, plans and programmes: the end-purpose of this ordinance is to bring french law into conformity with European law regarding environmental assessments;
- Ordinance 2016-1060 of 3 August 2016 reforming the procedures designed to ensure public information and participation in the drafting of certain decisions liable to have an effect on the environment: this ordinance reinforced the consultation phase upstream of any decisions with an effect on the environment.

Article 7 of the Decree modifies the annex of Article R.122-2 of the Environment Code, by creating three new categories of Installations Classified for Protection of the Environment (ICPEs) subject to a systematic environmental assessment:

- integrated ironworks and steel mills;
- facilities for the disposal of hazardous waste –as defined in Article 3, point 2, of European Parliament and Council Directive 2008/98/EC of 19 November 2008 relative to waste– by incineration, chemical treatment, as defined in Annex I, D 9, of said Directive, or landfill dumping;
- the facilities intended for the extraction of asbestos and the treatment and transformation of asbestos and products containing it.

Article 9 of the Decree creates an Annex to Article R. 122-3-1 of the Environment Code, which lists the criteria used to decide whether a project subject to a case by case examination must undergo an environmental assessment; these criteria are those set out in Annex III to Directive 2011/92/EU of 13 December 2011 concerning the assessment of the impacts of certain public and private projects on the environment, as modified by Directive 2014/52/EU of 16 April 2014, incorporated in full.

Article 10 of the Decree modifies Article R. 593-5 of the Environment Code, to specify that the impact assessment must take account of the opinion issued by the authority with competence to take the authorisation decision, when it has been solicited by the project owner, on the basis of Article R. 122-4 of the same Code. The project owner must take account of the available results of other pertinent assessments of the effects on the environment, required pursuant to other applicable legislations.

Article 26 of the Decree modifies Article R. 123-46-1 of the Environment Code, to specify the content of the file for the projects which are to undergo an environmental assessment and which, although not requiring a public inquiry, are subject to online public consultation on the basis of Article L. 123-19 of the same Code. It is now specified that the file subject to public participation on the basis of Article L. 123-19 must contain the same items as those mentioned in Article R. 123-8 of the Environment Code. Article R. 123-8 of the Environment Code specifies the items to be contained in a public inquiry file; this notably comprises the updated impact assessment, the opinion from the environmental authority and the licensee's response, other mandatory opinions, the licensee's response, an indication of the texts governing the consultation and of how this consultation fits into the administrative procedure, the decision(s) which could be adopted further to the consultation and the authorities with competence to take the authorisation decision, as well as any indication that the project is subject to a transboundary assessment.

It is also now specified that the references to the public inquiry in this Article R. 123-8 of the Environment Code are replaced, for application of Article R. 123-46-1 of the same Code, by those relative to online public participation and that the request for consultation on a paper version of the file, as applicable, set out in point II of Article L. 123-19 of the Environment Code, is made in the conditions stipulated in Article D. 123-46-2 of the same Code.

▶ Decree 2021-903 of 7 July 2021 supplementing Section 9 of Chapter III of Title IX of Book V of the Environment Code

Article L.593-19 of the Environment Code states that the provisions for remedying the anomalies found or for improving the protection of the interests mentioned in Article L. 593-1 of the same Code, proposed by the licensee during the reviews beyond the 35th year of operation of a Nuclear Power Plant (NPP) reactor, are the subject of a public inquiry. The Decree clarifies the NPP reactor review process beyond their 35th year of operation and specifies the scope and organisational arrangements for the public inquiry and consultations planned as part of these reviews. The Decree thus specifies the methods for implementing the legislative measures by supplementing Section 9 of Chapter III of Title IX of Book V of this Code (regulatory part):

- on the one hand, to make its implementation legally secure;
- on the other, to promote effective public participation, by enabling it to assess those safety improvements already made and those planned by the licensee for continued operation of its facility.

Article R. 593-62-1 of the Environment Code makes it possible for the licensee of several NPP reactors of similar design to carry out a part of their periodic safety reviews that is common to all of them, even if they are located on different sites. This possibility is in fact already used for the French NPP reactors owing to the standardisation of the fleet operated by EDF (the generic phase of the periodic safety review is conducted per plant series). The benefit of the provision is to manage this possibility and enshrine it in the regulations. The text specifies that in this case and for the periodic safety review of each reactor, the licensee incorporates the conclusions of this common part in the review report, together with any follow-up measures decided on by ASN. Prior to each review, the licensee checks that the conclusions of this common part remain valid with regard to changing knowledge and operating experience feedback.

Article R. 593-62-1 of the Environment Code stipulates that this possibility can only be used for NPP reactors (its application to Basic Nuclear Installations –BNIs– other than NPP reactors would not appear to be appropriate owing to their diversity) and for each periodic safety review (not only as of the fourth review).

The Decree creates a specific sub-section (1 bis) within Section 9 of Chapter III of Title IX of Book V of the Environment Code, comprising Articles R. 593-62-2 to R. 593-62-9, applicable to periodic safety reviews of NPP reactors beyond their 35th year of operation.

These Articles set the organisational arrangements for the public inquiry and the consultations planned as part of these reviews.

Even if the legislative provisions do not so require, the decision has been made to apply the common law regulatory provisions relating to the procedure and the performance of the "environment" public inquiry (Section 2 of Chapter III of Title II of Book I of the regulatory part of the Environment Code), with the necessary adaptations (Articles R. 593-62-2 to R. 593-62-8).

It is first of all stipulated that the public inquiry covers the provisions proposed by the licensee and what the Prefect transmits to the Chair of the administrative tribunal when he or she asks them to appoint an inquiry commissioner or a board of inquiry (Article R. 593-63-3).

This provision removes all ambiguity regarding the scope of the public inquiry and the procedure applicable to it. According to the actual terms of the law, the public inquiry covers "*the provisions proposed by the licensee*".

Article R. 593-62-4 sets the composition of the file submitted to the public inquiry (which therefore is not that of Article R. 123-8 of the Environment Code).

▶ Decree 2021-1000 of 30 July 2021 containing various provisions implementing the public action acceleration and simplification and environmental simplification Act

The Decree implements the provisions of Title III of the public action acceleration and simplification and environmental simplification Act. It:

- modifies the table in Article R. 121-2 of the Environment Code listing the categories of operations involved in development and equipment projects referred to the National Commission for Public Debate (CNDP);
- modifies the provisions concerning the case of ICPEs located within the perimeter of a BNI but not necessary for this BNI, for which ASN has competence (authorisation, registration, time-frame);
- adds that, in the same way as the manufacturers, the representatives are now subject to certain pressure equipment obligations.

This concerns the State services, professionals, private individuals, project owners, associations, design offices.

It entered into force on 1 August 2021, but does contain interim provisions.

Pursuant to these provisions, Article R. 121-2 of the Environment Code contains a table listing the categories of operations concerning development or equipment projects which are automatically referred to the CNDP and those concerning development or equipment projects made public and for which this referral is optional.

Articles 2 to 6 of the Decree modify numerous procedural provisions, notably regarding the licensing and registration of ICPEs located within the perimeter of a BNI but not necessary for this BNI and for which ASN has competence.

In the same way as the manufacturers, the representatives are now subject to certain pressure equipment obligations. With regard to the obligations of the economic operators, the term "representative" is added to that of "manufacturer". It is now the manufacturers or, as applicable, their representatives, who give their name, their corporate name or their trade mark and the postal address at which they can be contacted, on the product or equipment or, when this is not possible, on its packaging or in a document accompanying the product or equipment (Article R. 557-2-5 of the Environment Code).

▶ Decree 2021-1096 of 19 August 2021 modifying various provisions concerning polluted soils and the cessation of activity by ICPEs

Article 57 of Act 2020-1525 accelerating and simplifying public action modified Articles L. 512-6-1, L. 512-7-6 and L. 512-12-1 of the Environment Code, by creating an obligation for the licensees –as part of the cessation of activity procedure for an ICPE– to have a company that is certified in the field of polluted sites or soils, or with equivalent competence in the provision of services in this field, confirm the implementation of operations to make the site safe plus, as applicable, the adequacy of the measures proposed for rehabilitation of the site and then implementation of said measures.

The Decree of 19 August 2021 defines the means of application of this Article 57 and revises the cessation of activity procedure accordingly. It also modifies certain provisions regarding the soil hazard information sectors. Finally, it specifies the means of applying the transfer from a third-party applicant to another third-party applicant, created by this same Article 57.

As with all regulations regarding ICPEs, these provisions apply to ICPEs within the perimeter of a BNI but not necessary for it, with ASN exercising the powers regarding individual resolutions and oversight vested in the Prefect.

Article 2 of this Decree modifies Article L.125-43 of the Environment Code. In the new Article R. 125-43, the BNIs no longer appear explicitly in the exclusions "*of the soil hazard information sectors defined in Article L. 125-6*". However, the new formulation "*the land on which nuclear activities mentioned in Article L. 1333-1 of the Public Health Code are carried out*" includes nuclear activities carried out in BNIs and "nuclear" ICPEs.

The Decree of 19 August 2021 enters into force on 1 June 2022, with the exception of Articles 2, 3, 4, 21 and 27, which enter into force the day following its publication.

▶ Decree 2021-1802 of 23 December 2021 concerning the civil service secularity coordinator

Act 2021-1109 of 24 August 2021 confirming compliance with the principles of the Republic created a secularity coordinator within the State's administrations, regional authorities and public health establishments, who is more particularly responsible for providing all necessary advice regarding the principle of secularity for any civil servant or department head wishing to consult him or her. This coordinator is also responsible for organising a secularity day on 9 December of each year.

The Decree determines the duties, the methods and the criteria for appointing this secularity coordinator.

Article 1 of the Decree states that the secularity coordinators are appointed at a level enabling them to effectively carry out their duties. These authorities designated by the Decree may make provision for a secularity coordinator common to several departments or establishments. In this case, the secularity coordinators are then appointed by the competent head of department at the level determined, for a duration set by this latter. Article 5 of the Decree stipulates that the secularity coordinator advises the heads of department and civil servants with regard to implementing the principle of secularity, notably by analysing and responding to queries from these latter regarding individual situations or more general questions, raises civil servants' awareness of the principle of secularity and disseminates information regarding this principle within the administration concerned, at his or her level and, as applicable, in coordination with other secularity coordinator, and organises the secularity day on 9 December of each year.

At the request of the authority which determined the level at which the secularity coordinator is appointed, this latter may be called on in the event of difficulty in application of the principle of secularity between a civil servant and users of the public service. The same authorities may specify the means whereby these duties are carried out.

▶ Decree 2021-1947 of 31 December 2021 implementing Article 10-1 of Act 2000-321 of 12 April 2000 and approving the contract of Republican commitment by associations and foundations receiving public subsidies or State approval

The Decree determines the content of the contract of Republican commitment by associations and foundations receiving public subsidies or State approval. It determines how this commitment is made and specifies the conditions surrounding any revocation of public subsidies.

Its Article 5 specifies that the association or foundation ensures that the contract of Republican commitment is adhered to by its managers, its staff, its members and its volunteers. This same Article indicates that any violations committed by its managers, staff, members or volunteers acting in this capacity are attributable to the association or foundation, along with any violation committed by them and directly linked to the activities of the association or foundation, if its management –although informed of these actions– failed to take the necessary to ensure their cessation, taking account of the means at their disposal. A violation of the undertakings made under the contract of republican commitment is such as to justify revocation of a subsidy, in cash or in kind.

▶ **Order of 30 June 2021 creating a protected zone**

In accordance with the provisions of Article 413-7 of the Penal Code, a protected zone is created at the ASN headquarters, located 15-21, rue Louis-Lejeune in Montrouge (92120). The result of the creation of such a protected zone is to prohibit entry into the ASN premises without authorisation, under penalty of prosecution (Articles 413-7 and 413-8 of the Penal Code).

1.2.1 Radiation protection

TEXTS ISSUED PURSUANT TO THE PUBLIC HEALTH CODE

General provisions for all nuclear activities

▶ **Order of 27 January 2021 setting a list of categories of nuclear activities considered to be justified**

The Order, issued pursuant to Article R. 1333-9 of the Public Health Code, sets the list of categories of nuclear activities which are considered justified as stated in 1° of Article L. 1333-2 of the Public Health Code. Thus, notwithstanding the general provisions, when a nuclear activity falls within a category on this list, the party responsible for the nuclear activity, if it can establish that this activity meets the criteria for inclusion in this category, is not required to provide further evidence of justification.

Radon

▶ **Order of 30 June 2021 relative to specific workplaces which could expose workers to radon**

The text defines specific workplaces, other than buildings, where the radon risk assessment for workers occasionally or regularly present in these premises cannot be primarily based on zones with a radon potential originating in the soil. Moreover, it sets certain procedures to be adopted by the employers in their radon risk assessment.

TEXTS ISSUED PURSUANT TO THE LABOUR CODE

▶ **Decree 2021-1091 of 18 August 2021 relative to the protection of workers against the hazards of ionising and non-ionising radiation**

The Decree modifies the Labour Code, notably by extending the duration of the transitional period for the implementation of the new radiation protection organisation and the certification and accreditation of the necessary organisations. It also specifies the provisions applicable to workers subject to lasting exposure as a result of a major nuclear accident. It also make a number of modifications to the provisions applicable to radon: modification of the scope of the Order concerning the specific premises mentioned in Article R. 4451-4 of the Labour Code, to enable the provisions of the Labour Code to be adapted in these premises, obligation of training of workers exposed solely to radon, elimination of the possibility of resorting to an ASN-approved organisation to measure radon for the initial verification of "radon zones" as of 1 January 2022.

List of categories of nuclear activities considered to be justified by the Order of 27 January 2021

SOURCES OF IONISING RADIATION	PURPOSE	TYPES OF SOURCES OR TECHNIQUES CONCERNED
Electrical devices emitting X-rays(1)	• Computed tomography scanners for diagnostic purposes • Fluoroscopy-guided interventional practices	Computed tomography devices, including: • computed tomography devices coupled with single photon emission computed tomography devices • computed tomography devices coupled with positron emission tomography devices
	• Fluoroscopy-guided interventional practices	Fixed or mobile devices
	• Conventional imaging or examinations for diagnostic purposes	Fixed or mobile devices, including mammography devices and quantitative computed tomography bone density scanners
	• Conventional imaging or examinations for screening purposes	2D digital mammography devices
	• Dental imaging for diagnostic purposes	Fixed or mobile intra-oral radiography, dental panoramic radiography, with or without cone beam computed tomography

(1) Electrical device designed to emit X-rays or inadvertently emitting them. In the case of an electrical device designed to emit X-rays, it comprises at least a high-voltage generator, an X-ray emitting device and a control system or any other equivalent device.

▶ **Order of 12 November 2021 modifying the Order of 18 December 2019 relative to the procedures for training the Radiation Protection Expert-Officer (RPE-O) and the certification of training organisations and Radiation Protection Organisations (OCR) and the Order of 23 October 2020 regarding measurements taken for the assessment of risks and checks on the effectiveness of the prevention means put into place for the protection of workers against the hazards of ionising radiation**

The procedures for entry into force of these two Orders are brought into conformity with the provisions of the above-mentioned Decree. The Order of 18 December 2019, issued pursuant to Article R. 4451-126 of the Labour Code, defines the conditions for performance of the duties of the Radiation Protection Adviser (RPA). The Order of 23 October 2020, issued pursuant to Article R. 4451-51 of the Labour Code, specifies the methods for taking measurements for risk assessments. It reorganises the procedures and the conditions for performance of technical inspections, henceforth called "verifications", by making them proportional to the scope of the implications for worker radiation protection. Calling on an accredited organisation is only required at commissioning of the installation and the working equipment, as well as after any major modification of them liable to affect the health and safety of the workers. Finally, the employer may use the company's own resources for the periodic verifications, notably by or under the supervision of its Radiation Protection Adviser.

The radiation protection competence centres

▶ **Order of 28 June 2021 concerning the radiation protection competence centres**

The Order is issued pursuant to Article R. 4451-126 of the Labour Code. For the BNIs, it allows the implementation of the new Radiation Protection Organisation introduced by Decree 2018-437 of 4 June 2018, which contributes to the transposition of Council Directive 2013/59/Euratom of 5 December 2013 setting the Basics Standards for Health Protection against the hazards resulting from exposure to ionising radiation.

The competence centres are the RPAs for the employer and the licensee of a BNI.

The Order defines the roles and the organisational requirements of the radiation protection competence centres mentioned in Article R. 4451-113 of the Labour Code and Article R. 593-112 of the Environment Code, and the procedures and conditions for approval of these centres. It in particular states that the employer and the licensee of a BNI must submit their request for approval of the ASN competence centres before 2 January 2022. Pending their approval, the employer and the licensee must set up provisional competence centres.

1.2.2 Basic Nuclear Installations

▶ **Order of 7 February 2012 setting the general rules concerning Basic Nuclear Installations ("BNI Order")**

The work to revise this Order continued in 2021.

1.3 ASN resolutions

▶ **ASN resolution 2021-DC-0707 of 2 March 2021 concerning the procedures for remote hearing by the Commission of persons from outside ASN**

This resolution organises the procedures for remote hearings by the ASN Commission. The ASN Chairman may decide that persons from outside ASN will be given a hearing by the Commission by telephone or audiovisual means, or by any process allowing the electronic exchange of written documents, in the conditions set out by Ordinance 2014-1329 of 6 November 2014 regarding the remote deliberations of collegial administrative bodies and Decree 2014-1627 of 26 December 2014 concerning the procedures for the organisation of remote deliberations by collegial administrative bodies.

▶ **Resolution of 19 October 2021 adopting the internal regulations of the ASN administrative enforcement Committee**

The internal regulations of the ASN administrative enforcement Committee were adopted by the members of the Committee on 19 October, during the session instituting the latter. It comprises provisions regarding the working of the Committee, how it investigates requests for issue of a fine referred to it, summons procedures, the running of sessions, deliberations, as well as a reminder of the references of the texts governing incompatibilities and the professional ethics obligations of its members.

The internal regulations of the ASN administrative enforcement Committee were published in the *Official Journal* on 5 November 2021 and in the ASN *Official Bulletin* on 8 November 2021.

1.3.1 Radiation protection

▶ **ASN resolution 2020-DC-0694 of 8 October 2020 concerning the qualifications of physicians or dental surgeons who perform procedures using ionising radiation for medical or research purposes involving humans, the qualifications required in order to be appointed a coordinating physician of a nuclear activity for medical purposes or request a license or registration as a natural person**

ASN updated the qualifications required for physicians or dental surgeons using ionising radiation for medical or research purposes involving humans, in order to adapt the regulatory provisions to changing techniques and performance conditions.

This resolution repeals the previous one dating from 2011 (ASN resolution 2011-DC-0238) and clarifies the definition of the qualifications:

1. of the physician or dental surgeon performing procedures using ionising radiation for medical or research purposes involving humans;
2. of the physician coordinating the steps taken to ensure radiation protection of the patients (Article 1333-131 of the Public Health Code);
3. of the natural person responsible for a nuclear activity for medical purposes, in other words a physician who reports a nuclear activity to ASN or a physician who requests ASN authorisation for radiotherapy, nuclear medicine or computed tomography.

It entered into force on 7 July 2021, after publication of its approval order of 5 July 2021 in the *Official Journal*.

▶ **ASN resolution 2021-DC-0703 of 4 February 2021 establishing the list of nuclear activities using sources of ionising radiation for industrial, veterinary or research purposes (other than research involving humans) subject to the registration system, and the binding requirements applicable to these activities**

A third administrative system, registration, was introduced into the Public Health Code by Decree 2018-434 of 4 June 2018; it corresponds to a simplified authorisation and applies to nuclear activities not needing specific individual requirements. Resolution 2021-DC-0703 implementing Articles L. 1333-8 and R. 1333-113 (*et seq.*) of the Public Health Code, notably specifies:

- the list of nuclear activity categories now subject to the registration system and previously requiring authorisation (appendix 1);
- the practicalities for submitting an initial application, a modification application or registration renewal application, and the list of information and documents to be provided for a registration application (appendix 2);
- the general requirements specific to the different nuclear activity categories (appendix 3) which are binding on the nuclear activity manager and any breach of which can be punished;
- the interim provisions applicable to authorised activities switching from the authorisation system to the registration system. In the absence of any modification to the authorised nuclear activity, the authorisations issued before the date this resolution enters into force Act as the registration up until their expiry date (an initial registration application shall be submitted no later than six months before the authorisation expiry date).

It entered into force on 1 July 2021, after publication of its approval order of 15 June 2021 in the *Official Journal*.

▶ **ASN resolution 2021-DC-0704 of 4 February 2021 establishing the list of medical activities using medical devices emitting ionising radiation subject to the registration system and the requirements relative to these activities**

Transposition into French law of Directive 2013/59/Euratom (known as the "BSS" Directive) led to modification of the Public Health Code. This was notably done through publication of Decree 2018-434 of 4 June 2018 introducing various provisions concerning nuclear activities. This resolution modifies and repeals ASN resolution 2018-DC-0649 of 18 October 2018 implementing 2° of Article R. 1333-109 and Article R. 1333-110 of the Public Health Code, setting the list of nuclear activities subject to the notification system and the information to be mentioned in these notifications.

This results in a significant change concerning fluoroscopy-guided interventional practices. Article 12 of the resolution concerning the interim provisions applicable to fluoroscopy-guided interventional practices requires that "*for fluoroscopy-guided interventional practices which have been notified to ASN, a description of the types of procedures carried out, according to the list given in Article 1, along with the references of the notification concerned, shall be transmitted within twelve months following entry into force of this resolution*".

To enable this information to be transmitted to ASN, a notification form was created.

The facilities are asked to notify their activities *via* an online form available on the Framaforms website.

The registration is only valid if it complies with the specific general requirements concerning the medical devices emitting X-rays used (maintenance, loan for test purposes, organisation of patient radiation protection for fluoroscopy-guided interventional practices). The provisions to be implemented are formally set out in the quality management system put into place pursuant to ASN resolution 2019-DC-660 of 15 January 2019.

It entered into force on 1 July 2021, after publication of its approval order of 15 June 2021 in the *Official Journal*.

▶ **ASN resolution 2021-DC-0708 of 6 April 2021 setting quality assurance obligations for procedures using ionising radiation for therapeutic care purposes**

Following the transposition of Directive 2013/59/Euratom[1], ASN entirely revised the regulatory arrangements regarding the quality assurance obligations for medical procedures utilising ionising radiation.

ASN resolution 2021-DC-0708 applies to the four therapeutic fields using ionising radiation, preparatory and monitoring computed tomography examinations and research involving humans:

- external radiotherapy, including contact therapy and pre-operative radiotherapy;
- brachytherapy;
- therapeutic nuclear medicine (Targeted Internal Radiotherapy);
- radiosurgery.

The resolution repeals resolution 2008-DC-0103 of 1 July 2008 and expands the scope of procedures using ionising radiation for therapeutic purposes subject to the quality assurance obligation.

The requirements are harmonised with the medical imaging sector (resolution 2019-DC-0660).

This resolution prescribes new applicable quality assurance requirements:

- extension of quality assurance obligations to therapeutic nuclear medicine (art. 1).

The following points must be formalised:

- the procedures for training of professionals in radiation protection of patients and the use of a new medical device or a new technique (art. 7);
- the tasks to be performed by an internal procedure for qualification on the workstation by new arrivals, for all professions or when changing positions or medical devices (art. 7);
- project management for any change affecting the quality and safety of patient care (medical devices, information systems, premises, treatment practices, etc.) by means of a procedure (art. 8);
- the respective responsibilities of the ordering party and the service provider if the activity is out-sourced (subcontracted tasks, medical devices or operations concerned, technical measures taken), for example in the form of a contract (art. 3);
- the responsibilities, authorities and delegations of professionals, including in the event of intervention by external service providers (art. 5).

The quality management system shall make provision for the performance of the audits defined.

It entered into force three months after publication of its approval order of 17 May 2021 in the *Official Journal*.

1. *Ordinance 2016-128 of 10 February 2016 for the legislative part and Decree 2018-434 of 4 June 2018 for the regulatory part.*

1.3.2 Pressure Equipment

▶ **ASN resolution 2021-DC-0702 of 26 January 2021 modifying resolution 2020-DC-0688 of 24 March 2020, concerning the qualification of organisations tasked with the inspection of Nuclear Pressure Equipment**

This resolution corrects an error in the 2020 resolution; the conformity evaluation which takes place when installing a Nuclear Pressure Equipment (NPE) or nuclear assembly (mentioned in 4.1 a) in Annex V of the Order of 10 December 2015 having been omitted from the scope of qualification. The modifying resolution corrects this error.

It entered into force on 27 February 2021, after publication of its approval order of 16 February 2021 in the *Official Journal*.

1.4 The professional guidelines approved by ASN

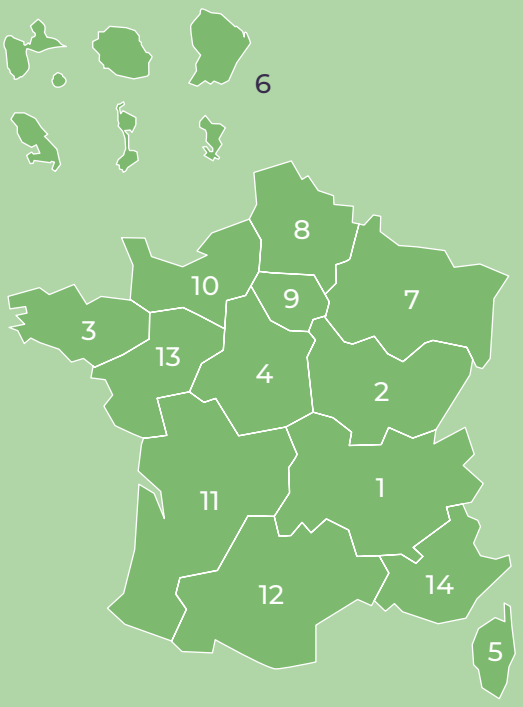
▶ **ASN resolution 2021-033633 of 12 July 2021 by the ASN Chairman accepting professional guidelines regarding the installation of in-service leak plugging systems on Nuclear Pressure Equipment**

This is a resolution accepting the EDF professional guidelines reference D450712014967 index 5 regarding the installation of in-service leak plugging systems on NPE. Article 10-4 of the Order of 30 December 2015 regarding NPE and some of its protection accessories enables the licensee to fit a leak plugging system to the NPE during operation, in accordance with the procedures of professional guidelines submitted to ASN for acceptance. The specified resolution approves the guidelines proposed by EDF.

REGIONAL OVERVIEW

of nuclear safety and radiation protection

ASN, the French Nuclear Safety Authority, has 11 regional divisions through which it carries out its regulatory duties throughout metropolitan France and in the French overseas *départements*(*) and regions. Several ASN regional divisions can be required to coordinate their work in a given administrative region. As at 31 December 2021, the ASN regional divisions totalled 226 employees, of whom 169 are inspectors.



Under the authority of the regional representatives (see chapter 2 of the full ASN Report), the ASN regional divisions carry out on-the-ground inspections of the Basic Nuclear Installations (BNIs), of radioactive substance transport operations and of small-scale nuclear activities; they examine the majority of the licensing applications submitted to ASN by the persons/entities responsible for nuclear activities within their regions. The regional divisions check application within these installations of the regulations relative to nuclear safety and radiation protection, to pressure equipment and to Installations Classified for Protection of the Environment (ICPEs). They ensure the labour inspection in the Nuclear Power Plants (NPPs).

In radiological emergency situations, the ASN regional divisions check the on-site measures taken by the licensee to make the installation safe and assist the Prefect of the *département*(*), who is responsible for protection of the population. To ensure emergency situation preparedness, they help draw up the emergency plans established by the Prefects and take part in the periodic exercises.

The ASN regional divisions contribute to the mission of informing the public. They take part, for example, in the meetings of the Local Information Committees (CLIs) of the BNIs and maintain regular relations with the local media, elected officials, associations, licensees and local administrations.

This section presents ASN's oversight action in the BNIs of each region and its assessment of nuclear safety and radiation protection.

Actions to inform the public and cross-border relations are addressed in chapters 5 and 6 of the full ASN Report respectively.

IMPORTANT

Oversight of small-scale nuclear activities (medical, research and industry, transport) is presented in chapters 7, 8, and 9 of the full ASN Report, available on *asn.fr*.

MEDICAL FIELD > 07

RESEARCH AND INDUSTRY > 08

TRANSPORT > 09

(*) Administrative region headed by a Prefect.

Auvergne-Rhône-Alpes Region

The Lyon division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 12 *départements* of the Auvergne-Rhône-Alpes region.

In 2021, ASN carried out 328 inspections in the Auvergne-Rhône-Alpes region, comprising 117 in the Bugey, Saint-Alban, Cruas-Meysse and Tricastin Nuclear Power Plants (NPPs), 92 in plants and installations undergoing decommissioning, 104 in small-scale nuclear activities and 15 in the radioactive substance transport sector.

ASN also carried out 40 days of labour inspections in the four NPPs and on the Creys-Malville site.

In 2021, ASN was notified of 26 significant events rated level 1 on the International Nuclear and Radiological Event Scale (INES scale), of which 21 occurred in Basic Nuclear Installations (BNIs) and 5 in small-scale nuclear activities. One significant radiation protection event that occurred on the Cruas-Meysse site was rated level 2 on the INES scale.

BUGEY SITE

The Bugey industrial site comprises various facilities, including the Bugey NPP operated by EDF on the municipality of Saint-Vulbas, in the Ain *département*, 35 km east of Lyon. It comprises four Pressurised Water Reactors (PWRs), each of 900 Megawatts electric (MWe), commissioned in 1978 and 1979. Reactors 2 and 3 constitute BNI 78, and reactors 4 and 5 constitute BNI 89.

The site also accommodates Bugey 1, a graphite-moderated Gas-Cooled Reactor (GCR) commissioned in 1972, shut down in 1994 and currently undergoing decommissioning, the Activated waste packaging and interim storage facility (Iceda) and the Inter-Regional Warehouse (MIR) for fuel storage.

Lastly, the site accommodates one of the regional bases of the special Nuclear Rapid Intervention Force (FARN), created by EDF in 2011, further to the Fukushima Daiichi NPP accident in Japan. Its role is to intervene in pre-accident or accident situations, on any NPP in France, by providing additional human resources and emergency equipment.

Bugey nuclear power plant

Reactors 2, 3, 4 and 5 in operation

ASN considers that the overall performance of the Bugey NPP with regard to nuclear safety, radiation protection and environmental protection is in line with ASN's general assessment of the EDF plant performance.

ASN considers that the nuclear safety performance of the NPP is in line with ASN's general assessment of EDF plant performance, but remains contrasted. The weaknesses observed in 2020 concerning the implementation of practices to increase the rigour of system configuring persisted in 2021. Furthermore, shortcomings have been found in the local application of the test rules applicable as of the fourth ten-yearly reactor outages, in emergency situation management and in the control of fire-related risks. On the other hand, ASN conducted a series of unannounced control room inspections which revealed improvements in monitoring and compliance with the operating technical specifications.

With regard to maintenance, in a particularly busy industrial context with the fourth ten-yearly outage of reactor 4 continuing until June 2021 and that of reactor 5 beginning in July 2021, ASN noted weaknesses in the planning and preparation of the maintenance activities. In addition, concerning the integration of modifications, difficulties relative to the updating of the set of reference documents and integration of the operating experience feedback from reactor 2 were observed in the fourth ten-yearly outages conducted in 2021. The management of conformity deviations, however, has improved. ASN therefore expects an improvement in the management of outages in 2022, which represent a smaller activity workload than in 2021.

With regard to radiation protection, ASN considers that the Bugey NPP's performance is in line with the general assessment of the EDF plants. As far as the conditions of operations in controlled areas are concerned, despite some improvements, recurrent fragilities are observed in the radiological cleanliness of the facilities, in the containment of worksites with contamination dispersal risks, and the provision of radiation protection equipment. Furthermore, ASN expects to see improvements in the prevention of contamination of the site road systems.

ASN considers that the environmental protection performance of the NPP is in line with its general assessment of the EDF plants. The overall standard of waste management remains satisfactory. Some deviations observed in 2020 concerning control of the conformity of the ultimate retention systems, which contribute to environmental protection, were again

noted in 2021, but EDF has now put in place a special organisation for addressing the deviations affecting these equipment items.

Concerning labour inspection, ASN considers that the site's accident results are satisfactory, despite the very intense programme of activities in 2021. Improvements are nevertheless expected in the licensee's control of risks associated with work at height and chemicals.

Reactor 1 undergoing decommissioning

Bugey 1 is a GCR. This first-generation reactor functioned with natural uranium as the fuel, graphite as the moderator and it was cooled by gas. The Bugey 1 reactor is an "integrated" GCR, whose heat exchangers are situated inside the reactor vessel beneath the reactor core.

In March 2016, in view of the technical difficulties encountered, EDF announced a complete change of decommissioning strategy for its definitively shut down reactors. In this new strategy, the planned decommissioning scenario for all the reactor pressure vessels involves decommissioning "in air" rather than "under water" as initially envisaged. Through ASN Chairman's resolution CODEP-CLG-2020-021253 of 3 March 2020, further to the change in EDF's decommissioning strategy, ASN requires EDF to complete the decommissioning operations on the building and equipment that are not necessary for decommissioning of the reactor pressure vessel by 2024 at the latest.

In 2020, ASN authorised the creation of a new effluents storage facility at the Bugey 1 reactor to replace the old station, which will be put out of service, decommissioned and cleaned out.

ASN considers that the Bugey 1 reactor decommissioning and vessel characterisation operations are proceeding with a satisfactory level of safety. The licensee ensures rigorous monitoring of the equipment and the ongoing decommissioning works. After analysing the periodic safety review concluding report for the GCRs, ASN stated in December 2021 that it had no objection to continuing the decommissioning of this reactor.

Activated waste packaging and interim storage installation

The Activated waste packaging and interim storage facility (Iceda), which constitutes BNI 173, is intended for the packaging and storage of various categories of radioactive waste on the Bugey site (in the Ain *département*). It is designed for the reception, packaging and interim storage of:

- **low-level, long-lived (LLW-LL) graphite waste from the dismantling of the Bugey 1 reactor, which is destined –after interim storage– for near-surface disposal in a facility whose concept is still being studied;**
- **activated metallic intermediate-level, long-lived waste (ILW-LL) from the operation of the in-service power plants, for example parts which have spent time near the reactor core, such as control rod clusters, destined for deep geological disposal after interim storage;**

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Nuclear Power Plants operated by EDF:**
  - Bugey (4 reactors of 900 MWe),
  - Cruas-Meysse (4 reactors of 900 MWe),
  - Saint-Alban (2 reactors of 1,300 MWe),
  - Tricastin (4 reactors of 900 MWe);
- **the nuclear fuel fabrication plants operated by Framatome in Romans-sur-Isère;**
- **the "nuclear fuel cycle" plants operated by Orano on the Tricastin industrial platform;**
- **the Operational Hot Unit (BCOT) at Tricastin operated by EDF;**
- **The High Flux Reactor (RHF) operated by the Laue-Langevin Institute in Grenoble;**
- **the Activated waste packaging and storage facility (Iceda) on the Bugey nuclear site and the Bugey Inter-Regional Warehouse (MIR) for fuel storage, operated by EDF;**
- **reactor 1 undergoing decommissioning at the Bugey NPP operated by EDF;**
- **the Superphénix reactor undergoing decommissioning at Creys-Malville and its auxiliary installations, operated by EDF;**
- **the Ionisos irradiator in Dagneux;**
- **the Effluents and Solid waste Treatment and decay storage Station (STED) of the CEA in Grenoble, which is waiting to be delicensed following decommissioning;**
- **the CERN international research centre located on the Swiss-French border;**
- **small-scale nuclear activities in the medical sector:**
  - 22 external-beam radiotherapy departments,
  - 6 brachytherapy departments,
  - 23 nuclear medicine departments,
  - 121 facilities using fluoroscopy-guided interventional practices,
  - 154 scanners within 115 facilities,
  - some 10,000 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - 1 synchrotron,
  - about 700 veterinary practices (surgeries or clinics),
  - 35 industrial radiology agencies,
  - about 600 users of industrial equipment,
  - about 70 public or private research units;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 3 organisations and 7 agencies approved for radiation protection controls.

- **some low-level or intermediate-level, short-lived waste (LL/ILW-SL), called "deferred transfer" waste, intended for above-ground disposal but requiring a period of radioactive decay ranging from several years to several decades before being accepted at the Aube repository (CSA –BNI 149), operated by the French national agency for radioactive waste management (Andra).**

On 28 July 2020, ASN authorised the commissioning of Iceda and regulated operation of the facility through requirements relative to the operating range, the maximum storage durations for radioactive waste, the defining of criteria for activating the On-site Emergency Plan (PUI), the content of the end-of-startup file, compliance with waste package qualification heights, and the conditions of reception of source rods from Chooz A. The first activated waste package was received in late September 2020. By letter of 5 May 2021, EDF submitted to the Minister responsible for nuclear safety a request to amend the Iceda's Creation Authorisation Decree (DAC), to allow the acceptance of decommissioning waste from the Fessenheim NPP.

The inspections conducted in 2021 in this facility reveal that the periodic inspections and tests and the monitoring of the service providers performing them must be improved.

Inter-Regional Warehouse

The Inter-Regional Warehouse (MIR –BNI 102) operated by EDF at Bugey is a storage facility for fresh nuclear fuel intended for the NPP fleet in operation.

MIR presented a satisfactory overall level of safety in 2021, a year in which its activities remained restricted to allow the renovation of various items of equipment. ASN noted an increase in the operational monitoring of the activities.

Saint-Alban nuclear power plant

The Saint-Alban NPP, operated by EDF in the Isère *département* on the municipalities of Saint-Alban-du-Rhône and Saint-Maurice-l'Exil, 40 km south of Lyon, comprises two 1,300 MWe PWRs commissioned in 1986 and 1987. Reactor 1 constitutes BNI 119 and reactor 2 BNI 120.

ASN considers that the nuclear safety and radiation protection performance of the Saint-Alban NPP stands out positively with respect to its general assessment of EDF plant performance, and that its environmental protection performance is in line with this general assessment.

With regard to nuclear safety, ASN notes that the Saint-Alban NPP maintained its good performance in 2021, which is at a higher level than ASN's general assessment of the EDF plants. The site has made progress in the lockout/tagout and system configuring operations in particular. There are still areas for improvement in the monitoring of the work plans issued to workers. With regard to the integrity of the fuel assembly cladding, which constitutes the first barrier, ASN notes that accelerated corrosion of some assemblies has been identified on the two reactors and has been subject to special monitoring.

Packaging of ILW-LL in C1PG^{SP} packages in Iceda

Intermediate-level, long-lived waste (ILW-LL) is activated operational waste from the nuclear reactors and activated waste from the dismantling of certain NPPs. This waste is intended for deep geological disposal in application of Article L. 542-1-2 of the Environment Code.

The radioactive waste produced during BNI operation and decommissioning phases must be managed safely right through to their transfer to an appropriate disposal facility. Each of these steps must therefore be compatible with the subsequent steps, especially the disposal. Article 6.7 of the Order of 7 February 2012 setting the general rules for BNIs thus stipulates that the packaging of waste intended for radioactive waste disposal facilities currently being studied and provided for in Articles 3 and 4 of the Act of 28 June 2006 and not having acceptance specifications is subject to the approval of ASN.

On 23 November 2018 EDF submitted an application file for approval of the packaging of ILW-LL waste in a package model baptised "C1PG^{SP}". After being sorted, characterised, cut up if necessary, and placed in a basket, the ILW-LL waste is blocked with a "blocking" cementitious slurry, filling the voids in the basket between the pieces of waste and ensuring the mechanical resistance of the block of waste. Once the blocking slurry has set, the baskets are washed and dried, then immobilised in a concrete shell using an "immobilising" slurry. Once the immobilising slurry has set, the packages are capped with concrete of the same formulation as the shell. The package then undergoes inspections and radiological measurements and is transferred to an Iceda storage hall.

On completion of the examination of this file, ASN considered that the process envisaged by EDF would allow the production of waste packages that will be able to be stored and then disposed of safely. ASN therefore authorised EDF to package its waste in the C1PG^{SP} package through resolution CODEP-DRC-2021-013808 of 19 July 2021. It nevertheless noted that complementary studies were still in progress and decided, in its authorisation, to limit the thermal power released by each package and within each storage hall and to limit the validity of its packaging agreement to 31 December 2023. The extension of this agreement is conditional upon submittal of the abovementioned additional studies no later than 31 December 2022 and the agreement of ASN following their examination.

On 6 September 2021, EDF started production of the first packages of decommissioning waste from Chooz A and operational waste from Fessenheim. The first C1PG^{SP} package was thus produced in October 2021 in Iceda and has been stored there.

With regard to maintenance, the site's two reactors were shut down in 2021 for scheduled maintenance and partial refuelling. ASN considers that EDF competently carried out the planned activities and complied with the corresponding safety requirements.

With regard to worker radiation protection, ASN considers that the operational results were satisfactory. The availability of radiation protection equipment and monitoring of the entry areas of contamination-prone work sites have continued to improve. ASN has observed the improvement in the estimated dosimetry evaluations, particularly of the operational management service teams. Nevertheless, ASN is still waiting to see an improvement in the display of, and compliance with, work site access rules and strengthening of the radiation protection culture in work site preparation.

ASN considers that the environmental protection performance of the Saint-Alban NPP is in line with its general assessment of the EDF plants. Although the simulated liquid pollution event organised on the site by ASN as part of a national inspection campaign confirmed that each responder had a sound knowledge of the applicable procedures, it nevertheless showed that the preparation and speed of the responses planned for such situations could be improved.

With regard to labour inspection, ASN considers the site's results to be relatively satisfactory. Although the site suffered no serious or critical risk-related accidents, accident levels, particularly during reactor outages, remain higher than on other comparable NPPs.

Cruas-Meysse nuclear power plant

Commissioned between 1984 and 1985 and operated by EDF, the Cruas-Meysse NPP is situated in the Ardèche *département* on the municipalities of Cruas and Meysse and comprises four PWRs of 900 MWe each. Reactors 1 and 2 constitute BNI 111, and reactors 3 and 4 constitute BNI 112.

ASN considers that the nuclear safety performance of the Cruas-Meysse NPP is in line with ASN's general assessment of EDF plant performance. The environmental and radiation protection performance levels of this NPP, however, are slightly below average.

With regard to nuclear safety, ASN notes a satisfactory position of the independent safety organisation and an improvement in operating rigour. ASN moreover considers that the performance in fire risk management is improving.

With regard to maintenance of the facilities, ASN considers that the monitoring of outside contractors, application of the maintenance baseline requirements and the physical conformity of the facilities with respect to the applicable requirements must be improved. This is because several ASN inspections and significant events reported reveal anomalies further to maintenance operations. The site has also had difficulties in demonstrating to ASN at the end of the outage that these anomalies had been duly resolved.

With regard to radiation protection, ASN observes that shortcomings persist in the radiological cleanliness of the facilities and control of the contamination risk during reactor outage periods. In 2021, one site employee received a skin dose exceeding the authorised annual limit, entailing the reporting of a significant radiation protection event rated level 2 on the INES scale.

With regard to environmental protection, ASN considers that the performance of the Cruas-Meysse NPP must also be improved, particularly concerning effluent containment and the actions taken in pollution situations.

With regard to labour inspection, the site's results are on the whole satisfactory. ASN's inspections have confirmed that the site has met its commitments regarding the electrical conformity of the facilities and the measures taken to guarantee conformity of the ventilation of premises subject to specific pollution. The vigilance and the efforts must nevertheless be maintained with regard to electrical risks and the risks associated with the use of machinery during handling operations.

TRICASTIN SITE

The Tricastin nuclear site, situated in the Drôme and Vaucluse *départements*, is a vast industrial site accommodating the largest concentration of nuclear and chemical facilities in France. It is situated on the right bank of the Donzère-Mondragon Canal (a diversion channel of the river Rhône) between Valence and Avignon. It occupies a surface area of 800 hectares covering three municipalities, namely Saint-Paul-Trois-Châteaux and Pierrelatte in the Drôme *département*, and Bollène in the Vaucluse *département*. The site harbours a large number of installations, with a NPP comprising four 900 MWe reactors, nuclear fuel cycle facilities, and lastly the Tricastin Operational Hot Unit (BCOT), which fulfilled maintenance and storage functions.

Tricastin nuclear power plant

The Tricastin NPP comprises four 900 MWe PWRs: reactors 1 and 2 were commissioned in 1980 and constitute BNI 87, while reactors 3 and 4, commissioned in 1981, constitute BNI 88.

ASN considers that the overall performance of the Tricastin NPP with regard to nuclear safety, radiation protection and environmental protection in 2021 is in line with ASN's general assessment of EDF plant performance.

ASN considers that the nuclear safety performance of the NPP, which has been improving since 2019, is in line with the general assessment of the EDF plants. From the maintenance aspect, the four reactors of the Tricastin NPP were shut down in 2021 for scheduled maintenance and partial refuelling, reactor 2 having undergone its fourth ten-yearly outage, which represents tightened maintenance. ASN considers that these outages are managed with rigour, particularly in the planning and preparation of the maintenance activities. The modifications planned to reinforce safety during the fourth ten-yearly outage of reactor 2 were integrated satisfactorily. Control of the integrity of the first barrier, that is to say the fuel assembly claddings, is also improving. The attentiveness of the independent safety organisation, assessed in 2021, is deemed satisfactory and the quality of the significant events analysis remains good. Weaknesses are nevertheless still observed in some areas, such as the monitoring of control room activities and system configuring.

With regard to radiation protection, ASN considers that the NPP's performance is in line with the general assessment of the EDF plants and has improved with respect to 2020, continuing the momentum that began in 2019. The dosimetry received by the personnel of EDF and outside contractors alike seems under control, and significant progress has been made in establishing the forecast dosimetric evaluations of the outages. As stated in 2020 however, the radiological cleanliness of the premises during reactor outages could be improved.

ASN considers that the environmental protection performance of the NPP is down compared with 2020 and slightly below its general assessment of the EDF plants in this area. The liquid pollution containment exercise organised by ASN showed that the preparation and the speed of the responses planned for these situations needed to be reinforced. The pollution of groundwater at the end of the year by effluents containing tritium and the reactive inspection by ASN demonstrated the need to improve the management of effluent transfers and interim storage. ASN expects to see improvements in this area in 2022.

With regard to labour inspection, ASN considers the site's results show a distinct improvement. Accident prevention, particularly during reactor outages, has been well managed, with a drop in the number of accidents not necessitating lost-time. ASN nevertheless notes that one serious accident occurred this year during the intervention of a diver.

THE "NUCLEAR FUEL CYCLE" FACILITIES

The Tricastin fuel cycle installations mainly cover the upstream activities of the "fuel cycle" and, as of the end of 2018, they are operated by a single licensee, Orano Cycle, which became *Orano Chimie-Enrichissement* on 1 January 2021 and is called Orano hereinafter.

The site comprises:

- **the TU5 facility** (BNI 155) for converting uranyl nitrate $UO_2(NO_3)_2$ resulting from the reprocessing of spent fuels into triuranium octoxide (U_3O_8);
- **the W plant** (ICPE within the perimeter of BNI 155) for converting depleted UF_6 into U_3O_8;
- **the former Comurhex facility** (BNI 105) and the Philippe Coste plant (ICPE within the perimeter of BNI 105) for converting uranium tetrafluoride (UF_4) into uranium hexafluoride (UF_6);
- **the former Georges Besse I plant** (BNI 93) for the enrichment of UF_6 by gaseous diffusion;
- **the Georges Besse II plant** (BNI 168) for centrifuge enrichment of UF_6;
- **the uranium storage areas at Tricastin** (BNIs 178 and 179) for storing uranium in the form of oxides or UF_6;
- **the maintenance, liquid effluent treatment and waste packaging facilities** (IARU –BNI 138);
- **the Atlas process samples analysis and environmental monitoring laboratory** (BNI 176);
- **a Defence Basic Nuclear Installation** (DBNI), which more specifically accommodates former facilities undergoing decommissioning, radioactive substance storage yards and a liquid effluent treatment unit.

Following the inspections it conducted in 2021, ASN considers that the level of safety of the Orano facilities on the Tricastin site is improving. The year 2021 was marked by the change of licensee planned for through the PEARL project, with Orano Cycle –the single licensee of the platform– becoming *Orano Chimie-Enrichissement* on 1 January 2021. The Philippe Coste plant has reached more stable operating conditions. ASN has updated its requirements and monitored continuation

of the starting of this plant's support functions. Trident, the new waste treatment unit of BNI 138 also gradually started operating in 2021. Construction of "FLEUR", the new reprocessed uranium storage facility, began at the same time as the examination of its license. Lastly, ASN continued examination of the creation authorisation application for the future containers maintenance unit (AMC2). It will take over from the existing unit (AMC), which is to stop operating in 2024. This authorisation application was the subject of a public inquiry from 10 December 2021 to 12 January 2022.

In 2021, ASN conducted a campaign of simultaneous unannounced inspections in BNIs 93, 105, 138, 155, 168 and 178 focusing on the periodic inspections and tests and maintenance, with the aim of checking Orano's organisation in these areas. The inspectors were thus able to attend more than ten periodic inspections and tests or maintenance operations and visit the spare parts stores. The overall assessment of these inspections is satisfactory.

Orano has submitted to ASN its strategy for changing the industrial scheme for managing all the site's liquid effluents. ASN has set up regular monitoring of implementation of this strategy, which is necessary to plan ahead for the technical developments. To check the progress of treating the backlog of diverse radioactive substances stored on the site, ASN has also asked Orano to present an annual statement on the progress of its action plan for the treatment of these substances.

In 2022, ASN will also ensure that Orano improves its organisation for analysing the conformity of the facilities with the regulations and further improves its follow-up of the commitments made to ASN.

Orano uranium chemistry plants TU5 and W

BNI 155, called TU5, can handle up to 2,000 tonnes of uranium per year, which enables all the uranyl nitrate ($UO_2(NO_3)_2$) from the Orano plant in La Hague to be processed for conversion into U_3O_8 (a stable solid compound that can guarantee storage of the uranium under safer conditions than in liquid or gaseous form). Once converted, the reprocessed uranium is placed in storage on the Tricastin site. The W plant situated within the perimeter of BNI 155 can process the depleted UF_6 from the Georges Besse II plant, to stabilise it as U_3O_8.

ASN considers that the safety of operation of the facilities situated within the perimeter of BNI 155 is satisfactory, but it notes an increase in significant events related to occupational radiation protection.

For the TU5 plant, ASN made public its analysis of the facility's periodic safety review report in 2021. It is continuing to check implementation of the commitments made in this context.

ASN will be attentive to the licensee's actions in 2022 on the theme of the safety and radiation protection culture and will remain vigilant with regard to maintaining sufficient rigour in the operation and maintenance actions and in the monitoring of detected deviations.

Orano uranium fluorination plants

Pursuant to the ASN requirement, the oldest fluorination facilities were shut down definitively in December 2017. The shut down facilities have since been emptied of the majority of their hazardous substances and are now in the decommissioning preparation phase.

The decommissioning of BNI 105 is authorised by Decree 2019-1368 of 16 December 2019. The main issues associated with decommissioning concern the risks of dissemination of radioactive substances, of exposure to ionising radiation and of criticality, on account of the residual uranium-bearing substances present in some items of equipment.

In 2021, ASN also inspected the continuation of the upgrading of the Philippe Coste plant, whose facilities are classified Seveso high threshold and replace those of BNI 105 (formerly Comurhex). The main units of this plant were commissioned in 2019, but in 2020 the licensee had to replace all the crystallising containers and solve various technological difficulties. This upgrading of the process core restored more stable and therefore safer functioning in 2021, producing fewer minor atmospheric discharges associated with operating transients. The new fluorine production unit has also been commissioned. ASN will be attentive in 2022 to the maintaining of operating conditions, particularly those of the old conversion effluent treatment units. This is because the new effluent treatment unit of the Philippe Coste plant has to be modified in depth and will not be available for several years.

Furthermore, as regards the shut down facilities, ASN considers that the package repackaging projects have not made sufficient progress and expects the licensee to make greater efforts to ensure the repackaging of the packages containing radioactive and hazardous substances on areas 61 and 79 within the assigned times.

Georges Besse I enrichment plant

The Georges Besse I (Eurodif) uranium enrichment facility, constituting BNI 93, consisted essentially of a plant for separating uranium isotopes by the gaseous diffusion process.

After stopping production at this plant in May 2012, the licensee carried out, from 2013 to 2016, the Eurodif "Prisme" process of "intensive rinsing followed by venting", which consisted in performing repeated rinsing of the gaseous diffusion circuits with chlorine trifluoride (ClF_3), a toxic and dangerous substance. These operations, which are now completed, allowed the extraction of virtually all the residual uranium deposited in the diffusion barriers.

The licensee submitted its application for final shutdown and decommissioning of the facility in March 2015. The Decree ordering Orano to proceed with the decommissioning of the Georges Besse 1 plant was published on 5 February 2020.

The decommissioning issues particularly concern the large volume of very low-level waste (VLLW) produced, including 160,000 tonnes of metal waste which are undergoing

specific studies (see "Orano's decommissioning and waste management strategy", in "Notable events" in the introduction to this report). In 2021, ASN carried out a tightened inspection of the action plan resulting from the periodic safety review file. ASN considers that the actions are carried out correctly but tracking of the action plan updates should be reinforced. The main residual risk of BNI 93 is now associated with the UF_6 containers in the storage yards, which are still attached to the perimeter of the facility. These yards should ultimately be attached to the Tricastin uranium storage yards (BNI 178).

Georges Besse II enrichment plant

The Georges Besse II plant, BNI 168, is the site's new enrichment facility following the shutdown of Eurodif. It uses the centrifuge process to separate uranium isotopes.

The standard of safety of the plant's facilities in 2021 was satisfactory. The technologies utilised in the facility enable high standards of safety, radiation protection and environmental protection to be reached. ASN considers that the licensee is duly following its commitments to ASN.

The outdoor gantries for handling the UF_6 cylinders have been out of service since October 2020 due to damage to their running tracks. The licensee moves the cylinders using handling equipment and is still looking into the repairability of the gantries. In 2021, ASN also inspected the actions taken by the licensee to reduce discharges of refrigerant into the atmosphere. Compliance with the examined requirements proved satisfactory and the licensee is continuing its efforts to control discharges of this type.

ASN issued an authorisation in 2021 allowing the mode of operation of certain enrichment cascades to be changed. ASN will check that these modifications are carried out safely.

Maintenance, effluent treatment and waste packaging facilities

The effluent treatment and uranium recovery facility (IARU), which constitutes BNI 138, ensures the treatment of liquid effluents and waste, as well as maintenance operations for various BNIs.

ASN considers that the efforts made by the licensee in 2021 to improve the level of operational safety and the rigour of operation of BNI 138 must be continued. In 2021, ASN checked compliance with the numerous fire-related commitments made to ASN in 2020. Improvements were observed but actions still have to be accomplished. ASN moreover conducted a tightened inspection of the action plan and the studies associated with the periodic safety review, as well as an inspection dedicated to the surface treatment activities, which led to numerous upgrading requests.

Decree 2019-113 of 19 February 2019 authorised substantial modification of the BNI, in particular to create "Trident", a unit for processing the site waste, some of whose modules started in 2021 following on from the first modules the previous year.

The technical examination of the updating of the discharge resolutions for the entire BNI 138 was carried out in 2021, with a public consultation from 15 November to 6 December 2021, and the regulatory procedure should be concluded in 2022.

ASN will be attentive in 2022 to the continuation of the measures taken by the licensee to reinforce operating rigour. ASN will also examine the integration of the conclusions of the periodic safety review, including prevention of the fire risk and upgrading of the surface treatment activities.

Tricastin uranium-bearing material storage yards and P35

Following the delicensing of part of the Pierrelatte DBNI by decision of the Prime Minister, the Tricastin uranium-bearing materials storage yards (BNI 178) have been created. This facility groups the uranium storage yards and the new emergency management premises of the Tricastin platform. Following on from this delicensing process, facility P35 (BNI 179) was created. It groups together ten uranium storage buildings. A complementary storage project called "FLEUR" is in progress; the creation authorisation application was the subject of a public inquiry from 2 November to 3 December 2020 and its examination continued in 2021.

The overall level of safety of BNIs 178 and 179 operated by Orano was satisfactory in 2021. The standard of upkeep and cleanliness of the facilities has remained good. More generally, the licensee must always take care to meet the deadlines for the commitments made to ASN. ASN inspected the construction of the future additional storage buildings associated with the FLEUR project and found no deviations. With regard to the emergency management building and its equipment, the licensee has continued the efforts aiming to guarantee operation of the emergency centre and the various mobile emergency equipment items. Technical difficulties were nevertheless encountered in 2021, with some population alert sirens out of service.

Tricastin analysis laboratory

Authorised by Decree 2015-1210 of 30 September 2015 and commissioned in May 2017, Atlas, the Tricastin analysis laboratory, constitutes BNI 176. The facility represents a significant improvement in safety compared with the old laboratories it replaces.

Whereas difficulties were encountered until 2020 on one of the UF_6 analysis and sampling benches, all three are now functioning correctly.

More generally, ASN's inspections in 2021 found improvements in the area of fire prevention and criticality. The commitments the licensee made to ASN are being met and are well tracked, and the management of deviations has also been improved.

Tricastin Operational Hot Unit (BCOT)

The Tricastin Operational Hot unit (BCOT) constitutes BNI 157. Operated by EDF, it was intended for the maintenance and storage of equipment and tooling, fuel elements excluded, originating from contaminated systems and equipment of the nuclear power reactors.

In a letter dated 22 June 2017, EDF declared final shutdown of the BCOT in June 2020. The storage activities and maintenance operations are now carried out in its Saint-Dizier maintenance base.

The last operating activity consisted in finishing cutting up the used fuel cluster guide tubes from the PWRs operated by EDF. The facility is now being prepared for decommissioning, for which the review procedure is in progress. ASN considers that the level of safety of the BCOT is satisfactory.

ROMANS-SUR ISÈRE SITE

On its Romans-sur-Isère site in the Drôme *département*, Framatome operates BNI 63-U, baptised "Nuclear fuel fabrication plant" resulting from the merging of two BNIs, namely the Unit fabricating fuel elements for research reactors (formerly BNI 63) and the Unit fabricating nuclear fuel for the PWRs (formerly BNI 98).

Framatome nuclear fuel fabrication plants

The fabrication of fuel for electricity generating reactors involves the transformation of UF_6 into uranium oxide powder. The pellets fabricated from this powder in Framatome's Romans-sur-Isère plant, called "FBFC" (formerly BNI 98), are placed in zirconium metal clads to constitute the fuel rods, then brought together to form the assemblies for use in the NPP reactors. In the case of experimental reactors, the fuels used are more varied, with some of them using, for example, highly-enriched uranium in metal form. These fuels are also fabricated in the Romans-sur-Isère plant, called "Cerca" (formerly BNI 63).

The former BNI 63 includes building F2, which houses the "uranium zone" where compacted powder cores placed in aluminium frames and plates are produced. The licensee has undertaken to replace this uranium zone by a new uranium zone called "NZU", in order to improve more specifically the containment of the premises, the process and the prevention of risks in the event of an extreme earthquake. The NZU construction work began in late 2017. These new buildings shall accommodate the current activities of the uranium zone of building F2 before 31 December 2022. This is because as from that date, which is stipulated in ASN resolution 2019-DC-0670 of 4 June 2019 relative to the periodic safety review of former BNI 63, the presence of radioactive substances in the uranium zone of building F2 shall be prohibited. Construction of the NZU continued in 2021, notably with the manufacture and installation of new equipment and performance of the first operating tests. The update of the safety report and the new general operating rules associated with the NZU were submitted to ASN in the first half of 2021, leading to complementary information requests on its part.

A request for a modification of the Order of 22 June 2000 governing water intakes, discharges and environmental monitoring of the Romans-sur-Isère nuclear site was also submitted to ASN in July 2020. This request follows on from several changes, including in particular the modification of the DAC of former BNI 98 to increase its production capacity, the stopping of certain activities, the taking into account of the changes made to the liquid effluent treatment facilities, and the changeover from continuous discharging of liquid effluents to discharging into tanks. This file will give rise to the publication of two ASN resolutions: the first stipulating the requirements relative to the conditions of effluent discharge, water intakes and consumption and environmental monitoring, the second stipulating the environmental discharge limits. The draft resolutions were made available for public consultation from 14 July to 29 August 2021.

By a resolution of 20 December 2021, ASN authorised the "Training, Research, Isotopes, General Atomics" (TRIGA) unit, intended for the production of fuels for american-designed research reactors, to be put back into operation.

A substantial modification request submitted for former BNI 98 in December 2020 aims to allow increased production of fuels based on enriched reprocessed uranium. It is currently being examined.

Given that the buildings of former BNIs 98 and 63 are very closely interlinked on the same site, a request to unite the two BNIs was submitted in 2020. On 23 December 2021, the two BNIs were merged by Decree 2021-1782 into a single BNI 63-U, called "Nuclear fuel fabrication plant".

Six significant events relating to control of the criticality risk and rated level 1 on the INES scale by Framatome were reported in 2021. These events are not inter-related and concern both BNIs. ASN performed a reactive inspection for two of these events and remains vigilant regarding the implementation of effective measures to prevent such events from recurring.

The inspections performed in 2021 confirmed the integrity of the facilities during the summer works and compliance with commitments, particularly concerning the control of maintenance. However, the inspection concerning the checking of laboratory L1's approval for taking environmental radioactivity measurements highlighted shortcomings for which the licensee established a major action plan. These improvements were verified in the last quarter of 2021 with satisfactory conclusions through an unannounced inspection.

ASN will be attentive to the progress of the NZU construction site in 2022, and to maintaining operating rigour and deploying a good questioning attitude, a guarantee of operational safety, in a context of major movements within the safety and radiation protection teams and continuation of the modifications to the facilities. Furthermore, the waste management rules must continue to be applied and brought to people's attention in the various facilities of the site.

THE INDUSTRIAL AND RESEARCH FACILITIES

High-flux reactor of the Laue-Langevin Institute

The Laue-Langevin Institute (ILL), an international research organisation, accommodates a 58 Megawatts thermal (MWth) heavy-water High-Flux Neutron Reactor (RHF) which produces high-intensity thermal neutron beams for fundamental research, particularly in the areas of solid-state physics, neutron physics and molecular biology.

The RHF constitutes BNI 67 which accommodates the European Molecular Biology Laboratory (EMBL), an international research laboratory. Employing some 500 persons, this BNI occupies a surface area of 12 hectares situated between the rivers Isère and Drac, just upstream of their confluence, near the CEA Grenoble centre.

ASN considers that safety management of the RHF in 2021 is satisfactory. The ILL confirmed the improvements noted since 2019 regarding compliance with the requirements concerning protection of people and the environment.

In 2021, the ILL continued progressing with the action plan established for its third periodic safety review and enriched by the commitments made further to the examination of its conclusions. The year-end saw the beginning of the first works of a major outage forecast to last 14 months. They concern in particular the replacement of technological equipment constituting the reactor pressure vessel, reinforcement of the reactor building external air intake and the installation of anchors for the future renovation work on the main polar crane.

ASN consulted the public in 2021 on a draft resolution governing the continued operation of this facility further to its periodic safety review. It will be particularly attentive in 2022 to the deployment of the ILL's action plan resulting from the safety review, especially regarding the management of fire-related and handling-related risks. The continuation of preparation of the residual radioactive inventory pre-clean-up operations in the former detritiation facility shall also be verified.

Ionisos irradiator

The company Ionisos operates an industrial irradiator in Dagneux, situated in the Ain *département*. This irradiator, which constitutes BNI 68, uses the radiation from Cobalt-60 sources for purposes such as sterilising medical equipment (syringes, dressings, prostheses) and polymerising plastic materials.

The level of safety of the facility was found to be satisfactory in 2021.

ASN considers that the licensee must continue the foundation work aiming to better define the Components Important to Protection (PIC) of the interests of the facility and more rigorous application of their requirements defined in the periodic inspection and test procedures.

An authorisation for recovery of the sludge from pool D1 (operated until November 1996) was issued by ASN in the third quarter of 2021.

CERN accelerators and research centre

Following the signing of an international agreement between France, Switzerland and the European Organisation for Nuclear Research (CERN) on 15 November 2010, ASN and the Swiss Federal Office of Public Health (OFSP) –the Swiss radiation protection oversight body– are contributing to the verification of the safety and radiation protection requirements applied by CERN. The joint actions concern transport, waste and radiation protection.

Two joint visits by the Swiss and French nuclear Authorities took place in 2021 on the theme of emergency situation preparedness and putting back into service the beam line called "n-TOF" –Neutron Time of Flight– after its modernisation. These visits found the practices to be satisfactory.

SITES UNDERGOING DECOMMISSIONING

Superphénix reactor and fuel storage facility

The Superphénix fast neutron reactor (BNI 91), a 1,200 MWe sodium-cooled industrial prototype is situated at Creys-Malville in the Isère *département*. It was definitively shut down in 1997. The reactor has been unloaded and the majority of the sodium has been neutralised in concrete. Superphénix is associated with another BNI, the APEC fuel storage facility (BNI 141). The APEC essentially comprises a pool containing the fuel unloaded from the reactor pressure vessel and the area for storing the soda concrete packages resulting from neutralisation of the sodium from Superphénix.

EDF has submitted the periodic safety review concluding reports for BNI 141 and BNI 91. ASN made public its conclusions concerning the Superphénix periodic safety review on 28 July 2021 and has approved continuation of the decommissioning operations. It made a draft resolution governing continued operation of APEC available for public consultation from 23 September to 8 October 2021.

ASN considers that the safety of Superphénix decommissioning operations and of APEC operation is on the whole satisfactory. In 2018, ASN authorised commencement of the second Superphénix decommissioning phase, which consists in opening the reactor pressure vessel to dismantle its internal components, in dedicated facilities constructed in the reactor building, by direct or remote manipulation. The site has fallen behind schedule with the "core cover plug" cutting operations, due to technical difficulties with the cutting robot. The safety and radiation protection measures implemented by EDF for these operations are on the whole satisfactory.

In 2020, ASN carried out a reactive inspection further to a fire outbreak that led EDF to activate its PUI. Shortcomings had been discovered at various levels in the course of the procedures. An unannounced night-time fire exercise carried out by ASN in September 2021 revealed the persistence of certain malfunctions in the licensee's organisation.

Concerning the management of facility obsolescence, EDF reported difficulties in procuring certain items of equipment and significant delays in the replacement and repair of parts. ASN has asked the licensee to carry out a site-level diagnosis and to draw up an action plan on this subject. An inspection carried out in the first quarter of 2021 revealed that the plan had effectively been initiated but there were delays in its application.

ASN will be particularly attentive in 2022 to the improvement of the site's emergency organisation and to the management of deviations, judged unsatisfactory in the course of several inspections.

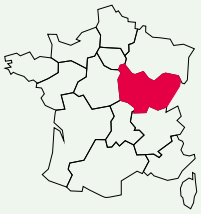
Siloette, Siloé, LAMA reactors and effluents and solid waste treatment station – *CEA Centre*

The CEA Grenoble centre (Isère *département*) was inaugurated in January 1959. Activities associated with the development of nuclear reactors were carried out there before being gradually transferred to other CEA centres in the 1980's. The Grenoble centre now carries out research and development in the areas of renewable energies, health and microtechnology. In 2002, the CEA Grenoble centre began a site delicensing process.

The site accommodated six nuclear installations which have gradually stopped their activities and are now in the decommissioning phase with a view to delicensing. Delicensing of the Siloette reactor was declared in 2007, that of the Mélusine reactor in 2011, of the Siloé reactor in January 2015 and of the LAMA reactor in August 2017.

The last BNIs on the site (BNI 36 and 79) are the Effluents and Solid Waste Treatment Station and the decay storage facility (STED). All the buildings have been dismantled, in accordance with their decommissioning decree.

With regard to radiological and chemical remediation of the STED soils, all the operations technically achievable at a reasonably acceptable cost have been carried out. In view of the presence of residual chemical and radiological contamination, the licensee submitted a new delicensing file in June 2021 which is currently being examined by ASN, which refused its first file in 2019. This delicensing will be subject to the implementation of active institutional controls.



Bourgogne-Franche-Comté Region

The Dijon division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 8 *départements* of the Bourgogne-Franche-Comté region.

ASN conducted 62 inspections in small-scale nuclear activities in the Bourgogne-Franche-Comté region in 2021, comprising 23 in the medical sector, 24 in the industrial research and veterinary sectors, 2 concerning radon exposure, 6 to monitor approved organisations and laboratories, and 7 in the transport of radioactive substances.

One significant event rated level 1 on the INES scale was reported to ASN in 2021.

ASN also devoted particular attention to the Framatome manufacturing plants situated in the Bourgogne-Franche-Comté region. The actions conducted by ASN in this context are described in chapter 10 of the full ASN Report. In Bourgogne-Franche-Comté in 2021, ASN carried out 2 inspections of Nuclear Pressure Equipment (NPE) manufacturers in their plants and 4 inspections of organisations accredited for the inspection of NPE.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **small-scale nuclear activities in the medical sector:**
  - 8 external-beam radiotherapy departments,
  - 4 brachytherapy departments,
  - 14 nuclear medicine departments, of which 3 practise internal targeted radiotherapy,
  - 35 centres performing fluoroscopy-guided interventional practices,
  - 55 computed tomography scanners for diagnostic purposes,
  - about 800 medical radiology devices,
  - about 2,000 dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - about 250 veterinary practices, 4 of them equipped with scanners,
  - about 400 industrial research centres, including 32 companies with an industrial radiography activity,
  - 1 industrial irradiator per radioactive source,
  - 1 computed tomography scanner dedicated to research,
  - 2 accelerators, one for industrial irradiation, the other for research and the production of drugs for medical imaging;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 3 organisations approved for radiation protection controls,
  - 8 organisations approved for measuring radon,
  - 1 laboratory approved for taking environmental radioactivity measurements.

Bretagne
Region

The Nantes division regulates radiation protection and the transport of radioactive substances in the 4 *départements* of the Bretagne region. The Caen division regulates the nuclear safety of the Monts d'Arrée NPP (Brennilis), currently undergoing decommissioning.

ASN carried out 47 inspections in 2021, comprising 2 at the Monts d'Arrée NPP undergoing decommissioning, 2 for monitoring approved organisations, 11 in the transport of radioactive substances and 32 in small-scale nuclear activities (22 in the medical sector and 10 in the industrial, veterinary or research sectors).

No significant event in 2021 was rated level 1 or higher on the INES scale or level 2 or higher on the ASN-SFRO scale.

The Brennilis nuclear power plant

The Brennilis NPP is situated in the Finistère *département*, on the Monts d'Arrée site, 55 km north of Quimper. Baptised "EL4-D", this installation (BNI 162) is an industrial electricity production prototype (70 MWe) moderated with heavy water and cooled with carbon dioxide, and it was definitively shut down in 1985.

Decree 2011-886 of 27 July 2011 authorised the NPP decommissioning operations, with the exception of the reactor block. In July 2018, EDF submitted an application file for the complete decommissioning of its facilities, and this file was subject to a public inquiry from 15 November 2021 to 3 January 2022. ASN notes the involvement of EDF in the conduct of the public inquiry on the Brennilis decommissioning file and, more generally, its efforts regarding transparency and communication.

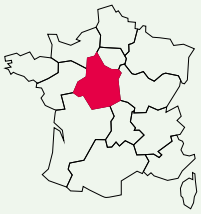
During 2021 EDF continued its decommissioning preparation work:

- completion of the reactor block sampling operations, authorised by ASN resolution of 20 September 2019,
- continuation of the preparations prior to decommissioning of the reactor block, such as the removal of unused equipment from the reactor containment; production of a detailed radiological mapping of the reactor containment premises and the asbestos removal operations;
- continuation of the repair work on the site's stormwater collection networks.

ASN considers that the licensee is conducting its work in compliance with the safety, radiation protection and environmental protection requirements and is demonstrating transparency in the detection, handling and analysis of the malfunctions and events occurring on its site.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **the Basic Nuclear Installation:**
  - the Monts d'Arrée NPP (Brennilis), undergoing decommissioning;
- **small-scale nuclear activities in the medical sector:**
  - 10 external-beam radiotherapy departments,
  - 5 brachytherapy departments,
  - 9 nuclear medicine departments,
  - 39 centres performing fluoroscopy-guided inerventional practices,
  - 54 computed tomography scanners,
  - some 2,500 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - 1 cyclotron,
  - 12 industrial radiography companies, including 3 performing gamma radiography,
  - 28 research units,
  - about 400 users of industrial equipment;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 13 organisations approved for measuring radon,
  - 3 head-offices of laboratories approved for taking environmental radioactivity measurements.



Centre-Val de Loire
Region

The Orléans division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 6 *départements* of the Centre Val de Loire region.

ASN conducted 151 inspections in the Centre-Val de Loire region in 2021, of which 119 were in nuclear facilities of the EDF sites of Belleville-sur-Loire, Chinon, Dampierre-en-Burly and Saint-Laurent-des-Eaux and 32 in small-scale nuclear activities.

ASN also carried out 51 days of labour inspections in the four nuclear power plants.

In 2021, 12 significant events rated level 1 on the INES scale were reported to ASN.

ASN inspectors issued one violation report in the exercise of their oversight duties.

Belleville-sur-Loire nuclear power plant

The Belleville-sur-Loire NPP is situated in the north-east of the Cher *département*, on the left bank of the river Loire, at the crossroads of four *départements* (Cher, Loiret, Nièvre and Yonne) and two administrative regions (Bourgogne-Franche-Comté and Centre-Val de Loire). The NPP comprises two 1,300 MWe reactors commissioned in 1987 and 1988, which constitute BNIs 127 and 128 respectively.

ASN considers that the performance of the Belleville-sur-Loire NPP is in line with ASN's general assessment of the EDF plants in the areas of nuclear safety, the environment and radiation protection.

In the operational management of the facilities, the site maintained the generally satisfactory performance levels of 2020 with regard to nuclear safety. ASN nevertheless considers that improvements are required in performance of the periodic tests and the quality of the documentation used by the operational management teams.

With regard to maintenance of the facilities, the performance of the NPP has to be improved, particularly in view of the unexpected events detected in 2021, most of which resulted from the preceding shutdowns, particularly during the ten-yearly outages of 2019 and 2020. Improvements in management of the fire risk on the site were made in 2021.

The site had only one reactor refuelling outage in 2021. With two outages in 2022, one of which is a maintenance one outage, ASN considers that the site must be attentive to the maintenance of the facilities and management of the fire risk, areas in which recurrent deviations had been observed during the ten-yearly outages of the preceding years.

ASN considers that the radiation protection performance of the Belleville-sur-Loire NPP is satisfactory and has improved since last year. It underlines the integration of experience feedback in the shutdown of reactor 2 and the defining of the monitoring programmes, the appropriateness of the radiation protection actions and the site's responsiveness in dealing with the problems of radiological cleanliness during the reactor outages. It nevertheless emerges that the optimisation of activity dosimetry can be improved, as can the management of radiological cleanliness as a whole. The recommendations of the radiation protection skills centres are not yet applied to sufficient effect.

In the area of the environment, ASN considers that effluent management, waste management and the monitoring of discharges in normal operating conditions are satisfactory. The inspections conducted in 2021 also revealed improvements in the management of fire extinguishing water retention, despite the need for further progress in this area. A public inquiry into the site's request to implement a new system to prevent the proliferation of pathogenic organisms and to change the authorised limits of certain discharges was opened in December 2021.

With regard to labour inspection, and in a context of stabilisation of the Covid-19 pandemic, the monitoring of accidents and near-accidents and the performance of the regulatory electrical inspections (and lifting of the anomalies detected) were the predominant subjects in 2021, the latter being part of a collective country-wide procedure. They revealed firstly a need to analyse some accidents or near-accidents in greater depth, and secondly, weaknesses in the site's organisation to permit the smooth running of the electrical inspections or to coordinate these inspections between the different EDF entities (particularly as concerns the tertiary buildings).

Dampierre-en-Burly nuclear power plant

The Dampierre-en-Burly NPP is situated on the right bank of the Loire river, in the Loiret *département*, about 10 km downstream of the town of Gien and 45 km upstream of Orléans. It comprises four 900 MWe reactors which were commissioned in 1980 and 1981. Reactors 1 and 2 constitute BNI 84, and reactors 3 and 4 BNI 85. The site accommodates one of the regional bases of the Nuclear Rapid Intervention Force (FARN), the special emergency response force created by EDF in 2011, following the Fukushima Daiichi NPP accident. Its role is to intervene in pre-accident or accident situations, on any NPP in France, by providing additional human resources and emergency equipment.

ASN considers that the nuclear safety performance of the Dampierre-en-Burly NPP is in line with its general assessment of the EDF plants. Environmental and radiation protection performance, for their part, remain below the national average.

With regard to nuclear safety, although normal operational management of the facility remains satisfactory on the whole (improvements in periodic test management are to be underlined), organisational deficiencies linked to shortcomings in the documents and communication between the management teams were the cause of several significant events during the year 2021. As far as maintenance of the facilities is concerned, the site's performance is considered satisfactory, particularly in an industrial context where a first reactor on the site is undergoing its fourth ten-yearly outage. Although improvements in management of the explosion risk were observed in 2021, fire risk management remains sub-standard and will be a priority area of ASN action in 2022.

The radiation protection performance of the Dampierre-en-Burly NPP remains seriously inadequate, as has been the case for several years. Although the outside contractor monitoring programmes and verifications conducted by the independent safety organisation are found appropriate, numerous deviations were again observed in 2021, particularly in the control of radiological cleanliness and the dispersion of contamination on the work sites in controlled areas. A plan of rigour was put in place on the site in 2017, but it has not yet restored the expected levels of performance. Given this situation, ASN will maintain targeted monitoring of the site's radiation protection in 2022.

Lastly, the environmental protection performance of the Dampierre-en-Burly NPP also remains insufficient. Although the discharge limits for gaseous effluents are respected and a significant improvement in management of the microbiological risk compared with the preceding years was noted in 2021, cases of exceeding the liquid effluent discharge limits for certain chemical parameters were observed. Furthermore, the national action concerning management of the containment of dangerous substances conducted by ASN in 2021 on several EDF sites revealed the Dampierre-en-Burly site to be very far below average in this area. The necessary corrective actions in this area are therefore expected in 2022. An administrative procedure to modify the environmental resolutions governing the site's discharges engaged in 2021 will continue in 2022 to allow the implementation of a new treatment against the proliferation of pathogenic organisms and changing of the discharge limits of several substances.

Lastly, with regard to labour inspection, further to the actions conducted in 2021, management of the electrical risk will remain a priority in 2022 in view of the organisational difficulties detected in this respect on the Dampierre-en-Burly site. ASN nevertheless notes that the site has put in place a schedule for performing the regulatory electrical inspections. Inspections were moreover carried out on diverse themes such as handling, lifting devices, activities and works taking place during reactor outages. Organisational difficulties discovered during these inspections oblige the licensee to put in place corrective actions, which shall be specifically monitored in 2022.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations:**
  - the Belleville-sur-Loire NPP (2 reactors of 1,300 MWe),
  - the Dampierre-en-Burly NPP (4 reactors of 900 MWe),
  - the Saint-Laurent-des-Eaux site: the NPP in operation (2 reactors of 900 MWe), and the 2 Gas-Cooled Reactors (GCRs) undergoing decommissioning and the irradiated graphite sleeve storage silos,
  - the Chinon site: the NPP in operation (4 reactors of 900 MWe), the 3 GCRs undergoing decommissioning, the Irradiated Material Facility (AMI) and the Inter-Regional Fuel Warehouse (MIR);
- **small-scale nuclear activities in the medical sector:**
  - 8 external-beam radiotherapy departments,
  - 3 brachytherapy departments,
  - 11 nuclear medicine departments,
  - 32 centres performing fluoroscopy-guided interventional practices,
  - 38 computed tomography scanners,
  - some 2,700 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - 10 industrial radiography companies,
  - about 330 industrial, veterinary and research radiography devices;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 2 organisations approved for radiation protection controls,
  - 4 laboratories approved for taking environmental radioactivity measurements.

CHINON SITE

Situated in the municipality of Avoine in the Indre-et-Loire *département*, on the left bank of the river Loire, the Chinon site accommodates various nuclear installations, some in operation, others shut down or undergoing decommissioning. On the south side of the site, the Chinon B NPP comprises four in-service 900 MWe reactors; the first two –constituting BNI 107– were commissioned in 1982-1983, while the second two –constituting BNI 132– were commissioned in 1986-1987. To the north, the three old graphite-moderated GCRs designated Chinon A1, A2 and A3, are currently being decommissioned. The site also accommodates the Irradiated Materials Facility (AMI), designed for the expert assessment of activated or contaminated materials, whose assessment activities have now ceased and been entirely transferred to a new laboratory called "the Lidec", and to the Inter-Regional Fresh Fuel Warehouse (MIR).

Chinon nuclear power plant

Reactors B1, B2, B3 and B4 in operation

ASN considers that the performance of the Chinon NPP is in line with its general assessment of the EDF plants in the areas of nuclear safety and radiation protection. The environmental performance, which was below average at the beginning of 2021, improved significantly in the course of the year. Although progress was observed in 2021, particularly in terms of safety, the results in the areas of the environment and radiation protection must be consolidated.

With regard to safety, ASN considers that the incident and accident management situation is once again satisfactory, even if it noted difficulties in the management of the On-Site Emergency Plan (PUI) documentation. Alongside this, although ASN observes a drop in the number of significant events resulting from noncompliance with the reactor General Operating Rules (RGE) by the operational management teams, the analysis of deviations that can affect safety can be further improved.

ASN considers that the radiation protection performance of the Chinon NPP remains relatively satisfactory. The ASN inspections conducted in 2021 showed that progress had been made, which was expected further to the 2020 assessment, but also that organisational improvements were still required. In view of the site's good performance in this area before 2020, ASN considers that it must be a priority for the site in 2022.

The environmental protection performance of the Chinon NPP must be improved. The gaseous and liquid effluent discharges are well below the national average. ASN nevertheless considers that management of the hydrocarbons leaving the oil filters is a point requiring particular attention in 2022. In addition, waste management is poorly compliant with best practices and must be improved in 2022.

In 2021, labour inspection revealed the site's weaknesses in the prevention of risks of falling from height, in the legibility of some asbestos identification/location files, or even the exhaustiveness of the checks carried out, due to the organisational set-ups between various EDF entities. Inspection of the electrical risk continued in 2021 (and will remain a priority in 2022); it revealed several shortcomings, particularly concerning the knowledge of the premises and installations to inspect, the initial regulatory verifications and the correction of the identified deviations. Lastly, several accidental exposures of employees to asbestos led ASN to challenge EDF on the quality and legibility of the asbestos identification/location files, by asking the licensee to work on the subject in 2022.

Reactors A1, A2 and A3 undergoing decommissioning

The graphite-moderated GCR series comprises six reactors, including Chinon A1, A2 and A3. These first-generation reactors used natural uranium as the fuel, graphite as the moderator and were cooled by gas. This plant series includes "integrated" reactors, whose heat exchangers are situated under the reactor core inside the vessel, and "non-integrated" reactors, whose heat exchangers are situated on either side of the reactor vessel. The Chinon A1, A2 and A3 reactors are "non-integrated" GCRs. They were shut down in 1973, 1985 and 1990 respectively.

Reactors A1 and A2 were partially decommissioned and transformed into storage facilities for their own equipment (Chinon A1 D and Chinon A2 D). These operations were authorised by the Decrees of 11 October 1982 and 7 February 1991 respectively. Chinon A1 D is partially decommissioned at present and has been set up as a museum –the Museum of the Atom– since 1986. Chinon A2 D is also partially decommissioned and houses the GIE Intra (which operates robotised machines for interventions on accident-stricken nuclear installations). Complete decommissioning of the Chinon A3 reactor was authorised by the Decree of 18 May 2010, with a decommissioning "under water" scenario.

In March 2016, EDF announced a complete change of decommissioning strategy for its definitively shut down reactors. In this new strategy, the planned decommissioning scenario for all the reactor pressure vessels is decommissioning "in air" and the Chinon A2 reactor pressure vessel would be decommissioned first (see chapter 13 of the full ASN Report). In this context, ASN has analysed the periodic safety review concluding reports submitted by EDF for the six GCRs, supplemented further to the requests from ASN. On completion of its analysis, ASN indicated in December 2021 that it has no objection to the continued operation of BNI 133 (Chinon A1 reactor), BNI 153 (Chinon A2 reactor) and BNI 161 (Chinon A3 reactor). It will verify during the examination of the decommissioning files for these reactors, which are to be submitted by EDF in late 2022, that the decommissioning operations are carried out under suitable conditions of safety and radiation protection, within controlled time frames.

For the Chinon A2 reactor, EDF has continued the decommissioning preparation operations situated outside the reactor pressure vessel, particularly as concerns removal of the shells from the heat exchanger premises, and continued the investigations inside the pressure vessel. EDF has also

continued decommissioning the Chinon A3 heat exchangers; decommissioning the South Heat Exchangers room is finished and all the cylinders have been transferred to the Industrial centre for grouping, storage and disposal (Cires).

ASN considers that the level of safety of the Chinon nuclear installations undergoing decommissioning (Chinon A1, A2 and A3) is satisfactory. The inspections carried out in 2021 revealed in particular good emergency management in an on-site exercise situation, and good tracking of the inspections of fire-related equipment. This being said, improvements are expected in the knowledge of the premises and the equipment on the part of the personnel attached to the in-service NPP who might have to intervene in the facilities undergoing decommissioning.

"NUCLEAR FUEL CYCLE" FACILITIES

Inter-Regional Fuel Warehouse

Commissioned in 1978, the Chinon Inter-Regional Fuel Warehouse (MIR) is a facility for storing fresh fuel assemblies pending their utilisation in various EDF reactors. It constitutes BNI 99. Along with the Bugey MIR, it contributes to the management of flows of fuel assembly supplies for the reactors.

The facility has been operating nominally since the reception and storage of fresh fuel assemblies resumed in 2020, in a configuration in which the facility was equipped with a new handling crane in 2019 and under an updated baseline authorised by ASN.

RESEARCH FACILITIES UNDERGOING DECOMMISSIONING

Irradiated Materials Facility

The Irradiated Materials Facility (AMI), which was declared and commissioned in 1964, is situated on the Chinon nuclear site and operated by EDF. This facility (BNI 94) has stopped operating and is being decommissioned. It was primarily intended for performing examinations and expert assessments on activated or contaminated materials from the PWRs.

The analysis and expert assessment activities were entirely transferred in 2015 to a new facility on the site, the Ceidre integrated laboratory (Lidec).

Decree 2020-499 for AMI decommissioning was published on 30 April 2020 and the new RGEs were approved by ASN in April 2021, thereby enabling the Decree to enter into application.

The legacy waste treatment and removal activities continued in 2021. The legacy magnesian waste has been packaged and recharacterised. The characterisation results were not as expected, making it necessary to apply to the French national agency for radioactive waste management (Andra), for a waiver to allow acceptance of the waste. The waste removal work was therefore stopped pending the outcome of this procedure.

ASN considers that the management of the periodic inspections and tests, particularly those concerning the fire risk, is satisfactory. Particular attention must nevertheless be paid to tracking of the fire door inspections and monitoring of the ageing of the facility's civil engineering structures.

SAINT-LAURENT-DES-EAUX SITE

The Saint-Laurent-des-Eaux site, situated on the banks of the river Loire in the municipality of Saint-Laurent-Nouan in the Loir-et-Cher *département*, comprises various nuclear installations, some of them in operation and others undergoing decommissioning. The Saint-Laurent-des-Eaux NPP comprises two operating reactors, B1 and B2, which were commissioned in 1980 and 1981, and constitute BNI 100. The site also features two old GCRs, A1 and A2, currently in the decommissioning phase, and two silos for storing the graphite sleeves from the operation of reactors A1 and A2.

Saint-Laurent-des-Eaux nuclear power plant

Reactors B1 and B2 in operation

ASN considers that the performance of the Saint-Laurent-des-Eaux NPP with regard to radiation protection is in line with its general assessment of the EDF plants, and stands out positively for the environment. The performance in the area of safety, however, has deteriorated. In the middle of the year site senior management presented a reactive action plan, whose effect will be checked by ASN in 2022, particularly during the site in-depth inspection.

ASN considers that the site's nuclear safety performance deteriorated in 2021 and is inadequate. The safety management plan put in place in 2020 has not restored the expected level of performance. Numerous events have revealed a lack of both safety culture and a questioning attitude on the part of the workers, deviations in the handling of anomalies and conformity deviations in particular, as well as shortcomings in the integration of experience feedback, in the quality of the documentation and in the monitoring of work performance. ASN nevertheless underlines the good overall upkeep of the worksites and satisfactory apparent condition of the inspected equipment. It does however expect to see significant improvements on the part of the licensee in 2022.

Generally speaking, the management of radiation protection at the Saint-Laurent-des-Eaux NPP meets ASN expectations. The site's performance is considered stable compared with 2020, even if organisational improvements are required, particularly through the setting up of the radiation protection skills centre, which will take place in 2022.

The site's organisation to meet the regulatory environmental protection requirements is considered highly successful, particularly in view of the quantities of effluents discharged.

The management of an accidental spillage situation, checked during an exercise, is appropriate and the various retention systems inspected are well kept. Some improvements are nevertheless required in the knowledge of hazardous substances volumes and the volumes to be contained.

The labour inspections carried out in 2021 under national or local initiatives revealed some weaknesses in the site's organisation and the correction of deviations, and in the management of risks of falling from height. They have also prompted the labour inspectorate to ask for additional information in several areas, such as the optimisation of radiation protection on work sites, the cleaning and filtration of the air in certain rooms presenting particular risks and the management of risks associated with the Covid-19 pandemic.

Reactors A1 and A2 undergoing decommissioning

The former Saint-Laurent-des-Eaux NPP constitutes a BNI comprising two "integrated" GCRs, reactors A1 and A2. These first-generation reactors used natural uranium as the fuel, graphite as the moderator and were cooled by gas. Their final shutdown was declared in 1990 and 1992 respectively. Complete decommissioning of the installation was authorised by the Decree of 18 May 2010.

On completion of the analysis of the periodic safety review concluding reports for all the GCRs, ASN indicated in December 2021 that it has no objection to the continued operation of BNI 46 (Saint-Laurent reactors A1 and A2). It will verify during the examination of the new decommissioning files for these reactors, which are to be submitted by EDF in late 2022 to set out the new "in air" decommissioning strategy, that the decommissioning operations are carried out under suitable conditions of safety and radiation protection, within controlled time frames.

In 2021, EDF resumed the decommissioning work sites that were stopped on account of the restrictions laid down to combat the Covid-19 pandemic. ASN considers that the level of safety of the Saint-Laurent-des-Eaux A reactors is satisfactory. ASN's inspections found that the overall upkeep of the premises and worksites was good. In addition, the organisation put in place to meet the commitments made further to the inspections and significant events is satisfactory, as is waste management. However, improvements are required in the management of fire-extinguishing waters and the traceability of the monitoring of outside contractors working in the facility.

Saint-Laurent-des-Eaux silos

The facility, authorised by the Decree of 14 June 1971, consists of two silos whose purpose is the storage of irradiated graphite sleeves originating from the operation of Saint-Laurent-des-Eaux A GCRs. Static containment of this waste is ensured by the concrete bunker structures of the silos, which are sealed by a steel lining, but whose behaviour in the event of an earthquake needs to be assessed. In 2010, EDF installed a geotechnical containment around the silos, reinforcing the control of the risk of dissemination of radioactive substances, which is the main risk presented by the installation.

Operation of this BNI is limited to surveillance and upkeep measures: radiological monitoring inspections and measurements in the silos, checking there is no water ingress, checking the relative humidity, the dose rates around the silos, the activity of the water table, monitoring the condition of the civil engineering structures.

In the context of the change of decommissioning strategy for the GCRs, EDF announced in 2016 its decision to start removing the graphite sleeves from the silos without waiting for a graphite waste disposal route to become available. To this end, EDF envisages creating a new graphite sleeve storage facility on the Saint-Laurent-des-Eaux site.

ASN is waiting for EDF to declare final shutdown of the facility. Submission of the decommissioning file, which will take into account the emptying, post-operational clean-out and demolition of the existing silos, is planned for the end of 2022.

Corse
Collectivity

The Marseille division regulates radiation protection and the transport of radioactive substances in the Corse collectivity.

In 2021, ASN carried out 4 inspections in Corse, of which 3 were in the medical sector and 1 in the industrial sector.

During 2021, one significant event occurring in the industrial sector and rated level 1 on the INES scale was reported.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **small-scale nuclear activities in the medical sector:**
  - 2 external-beam radiotherapy departments,
  - 2 nuclear medicine departments,
  - 7 centres performing fluoroscopy-guided interventional practices,
  - 9 computed tomography scanners,
  - about 330 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - some 40 veterinary surgeons using diagnostic radiology devices,
  - some 40 industrial and research centres, including 2 companies exercising an industrial radiography activity;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 2 organisations approved for measuring radon.

Overseas
Départements and regions

The regulation of radiation protection and the transport of radioactive substances in the 5 overseas *départements* and regions (Guadeloupe, Martinique, Guyane, La Réunion, Mayotte) and in certain overseas collectivities is ensured by the Paris division. It also acts as expert to the competent authorities of Nouvelle-Calédonie and French Polynesia.

In 2021, 21 inspections were carried out in the small-scale nuclear activities sector in the French Overseas *départements*, regions and collectivities. Four on-site inspection campaigns were carried out by the ASN Paris division.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **small-scale nuclear activities in the medical sector:**
  - 4 external-beam radiotherapy departments,
  - 1 brachytherapy department,
  - 3 nuclear medicine departments,
  - 24 centres performing fluoroscopy-guided interventional practices,
  - about 30 centres holding at least 1 computed tomography scanner,
  - about 100 medical radiology practices,
  - about 1,000 dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - more than 70 users of veterinary radiology devices,
  - 3 industrial radiology companies using gamma radiography devices,
  - 1 cyclotron;
- **activities associated with the transport of radioactive substances.**

Grand Est Region

The Châlons-en-Champagne and Strasbourg divisions jointly regulate nuclear safety, radiation protection and the transport of radioactive substances in the 10 *départements* of the Grand Est region.

In 2021, ASN conducted 186 inspections in the Grand Est region, of which 63 were in the NPPs in service, 11 in radioactive waste disposal facilities and on the sites of the Fessenheim and Chooz A NPPs currently being decommissioned, 87 in the small-scale nuclear activities sector, 14 in the transport of radioactive substances and 11 concerning approved organisations or approved laboratories.

ASN also carried out 22 days of labour inspections in the NPPs.

During 2021, 16 significant events reported by nuclear installation licensees in the Grand Est region were rated level 1 on the INES scale.

One significant event in small-scale nuclear activities (industrial sector) was rated level 1 on the INES scale, while the event concerning the discovery of radiological contamination in an old building of the Strasbourg civil hospital was revised to level 2.

Cattenom nuclear power plant

The Cattenom NPP is situated on the left bank of the river Moselle, 5 km from the town of Thionville and 10 km from Luxembourg and Germany.

It comprises four PWRs each with a power rating of 1,300 MWe, commissioned between 1986 and 1991. Reactors 1, 2, 3 and 4 constitute BNIs 124, 125, 126 and 137 respectively.

ASN considers that the safety performance of the Cattenom NPP is in line with its general assessment of the EDF plants following the improvements observed in 2020. As in the preceding years, the environmental protection and radiation protection performance are situated within the average, but progress is still expected.

With regard to operation and reactor management, ASN considers that the results confirm the start of improvement noted in 2020, despite several areas in which progress can still be made. The inspections have found that the operational management teams are proficient and the periodic tests meet expectations on the whole, despite a few deviations in the documents and recurrent contrasts in the indicators. More specifically, the number of significant events rated level 1 on the INES scale is higher than in preceding years.

The maintenance workload in 2021 was relatively higher than in 2020, with three reactor outages, including the third ten-yearly outage of reactor 3. The work undertaken by the site to improve the quality of maintenance, through the plan of rigour applied since 2020 is starting to produce effects. ASN notes in particular improved technical monitoring of the work sites, the insourcing of certain activities and the deployment of measures to prevent the risk of fraud. Despite this, the year

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations:**
  - the Cattenom NPP (4 reactors of 1,300 MWe),
  - the Chooz A NPP (1 reactor of 305 MWe undergoing decommissioning),
  - the Chooz B NPP (2 reactors of 1,450 MWe),
  - the Fessenheim NPP (2 reactors of 900 MWe in final shutdown status),
  - the Nogent-sur-Seine NPP (2 reactors of 1,300 MWe),
  - the CSA storage centre for short-lived low- and intermediate-level radioactive waste located in Soulaines-Dhuys in the Aube *département*;
- **the *Cigéo* geological disposal project for long-lived high- and intermediate-level radioactive waste;**
- **small-scale nuclear activities in the medical sector:**
  - 14 external-beam radiotherapy departments,
  - 5 brachytherapy departments,
  - 22 nuclear medicine departments,
  - 96 computed tomography scanners,
  - 80 centres performing fluoroscopy-guided interventional practices,
  - some 2,100 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - 277 industrial and veterinary activities subject to the licensing system,
  - 24 companies exercising an industrial radiography activity,
  - 47 research laboratories situated primarily in the universities of the region;
- **activities associated with the transport of radioactive substances;**
- **5 head offices of organisations approved in radiation protection.**

was again marked by a number of technical deficiencies which could not always be detected during the requalification of the equipment items concerned.

The hydrostatic test of the primary system and the test of reactor 3 containment during its ten-yearly outage ran smoothly; the results comply with the safety requirements. Damage to the turbo charger of an emergency diesel generator set had a major impact on the duration of the refuelling outage of reactor 2 at the end of the year. Lastly, during reactor 2 and 3 outages, an abnormal corrosion phenomenon –not related to maintenance– was observed in the fuel assemblies; it required the implementation of compensatory measures and complementary analyses which are still in progress.

The total number of significant events reported remains within the average for the EDF reactors, but an unusually high proportion of them were rated level 1 on the INES scale, without this trend being able to be interpreted as a drift. As in 2020, the Cattenom site is prompt in its reporting of significant events. ASN notes that the significant events management process is well mastered on the whole and effectively mobilises the site players up to senior management level.

In the area of fire risk prevention, the findings of the inspections reveal many deviations. ASN considers that this entire subject needs to be brought back under control, as regards, for example, the calorific potential in the premises, sectorisation, fire permit management, or the time taken to remedy anomalies.

The site's emergency management was assessed through an unannounced exercise with a scenario of accidental spillage of soda into the stormwater system. The ability of the site to set up the required emergency organisation, which was put to the test by kinetics of the scenario, proved to be robust. Areas for improvement were nevertheless identified in the choice of measures to deploy on the ground to cope with the speed of the simulated event.

With regard to environmental protection, gaseous and liquid effluent discharges and waste management are well controlled, but the site still has weaknesses which are illustrated by the relatively high number of events. It was found that the management of deviations and threshold overshoots can be improved, notably because the times and the analysis parameters were not appropriate for the implementation of relevant and effective corrective actions. Controlling the risk of proliferation of microorganisms in the cooling towers still necessitates reinforced biocide treatments which have consequences on the aqueous discharges.

Lastly, in the areas of radiation protection and occupational safety the picture remains contrasted: although some deviations observed in preceding years, such as the control of accesses in prohibited areas, have not been repeated, the number of events remains high, including concerning radiation protection fundamentals, such as the marking out of limited stay areas. The relative improvement in the second half of the year compared with the first, possibly linked to the awareness-raising efforts the site made with the outside contractors, must be confirmed on the ground and last over time. A few events occasionally highlighted weaknesses in the occupational safety culture.

Chooz nuclear power plant

The Chooz NPP operated by EDF is situated in the municipality of Chooz, 60 km north of Charleville-Mézières, in the Ardennes *département*. The site accommodates the Ardennes NPP, called Chooz A, comprising reactor A (BNI 163), operated from 1967 to 1991, for which the final shutdown and decommissioning operations were authorised by Decree 2007-1395 of 27 September 2007, and the Chooz B NPP, comprising two 1,450 MWe reactors (BNIs 139 and 144), commissioned in 2001.

Reactors B1 and B2 in operation

ASN considers that the overall performance of the Chooz B NPP with regard to nuclear safety, radiation protection and environmental protection is in line with ASN's general assessment of the EDF plant performance.

At the end of 2021, EDF detected stress corrosion-related cracks in the circuits connected to the main pipes of the primary system of the two reactors. This issue will lead to a large-scale inspection and repair programme in 2022.

With regard to nuclear safety, ASN notes that despite a promising start to the year, the dynamic of progress in reactor operation observed for several years now was not fully maintained, with more specifically a deterioration in the conducting of reactor management operations in the second half of the year, which led to a significant rise in the number of significant events. The efforts made by the licensee in its plan to regain operating rigour must be maintained. Particular vigilance must be applied to the quality of work preparation and management of the transient operating phases.

With regard to maintenance and the works associated with the reactor 2 refuelling outage, ASN considers that the inspection activities ran satisfactorily, over and beyond the problem linked to the spalling of the cladding of several fuel rods –which prolonged the outage and necessitated the implementation of specific reactor control measures.

In the area of radiation protection, progress has been noted in the dose optimisation procedure. This trend must nevertheless be analysed in the context of a relatively low maintenance work load in 2021, which is more conducive to good results. It therefore remains to be confirmed. Inappropriate individual behaviours in terms of radiation protection culture and observance of the basic principles have moreover been observed.

ASN considers that the site's environmental protection organisation is on the whole satisfactory. Improvements

are however required in the management of hazardous substances.

The labour inspections focused on the conformity of the work equipment and the electrical installations. An initiative concerning the prevention of the risk of falling from height was also conducted. EDF must be particularly attentive to the meeting of commitments and to the compliance work on the electrical installations.

Reactor A undergoing decommissioning

Decommissioning of the equipment inside the reactor vessel was completed in 2021. The next step is the emptying of the reactor building pool with a view to decommissioning the reactor vessel. An evaporator is currently being installed to treat the pool water prior to discharge, with start of operation planned for the second quarter 2022.

The decommissioning work on all the equipment still present in the bunkers of the "auxiliary" cavern has resumed after a long interruption due to technical problems. This work is carried out mainly by remote operation using a robotic arm.

In addition to this, decommissioning of the effluent treatment station equipment that is not necessary for treating the water from the rock or floor drains is in progress.

The site's organisation with regard to fire risk management is satisfactory on the whole.

In the area of radiation protection, the organisation set up for managing the risk of contamination with alpha particles seems satisfactory, even if interactions with the outside contractors can be further improved. The increase in cases of internal contamination during the second quarter of 2021 shows that the licensee must remain fully vigilant with respect to this risk.

Lastly, with regard to occupational safety, the nuclear safety inspection on the theme of fire was used to verify compliance with the provisions of the Labour Code on this subject. No significant deviation was observed.

Fessenheim nuclear power plant

The Fessenheim NPP comprises two PWRs, each with a unit power of 900 MWe. It is situated 1.5 km from the german border and about 30 km from Switzerland. The two reactors, which were commissioned in 1977 and definitively shut down in 2020, are currently undergoing preparation for decommissioning.

ASN considers that the site has maintained a robust level of seriousness and vigour in the monitoring of operation of the facilities, despite the significant reduction in the operating and maintenance activities compared with the period when it was in production.

The year 2021 was thus primarily taken up by the continuation of the decommissioning preparation activities, such as the preparation of the decontamination activity files, installation of new effluent treatment capacities, removal of a large number of spare parts and the work to develop new organisational baseline requirements for the site, such as the emergency plans. The site has moreover undertaken an effective drive to remove the legacy waste from the site, along with chemical products that are no longer necessary.

These activities are proceeding satisfactorily, in accordance with the submitted schedules. Major milestones have been reached, such as the finalising of removal of the fuel from reactor 1, and the first shipping of upper sections of the old steam generators, for decontamination and recycling by a melting process in the Cyclife facilities in Sweden.

Several major work sites will be continuing in 2022, notably with removal of the fuel from the second reactor, the decontamination of the primary systems of the two reactors and the creation in the turbine hall of the facility for managing the waste resulting from the decommissioning.

With regard to radiation protection, despite confirmation of the improvement in the prevention of contamination of the site road systems and a strongly downward trend in the overall dosimetry of the works carried out in the facilities, vigilance must be maintained given the occurrence of several events revealing a lack of precautions by certain workers with respect to the conditions for leaving controlled areas, for marking out controlled areas, or individual dosimetry.

Nogent-sur-Seine nuclear power plant

Operated by EDF and situated in the municipality of Nogent-sur-Seine in the Aube *département*, 70 km north-west of Troyes, the Nogent-sur-Seine NPP comprises two PWRs each of 1,300 MWe, commissioned in 1987 and 1988. Reactor 1 constitutes BNI 129 and reactor 2 BNI 130.

ASN considers that the performance of the Nogent-sur-Seine NPP is in line with its general assessment of the EDF plants in the areas of nuclear safety and the environment. This assessment also concerns the areas of radiation protection, but with a reservation on account of a number of improvements that are required.

ASN notes that the licensee has progressed in the area of nuclear safety, particularly in its mastery of the reactor operating technical specifications. ASN nevertheless considers that this progress remains fragile and that EDF must continue its efforts to further improve the rigour of operation of the reactors. Some significant events still reveal shortcomings in staff training and in the monitoring of the facilities. Specific action must also be taken to restore an adequate headcount in the independent safety organisation.

With regard to maintenance, ASN considers the situation satisfactory on the whole, even if the preparation of activities,

especially unscheduled activities, and the management of deviations during works performance can be improved.

In the area of occupational radiation protection, the year was marked by a deterioration in the radiation protection culture of workers, mainly outside contractors. An increase in situations of non-compliance with the elementary radiation protection measures, such as wearing a dosimeter, was observed. ASN has moreover regularly noted shortcomings in the risk analysis of work sites and in the implementation of the defences planned for by these analysis during maintenance activities, which have led in particular to internal exposures of workers. Effective measures are required in order to restore proper consideration of the radiation protection issues.

With regard to environmental protection, ASN considers that the site's good results of the preceding year have been confirmed. The licensee must nevertheless be vigilant regarding control of the volume of waste present in the effluents treatment building.

The labour inspection actions focused essentially on the conformity of the electrical installations and the prevention of the risk of falling from height. EDF must be particularly attentive to the meeting of commitments and to the compliance work on the electrical installations.

Aube waste disposal facility

Authorised by a Decree of 4 September 1989 and commissioned in January 1992, the Aube repository (CSA) took over from the Manche repository which ceased its activities in July 1994, while benefiting from the experience gained with the latter. This facility, located in Soulaines-Dhuys, has a disposal capacity of one million cubic metres (m^3) of low and intermediate-level, short-lived waste (LL/ILW-SL). It constitutes BNI 149. The operations authorised in the facility include the packaging of waste, either by injecting mortar into metal containers of 5 or 10 m^3 volume, or by compacting 200-litre drums.

At the end of 2021, the volume of waste in the facility had reached about 363,000 m^3, or 36% of the authorised capacity. According to the estimates made by Andra in 2016 in the concluding report on the CSA periodic safety review, the CSA could be completely filled by 2062 rather than 2042 as initially forecast, this estimate being based not only on better knowledge of the future waste and the waste delivery schedules, but also an optimisation of waste management through the compacting of certain packages.

In 2021, the activity of the centre facilities returned to normal (post-crisis due to the Covid-19 pandemic). The construction of new disposal structures for the future waste continued at the same time.

ASN considers that the CSA is operated satisfactorily in the areas of safety, radiation protection and the environment. The inspections conducted in 2021 revealed more specifically:

- satisfactory management of modifications;
- appropriate implementation of the commitments made concerning control of the fire risk following the second periodic safety review;
- the quality and rigour of the CSA's dosimetric monitoring and the availability and regulatory conformity of the means of verification.

Deep geological disposal repository project

ASN considers that the scientific experiments and work conducted by Andra in the underground laboratory at Bure continued in 2021 with a good standard of quality, comparable with that of the preceding years.

Hauts-de-France Region

The Lille division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 5 *départements* of the Hauts-de-France region.

ASN carried out 150 inspections in the Hauts-de-France region in 2021, of which 30 were in the Gravelines NPP, 106 in small-scale nuclear activities, 12 in the transport of radioactive substances, and 2 at suppliers of equipment for BNIs.

ASN also carried out 14.5 days of labour inspection in the Gravelines NPP.

In the course of 2021, 11 significant events rated level 1 on the INES scale were reported by the Gravelines NPP, including one concerning radiation protection.

In small-scale nuclear activities, 3 events were rated level 1 on the INES scale. In radiotherapy, 2 events were rated level 1 on the ASN-SFRO scale.

Gravelines nuclear power plant

The Gravelines NPP operated by EDF is located in the Nord *département* on the shores of the North Sea, between Calais and Dunkerque. This NPP comprises six PWRs (900 MWe) representing a total power of 5,400 MWe. Reactors 1 and 2 constitute BNI 96, reactors 3 and 4 BNI 97, and reactors 5 and 6 BNI 122.

ASN considers that the performance of the Gravelines NPP with regard to nuclear safety and radiation protection is below ASN's general assessment of EDF plant performance. The environmental protection performance of the NPP is in line with ASN's general assessment of the EDF plants.

Nuclear safety performance did not improve in 2021, particularly with regard to the rigour of work interventions. The first measures taken by the licensee have not put an end to inappropriate practices or behaviours. The site must therefore continue its efforts to federate all the protagonists. ASN will conduct an interim assessment in mid-2022.

With regard to maintenance, the year 2021 was marked by significant increases in the refuelling and maintenance outage times. This situation increased the workload of an already very intense industrial programme, involving more specifically the fourth ten-yearly outage of reactor 1, replacement of the Steam Generators (SGs) of reactor 6 and the work on the peripheral protection against external flooding, implemented further to the lessons learned from the Fukushima Daiichi NPP accident.

Concerning environmental protection, ASN considers that the Gravelines NPP must continue its efforts in the maintenance of equipment that uses the insulating greenhouse gas (SF_6) and the facilities for treating the radioactive effluents produced by reactor operation.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installation:**
  - the Gravelines NPP (6 reactors of 900 MWe) operated by EDF;
- **small-scale nuclear activities in the medical sector:**
  - 19 external-beam radiotherapy departments,
  - 3 brachytherapy departments,
  - 31 nuclear medicine departments,
  - 92 centres performing fluoroscopy-guided interventional practices,
  - 127 computed tomography scanners,
  - some 4,600 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - 1 accelerator for the inspection of freight trains,
  - 600 industrial and research organisations, including 29 companies exercising an industrial radiography activity, 3 particle accelerators including 2 cyclotrons, 38 laboratories, mainly located in the universities of the region, and 19 companies using gamma ray densitometers,
  - 340 veterinary surgeries or clinics practising diagnostic radiology;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 3 agencies of organisations approved for radiation protection controls.

ASN considers that the situation regarding radiation protection remains sub-standard and that the site is still not managing to restore a satisfactory level, despite putting in place preventive measures at the beginning of the year. The efforts made must be increased in order to rapidly and sustainably restore satisfactory performance in occupational radiation protection in 2022. Radiation protection will be subject to a tightened inspection in 2022.

The labour inspection actions conducted in 2021 on the Gravelines NPP were split between the inspections on the maintenance work sites, particularly during reactor outages, and specific inspections focusing on subjects such as lifting, electrical risks and work times. Regular meetings were organised with senior management, members of the health,

safety and working conditions committee, and personnel representatives. The number of workplace accidents increased in 2021 despite the measures taken by the licensee. Deficiencies in taking on board the risks associated with the activities, failure of individuals to comply with basic safety rules and lack of proficiency in electrical equipment lockouts/tagouts figure among the recurrent causes recorded. The labour inspectorate will be particularly attentive to these aspects in its next inspections.

Île-de-France Region

The Paris division regulates radiation protection and the transport of radioactive substances in the 8 *départements* of the Île-de-France region. The Orléans division regulates nuclear safety in the BNIs of this region.

ASN carried out 272 inspections in the Île-de-France region in 2021, of which 84 were in the field of nuclear safety, 135 in small-scale nuclear activities, 24 in the transport of radioactive substances and 29 concerning approved organisations or laboratories.

In the small-scale nuclear activities sector, 2 significant events were rated level 2 on the ASN-SFRO scale, and 8 were rated level 1 on the INES scale.

CEA SACLAY SITE

Since 2017, the CEA Paris-Saclay centre accommodates activities previously conducted on several geographically distinct sites close to Paris, and the sites of Saclay and Fontenay-aux-Roses in particular.

The CEA Paris-Saclay centre, of which the main site covers an area of 125 hectares, is situated about 20 km south-west of Paris, in the Essonne *département*. About 6,000 people work there. Since 2005, this centre has been primarily devoted to physical sciences, fundamental research and applied research. The applications concern physics, metallurgy, electronics, biology, climatology, simulation, chemistry and the environment. The main aim of applied nuclear research is to optimise the operation and enhance the safety of the French NPPs. Eight BNIs are located on this site.

Nearby are also located an office of the French National Institute for Nuclear Science and Technology (INSTN) –a training institute– and two industrial firms: Technicatome, which designs nuclear reactors for naval propulsion, and CIS bio international, which produces radiopharmaceuticals for nuclear medicine.

THE INDUSTRIAL AND RESEARCH FACILITIES

Osiris and Isis reactors

The Osiris pool-type reactor has an authorised power of 70 Megawatts thermal (MWth). It was primarily intended for technological irradiation of structural materials and fuels for various power reactor technologies. Another of its functions was to produce radionuclides for medical purposes.

Its critical mock-up, the Isis reactor with a power of 700 kilowatts thermal (kWth), was essentially used for training purposes. These two reactors were authorised by a Decree of 8 June 1965 and constitute BNI 40.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations regulated by the Orléans division:**
  - the CEA Saclay site of the CEA Paris-Saclay centre,
  - the Artificial Radionuclide Production Plant (UPRA) operated by CIS bio international in Saclay,
  - the CEA Fontenay-aux-Roses site of the CEA Paris-Saclay centre;
- **small-scale nuclear activities in the medical sector regulated by the Paris division:**
  - 26 external-beam radiotherapy departments,
  - 12 brachytherapy departments,
  - 39 *in-vivo* nuclear medicine departments and 13 *in-vitro* nuclear medicine departments (medical biology),
  - 148 centres performing fluoroscopy-guided interventional practices,
  - more than 200 centres possessing at least 1 computed tomography scanner,
  - about 850 medical radiology practices,
  - about 8,000 dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors under the oversight of the Paris division:**
  - some 650 users of veterinary radiology devices,
  - 6 industrial radiology companies using gamma radiography devices,
  - some 120 licenses concerning research activities involving unsealed radioactive sources;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 9 organisations approved for radiation protection controls.

Given the old design of this facility by comparison with the best available techniques for protection against external hazards and for containment of materials in the event of an accident, the Osiris reactor was shut down at the end of 2015. The Isis reactor was definitively shut down in March 2019. Following submission of the decommissioning file for the entire facility in October 2018, ASN requested and received additional information giving more details on the operations planned at each stage of decommissioning and substantiating more precisely the initial state envisaged at the start of decommissioning and the results of the impact assessment.

Since the shutdown of the Osiris and Isis reactors and pending decommissioning of the facility, the removal of radioactive and hazardous materials and the decommissioning preparation operations are underway, with an organisation adapted to the new state of the facility. More specifically, the last of the irradiated fuel stored in the facility was removed in the second half of 2021.

Control of the fire risk is characterised by good fire permit management and constructive improvement measures in view. However, the monitoring of fire loads, especially the waste accumulated in the facility, is inadequate. The monitoring of outside contractors performing the periodic inspections and tests is not sufficiently formalised. The electrical equipment maintenance operations are performed correctly, despite some shortcomings in the verifications performed by outside contractors. Improvements are expected in the follow-up of the recommendations for protection against lightning-related risks. Management of the decommissioning preparation operations is satisfactory from the technical aspects, but delays are observed, as in the previous years.

ASN considers that the licensee must be attentive to control of the decommissioning preparation operations and improving waste management.

Orphée reactor

The Orphée reactor (BNI 101), a neutron source reactor, was a pool-type research reactor with a licensed power of 14 MWth. The highly compact core is located in a tank of heavy water acting as moderator. Creation of the reactor was authorised by the Decree of 8 March 1978 and its first divergence took place in 1980. It was used for conducting experiments in areas such as physics, biology and physical chemistry. The reactor allowed the introduction of samples to be irradiated for the production of radionuclides or special materials, and to perform non-destructive tests on certain components.

The Orphée reactor, which was definitively shut down at the end of 2019, is now in the decommissioning preparation phase. The licensee submitted its decommissioning file in March 2020. The last irradiated fuel from the Orphée reactor was removed in 2020, greatly reducing the risks the facility represents.

Based on the facility inspections and monitoring carried out in 2021, ASN considers that the level of safety of the Orphée reactor is on the whole satisfactory. Nevertheless, some aspects in the management of radioactive sources and pressure equipment require particular attention, and individual assessments of exposure to ionising radiation at the work station must be established. The management of fire loads, the management of a waste storage area and the conformity of waste zoning must be improved. Although the preparation of the decommissioning preparation operations is satisfactory, delays are observed. Progress in fulfilling the commitments following the periodic safety review is satisfactory. The significant events nevertheless show that vigilance is required with the organisation of equipment maintenance.

Following reactor shutdown, the decommissioning preparation phase is subject to particular scrutiny by ASN, notably the adaptation of the organisation and the personnel skills to manage new activities while maintaining the level of safety of the facility and keeping the activity schedules on track.

Spent fuel testing laboratory

The Spent Fuel Testing Laboratory (LECI) was built and commissioned in November 1959. It was declared a BNI on 8 January 1968 by the CEA. An extension was authorised in 2000. The LECI (BNI 50) constitutes an expert assessment aid for the nuclear licensees. Its role is to study the properties of materials used in the nuclear sector, whether irradiated or not.

From the safety aspect, this facility must meet the same requirements as the nuclear installations of the "fuel cycle", but the safety approach is proportional to the risks and drawbacks it presents.

Further to the last periodic safety review, ASN issued the resolution of 30 November 2016 (amended on 26 June 2017) regulating the continued operation of the facility through technical prescriptions, relating in particular to the improvement plan that CEA had undertaken to implement. Some of the CEA's commitments have not been fulfilled within the deadlines. In particular, the CEA has requested pushing back of the deadlines for removal of the radioactive substances whose utilisation cannot be justified, and for the implementation where necessary of measures to place and maintain the BNI in a safe condition in the event of fire in the areas adjacent to the nuclear areas. The decommissioning of Célimène (unit formerly intended for the examination of fuels from reactor EL3) is also concerned by this request. ASN is therefore still waiting for the CEA to submit a robust action plan.

In the years to come, BNI 72 will no longer accept irradiating waste from the CEA Saclay site. Consequently, the CEA has started the clean-out work on a unit of the LECI which will be dedicated to the overpacking of the waste from BNI 50. ASN will check the progress of the associated work.

Operational management of the Organisational and Human Factors (OHF) is satisfactory, despite a high staff turnover. Improvements are however expected in the management of the criticality risk, in the integration of the lightning-related risk and the monitoring of outside contractors, notably with the adaptation of the BNI monitoring programme to the activities entrusted to these contractors.

Poséidon irradiator

Authorised in 1972, the Poséidon facility (BNI 77) is an irradiator comprising a storage pool for cobalt-60 sources, partially surmounted by an irradiation bunker. The BNI moreover includes another bunkered irradiator baptised Pagure, and the Vulcain accelerator.

This facility is used for studies and qualification services for the equipment installed in the nuclear reactors, notably thanks to an immersible chamber, as well as for the radiosterilisation of medical products. The main risk in the facility is of personnel exposure to ionising radiation due to the presence of very high-activity sealed sources.

ASN has regulated the continued operation of the facility following its periodic safety review through ASN Chairman's resolution CODEP-CLG-2019-048416 of 22 November 2019. The major areas for improvement are in particular the resistance of the building to seismic and climatic (snow and wind in particular) hazards, and the monitoring of ageing of the Poséidon storage pool.

ASN considers that the facility is operated satisfactorily and with the aim of continuously improving its safety. ASN has effectively observed that the licensee provides adequate responses within the set deadlines to its commitments resulting from the preceding periodic safety review (commitments made by licensee, technical requirements or requests from ASN). The periodic inspections and tests are suitably monitored, and any corrective measures required further to these inspections are duly implemented. ASN nevertheless considers that improvements must be made in the management of radioactive sources, particular in the tracking of expiry dates. Lastly, the license must conduct work to determine the cause of a recent increase in tritium activity observed in the Poséidon pool water.

SOLID WASTE AND LIQUID EFFLUENT TREATMENT FACILITIES

The CEA operates diverse types of facilities: laboratories associated with "fuel cycle" research as well research reactors. The CEA also carries out numerous decommissioning operations. Consequently, it produces diverse types of waste. The CEA has specific processing, packaging and storage facilities for the management of this waste.

Solid radioactive waste management zone

The solid radioactive waste management zone (BNI 72) was authorized by the Decree of 14 June 1971. Operated by the CEA, this facility processes, packages and stores the high, intermediate and low-level waste from the Saclay centre facilities. It also stores legacy materials and waste (spent fuels, sealed sources, scintillating liquids, ion-exchange resins, technological waste, etc.) pending disposal.

In view of the "dispersable inventory[1]" currently present in the facility, BNI 72 is one of the priorities of the CEA's decommissioning strategy, which has been examined by ASN, who stated its position on these priorities in May 2019 (see chapter 13 of the full ASN Report).

The commitments made further to the preceding safety review in 2009 aimed to guarantee an acceptable level of safety of the facility for the next ten years. They concerned in particular the removal of the majority of the "dispersible inventory" from the facility and stopping the reception of new waste from the Saclay centre in order to concentrate the facility's resources on the retrieval and packaging of the legacy waste and on the decommissioning. These commitments have not been met.

In 2017, in view of the delays in the removal from storage operations, the CEA requested that the deadlines prescribed in ASN resolution 2010-DC-0194 of 22 July 2010 for removal of the irradiated fuel from storage and removal of the waste stored in the "40 wells" area be pushed back by several years. In 2020, the CEA asked that the deadline for the removal of the waste stored in the "40 wells" area be further pushed back to 31 December 2030, a request which was validated by ASN Chairman's resolution CODEP-CMG-2022-05822 of 2 February 2022.

In order to be able to continue using the BNI for managing the radioactive waste from the Saclay BNIs, the CEA in 2017 asked for a change in the date of final shutdown of the facility, postponing it until the first of the following two terms was reached: either the effective date of the Decommissioning Decree or the date of 31 December 2022. It is also requesting certain arrangements for the management of certain types of waste until 2025.

After analysing the periodic safety review report for BNI 72 submitted at the end of 2017 and examined jointly with the decommissioning file, ASN regulated the conditions of continued operation of the facility through ASN Chairman's resolution CODEP- CLG-2022-05822 of 2 February 2022.

ASN considers that the safety of the facility is acceptable, while at the same time noting numerous delays in the operations to remove the fuel and waste from storage. ASN nevertheless takes positive note of the removal of three strontium sources from the facility in 2021, which contributes to the gradual reduction of its "dispersible inventory".

In 2021, ASN inspected the organisation and measures implemented by the CEA to remove the irradiated fuels from block 108 and from the pool. Despite the observed delays, ASN underlines the CEA's ability to adapt to the various contingences encountered. Nevertheless, the action plans to ensure compliance with the stated schedules must be more rigorous. ASN underlines that projects that contribute to reducing the "dispersible inventory" within facilities constitute priorities for safety.

1. Part of the inventory of the radionuclides of a nuclear facility that groups the radionuclides that could be dispersed in the facility in the event of an incident or accident, or even, for a fraction of them, be released into the environment.

Alongside this, ASN's inspections find the facility to be in good overall condition. ASN nevertheless notes insufficient tracking of the periodic regulatory verifications of electrical equipment.

Liquid effluents management zone

The liquid effluents management zone constitutes BNI 35. Declared by the CEA by letter of 27 May 1964, this facility is dedicated to the treatment of radioactive liquid effluents. CEA was authorised by a Decree of 8 January 2004 to create "Stella", an extension in the BNI for the purpose of treating and packaging low-level aqueous effluents from the Saclay centre. These effluents are concentrated by evaporation then immobilised in a cementitious matrix in order to produce packages acceptable by Andra's above-ground waste disposal centres.

The evaporation facility used to treat the radioactive effluents has been out of service since 2019, due to technical anomalies on an equipment item. Its return to service requires the preparation of a specific safety assessment file which ASN is waiting to receive. At present the facility is no longer capable of fulfilling its functions (evaporation of effluents, encapsulation of concentrates in cement, collection of effluents from the Saclay effluent producers).

The production of packages by cement encapsulation is subject to a robust and operational inspection plan. This process, which is used to treat the concentrates in the facility, was nevertheless stopped temporarily by the CEA in June 2021. The CEA's decision was made further to the production of two active packages that did not comply with the 12H packaging approval obtained from Andra in 2018. ASN authorised entry into service of the process in 2020. In view of the work to be carried out by the CEA to remedy this situation, the cement encapsulation activity is not expected to start again in the short term.

Alongside this, the CEA has suspended reception of effluents from other BNIs since 2016, due to the conducting of complementary investigations into the stability of the structure of the room for storing low-level liquid effluents (room 97). The majority of the low- and intermediate-level (LL and IL) radioactive effluents produced by the Saclay site production sources are now directed to the Marcoule Liquid Effluent Treatment Station (STEL).

This situation, which raises questions about the possibility of resuming management of liquid effluents in the BNI in the coming years, receives particular attention from ASN in its discussions with the CEA on its effluent management strategy. ASN expects the CEA to make a significant investment to render the facility operational so that, in priority, the legacy effluents stored there can be retrieved and packaged within appropriate time frames.

Several other issues of major importance for the BNI are currently being discussed or examined. These include in particular the emptying of the tanks containing organic effluents in pit 99 - which remains a major clean-out challenge, determining the clean-out strategy for the MA 500 tanks, and finalising the emptying of tank MA 507.

The facility has a good fire-response organisation which undergoes regular exercises. Alongside this, the tracking of commitments made to ASN is satisfactory. On the other hand, improvements are required in fire risk management, with regard to the upkeep of several fire protection devices, the limiting of the fire loads present in certain premises and proper performance of the control inspections after hot spot work.

FACILITIES UNDERGOING DECOMMISSIONING

The decommissioning operations performed on the Saclay site concern two finally shut down BNIs (BNIs 18 and 49) and three BNIs in operation (BNIs 35, 40 and 72), parts of which have ceased activity and in which operations in preparation for decommissioning are being carried out. They also concern two Installations Classified for Protection of the Environment –ICPEs– (EL2 and EL3), previously classified as BNIs but which have not been completely decommissioned due to the lack of a disposal route for the low-level long-lived waste (LLW-LL). Their downgrading from BNI to ICPE status in the 1980's, in compliance with the regulations of that time, could not be done today.

Broadly speaking, the CEA's decommissioning and waste management strategy has been examined by ASN, which stated its position in May 2019 on the priorities defined by the CEA (see chapter 13 of the full ASN Report).

Ulysse reactor

Ulysse was the first French university reactor. The facility, which constitutes BNI 18, has been in final shutdown status since February 2007 and has contained no fuel since 2008. The BNI Decommissioning Decree was published on 21 August 2014 and provides for a decommissioning duration of five years. This facility presents limited safety risks.

On 8 August 2019, the CEA announced the end of the decommissioning operations provided for in the Decommissioning Decree, with the completion of final post-operational clean-out. The facility therefore no longer has any areas regulated on account of radiation protection, or areas where nuclear waste can be produced.

After declaring the delicensing of the facility's waste zoning in September 2020, the CEA sent ASN a delicensing application file in February 2021, with a view to deleting the Ulysse reactor from the list of BNIs. After analysing this file, ASN made complementary information requests in April 2020, more specifically concerning the analysis of the soils and groundwater. As the CEA took these requests into account in its file update in July 2021, ASN was able to initiate the consultations of the Essonne *département* Prefecture and the Saclay Local Information Committee in September 2021. The examination of this delicensing application file should lead to an ASN position statement in 2022. As the clean-out targets have been reached and the facility has no residual pollution (chemical or radioactive), ASN at this stage is considering delicensing of the facility without active institutional controls.

Assessment of the CEA Saclay site

ASN considers that the CEA Saclay site BNIs are operated under suitably safe conditions on the whole, and observes that the operations to reduce the radiological inventory stored in the BNIs continued in 2021. In this respect, the last irradiated fuels were removed from BNI 40 in October 2021.

The decommissioning and waste recovery and packaging operations continued to fall behind schedule in 2021. ASN considers that the progress of the decommissioning projects is one of the major safety challenges for the shutdown installations and that the management of the waste from the decommissioning operations is crucial for the smooth running of the decommissioning programmes. The majority of the CEA Saclay centre BNIs are concerned, either directly or indirectly, by decommissioning or decommissioning preparation operations. ASN therefore expects the CEA to continue its efforts to make its implementation schedules for these operations more robust. ASN will maintain particular vigilance in monitoring the progress of the decommissioning and waste retrieval and packaging projects, with the aim of ensuring control of the schedules.

Particular attention must be paid to management of very-low level (VLL) waste and liquid radioactive effluents. In effect, following the temporary suspension of acceptance of VLL waste by one of the centre's facilities at the start of 2021, management of VLL waste within the BNIs had to be modified for a transient period. In addition to this, the liquid radioactive effluents produced on the Saclay site have been directed to the Marcoule STEL for several years now, given the difficulties encountered by the liquid effluent management zone (BNI 35).

The projected schedule for retrieval of the effluents in BNI 35 is not clearly defined at present.

During 2021, an abnormally high tritium content was discovered in the Fontainebleau Sands aquifer, at a new piezometer installed on the site. Identifying the precise origin of this pollution and how it will evolve over the medium and long term necessitates complementary investigations, which ASN will specifically monitor.

On another note, further to the Fukushima Daiichi NPP accident, ASN had ordered the creation on the Saclay site of new emergency management facilities capable of withstanding extreme conditions. After receiving a compliance notice from ASN in September 2019, the CEA submitted in December 2019 its file presenting and justifying the dimensioning of the future emergency management buildings. After discovering faults in the civil engineering reinforcements, the work site was suspended in mid-2021, preventing the CEA from meeting its commitment to have the premises commissioned before the end of 2021.

With regard to the emergency organisation and means, the CEA submitted an update of its On-site Emergency Plan (PUI) in late 2021. ASN conducted an unannounced inspection which found that the emergency management organisation implemented by the CEA Saclay site is satisfactory.

Management of the pressure equipment and the NPE has improved. The management of on-site and off-site transport of radioactive substances is satisfactory. ASN has nevertheless observed that the monitoring of the main and backed-up electrical power supplies needs to be improved, as does the monitoring of outside contractors working on several BNIs on the site.

High Activity Laboratory

The High Activity Laboratory (LHA) comprises several laboratories which were intended for research or production work on various radionuclides. It constitutes BNI 49. On completion of the decommissioning and clean-out work authorised by Decree of 18 September 2008, only three cells, including two laboratories currently in operation, should ultimately remain under the ICPE System. These two laboratories are the laboratory for the chemical and radiological characterisation of effluents and waste, and the packaging and storage facility for the retrieval of unused sources.

Despite the progress of the clean-out and decommissioning operations, the accumulated delays have prevented the CEA from meeting the deadline of 21 September 2018 set by the Decree authorising LHA decommissioning. The discovery of pollution in certain "intercell yards" in 2017 also led to changes being made in the operations to be carried out. Investigations into the radiological status of the soils were conducted over the 2019-2021 period. The licensee submitted a Decommissioning Decree modification file in December 2021. The justification for the time necessary to complete the decommissioning operations authorised by the Decree of 18 September 2008 shall be reviewed during the examination of this file.

The year 2021 was marked chiefly by the continuation of the soil investigations and studies, which enabled the CEA to finalise the decommissioning modification application file submitted at the end of 2021. The clean-out and decommissioning operations, suspended since the end of 2018, are expected to start again in 2022.

ASN considers that the level of safety of BNI 49 undergoing decommissioning is on the whole satisfactory. The commitments made by the facility are followed up satisfactorily. The conclusions of the fire risk analysis resulted in the rapid implementation of an action plan. The inventory of ionising radiation sources currently in use is kept duly up to date.

On the other hand, the inspections revealed deficiencies in the management of disused sources within the packaging and storage facility for the recovery of sources with no identified use, leading to two significant events linked to the presence of unauthorised sources or sources with activities exceeding the authorised limits. The management of sources used

within the perimeter undergoing decommissioning must therefore be improved. Lastly, improvements are required in the management of the maximum permissible fire loads in each room of the facility, and in the sealing of certain roofs.

During its inspections, ASN will check the conditions for resuming, in the future, the decommissioning work on the TOTEM shielded system, which constitutes the predominant radiological inventory of BNI 49 (contaminated soils excluded).

Artificial Radionuclide Production Plant of CIS bio international

The Artificial Radionuclide Production Plant (UPRA) constitutes BNI 29. It was commissioned in 1964 on the Saclay site by the CEA, which in 1990 created the CIS bio international subsidiary, the current licensee. In the early 2000's, this subsidiary was bought up by several companies specialising in nuclear medicine. In 2017, the parent company of CIS bio international acquired Mallinckrodt Nuclear Medicine LCC, now forming the Curium group, which owns three production sites (in the United States, France, and the Netherlands).

The Curium group is an important player on the French and international market for the production and development of radiopharmaceutical products. The products are mainly used for the purposes of medical diagnoses, but also for therapeutic uses. Until 2019, the role of BNI 29 was also to recover disused sealed sources which were used for radiotherapy and industrial irradiation. Removal of these sources, which have been stored in the facility, is well advanced. The group moreover decided to stop its iodine-131-based productions on the Saclay site at the end of 2019, which has significantly reduced the consequences of accident situations.

Broadly speaking, ASN finds that the drive to improve the safety of the facility, already observed in the preceding two years, continued in 2021 despite the disruptions caused by the Covid-19 pandemic. The stability of the organisation and better skills management were factors that favoured this approach.

Several projects bringing significant improvements in safety have been completed or should be completed in the short term. Nevertheless, the time frames for carrying out the major actions undertaken by CIS bio international, some of which are difficult to deploy, must be better controlled. The emergency organisation undergoes efficient preparation exercises.

The equipment modification and qualification management processes are found to be appropriate. Control of the work sites involving dosimetric risks and the deployment of the legacy waste removal operations are satisfactory. The organisation for managing transport operations, which are numerous and involve packages with varied contents, is also efficient; quality assurance and document management have been improved.

The overall improvement in liquid effluent management following the deviations observed in the last few years is continuing, reflecting an appropriate response which is checked during the ASN inspections.

However, management of the periodic inspections of pressure equipment needs to be improved.

Although the number of significant events is stable, there are still numerous organisational or human failings. Consequently, compliance with the operational management rules, the operating range, the performance of maintenance and the integration of experience feedback must be further improved. ASN also expects to see improvements in the identification of significant events.

Improvements are moreover still necessary to meet the licensee's commitment deadlines.

To conclude, ASN observes that CIS bio international is maintaining the recovery drive it initiated in the preceding years. Areas for improvement on which CIS bio international must continue to focus its efforts include the cross-cutting functioning of the organisation, compliance with the facility baseline requirements, schedule control and operations monitoring, while remaining vigilant with regard to operating rigour and improving the safety culture.

THE CEA FONTENAY-AUX-ROSES SITE

Created in 1946 as the CEA's first research centre, the Fontenay-aux-Roses site is continuing its transition from nuclear activities towards research activities in living sciences.

The CEA Fontenay-aux-Roses site, part of the CEA Paris-Saclay centre since 2017, comprises two BNIs, namely Procédé (BNI 165) and Support (BNI 166). BNI 165 accommodated the research and development activities on nuclear fuel reprocessing, transuranium elements, radioactive waste and the examination of irradiated fuels. These activities were stopped in the 1980s-1990s. BNI 166 is a facility for the characterisation, treatment, reconditioning and storage of legacy radioactive waste from the decommissioning of BNI 165.

Broadly speaking, the CEA's decommissioning and waste management strategy has been examined by ASN, which stated its position in May 2019 on the priorities defined by the CEA (see chapter 13 of the full ASN Report).

Decommissioning of the Fontenay-aux-Roses site includes priority operations because it presents particular risks, linked firstly to the quantity of radioactive waste present in the facilities, and secondly to the radiological contamination of the soils under part of one of the BNI 165 buildings. In addition to this, the Fontenay-aux-Roses centre, which is situated in a densely-populated urban area, is engaged in an overall delicensing process.

Procédé and Support facilities

Decommissioning of the two facilities Procédé and Support, which constitute BNI 165 and BNI 166 respectively, was authorised by two Decrees of 30 June 2006. The initial planned duration of the decommissioning operations was about ten years. The CEA informed ASN that, due to strong presumptions of radioactive contamination beneath one of the buildings, to unforeseen difficulties and to a change in the overall decommissioning strategy of the CEA's civil centres, the decommissioning operations had to be extended and that the decommissioning plan would be modified. In June 2015, the CEA submitted an application to modify the prescribed deadlines for these decommissioning operations.

ASN deemed that the first versions of these decommissioning decree modification application files were not admissible. In accordance with the commitments made in 2017, the CEA submitted the revised versions of these files in 2018. These files were supplemented over the 2019-2021 period, particularly with respect to the planned decommissioning operations and their schedule. The CEA forecasts end of decommissioning of the BNIs beyond 2040, perhaps even 2050 in the case of BNI 165. The two draft decommissioning decree modifications are under examination. The new decrees will set the decommissioning characteristics, notably their completion time frame.

Assessment of the CEA Fontenay-aux-Roses site

The licensee must maintain its efforts to ensure the operational safety of its facilities. Safety is considered acceptable, even if areas for improvement have been identified in a number of technical subjects. The points requiring particular attention concern more specifically control of the lightning-related risk for BNI 165 and the prolonged unavailability of the fire extinguishing systems of the shielded systems of said BNI.

The management process for noteworthy modifications of the facilities is appropriate. Tracking of the maintenance and inspections of the power generating sets must nevertheless be improved.

The CEA also reported one environment-related significant event in 2021, following the discovery of legacy pollution in an inspection port linked to old pipes of the CEA Fontenay-aux-Roses site effluents system (traces of plutonium in sediments). ASN conducted a reactive inspection on this subject. The CEA took action to remove the pollution, which included cleaning operations and post-clean-out inspection. In the light of the elements given to ASN by the CEA, no consequences for people or the environment have been identified.

Broadly speaking, ASN concedes that the CEA is encountering real technical difficulties in retrieving the legacy waste currently stored in these facilities, but it again underlines the delays in performing the studies and in the scheduling of these projects. In 2021, as in the preceding year, the CEA presented ASN its forecasts concerning the coordination of the studies and work planned on the site to reduce the "dispersible inventory" within the facilities. The new organisation deployed since September 2020 for the periodic safety reviews and work on the facility decommissioning files is found to be robust but must continue to prove its effectiveness. ASN expects the CEA to continue to implement proactive measures to control and render reliable the time frames associated with these projects, particularly the deadlines announced for the submission of the decommissioning worksite preparatory studies.

Normandie
Region

The Caen division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 5 *départements* of the Normandie region.

In 2021, ASN carried out 212 inspections in Normandie, comprising 81 inspections in the NPPs of Flamanville, Paluel and Penly, 13 on the Flamanville 3 EPR reactor construction site, 64 on fuel cycle facilities, research facilities and facilities undergoing decommissioning, 48 in small-scale nuclear activities and 6 in the transport of radioactive substances.

In addition to this, 31 days of labour inspection were carried out on the NPP sites and the Flamanville 3 construction site.

In 2021, 18 significant events rated level 1 on the INES scale were reported to ASN.

In the context of their oversight duties, the ASN inspectors issued one violation report. ASN also served formal notice on two nuclear facility licensees to comply with the regulations.

Flamanville nuclear power plant

Operated by EDF and situated in the Manche *département* in the municipality of Flamanville, 25 km south-west of Cherbourg, the Flamanville NPP comprises two PWRs, each of 1,300 MWe commissioned in 1985 and 1986. Reactor 1 constitutes BNI 108 and reactor 2 BNI 109.

ASN considers that the performance of the Flamanville NPP with regard to nuclear safety, despite the observed improvements, remains slightly below its general assessment of EDF plant performance. As far as radiation protection and the environment are concerned, ASN considers that the performance is in line with its general assessment of the EDF plants.

ASN has observed improvements in nuclear safety resulting from implementation of the action plan requested as part of the tightened surveillance of the site. The inspections have more specifically revealed several organisational changes, greater attention in the monitoring of the condition of the facilities, and greater compliance with the procedures and rules of good workmanship by the workers, which leads to an improvement in the operating results. Nevertheless, the difficulties encountered when restarting reactor 1 following an outage to save fuel show that this progress must still be consolidated, particularly as concerns operational management of the reactors. Lastly, ASN notes that the time taken to characterise deviations after their detection must be shortened.

With regard to emergency management, ASN served formal notice on EDF to comply with the applicable regulations relative to emergency situation preparedness and the on-site emergency plan. Following this decision, ASN checked the measures taken to comply with the regulations and considers them to be satisfactory, as the licensee is now capable of managing an emergency situation with partial deployment of the emergency response teams. ASN also considers that improvements must be made in the management and operation of the emergency response centre, which was the subject of several anomalies during the year.

ASN notes that the situation in radiation protection is improving, more particularly with the reorganisation of the risk prevention department. Broadly speaking, the number of events concerning radiation protection reported in 2021 remains at the same level as in 2020, but with lower risks. Nevertheless, work site preparation and monitoring are still areas requiring attention in which ASN expects EDF to continue its efforts. In effect, numerous deviations are still detected due to failure to comply with work conditions and the conditions of access to controlled areas. ASN still considers that the preparation of operations involving high radiological risks must be improved.

With regard to protection of the environment, ASN notes an improvement in the organisation and good command of the activities on the part of the personnel tasked with nuclear waste management. ASN will nevertheless remain attentive to the maintaining of the efforts to clear the backlog of legacy waste stored on the site, the continuation of the action plan to reduce emissions of the greenhouse gas used for electrical isolation (SF_6), and to the operational control of the conditions of discharge into the environment and monitoring of the discharges.

ASN placed the Flamanville NPP under tightened surveillance in September 2019. In accordance with ASN's request, EDF submitted a first assessment of the practices improvement plan in early 2021 along with a projection of the actions remaining to be accomplished over the year. During the year, ASN observed various changes in the organisational methods that led to improved results. A finalised assessment of all the improvement actions was also submitted to ASN at the end of 2021. This assessment will be examined by ASN and undergo specific checks in 2022 to decide whether to maintain tightened surveillance or not.

With regard to labour inspection, ASN considers that the licensee must make improvements in the verification of the electrical installations and the protection of certain areas against the risk of falling from height.

Paluel nuclear power plant

The Paluel NPP operated by EDF in the municipality of Paluel in the Seine-Maritime *département*, 30 km south-west of Dieppe, comprises four 1,300 MWe PWRs, commissioned between 1984 and 1986. Reactors 1, 2, 3 and 4 constitute BNIs 103, 104, 114 and 115 respectively.

The site accommodates one of the regional bases of the Nuclear Rapid Intervention Force (FARN) created by EDF in 2011, further to the Fukushima Daiichi NPP accident. Its role is to intervene in pre-accident or accident situations, on any NPP in France, by providing additional human resources and emergency equipment.

ASN considers that performance of the Paluel NPP with regard to nuclear safety and environmental protection is broadly in line with the general assessment of the EDF plants. ASN considers that the radiation protection performance stands out positively with respect to its general assessment of the EDF plants.

The last two ultimate backup diesel generator sets were commissioned for the NPP reactors 1 and 2 in early 2021, in compliance with ASN resolution 2020-DC-0692 of 28 July 2020.

With regard to operation and operational management of the reactors, ASN considers that the knowledge and command of the general operating rules during the restarting phases must be improved. For this reason, ASN will be particularly attentive to the depth of the analyses performed when anomalies are encountered on safety important components. Along with this, various significant events related to equipment lockout/tagout deficiencies should make the licensee question the rigour of its practices. ASN does nevertheless observe a notable drop in significant safety events related to control of the reactors. The fire outbreak on the main transformer of reactor 1 also showed the fast response of the operating teams to an incident situation, despite shortcomings in the management of the extinguishing water.

With regard to maintenance, ASN considers that the site's performance in 2021 remains below average. Several inspections during maintenance outages highlighted deviations concerning the fastening and installation of equipment which the licensee had nonetheless deemed compliant. In addition, the analysis of several safety-related significant events, one of which led to a retained primary system leak, revealed a lack of preparation and shortcomings in the analyses of the risks of the activities. Improvements are therefore required, firstly through more rigorous preparation of the work interventions, and secondly by the operators duly appropriating the activities before carrying them out. Lastly, the reactor 1 refuelling and maintenance outage was marked by the discovery of traces of corrosion on the steam generator tubes. ASN inspected the specific installation operations of new welded plugs caps and considers that they were carried out properly.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations:**
  - the NPPs operated by EDF, namely Flamanville (2 reactors of 1,300 MWe), Paluel (4 reactors of 1,300 MWe) and Penly (2 reactors of 1,300 MWe),
  - the Flamanville 3 EPR reactor construction site,
  - the Orano spent nuclear fuel reprocessing plant at La Hague,
  - the Andra Manche repository (CSM),
  - the National large heavy ion accelerator (Ganil) in Caen;
- **small-scale nuclear activities in the medical sector:**
  - 8 external-beam radiotherapy departments (27 devices),
  - 1 proton therapy department,
  - 3 brachytherapy departments,
  - 12 nuclear medicine departments,
  - 50 centres performing fluoroscopy-guided interventional practices,
  - 70 computed tomography scanners,
  - some 2,100 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - about 450 industrial and research centres, including 20 companies with an industrial radiography activity,
  - 5 particle accelerators, including 1 cyclotron,
  - 21 laboratories located chiefly in the universities of the region,
  - 5 companies using gamma ray densitometers,
  - about 260 veterinary surgeries or clinics practising diagnostic radiology, 1 equine research centre and 1 equine hospital centre;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 9 head-offices of laboratories approved for taking environmental radioactivity measurements,
  - 1 organisation approved for radiation protection controls.

With regard to radiation protection performance, ASN notes an improvement compared with 2020. The overall doses received by the workers during maintenance outages in 2021 were all below the initial estimated evaluations. The inspections confirmed the good upkeep of the work sites and, more generally, satisfactory management of the contamination risk. Nevertheless, improvements are required in the compliance with procedures for accessing limited stay areas and in the preparation of activities with high radiation exposure risks.

With regard to environmental protection, ASN notes stable performance and a reduction in uncontrolled greenhouse gas discharges. Given shortcomings observed in fire extinguishing water management during the fire on the main transformer of reactor 1, ASN carried out an on-site exercise simulating

a spillage of hazardous substances. This exercise revealed improvements in the prevention of uncontrolled flows in the facility. Moreover, EDF must now endeavour to define the material modifications necessary to ensure greater robustness in the management of accidental spillages combined with heavy rainfall.

With regard to labour inspection, ASN observes on the whole that the workers know and comply with the safety requirements, but that continued improvements are necessary in this area. The ASN inspections have also evidenced deviations concerning, for example, compliance with work times, the electrical installation verifications and the management of risks of tripping and falling.

Penly nuclear power plant

The Penly NPP operated by EDF in the Seine-Maritime *département* in the municipality of Penly, 15 km north-east of Dieppe, comprises two 1,300 MWe PWRs commissioned between 1990 and 1992. Reactor 1 constitutes BNI 136 and reactor 2 BNI 140.

ASN considers that the performance of the Penly NPP with regard to nuclear safety, radiation protection and environmental protection is on the whole in line with its general assessment of EDF plant performance. At the end of 2021, EDF detected stress corrosion-related cracks in the circuits connected to the main pipes of the primary system of reactor 1. This issue will lead to a large-scale inspection and repair programme in 2022.

With regard to nuclear safety, ASN considers that operating rigour dropped in 2021. Several notable events linked to the operational management activities were observed. Greater attention must thus be paid to the preparation of operational management activities in order to enhance their proper appropriation by the personnel tasked with performing them. ASN also considers that the licensee must ensure that a calm atmosphere is maintained in the control room under all circumstances.

With regard to the maintenance operations, ASN considers that greater rigour is required in the management of the work files and that the monitoring of outside contractors must be further improved. Moreover, recurrent difficulties are found in the characterisation of deviations and their monitoring over time. Lastly, on several occasions during its inspections ASN has observed deficiencies in the summary reports of the Nuclear Pressure Equipment (NPE) inspections. The licensee must be attentive to the quality of the files submitted to ASN before they are put back into service.

The maintenance operations carried out during the reactor 2 refuelling outage were well managed on the whole. On the other hand, the start of the ten-yearly outage of reactor 1 was marked by a leak on the main primary system following the rupture of a flow meter during a valve tightness check. ASN conducted a reactive inspection which found deficient preparation and a lack of rigour in the development of the work intervention risk analyses.

In the area of radiation protection, ASN considers that the site must continue the ongoing actions to correct the deviations observed in the last few years. ASN observes recurrent anomalies in the preparation of activities in controlled areas and in the radiation protection culture of the operators. The licensee must in particular try to review the procedures for the reception and awareness briefing of outside contractors. ASN also considers that particular attention must be paid to control of the contamination risk.

With regard to environmental protection, the improvements made by the licensee have to be consolidated. More specifically, ASN considers that the Penly NPP has obtained satisfactory results in waste monitoring and management. EDF must nevertheless continue and finalise its action plan to significantly reduce its emissions of greenhouse gas (SF_6) used to insulate electric lines.

With regard to labour inspection, ASN considers that the licensee must improve its management of electrical installation conformity and the preparation of activities. ASN observed an increase in accidents in the second half of the year and will be attentive to the way the situation evolves and the measures taken by the licensee.

Flamanville 3 EPR reactor construction worksite

Following issuing of the Creation Authorisation Decree 2007-534 of 10 April 2007 and the building permit, the Flamanville 3 EPR reactor has been under construction since September 2007.

On 8 October 2020, ASN authorised partial commissioning of the Flamanville EPR reactor to allow the entry of nuclear fuel into the reactor perimeter and the performance of particular operating tests of the facility requiring the use of radioactive gases. Between 26 October 2020 and 24 June 2021, all the fuel assemblies were delivered for storage in the fuel building pool. In 2021, ASN conducted an inspection on the conditions of storage of these fuel assemblies and considers them satisfactory.

In the first half of 2021, ASN inspected the first utilisation of radioactive gases within the facility. This inspection showed that the test in question was well prepared and the authorisation conditions granted by ASN for the utilisation of these radioactive tracer gases were satisfied. The preparation for the overall requalification phase that EDF plans carrying out after repairing the Main Secondary Systems (MSS) was also inspected. ASN considers at this stage that it is conducted under satisfactory conditions.

Alongside this, ASN has continued the verification of the equipment quality review which was requested in 2018 due to the serious shortcomings observed in EDF's monitoring of its outside contractors. ASN ascertained at periodic meetings in 2021 that a programme of complementary verifications was established and implemented. ASN also carried out two inspections on this subject, which found that the conditions of performance of these verifications appeared on the whole to be good. EDF must nevertheless provide additional proof of the adequacy of the programme carried out. In 2022, ASN will examine the results of this review and the conclusions EDF draws from it.

Numerous systems, structures and components were shut down during the work carried out on the MSS's in 2020. After reviewing the preservation doctrine defined by EDF, ASN conducted several inspections in 2021 to check its implementation. These inspections confirmed the quality of the coordination and the measures taken to monitor the preservation actions. EDF was however sometimes obliged to make adjustments to the initially defined strategies. The inspections did not reveal any deviations linked to these adjustments, but EDF must be more attentive to the checks when bringing out of preservation.

ASN also continued its inspection of the MSS weld repairs through two field inspection campaigns and one specific inspection of EDF, four inspections of the manufacturer Framatome and three inspections of the notified body mandated by ASN to monitor these activities. ASN considers that the various parties involved have set up an organisation and a system for monitoring the activities conducive to achieving, with confidence, a high standard of quality in the production of these welds. ASN will continue to monitor these welding activities in 2022 and will be attentive to ensuring that the resources and the organisation are adequate to carry out a larger volume of repairs at the same time.

A large amount of work and examinations still have to be carried out before the reactor is commissioned (see chapter 10 of the full ASN Report), as well as preparation for future operation of the facility. Concerning this latter point, a follow-up mission to the suggestions and recommendations expressed during an Operational Safety Review Team (OSART) international audit mission conducted by IAEA experts in 2019 was carried out at the end of 2021. ASN will monitor the actions implemented by the site further to this review.

With regard to labour inspection, apart from checking that the companies working on the site comply with the provisions of labour law, ASN has checked the measures taken by the licensee further to the occurrence of several workplace accidents. ASN notes that the safety organisation is progressing and seems to be generally appropriate with regard to the regulations. Nevertheless, in view of the numerous low-level events, ASN will be attentive to compliance with the safety rules in 2022 in the transfers of equipment and premises to the future licensee.

Manche waste repository

The Manche waste disposal facility (CSM), which entered service in 1969, was the first radioactive waste repository operated in France. 527,225 m³ of waste packages are emplaced in it. The last waste packages to enter this facility were accepted in July 1994. From the regulatory aspect, the CSM is in the decommissioning phase (operations prior to its closure) until the installation of the long-term cover is completed. An ASN resolution shall specify the date of closure of the repository (entry into monitoring and surveillance phase) and the minimum duration of the monitoring and surveillance phase.

Examination of the periodic safety review guidance file had resulted in ASN formulating specific demands at the end of 2017, concerning the justification of the technical principles of deployment of the long-term cover, the CSM memory system and the updating of the impact study. In this context, ASN is currently examining the CSM periodic safety review report submitted by Andra in 2019. ASN performed a specific inspection on this subject in 2021, and notes that the review process was conducted satisfactorily by the licensee, as regards the organisational set-up, the methodology used, the resources allocated to the various studies and the quality of the documents submitted to ASN. Nevertheless, points requiring particular attention are noted, concerning the need to finalise the technical qualification of a spare geomembrane if it is necessary to perform one-off repairs, formalisation of the in-house check of documents and the level of precision of the periodic safety review follow-up action plan.

With regard to operation of the facilities, ASN considers that the measures taken by the licensee to guarantee environmental monitoring were satisfactory. The licensee must nevertheless be more rigorous in the performance of its network maintenance operations.

National Large Heavy Ion Accelerator

The National Large Heavy Ion Accelerator (Ganil) economic interest group was authorised in 1980 to create an ion accelerator in Caen (BNI 113). This research facility produces, accelerates and distributes ion beams with various energy levels to study the structure of the atom. The high-energy beams produce strong fields of ionising radiation, activating the materials in contact, which then emit radiation even after the beams have stopped. Irradiation therefore constitutes the main risk of Ganil.

"Exotic nuclei" are nuclei which do not exist naturally on Earth. They are created artificially in Ganil for nuclear physics experiments on the origins and structure of matter. In order to produce these exotic nuclei, Ganil was authorised in 2012 to build phase 1 of the SPIRAL2 project, whose commissioning was authorised by ASN in 2019.

The year 2021 was marked by the submission of the facility's second periodic safety review report. A substantial modification application was also filed for the facility and is currently being examined. This concerns the setting up of the Desintegration, Excitation and Storage of Radioactive Ions (DESIR) facility, whose main purpose is to create new experimentation areas based on radioactive ion beams from the SPIRAL1 and S3 facilities (experimental areas of the SPIRAL2 phase 1 facility). This project involves modifying the BNI perimeter.

ASN considers that the Ganil's performance in 2021 in the implementation of the periodic inspections and tests, control of ageing and fire-fighting is satisfactory. ASN moreover considers that the licensee has made improvements –still to be consolidated– in its documentation management, particularly in the updating of its safety baseline requirements. Improvements are still expected in the completeness of the analyses submitted in support of its various requests.

LA HAGUE SITE

The Orano site at La Hague is located on the north-west tip of the Cotentin peninsula, in the Manche *département*, 20 km west of Cherbourg and 6 km from Cap de La Hague. This site is situated about fifteen kilometres from the Channel Islands.

THE *ORANO RECYCLAGE* REPROCESSING PLANTS IN OPERATION AT LA HAGUE

The La Hague plants for reprocessing fuel assemblies irradiated in the nuclear reactors are operated by *Orano Recyclage* La Hague.

Commissioning of the various units of the fuel reprocessing and waste packaging plants UP3-A (BNI 116) and UP2-800 (BNI 117) and the Effluent Treatment Station STE3 (BNI 118) spanned from 1986 (reception and storage of spent fuel assemblies) until 2002 (R4 plutonium treatment unit), with the majority of the process units being commissioned in 1989-1990.

The Decrees of 10 January 2003 set the individual reprocessing capacity of each of the two plants at 1,000 tonnes per year, in terms of the quantities of uranium and plutonium contained in the fuel assemblies before burn-up (in the reactor), and limit the total capacity of the two plants to 1,700 tonnes per year. The limits and conditions for discharges and water intake by the site are defined by ASN resolutions 2015-DC-0535 and 2015-DC-0536 of 22 December 2015.

Operations carried out in the plants

The reprocessing plants comprise several industrial units, each intended for a particular operation. Consequently there are facilities for the reception and storage of spent fuel assemblies, for their shearing and dissolution, for the chemical separation of fission products, uranium and plutonium, for the purification of uranium and plutonium, for treating the effluents and for packaging the waste.

When the spent fuel assemblies arrive at the plants in their transport casks, they are unloaded either "under water" in the spent fuel pool, or dry in a leaktight shielded cell. The fuel assemblies are first stored in pools to cool them down.

They are then sheared and dissolved in nitric acid to separate the pieces of metal cladding from the spent nuclear fuel. The pieces of cladding, which are insoluble in nitric acid, are removed from the dissolver, rinsed in acid and then water, and transferred to a compacting and packaging unit.

The nitric acid solution comprising the dissolved radioactive substances is then processed in order to extract the uranium and plutonium and leave the fission products and other transuranic elements.

After purification, the uranium is concentrated and stored in the form of uranyl nitrate $UO_2 (NO_3)_2$. It will then be converted into a solid compound (U_3O_8) called "reprocessed uranium" in the TU5 facility on the Tricastin site.

After purification and concentration, the plutonium is precipitated by oxalic acid, dried, calcined into plutonium oxide, packaged in sealed containers and stored. The plutonium is then intended for the fabrication of Mixed OXide (MOX) fuels in the Orano plant in Marcoule (Melox).

The effluents and waste produced by the operation of the plants

The fission products and other transuranic elements resulting from reprocessing are concentrated, vitrified and packaged in standard vitrified waste packages (CSD-V). The pieces of assembly cladding are compacted and packaged in standard compacted waste packages (CSD-C).

Furthermore, the reprocessing operations described in the previous paragraph involve chemical and mechanical processes which produce gaseous and liquid effluents and solid waste.

The solid waste is packaged on site by either compaction or encapsulation in cement. The solid radioactive waste resulting from the reprocessing of the spent fuel assemblies from the French reactors is, depending on its composition, either sent to the Aube repository (CSA) or stored on the *Orano Recyclage* La Hague site until a definitive disposal solution is found (particularly the CSD-V et CSD-C packages).

In accordance with Article L. 542-2 of the Environment Code, radioactive waste from the reprocessing of spent fuels of foreign origin is shipped back to its owners. It is however impossible to physically separate the waste according to the fuel from which it originates. In order to guarantee an equitable distribution of the waste resulting from the reprocessing of the fuels of its various customers, the licensee has proposed an accounting system that tracks the entries into and exits from the La Hague plant. This system, called EXPER, was approved by the Order of 2 October 2008 of the Minister responsible for energy.

The installations at La Hague

SHUT DOWN INSTALLATIONS UNDERGOING DECOMMISSIONING

BNI 80 – Oxide High Activity facility (HAO):

- **HAO/North**: Facility for "under water" unloading and storage of spent fuel elements,
- **HAO/South**: Facility for shearing and dissolving spent fuel elements;

BNI 33 – UP2-400 plant, first reprocessing unit:

- **HA/DE**: Facility for separating uranium and plutonium from fission products,
- **HAPF/SPF (1 to 3)**: Facility for fission product concentration and storage,
- **MAU**: Facility for separating uranium and plutonium, uranium purification and storage as uranyl nitrate,
- **MAPu**: Facility for purification, conversion to oxide and initial packaging of plutonium oxide,
- **LCC**: Central product quality control laboratory,
- **ACR**: Resin conditioning facility;

BNI 38 – STE2 facility: effluent collection and treatment and storage of precipitation sludge, and AT1 facility, prototype facility currently being decommissioned;

BNI 47 – ELAN IIB facility, research installation currently being decommissioned.

INSTALLATIONS IN OPERATION

BNI 116 – UP3-A plant:

- **T0**: Facility for dry unloading of spent fuel elements,
- **Pools D and E**: Storage pools for spent fuel elements,
- **T1**: Facility for shearing fuel elements, dissolving and clarification of the resulting solutions,
- **T2**: Facility for separating uranium, plutonium and fission products and concentrating/storing fission product solutions,
- **T3/T5**: Facilities for purification and storage of uranyl nitrate,
- **T4**: Facility for purification, conversion to oxide and packaging of plutonium,
- **T7**: Fission products vitrification facility,
- **BSI**: Plutonium oxide storage facility,
- **BC**: Plant control room, reagent distribution facility and process control laboratories,
- **ACC**: Hull and end-piece compaction facility,
- **AD2**: Technological waste packaging facility,
- **ADT**: Waste transit area,
- **EDS**: Solid waste storage area,
- **E/D EDS**: Solid waste storage/removal from storage facility,
- **ECC**: Facilities for storage and retrieval of technological waste and packaged structures,
- **E/EV South-East**: Vitrified residues storage facility,
- **E/EV/LH and E/EV/LH 2**: Vitrified residues storage facility extensions;

BNI 117 – UP2-800 plant:

- **NPH**: Facility for "under water" unloading and storage of spent fuel elements in pool,
- **Pool C**: Spent fuel element storage pool,
- **R1**: Facility for shearing and dissolving fuel elements and clarification of the resulting solutions (including the URP: plutonium redissolution facility),
- **R2**: Facility for separating uranium, plutonium and fission products and concentrating of fission product solutions (including the UCD: centralised alpha waste conditioning unit),
- **SPF (4, 5, 6)**: Fission product storage facilities,
- **R4**: Facility for purification, conversion to oxide and initial packaging of plutonium oxide,
- **BST1**: Facility for secondary packaging and storage of plutonium oxide,
- **R7**: Fission products vitrification facility,
- **AML • AMEC**: Packaging reception and maintenance facilities;

BNI 118 – STE3 facility: Effluent collection and treatment and storage of bituminised waste packages:

- **E/D EB**: Alpha waste storage/removal from storage,
- **MDS/B**: Mineralisation of solvent waste.

Marking events of the year 2021

Fission product evaporators-concentrators

Six evaporators are used in facilities R2 and T2 to concentrate the fission product solutions before they undergo vitrification treatment. After measuring the thickness of the walls of these evaporators during the periodic safety reviews of the facilities as from 2012, a more advanced state of corrosion than predicted at the design stage was discovered. ASN therefore decided to regulate the continued operation of these evaporators, in order to tighten their surveillance and to have additional means installed to mitigate the consequences in the event of a leak or rupture.

In the context of this special surveillance, thickness measurements taken in September 2021 on evaporator 4120.23 of the T2 facility showed that the operational criterion for shutting down the evaporator had been reached. In view of this, Orano decided not to restart this evaporator.

To replace these evaporators, Orano has built new facilities baptised "New Fission Product Concentrations" (NCPF) and comprising six new evaporators. This project, which is particularly complex, has required several authorisations and was addressed by two ASN resolutions in 2021, concerning the active connection of the process of the three evaporators of NCPF T2 on the one hand, and the three evaporators of NCPF R2 on the other.

Storage of plutonium-bearing materials

Orano filed a noteworthy modification authorisation application in September 2021 aiming to increase the plutonium-bearing materials storage capacities in the BST1 facility. This application is part of the more general procedure conducted by Orano in response to the saturation of the storage capacities for these materials, which is linked to the operating difficulties experienced by the Melox plant. This problem gave rise to a specific hearing of Orano by the ASN Commission on 28 September 2021 and was also examined during the joint hearing of Orano and EDF relative to the balance of the "nuclear fuel cycle" on 10 February 2022.

Noncompliance with the halon substitution deadlines for certain fire-fighting devices

At the end of 2020, Orano informed ASN that the deadline of 31 December 2020 set by the European regulation governing the use of ozone-layer depleting substances could not be met for the disconnection of the halon fire-extinguishing system of facility AD2 due to contractual and technical difficulties in finding an alternative solution using another extinguishing agent. ASN conducted an inspection on 27 January 2021 to examine the industrial options chosen by the licensee to ensure compliance with the regulations and the project management steps since the regulation was published. The inspection confirmed that the fire-protection equipment using halon 1301 was still in service in the AD2 facility. It also revealed shortcomings in the leak detection methods used on these systems.

In view of these factors, ASN decided to regulate the time frames for modifying the fire-extinguishing system of the AD2 facility, by issuing a compliance notice dated 22 April 2021.

The gaseous effluents are released mainly when the fuel assemblies are sheared and during the dissolution process. These gaseous effluents are treated by washing in a gas treatment unit. The residual radioactive gases, particularly krypton and tritium, are checked before being discharged into the atmosphere.

The liquid effluents are treated and usually recycled. Some radionuclides, such as iodine and tritium, are channelled –after being checked– to the sea discharge outfall. This outfall, like the other outfalls of the site, is subject to discharge limits. The other effluents are routed to the site's packaging units (solid glass or bitumen matrix).

FINAL SHUTDOWN AND DECOMMISSIONING OPERATIONS ON CERTAIN FACILITIES

The former spent fuel reprocessing plant UP2-400 (BNI 33) was commissioned in 1966 and has been definitively shut down since 1 January 2004.

Final shutdown also concerns three BNIs associated with the UP2-400 plant: BNI 38 (which comprises the effluents and solid waste treatment station No. 2 –STE2, and the oxide nuclear fuel reprocessing facility No. 1 –AT1), BNI 47 (radioactive source fabrication unit –ELAN IIB) and BNI 80 (HAO facility).

Orano submitted two partial decommissioning authorisation requests for BNIs 33 and 38 in April 2018. The schedule push-backs requested by the licensee lead to decommissioning completion deadlines in 2046 and 2043 instead of 2035, the current deadline prescribed for the two BNIs. Further to Orano's additions to the file concerning firstly the elimination of the interactions between the MAPu facility and the plutonium BST1 facility in the event of an earthquake, and secondly the memorandum in response to the opinion of the environmental authority, a public inquiry was held from 20 October to 20 November 2020. At the end of the inquiry, the inquiry commission issued a favourable opinion. In 2021, ASN continued the examination of these files and remains particularly vigilant about the justification for the various decommissioning stages and the reassessment of the safety of the facilities that are maintained in their current condition.

ASN notes that the schedule push-backs requested are significant and largely due to the delays in legacy waste retrieval and packaging. Consequently, ASN will continue to monitor the management of these projects in 2022.

LEGACY WASTE RETRIEVAL AND PACKAGING OPERATIONS

Unlike the direct on-line packaging of waste, as is done with the waste produced in the new UP2-800 and UP3-A plants at La Hague, the majority of the waste produced by the first UP2-400 plant was stored in bulk without final packaging. The operations to retrieve this waste are complex and necessitate the deployment of substantial means. They present major safety and radiation exposure risks, which ASN monitors with particular attention.

The retrieval of the waste contained in the old storage facilities of the La Hague site is also a prerequisite for the decommissioning and clean-out of these storage facilities.

Retrieval and packaging of the STE2 sludges

The STE2 station of UP2-400 was used to collect the effluents from the UP2-400 plant, treat them and store the precipitation sludge resulting from the treatment. The STE2 sludges are thus precipitates that fix the radiological activity contained in the effluents and they are stored in seven silos. A portion of the sludges has been encapsulated in bitumen and packaged in stainless steel drums in the STE3 facility. Following ASN's banning of bituminisation in 2008, Orano studied other packaging methods for the non-packaged or stored sludges.

The scenario for the retrieval and packaging of the STE2 sludges presented in 2010 was broken down into three steps:
- retrieval of the sludges stored in the silos of STE2 (BNI 38);
- transfer and treatment, initially envisaged by drying and compaction, in STE3 (BNI 118);
- packaging of the resulting pellets into C5 packages for deep geological disposal.

ASN authorised the first phase of the work to retrieve the sludges from STE2 in 2015. The Creation Authorisation Decree for the STE3 effluents treatment station was modified by the Decree of 29 January 2016 to allow the installation of the STE2 sludges treatment process.

At the end of 2017 however, *Orano Recyclage* informed ASN that the process chosen for treating the sludges in STE3 could lead to difficulties in equipment operation and maintenance. Orano proposed an alternative scenario using centrifugation and in August 2019 it submitted a Safety Options Dossier (DOS), which is however based on as yet insufficiently substantiated hypotheses.

An inspection conducted at the end of 2019 confirmed that the project was not sufficiently mature for ASN to be able to give an opinion on this DOS. Orano submitted an update of the DOS to ASN in July 2020. This file is currently being examined.

At present, the technical discussions with Orano highlight the need to further the studies of the sludge treatment and packaging processes, and the possibility of interim storage of the retrieved sludge under suitably safe conditions so that this step can be separated from their final packaging.

Silo 130

Silo 130 is a reinforced concrete underground storage facility, with a carbon steel liner, used for dry storage of solid waste from the reprocessing of Gas-Cooled Reactor (GCR) fuels, and the storage of technological waste and contaminated soils and rubble. The silo received waste of this type as from 1973, until the 1981 fire which forced the licensee to flood the waste. The leak-tightness of the water-filled silo is only ensured at present by a single containment barrier consisting of a steel "skin". Today, the civil engineering structure of Silo 130 is weakened by ageing and by a fire that occurred in 1981. The water is therefore in direct contact with the waste and can contribute to corrosion of the carbon steel liner, which at present is the only containment barrier.

One of the major risks for this facility concerns the dispersion of radioactive substances into the environment (infiltration of contaminated water into the water table). The leak-tightness of Silo 130 is monitored by a network of piezometers situated nearby. Another factor that can compromise the safety of Silo 130 is linked to the nature of the substances present in the waste, such as magnesium, which is pyrophoric. Hydrogen, a highly inflammable gas, can also be produced by phenomena of radiolysis or corrosion (presence of water). These elements contribute to the risks of fire and explosion.

The waste retrieval and packaging scenario comprises four steps:
- retrieval and packaging of the solid GCR waste;
- retrieval of the liquid effluents;
- retrieval and packaging of the residual GCR waste and the sludges from the bottom of the silo;
- retrieval and packaging of the soils and rubble.

Orano has built a retrieval unit above the pit containing the waste and a new building dedicated to the storing and packaging operations. The works carried out on Silo 130 in 2021 allowed the retrieval of about twenty waste drums. These operations were initially carried out manually, then in semi-automatic mode. In view of the various technical problems encountered, the industrial commissioning step with waste retrieval in automatic mode could not be accomplished in 2021. Orano envisages carrying out this step in early 2022.

HAO silo and Organised Storage of Hulls

The Oxide High Activity Facility –HAO (BNI 80) ensured the first steps of the spent nuclear fuel reprocessing process: reception, storage, then shearing and dissolution. The dissolution solutions produced in BNI 80 were then transferred to the UP2-400 industrial plant in which the subsequent reprocessing operations took place.

BNI 80 comprises:
- HAO North, spent fuel unloading and storage site;
- HAO South, where the shearing and dissolution operations were carried out;
- the "filtration" building, which accommodates the filtration system for the HAO South pool;

- the HAO silo, in which are stored the hulls and end-pieces (fragments of cladding and fuel end-pieces) in bulk, fines coming primarily from shearing, and resins and technological waste from the operation of the HAO facility between 1976 and 1997;
- the Organised Storage of Hulls (SOC), comprising three pools in which the drums containing the hulls and end-pieces are stored.

In 2021, Orano continued the operations prior to retrieval of the waste from the HAO silo (notably the fitting out of the future waste retrieval unit) and the tests important to safety which began in 2019. On completion of the in-depth analysis of hard spots identified during the functional tests conducted in early 2021, Orano made organisational improvements and started significant material modifications. Implementing these modifications significantly pushes back the estimated date of waste retrieval.

Assessment of the La Hague site

ASN considers that the performance of the *Orano Recyclage* La Hague site in 2021 is satisfactory in the areas of nuclear safety, radiation protection and environmental protection.

With regard to nuclear safety, Orano must endeavour to continue the improvements underway in the formalising of operator authorisations and the deployment of the operational management teams. Particular attention must also be paid to the training and appointing of the operators ensuring the local response group functions, and to the rigour in the traceability of the various operational tracking registers.

ASN considers that the licensee has improved its aids for monitoring outside contractors, but must now try to be more rigorous in the filling out of these tracking documents. It would also seem necessary to conduct a cross-site reflection on the precision with which the monitoring stop points are defined during operations carried out by outside contractors and on the rigour of their validation. The licensee must also be attentive to the proper deployment of the teams of certain facilities placed under the responsibility of industrial operators, such as the asbestos laboratory, in order not to induce delays in the decommissioning and legacy waste retrieval operations.

ASN also considers that the licensee has satisfactorily carried out the required work to reinforce fire detection and protection. Orano has also adapted the human resources provided during unannounced fire-fighting exercises conducted by ASN. The licensee must nevertheless be vigilant regarding its rigour in the management of fire permits, fire loads and fire-fighting means specific to work sites.

ASN considers that Orano must reinforce its forward-looking initiatives for managing the capacities of certain storage areas, such as those for plutonium–bearing materials, in order to define storage arrangements and solutions offering a high level of safety.

Lastly, ASN considers that the licensee must be more rigorous when gathering the results of investigations associated with the corrosion phenomena on the fission product evaporators-concentrators, and take care to maintain a questioning attitude when analysing the results.

With regard to radiation protection, the year 2021 was marked by the continued implementation of the new radiation protection organisation. ASN notes that the La Hague site's organisation and results are satisfactory, particularly regarding compliance with the site's estimated dosimetric evaluations and control of exposure levels. However, ASN considers that Orano must be more rigorous with the traceability of radioactive sources and the management of outside contractors tasked with performing the regulatory technical verifications.

With regard to environmental protection, in June 2021 ASN carried out a tightened inspection of the measures adopted and implemented by the licensee to prevent and control the detrimental effects and environmental impact of the site's activity. This inspection revealed satisfactory control of the liquid and gaseous effluent discharges, and several recent improvements relating to the control of risks in the chemical product storage areas and the operational procedures for managing accidental pollution on the site. Orano must nevertheless be vigilant with regard to the conformity of equipment and facilities presenting a risk for protection of the environment, particularly the identification of the related requirements and the correct performance of the associated inspections.

As far as the management of decommissioning and legacy waste retrieval and packaging projects is concerned, progress was made in 2021, with Orano gradually implementing, as from early 2021, major improvements in project organisation and management, such as the putting in place of a collaborative tool that provides all the elements relating to decommissioning project management in digital format, or the use of readiness matrices for the various project steps. These improvements, which promote greater robustness, must nevertheless still be generalised and consolidated.

ASN does however observe that several legacy waste retrieval and packaging projects are facing difficulties leading to new delays (see the waste retrieval and packaging project observatory –chapter 13 of the full ASN Report).

ASN considers that Orano must guarantee that governance decisions are taken on the basis of soundly argued and formalised hypotheses. It must also plan ahead to define alternative solutions in the event of uncertainties in project implementation.

Nouvelle-Aquitaine Region

The Bordeaux division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 12 *départements* of the Nouvelle-Aquitaine region.

In 2021, ASN carried out 143 inspections in the Nouvelle-Aquitaine region, comprising 60 in the Blayais and Civaux NPPs, 66 in small-scale nuclear facilities, 7 in the area of radioactive substance transport and 10 concerning approved organisations and laboratories.

ASN also carried out 13 days of labour inspection at the Blayais NPP and 15.5 days at the Civaux NPP.

During 2021, 9 significant events rated level 1 on the INES scale were reported by the NPP licensees of Nouvelle-Aquitaine. In small-scale nuclear activities, 5 significant radiation protection events rated level 1 on the INES scale were reported to ASN.

Blayais nuclear power plant

The Blayais NPP situated in the Gironde *département*, 50 km north of Bordeaux, is operated by EDF. This NPP comprises four 900 MWe PWRs. Reactors 1 and 2 constitute BNI 86, and reactors 3 and 4 BNI 110.

ASN considers that the performance of the Blayais NPP with regard to nuclear safety, radiation protection and environmental protection is in line with ASN's general assessment of the EDF plants. However, despite this assessment, ASN considers that improvement measures are necessary to overcome the current deterioration in nuclear safety performance.

The nuclear safety performance of the Blayais NPP was variable during 2021. In the operational management of the reactors, the deployment of an action plan in the first half of the year to improve the quality of operation and supervision of control room activities resulted in satisfactory performance. A drop in performance during the summer and at the end of the 2021 however resulted in the reporting of numerous significant events. ASN considers it is necessary to take measures regarding the organisation and distribution of responsibilities in the control room. ASN also observes persistent deficiencies in the quality of the operational documentation covering the preparation and performance of the activities. On the other hand, in the area of maintenance, ASN notes a good command of the activities carried out during the reactor outages and appropriate handling of anomalies encountered.

A tightened inspection in the area of occupational radiation protection in 2021 showed that improvements were required. ASN considers that performance levels have improved compared with 2020 and underlines the deployment of an ambitious action plan in this area. Nevertheless, ASN's inspections still find numerous deviations in the way this risk is taken into account on the facilities, indicating a lack of radiation protection culture on the part of certain workers. It is therefore necessary to continue monitoring, training and providing information on this subject. Lastly, ASN notes that a number of detected events should have been reported and analysed in greater depth to prevent their recurrence.

With regard to environmental protection, ASN considers that the situation has significantly improved in various areas noted in the last few years, such as the treatment of legacy pollution of the soils and the confined aquifers of the site, or the reinforcement of the sealing of the liquid discharge pipes in the Gironde Estuary. ASN nevertheless notes that investigations are still necessary to characterise the exact origin of the liquid tritium pollutions, and that depollution actions must be continued in 2022. It observes moreover that work remains to be carried out to guarantee the containment of accidental liquid spillages on the site under all circumstances. ASN underlines with approval the licensee's transparency on these subjects and its drive in 2021 to remove waste that has been waiting to be removed for many years.

Concerning labour inspection, ASN considers that there is a deterioration in worker safety results. ASN has observed risk situations for personnel working at height, and the occurrence of events affecting safety linked to hand-held power tools. ASN has nevertheless noted positively the setting up of work site protection reviews. On 1 October last, the Bordeaux division and the Regional Directorates of the economy, employment, labour and solidarity of Nouvelle-Aquitaine and Occitanie held a half-day meeting with employers, ordering customers and employees of companies performing work that could cause the emission of asbestos fibres, in order to raise awareness on the prevention of this risk.

Civaux nuclear power plant

The Civaux NPP is operated by EDF in the Vienne *département*, 30 km south of Poitiers in the Nouvelle-Aquitaine region. It comprises two 1,450 MWe PWRs. Reactor 1 constitutes BNI 158 and reactor 2 BNI 159. The site accommodates one of the regional bases of the Nuclear Rapid Intervention Force (FARN) created by EDF in 2011, further to the accident at the Fukushima Daiichi NPP in Japan. Its role is to intervene in pre-accident or accident situations, on any NPP in France, by providing additional human resources and emergency equipment.

ASN considers that the nuclear safety and radiation protection performance of the Civaux NPP stand out positively with respect to its general assessment of EDF plant performance, and that its environmental protection performance is in line with this general assessment. At the end of 2021, EDF detected stress corrosion-related cracks in the circuits connected to the main pipes of the primary system of the two reactors. This issue will lead to a large-scale inspection and repair programme in 2022.

ASN considers that the nuclear safety performance of the Civaux NPP remained stable in 2021. ASN considers that the reactor management operations are on the whole conducted with rigour and that the NPP is capable of preventing, detecting and correcting inappropriate operating actions. ASN nevertheless considers that the licensee must improve its management of the system for treating and cooling the water of the fuel storage pools and the reactor pools, which was the subject of several significant safety event reports in 2021.

With regard to maintenance, ASN considers that, on the whole, the licensee proficiently handled performance of the scheduled activities during the reactor 2 refuelling and maintenance outage and that its management of contingencies was satisfactory. Nevertheless, the activities programme was significantly delayed by maintenance operations on the emergency generators; proficiency in these operations must be improved. ASN considers it necessary to maintain these levels of performance in 2022, given the forthcoming second ten-yearly outage of the two reactors.

With regard to radiation protection, ASN considers that the radiological cleanliness of the premises is one of the Civaux NPP's strong points. In 2021, ASN conducted a tightened radiation protection inspection which concluded that the limitation of occupational exposure to ionising radiation was satisfactory, except in industrial radiography work. Nevertheless, deficiencies in the purification of the primary system during the reactor 2 shutdown had a significant impact on the collective dosimetry received by the workers.

With regard to environmental protection, ASN considers that the Civaux NPP's management of radioactive waste and radiological effluents in 2021 was satisfactory. The licensee has defined a lasting solution for preventing run-offs and unplanned dispersion of radioactive or hazardous liquid substances into the environment. Nevertheless, an ultimate containment pond must be built to guarantee on-site containment of accidental spillages of liquid effluents or fire extinguishing water in the event of a fire combined with heavy rainfall.

With regard to labour inspection, ASN considers that the results in occupational safety are improving and notes positively the setting up of work site protection reviews and a good standard of activity preparation. ASN has nevertheless observed recurrent deficiencies in the control of the asbestos-related risk, which resulted in accidental exposures in 2021. ASN notes several events relating to occupational safety linked to hand-held power tools and risk situations for workers relating to work at height and electrical work. ASN considers that the regulatory monitoring of the electrical installations of the industrial and tertiary buildings must be improved.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations:**
  - the Blayais NPP (4 reactors of 900 MWe),
  - the Civaux NPP (2 reactors of 1,450 MWe);
- **small-scale nuclear activities in the medical sector:**
  - 19 external-beam radiotherapy departments,
  - 6 brachytherapy departments,
  - 24 nuclear medicine departments,
  - 85 centres performing fluoroscopy-guided interventional practices,
  - 116 computed tomography scanners,
  - some 6,000 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - about 700 industrial and research centres, including 55 companies with an industrial radiography activity,
  - 1 cyclotron particle accelerator,
  - 55 laboratories located chiefly in the universities of the region,
  - about 500 veterinary surgeries or clinics practising diagnostic radiology;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 4 organisations approved for radiation protection controls,
  - 14 organisations approved for measuring radon,
  - 6 laboratories approved for taking environmental radioactivity measurements.

Occitanie Region

The Bordeaux and Marseille divisions jointly regulate nuclear safety, radiation protection and the transport of radioactive substances in the 13 *départements* of the Occitanie region.

In 2021, ASN carried out 125 inspections in the Occitanie region, comprising 52 inspections in BNIs, 62 in small-scale nuclear activities, 6 in the transport of radioactive substances and 5 concerning organisations and laboratories approved by ASN.

ASN also carried out 14 days of labour inspection at the Golfech NPP.

During 2021, four significant events rated level 1 on the INES scale were reported by the licensees of the nuclear installations in Occitanie. In small-scale nuclear activities, 4 significant radiation protection events rated level 1 on the INES scale were reported to ASN (3 in the industrial sector and 1 in the medical sector).

Golfech nuclear power plant

The Golfech NPP operated by EDF is located in the Tarn-et-Garonne *département*, 40 km west of Montauban. This NPP comprises two 1,300 MWe PWRs. Reactor 1 constitutes BNI 135 and reactor 2 BNI 142.

ASN considers that the performance of the Golfech NPP with regard to nuclear safety is below ASN's general assessment of EDF plant performance. ASN considers that site's performance in environmental protection and radiation protection is in line with this general assessment.

With regard to nuclear safety, ASN considers that deployment of the Safety rigour plan since 2019 demonstrates senior management's commitment to improving the site's nuclear safety performance. Nevertheless, the actions and efforts undertaken in this context have not yet produced visible results on the Golfech NPP indicators. The reactor 2 maintenance and refuelling outage in 2021 revealed shortcomings in operational management, already identified in preceding years: skills deficiencies and insufficient serenity and organisation in the control room. These shortcomings resulted in the reporting of numerous significant safety events, three of which were rated level 1 on the INES scale. ASN considers that in 2022 the licensee must improve the monitoring of control room activities by enhancing the operators' skills and defining the role of each player, particularly as regards supervision of the activities.

The NPP's maintenance performance must be improved, particularly in view of the numerous unexpected events induced by operations performed during the reactor 2 outage, which overran the initial schedule by four and a half months. The deviations in the maintenance operations performed on the valves and the emergency diesel generator sets in particular, revealed deficiencies in proficiency and command of the activities. Despite an improvement in the handling of deviations detected on the equipment in 2021, ASN considers that the licensee must step up its efforts in this area to reach the required standard.

With regard to occupational radiation protection, ASN considers that the efforts made by the site in 2021 have borne fruit, more specifically through an improvement in the workers' attitude with respect to radiation protection rules. ASN noted that the collective dosimetry objectives were met during the reactor 2 outage, despite its prolongation. Two tightened inspections conducted in 2021 concluded that the situation regarding the limitation of occupational exposure to ionising radiation was satisfactory.

In the area of environmental protection, ASN considers that the Golfech NPP obtained satisfactory results. The Golfech site must nevertheless progress in its strategy for preventing run-offs and unplanned dispersion of radioactive or hazardous liquid substances into the environment, particularly as concerns the sealing of the containment pond and of the valves shutting off liquid discharges into the natural environment.

With regard to labour inspection, ASN considers that coordination of the risks associated with the interface between different activities must be improved, as must the quality of activity preparation and risk analyses. ASN considers that the occupational safety results for the site are improving. Nevertheless, an accidental exposure to asbestos in 2021 shows that this risk must be more seriously taken into account, as must the risk situations relating to work at height. ASN also noted recurrent deficiencies in the regulatory monitoring of the electrical installations.

MARCOULE PLATFORM

The Marcoule nuclear platform is situated to the west of Orange, in the Gard *département*. Its six civil installations are dedicated to research activities relating to the downstream part of the "fuel cycle" and the irradiation of materials, and to industrial activities concerning in particular the fabrication of Mixed Oxide (MOX) fuels, the processing of radioactive waste and the irradiation of materials. The majority of the site moreover consists of Defence Basic Nuclear Installations (DBNIs), under the oversight of the Ministry of Defence.

CEA MARCOULE CENTRE

Created in 1955, the CEA Marcoule centre accommodates three civil installations: the Atalante laboratories (BNI 148), the Phénix NPP (BNI 71) and the Diadem storage facility (BNI 177).

Atalante facility – *CEA centre*

The main purpose of the Alpha facilities and laboratories for transuranium elements analysis and reprocessing studies (Atalante –BNI 148), created in the 1980's, is to conduct research and development in the recycling of nuclear fuels, the management of ultimate waste, and the exploration of new concepts for fourth generation nuclear systems. In order to expand the research activities, equipment and activities from the CEA Cadarache centre's Laboratory for research and fabrication of advanced nuclear fuels (Lefca) were transferred there in 2017.

On completion of the analysis of the facility's periodic safety review report submitted in December 2016, ASN made available for public consultation a draft resolution intended to regulate the continued operation of the BNI. The CEA's improvement action plan in this context notably includes reinforcement of control of the fire risk.

In June 2021, laboratory L6 –which had been closed since an event of 19 December 2018, rated level 1 on the INES scale, involving the shattering of a flacon containing a radioactive liquid during handling in a glove box– was reopened by the licensee after having performed the periodic inspections and tests that were suspended following the accident. The licensee was thus able to carry out the operations to neutralise the reagents and retrieve the waste contained in the glove box in question. ASN considers that the follow-ups to this event were managed satisfactorily.

In 2020, ASN had observed shortcomings in radiation protection, in the management of deviations and the operational management of accident situations, as well as in the emergency organisation and means. ASN considers that efforts were made during 2021 to comply with the regulations in these areas.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations:**
  - the Golfech NPP (2 reactors of 1,300 MWe),
  - the CEA Marcoule research centre, which includes the civil BNIs Atalante and Phénix, and the Diadem waste storage facility construction site,
  - the Melox plant producing MOX nuclear fuel,
  - the Centraco low-level radioactive waste processing facility,
  - the Gammatec industrial ioniser;
  - the facility for storing Écrin waste on the Malvési site;
- **small-scale nuclear activities in the medical sector:**
  - 14 external-beam radiotherapy departments,
  - 6 brachytherapy departments,
  - 21 nuclear medicine departments,
  - 99 centres performing fluoroscopy-guided interventional practices,
  - 126 computed tomography scanners,
  - some 5,000 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - about 800 industrial and research centres, including 4 cyclotron particle accelerators, 31 companies exercising an industrial radiography activity and 65 laboratories situated mainly in the universities of the region,
  - about 560 veterinary surgeries or clinics practising diagnostic radiology;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 4 laboratories approved for taking environmental radioactivity measurements,
  - 6 organisations approved for measuring radon,
  - 7 organisations approved for radiation protection controls.

ASN considers that the overall level of safety is satisfactory in the areas of deviation management, consideration of organisational and human factors and the meeting of commitments, which are followed up and have good traceability, with technical actions that are carried out and checked. ASN remains vigilant regarding occupational radiation protection and compliance with the regulations concerning the use of hazardous substances.

Assessment of the CEA Marcoule centre

ASN considers that the level of nuclear safety and radiation protection of the civil facilities of the CEA Marcoule centre is satisfactory on the whole.

In 2021, ASN inspected the management of on-site transport and the measures taken to deliver the modification authorisations to the nuclear installations of the centre. Control of the modification management procedures and the application of modifications within the BNI is satisfactory on the whole. ASN nevertheless remains attentive to the quality of the checks carried out prior to transport operations.

In 2021, ASN conducted an in-depth inspection to assess the CEA's ability to apply its new waste management and decommissioning strategy both nationally and locally. ASN more specifically checked the measures implemented by the licensee to conduct, in accordance with the commitments made, the priority operations of reducing the dispersible inventory in the facilities undergoing decommissioning.

With regard to environmental protection, the CEA submitted a study in 2020 relative to the sanitary and environmental assessment of the liquid and gaseous chemical discharges from the Marcoule platform. ASN has asked the licensee to supplement its study and propose a third-party expert to appraise this assessment. ASN will make sure that the action plan to bring the piezometers of the CEA Marcoule centre into compliance with the Order of 11 September 2003 by 2024 is implemented. In addition, the CEA continued the initiative to improve management of the Phénix stormwaters in 2021. It informed ASN that the work initiated further to the technical-economic study on this subject should be completed by the end of the first half of 2022.

Phénix reactor – *CEA centre*

The Phénix NPP (BNI 71) is a demonstration fast breeder reactor cooled with liquid sodium. This reactor, with an electrical power rating of 250 MWe, was definitively shut down in 2009 and is currently being decommissioned.

The major decommissioning phases are regulated by Decree 2016-739 of 2 June 2016. ASN resolution 2016-DC-0564 of 7 July 2016 sets the CEA various milestones and decommissioning operations.

Removal of the spent fuel and equipment continued in 2021 in accordance with the ASN requirements and the licensee's commitments made during the facility's periodic safety review and transition to the decommissioning phase. Uncertainties concerning the future and the processing of the spent fuel from Phénix (see chapter 11 of the full ASN Report) nevertheless remain.

ASN considers that the level of nuclear safety and radiation protection of the Phénix NPP is satisfactory on the whole, particularly regarding the meeting of commitments and the monitoring of outside contractors, and that deviations are well managed. Progress has been made in bringing the facility into compliance with certain articles of resolution 2013-DC-0360 of 16 July 2013 and with the resolution that specifically regulates the discharges from the Phénix NPP. The facility has also begun a campaign of detailed radiological mapping of some of its premises, in order to optimise its waste zoning and thus direct the waste produced to appropriate management routes.

Construction of the NOAH facility, which will treat the sodium from Phénix and other CEA installations, progressed in 2021 and the operating tests prior to commissioning are continuing. ASN has however been informed of contractual difficulties on one of the site work packages, which will push back commissioning of the NOAH facility.

The licensee is currently redefining the reference scenario for facility decommissioning, in line with the decommissioning strategy for all the CEA facilities. These changes in the reference scenario will lead to a request to modify the decree, which requires NPP decommissioning to follow a predetermined schedule. The next periodic safety review report is moreover expected at the end of 2022.

Diadem facility – *CEA centre*

The Diadem facility, currently under construction, shall be dedicated to the storage of containers of radioactive waste from decommissioning emitting beta and gamma radiation, or waste rich in alpha emitters, pending construction of facilities for the disposal of long-lived waste (LLW) or low and intermediate-level short-lived wastes (LL/ILW-SL) whose characteristics –especially the dose rate– means they cannot be accepted in their present state by the Aube repository (CSA).

ASN considers that there are numerous shortcomings in the organisational set-up for project control, for exercising the responsibility of nuclear licensee and for processing deviations. The CEA must thus take all necessary measures to guarantee compliance with the regulatory requirements in these areas. The procedures undertaken by the licensee to restore an acceptable situation, further to ASN's oversight action concerning the processing of deviations or its responsibilities as nuclear licensee, are satisfactory on the whole, even if a considerable amount of work still has to be accomplished.

ASN emphasises that this facility is destined to play a key role in the CEA's overall decommissioning and waste management strategy, and that it is the only facility planned for the interim storage of waste packages it is to receive.

The CEA filed a request to modify the Creation Authorisation Decree (DAC) in 2021 further to change in the package closure technology. It also filed its commissioning authorisation application file for the facility in 2021. The operations necessary for its commissioning, today planned for 2024, must be a priority for the CEA.

Melox plant

Created in 1990 and operated by *Orano Recyclage*, the Melox plant (BNI 151) produces MOX fuel which consists of a mix of uranium and plutonium oxides.

ASN considers that the level of nuclear safety and radiation protection is satisfactory on the whole, particularly in the areas of maintenance, control of the fire risk, management of internal authorisations and the management of waste and the cooling functions.

The effectiveness of the containment barriers is maintained at a satisfactory level. Breaks in containment, which can occur under normal operating conditions, are subject to specific monitoring and measures to limit them. As one of the identified causes of these ruptures is the perforation of gloves in glove boxes, the licensee has developed specific reinforced gloves.

In addition, for several years now the licensee has had difficulties in producing the planned quantities of fuel in accordance with the safety specifications of the nuclear reactors. These difficulties seem to originate from the characteristics of the uranium powders used. The licensee has therefore decided to qualify a new type of powder whose production requires the creation of a new facility situated on Orano's Malvési site (see chapter 11 of the full ASN Report). This situation results in the production of a large quantity of fabrication rejects which are sent to La Hague for interim storage, leading in the short term to the site's plutonium storage areas being filled to maximum capacity. If these difficulties continue, they could have major consequences for the fuel cycle as a whole. This issue was discussed with the ASN Commission at the hearings of 28 September 2021 and 10 February 2022.

This situation induces significant maintenance needs at Melox, which have consequences in terms of radiation protection, with a growing reliance on outside contractors and a very high collective dosimetry.

The solutions envisaged at present to improve this situation in the facility consist firstly in thoroughly cleaning the glove boxes to reduce the ambient dose levels, and secondly in deploying a major maintenance programme, with the aim of restoring the level of availability of the production tools. With this aim in view, research and development work has started on the processes for cleaning the facility equipment and on the materials to protect the workers. More particularly, the dosimetry at the lens of the eye remains high. Substantial research and development work has led to the gradual introduction of ergonomic radiation-proof glasses, adapted to the sight of the workers (including outside contractor employees), with the aim of complying with the new downwardly-revised regulatory limits. Furthermore, a vast Machinery Repair Programme (PPRM project) began in 2021.

Construction of the emergency centre has fallen behind schedule for reasons linked to the technical and contractual difficulties encountered. At the request of the licensee, ASN has modified the requirement of the resolution concerning the deadline for commissioning of the emergency centre accordingly, which is now set at 2023.

Centraco plant

The Centraco plant (BNI 160), was created in 1996 and is operated by Cyclife France, a 100% subsidiary of EDF. The purpose of the Centraco plant is to sort, decontaminate, reuse, treat and package –particularly by reducing their volume– waste and effluents with low and very low levels of radioactivity. The waste resulting from the plant's processes is then routed to Andra's CSA repository. The facility comprises:

- **a melting unit, melting a maximum of 3,500 tonnes of metallic waste per year;**
- **an incineration unit, in which the incinerable waste is burned, with a maximum of 3,000 tonnes of solid waste and 2,000 tonnes of liquid waste per year;**
- **and storage areas.**

ASN considers that the level of safety of the facility is satisfactory on the whole, particularly with regard to meeting commitments, deviation management, water take-ups and effluent discharges, and the monitoring of discharges and the environment. ASN does however note an increase in the number of significant events reported in 2021.

A new version of the On-Site Emergency Plan (PUI) was authorised by ASN in April 2021, to render it compliant with resolution 2017-DC-0592 of 13 June 2017 relative to the obligations of BNI licensees regarding emergency situation preparedness and management.

Furthermore, Cyclife France sent ASN modification requests for its facility in 2020 to allow the treatment of particular types of waste in Centraco, with specific sorting put in place for this waste. ASN considers that the technical and organisational provisions presented by the licensee for this prior sorting operation in dedicated units are satisfactory in principle, but double-checking of the conformity of the waste introduced into the incineration or melting furnaces must be maintained without fail. ASN thus modified the requirements of ASN resolution 2008-DC-0126 of 16 December 2008 through resolution CODEP-CLG-2022-003400 of 19 January 2022.

The monitoring and control of ageing of the facility, especially as concerns the fire-risk protection equipment, are one of the major challenges of the periodic safety review, the conclusions of which were submitted by the licensee in 2021. In 2021, the licensee more specifically implemented corrective measures to prevent the risk of jamming of the incineration furnace waste introduction chamber flaps further to a fire outbreak in this chamber in 2020.

Gammatec ioniser

The Gammatec ioniser (BNI 170) is an industrial irradiator operated by the company Stéris since 2013. Gammatec treats products by ionisation (emission of gamma radiation), with the aim of sterilising them or improving the performance of the materials. The installation consists of an industrial bunker and an experimental bunker. Both bunkers contain sealed sources of cobalt-60, which provide the radiation necessary for the facility's activity.

ASN considers that the level of safety of the instrumentation and control system and radiation protection are satisfactory on the whole in 2021.

The licensee must remain attentive to the formalisation of the periodic inspection and test results and the currency of the personnel authorisations to enter the experimental bunker.

Écrin facility

The Écrin facility (BNI 175) is situated in the municipality of Narbonne in the Aude *département*, within the Malvési site operated by Orano, which represents the first step of the "fuel cycle" (excluding extraction of the ores). The transformation process produces liquid effluents containing nitrated sludge loaded with natural uranium. The entire plant is subject to the system governing Seveso high-threshold Installations Classified for Protection of the Environment (ICPEs).

The Écrin BNI consist of two storage basins (B1 and B2) containing the legacy sludge from the plant. These two basins have BNI classification, due to the presence of traces of artificial radioisotopes. This BNI was authorised by Decree of 20 July 2015 for the storage of radioactive waste, for a period of 30 years.

The Ecrin facility was commissioned by ASN resolution 2018-DC-0645 of 12 October 2018. This authorisation enabled the licensee to start the work defined in the DAC, which it effectively began in February 2019.

The activities continued in 2021 with the installation of a bituminous cover over the entire BNI apart from PERLE ("Project for reversible storage of lagoons"), which is a cell dug in the Écrin BNI to the south of basin B2 and allowing the storage of materials emptied from basins B5 and B6. The activities on this cell are still in progress.

An unannounced inspection was held in May 2021. ASN has noted that the sludge transfer work is well organised and considers that the activities are carried out satisfactorily.

On 12 February 2021, in application of Article 7 of the Decree of 20 July 2015, the licensee submitted the progress report for the 2015-2020 studies and investigations conducted to assess the feasibility of the disposal options for the waste currently stored within Écrin.

ASN considers that the level of safety and environmental protection remains satisfactory in view of the risks the facility presents.

Pays de la Loire
Region

The Nantes division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 5 *départements* of the Pays de la Loire region.

In 2021, ASN carried out 36 inspections, comprising 2 inspections in the facilities of the company Ionisos (Pouzauges and Sablé-sur-Sarthe), 2 inspections of approved organisations, 2 in the transport of radioactive substances and 30 in small-scale nuclear activities (16 in the medical sector and 14 in the industrial, research and veterinary sectors).

One significant event in the industrial sector was rated level 1 on the INES scale in 2021.

Ionisos irradiator

The company Ionisos operates two industrial ionisation installations on the sites of Pouzauges (Vendée *département*) and Sablé-sur-Sarthe (Sarthe *département*). These installations constitute BNIs 146 and 154 respectively.

The gamma radiation emitted is used to sterilise, destroy pathogenic germs or reinforce (by cross-linking) the technical properties of certain polymers, by exposing the products to be ionised (single-use medical equipment, packaging, raw materials and finished productions for the pharmaceutical and cosmetic industries, packing films) for a pre-determined length of time.

Each installation comprises a pool for underwater storage of the radioactive sources, surmounted by a bunker in which the ionisation operations are performed, premises for storing the products before and after treatment, and offices and technical rooms.

ASN considers that the operation of the Pouzauges and Sablé-sur-Sarthe irradiators is generally satisfactory with regard to nuclear safety and radiation protection, with improvements in waste management and the integration of operating experience feedback. Improvements must nevertheless be made in the management of modifications, the management of emergency situations and operating rigour. Two modifications of the Pouzauges facility were authorised in 2021, concerning the extension of the facility and the installation of equipment and provisions for checking the integrity of radioactive sources.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations:**
  - the Ionisos irradiator in Pouzauges,
  - the Ionisos irradiator in Sablé-sur-Sarthe;
- **small-scale nuclear activities in the medical sector:**
  - 7 external-beam radiotherapy departments,
  - 2 brachytherapy units,
  - 11 nuclear medicine departments,
  - 40 centres performing fluoroscopy-guided interventional practices,
  - 55 computed tomography scanners,
  - some 2,500 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - 1 cyclotron,
  - 26 industrial radiography companies, including 10 performing gamma radiography,
  - 20 research units,
  - about 400 users of industrial equipment;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 9 organisations approved for measuring radon,
  - 1 head-office of a laboratory approved for environmental radioactivity measurements.

Provence-Alpes-Côte d'Azur Region

The Marseille division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 6 *départements* of the Provence-Alpes-Côte d'Azur region.

In 2021, ASN carried out 130 inspections in the Provence-Alpes-Côte d'Azur (PACA) region, comprising 61 inspections in BNIs, 59 in small-scale nuclear activities, 5 in the transport of radioactive substances and 5 concerning organisations and laboratories approved by ASN.

During 2021, 9 significant events rated level 1 on the INES scale were reported by the nuclear installation licensees.

In small-scale nuclear activities, 2 significant events in the industrial sector and rated level 1 on the INES scale were reported to ASN. In the medical sector, 2 significant events rated level 2+ and 3 respectively on the ASN-SFRO scale were reported to ASN.

In the exercise of their oversight duties, the ASN inspectors served notice on one BNI licensee to comply with Regulation (EC) 1005/2009 of the European Parliament and Council of 16 September 2009 on substances that deplete the ozone layer.

CADARACHE SITE

CEA Cadarache centre

Created in 1959, the CEA Cadarache centre is situated in the municipality of Saint-Paul-lez-Durance in the Bouches-du-Rhône *département* and covers a surface area of 1,600 hectares. This site focuses its activity primarily on nuclear energy and, as concerns its civil installations in operation, on research and development to support and optimise the existing reactors and the design of new-generation systems.

The following BNIs are located on the site:

- the Pégase-Cascad installation (BNI 22);
- the Cabri research reactor (BNI 24);
- the Rapsodie research reactor (BNI 25);
- the Solid Waste Treatment Station (STD –BNI 37-A);
- the Active Effluent Treatment Station (STE –BNI 37-B);
- the Plutonium Technology Facility (ATPu –BNI 32);
- the Masurca research reactor (BNI 39);
- the Éole research reactor (BNI 42);
- the enriched Uranium Processing Facilities (ATUe –BNI 52);
- the Central Fissile Material Warehouse (MCMF –BNI 53);
- the Chemical Purification Laboratory (LPC –BNI 54);
- the High-Activity Laboratory LECA-STAR (BNI 55);
- the solid radioactive waste storage area (BNI 56);
- the Phébus research reactor (BNI 92);
- the Minerve research reactor (BNI 95);
- the Laboratory for research and experimental fabrication of advanced nuclear fuels (Lefca –BNI 123);
- the Chicade laboratory (BNI 156);
- the Cedra storage facility (BNI 164);
- the Magenta storage warehouse (BNI 169);
- the Effluent advanced management and processing facility (Agate –BNI 171);
- the Jules Horowitz Reactor (JHR –BNI 172), under construction.

At the Cadarache centre, 10 installations are in final shutdown status, 10 are in operation and one is under construction. The CEA Cadarache centre operates numerous installations, which vary in their nature and their safety implications. ASN has moreover started or is continuing the examination of the periodic safety review guidance files or the conclusion reports for 15 of the 21 installations: Pégase-Cascad, Cabri, Rapsodie, STD, STE, ATPu, Éole, LPC, STAR, the Storage area, Phébus, Minerve, Chicade, Cedra and Magenta, and has given its conclusions on the periodic safety reviews of the ATUe facilities and the MCMF. When examining these reports, ASN is particularly attentive to the robustness of the proposed and deployed action plans. It ensures that the installations are in conformity with the applicable regulations and that the risks and adverse effects are effectively controlled.

Pégase-Cascad facility – *CEA centre*

The Pégase reactor (BNI 22) entered service on the Cadarache site in 1964 and was operated for about ten years. The CEA was authorised by a Decree of 17 April 1980 to reuse the Pégase facility for the storage of radioactive substances, in particular spent fuel elements stored in a pool.

The Cascad facility, authorised by a Decree of 4 September 1989 modifying the Pégase facility and operated since 1990, remains in service, dedicated to the dry storage of irradiated fuel in wells.

In November 2021, the CEA provided additional elements for the Pégase facility decommissioning file, which was submitted in 2019 and is currently being examined.

With the aim of meeting the new deadlines of resolution CODEP-CLG-2020-062379 of 21 December 2020 concerning the removal of the radioactive substances present in the Pégase pool, the CEA submitted two authorisation application files to ASN in June 2021 concerning the setting up of the DECAP project for removal from storage of the araldite-encapsulated fuels of Pégase, for transfer to the Cascad facility. These applications are currently being examined by ASN.

In the course of the document verifications relative to the removal of the fuels stored in the Pégase BNI for transfer to the Cadarache DBNI, the CEA discovered a deviation concerning the physical-chemical nature of a fuel assembly transported between the two facilities in 2016. This gave rise to a significant event report in 2021 rated level 1 on the INES scale by ASN, for noncompliance with the conditions of use of the transport packaging.

ASN considers that the transfers of fuel from the Cascad facility to La Hague continued in accordance with the objectives set by the CEA in its last letter applying for renewal of the storage authorisation.

ASN considers that the nuclear safety and radiation protection of the Pégase and Cascad facilities for 2021 is on the whole satisfactory. ASN notes the continued satisfactory performance of the actions resulting from the last periodic safety review, particularly concerning the reinforcement and redundancy work on the two discharge outlets and the fire protection work.

The inspections in 2021 have also revealed proficiency in the modification management procedures and proper application of ASN resolution 2017-DC-0592 of 30 November 2017 on the management of emergency situations within the BNI.

Cabri research reactor – *CEA centre*

The Cabri reactor (BNI 24), created on 27 May 1964, is intended for conducting experimental programmes aiming to achieve a better understanding of the behaviour of nuclear fuel in the event of a reactivity accident. The reactor has been equipped with a pressurised water loop since 2006, in order to study the behaviour of the fuel at high combustion rates in accident situations of increasing reactivity in a PWR. Since January 2018, the CEA has been conducting a programme of tests called "CIP" (Cabri International Program), which began in the early 2000's and necessitated substantial modification and safety upgrading work on the facility.

On 25 September 2020, the licensee reported a significant event concerning a leak detected and collected in the "core water" system containment, and a second event on 17 February 2021 relative to a leak concerning a hodoscope, which is one of the neutron measuring instruments. ASN examined the safety of the reactor taking into consideration the action plan and the compensatory measures proposed by the CEA to deal with these two leaks. Resuming of the tests will thus be subject to ASN authorisation.

In this context, ASN is also examining a request, submitted in 2019, to modify the facility's Creation Authorisation Decree (DAC) with the aim of performing irradiation tests on electronic equipment.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

- **Basic Nuclear Installations:**
  - the CEA Cadarache research centre which counts 21 civil BNIs, including the Jules Horowitz Reactor currently under construction,
  - the ITER installation construction site, adjacent to the CEA Cadarache centre,
  - the Gammaster industrial ioniser;
- **small-scale nuclear activities in the medical sector:**
  - 13 external-beam radiotherapy departments,
  - 3 brachytherapy departments,
  - 16 nuclear medicine departments,
  - 112 centres performing fluoroscopy-guided interventional practices,
  - 118 computed tomography scanners,
  - some 8,200 medical and dental radiology devices;
- **small-scale nuclear activities in the veterinary, industrial and research sectors:**
  - about 400 industrial and research centres, including 3 cyclotron particle accelerators and 21 companies with an industrial radiography activity,
  - about 460 veterinary surgeries or clinics practising diagnostic radiology;
- **activities associated with the transport of radioactive substances;**
- **ASN-approved laboratories and organisations:**
  - 2 laboratories approved for taking environmental radioactivity measurements,
  - 1 organisation approved for measuring radon,
  - 7 organisations approved for radiation protection controls.

ASN considers that emergency management and the management of internal authorisations are satisfactory on the whole. The level of safety of the reactor is relatively satisfactory, but the observed faults require appropriate action before it is restarted.

Rapsodie research reactor – *CEA centre*

The Rapsodie reactor (BNI 25) is the first sodium-cooled fast-neutron reactor built in France. It operated from 1967 to 1978. A sealing defect in the reactor pressure vessel led to its final shutdown in 1983. Decommissioning operations were subsequently undertaken, but have been partially stopped further to a fatal accident in 1994 during the washing of a sodium tank. At present, the core has been unloaded, the fuel evacuated from the installation, a large part of the fluids and radioactive components have been removed and the reactor vessel is contained. The reactor pool has been emptied, partially cleaned out and decommissioned, and the waste containing sodium has been removed.

The Decree governing the Rapsodie decommissioning operations was signed on 9 April 2021. This Decree sets a new perimeter for the facility and regulates, until 2030, the next phase of reactor life, consisting in the treatment of the sodium from the reactor and introducing air into the tank containing it. The subsequent decommissioning operations, such as decommissioning of the reactor block or of the civil engineering structures, shall be covered by a new decommissioning file.

ASN has attached two resolutions to this Decree. Resolution 2021-DC-0712 of 3 August 2021 requires the CEA to obtain ASN's consent to start the operations to neutralise the sodium in the tank. Resolution CODEP-CLG-2021-037079 of 3 August 2021 details the content of the application file to be submitted for these operations and sets requirements for limiting the safety impact of a fire.

Furthermore, on this occasion, ASN ruled on the conclusions of the facility's periodic safety review. It considered that, subject to compliance with these two resolutions, it had no objection to the continued decommissioning of the facility.

ASN considers that the level of nuclear safety and radiation protection of this facility in 2021 is on the whole satisfactory. The licensee must nevertheless remain attentive to the monitoring of outside contractors.

Solid waste treatment station – *CEA centre*

BNI 37 of CEA Cadarache historically comprised the active Effluents Treatment Station (STE) and the Waste Treatment Station (STD), grouped into a single installation. As the CEA wishes to ensure continued operation of the STD and proceed with the final shutdown of the STE, BNI 37 was divided into two BNIs: 37-A (STD) and 37-B (STE) by ASN resolutions CODEP-DRC-2015-027232 and CODEP-DRC-2015-027225 of 9 July 2015. These records were made further to the Orders of 9 June 2015 defining the perimeters of these two BNIs.

At present, the STD is the CEA's only civil BNI licensed for the packaging of intermediate-level, long-lived (ILW-LL) radioactive waste before it is stored in the Cedra facility (BNI 164) pending transfer to a deep geological repository. This situation makes the STD an indispensable part of the CEA's decommissioning and waste management strategy.

The continued operation of the STD necessitates renovation work –particularly on the civil engineering structures, which has been prescribed by ASN Chairman's resolution CODEP-CLG-2016-015866 of 18 April 2016. ASN authorised these works on 20 January 2022. In view of the lateness in starting the works, which necessitated a complex examination process, the CEA could not meet the prescribed completion deadline of 2021 and requested an extension.

After in-depth analysis of the technical and organisational provisions proposed by the licensee, ASN gave authorisation in October 2021 for retrieval of the package which fell into the ILW-LL waste storage pit in 2017. The CEA carried out the retrieval operations on 15 December 2021. This return to normal should make it possible to increase the waste packaging rates in the STD and allow removal of the waste before operation of the facility is stopped temporarily for works. The lessons the licensee learned from this event regarding HOFs and the reliability of suction systems for handling packages must be taken into account in the operation of the facility.

ASN considers that the level of safety and radiation protection is satisfactory on the whole. Process management and the monitoring of outside contractors involved in operation have improved. However, more rigorous documenting of internal authorisation processing is necessary, and the work deployment organisation must be better formalised.

On 12 March 2021, ASN gave the CEA its opinion on the periodic safety review guidance file submitted on 23 September 2020. ASN will be particularly attentive to any actions required further to the last safety review and not yet carried out when the conclusions of the new periodic safety review are submitted, which is scheduled for in 2022.

Active effluents treatment station – *CEA centre*

The STE (BNI 37-B) has been shut down since 1 January 2014. The CEA submitted the decommissioning file for this facility in December 2021.

As part of the decommissioning file preparation, the licensee started characterising the soils and the equipment, in order to determine the initial radiological condition of the facility. This characterisation work revealed the presence of artificial radionuclides outside the identified contaminated areas and in the stormwater network. These contaminations were reported to ASN as significant events and gave rise to a stormwater management action plan, the effectiveness of which is monitored by the CEA.

Furthermore, the monitoring of outside contractors must be improved, particularly in view of the identified shortcomings, revealed by the detection of containment deficiencies on certain external tanks which had been inadequately inspected by an outside contractor.

ASN considers that the level of nuclear safety of BNI 37-B in 2021 is on the whole satisfactory with regard to the follow-up of commitments and significant events. Improvements are required in the monitoring of outside contractors and the management of legacy pollutions.

Plutonium Technology Facility and Chemical Purification Laboratory

– CEA centre

The Plutonium Technology Facility (ATPu –BNI 32) produced plutonium-based fuel elements intended for fast neutron or experimental reactors as from 1967, then, from 1987 until 1997, for PWRs using MOX fuel. The activities of the Chemical Purification Laboratory (LPC –BNI 54) were associated with those of the ATPu: physical-chemical verifications and metallurgical examinations, treatment of effluents and contaminated waste. The two facilities were shut down in 2003 and are currently undergoing decommissioning.

With regard to the ATPu, the campaigns for processing the drums containing alpha emitting radionuclides from BNI 56

have been finalised, in accordance with the last schedule proposed by the CEA in November 2020. A quarterly progress report shall be sent to ASN until the last waste has been removed from this site, planned for late December 2022.

As for the LPC, the cryotreatment process removal operations continued in 2021.

ASN considers that the monitoring of the containment barriers, the application of ASN resolution 2017-DC-0592 of 30 November 2017 relative to emergency situation management, the methodological procedure put in place for performing the periodic safety reviews and the tracking of the associated action plans by the two facilities are satisfactory on the whole. ASN will remain attentive to bringing the discharge outlet sampling points into compliance.

Masurca research reactor – *CEA centre*

The Masurca reactor (BNI 39), whose construction was authorised by a Decree of 14 December 1966, was intended for neutron studies, chiefly on the cores of fast neutron reactors, and the development of neutron measurement techniques. The reactor has been shut down since 2007.

Final shutdown of the facility was declared by the CEA on 31 December 2018. The licensee submitted the facility decommissioning file in December 2020 and in the interim has carried out decommissioning preparation work, such as removal of asbestos from the premises, rehabilitation of buildings and removal of conventional equipment.

The licensee's organisation for managing deviations is satisfactory on the whole. The license must nevertheless make progress in the detection and analysis of low-level events.

ASN considers that the level of nuclear safety and radiation protection of the Masurca BNI in 2021 is satisfactory on the whole.

Éole and Minerve research reactors
– CEA centre

The experimental reactors Éole and Minerve are very-low-power (less than 1 kW) critical mock-ups that were used for neutron studies, in particular to evaluate the absorption of gamma rays or neutrons by materials.

The Éole reactor (BNI 42), whose construction was authorised by a Decree of 23 June 1965, was intended primarily for neutron studies of moderated arrays, in particular those of PWRs and boiling water reactors. The Minerve reactor (BNI 95), whose transfer from the Fontenay-aux-Roses studies centre to the Cadarache studies centre was authorised by a Decree of 21 September 1977, is situated in the same hall as the Éole reactor. Teaching and research activities were carried out on these mock-ups until their final shutdown on 31 December 2017.

The CEA submitted the update of its decommissioning file in July 2021, further to the complementary information requests made in 2019. Pending decommissioning, preparatory operations aiming to remove the fissile materials and better characterise the remaining radioactive equipment, in order to determine the necessary clean-out operations, continued in 2021.

ASN considers that the level of nuclear safety and radiation protection of the Éole and Minerve reactors is satisfactory on the whole.

The enriched Uranium Processing Facilities – *CEA centre*

From 1963 to 1995, the enriched Uranium Processing Facilities (ATUe –BNI 52) converted uranium hexafluoride (UF_6) from the enrichment plants into sinterable oxide, and ensured the chemical reprocessing of waste from the manufacture of fuel elements. Decommissioning of this facility was authorised by Decree in February 2006.

The first decommissioning phases, which consisted in removing the process equipment and the ventilation, effluent and electrical infrastructures, were completed in 2008. The only activities in the facility today are the maintenance and regulatory periodic inspection operations. The licensee has fallen substantially behind the initial schedule in the decommissioning operations, especially the civil engineering structure clean-out. It requested a modification of its Decree in 2010 and 2014, to take account of the true radiological condition of the facility. The new Decommissioning Decree was published on 16 April 2021. ASN has regulated the performance of certain decommissioning operations by two resolutions of 14 October 2021.

Alongside this, ASN made public its analysis of the periodic safety review of the facility on 7 September 2021. It has no objection to the continuation of the decommissioning operations.

ASN considers that the level of safety of BNI 52 (ATUe) in 2021 is satisfactory on the whole. The commitments made further to the preceding significant events and the periodic safety review are correctly implemented.

Central fissile material warehouse
– CEA centre

Created in 1968, the Central Fissile Material Warehouse (MCMF –BNI 53) was a warehouse for storing enriched uranium and plutonium, until its final shutdown and removal of all its nuclear materials on 31 December 2017. The licensee submitted its decommissioning file in November 2018, and ASN is currently examining it.

The decommissioning preparation operations initiated in 2018, notably the chemical and radiological characterisations of the facility, continued in 2021.

ASN considers that the chemical and radiological characterisation of the facility is well managed on the whole.

ASN made public its conclusions on the last periodic safety review of the facility in June 2021. It has no objection to the continuation of the decommissioning preparation operations.

LECA-STAR High Activity Laboratory
– CEA centre

BNI 55 accommodates the Active Fuel Examination Laboratory (LECA) and its extension, the Treatment, Clean-out and Reconditioning Station (STAR), which constitute the CEA's expert assessment facilities for the analysis of irradiated fuels. Commissioned in 1964, the LECA laboratory enables the CEA to carry out destructive and non-destructive examinations of spent fuel from the nuclear power, research and naval propulsion sectors. As the facility is old, it was partially reinforced in the early 2010's to improve its earthquake resistance.

To ensure the long-term continuity of the facility, the CEA has undertaken to reduce the dispersible inventory of the LECA laboratory. During the inspection carried out in 2021 on compliance with the requirements and commitments made following the periodic safety review of 2013, ASN noted the good organisation deployed by the licensee to meet the requirements set by ASN.

Commissioned in 1999, the STAR facility is an extension of the LECA laboratory, designed for the stabilisation and reconditioning of spent fuel.

The licensee reported two significant events in April and July 2021, one rated level 1 on the INES scale, linked to malfunctions of lifting and grasping devices in the STAR shielded cells. The action plan established after analysing the root causes of the events, particularly the OHFs, and conducting an expert assessment of the failure of the handling devices and the operating experience feedback from these systems, should prevent their recurrence.

Further to the inspections carried out in 2021, ASN will be attentive to ensuring that the CEA meets its commitments relating to the inspections and the processing of significant events.

ASN considers that the level of nuclear safety and radiation protection of the LECA-STAR facility in 2021 is generally satisfactory, particularly the licensee's organisation for controlling nuclear chain reactions, the fire-fighting means and the maintaining of static and dynamic containment.

Solid radioactive waste storage area
– CEA centre

BNI 56, declared in January 1968 for the disposal of waste, is used for storing legacy solid radioactive waste from the Cadarache centre. It comprises 3 pools, 6 pits, 5 trenches and hangars, which contain in particular ILW-LL waste from the operation or decommissioning of CEA facilities. BNI 56 is one of the priorities identified by the CEA in its new decommissioning and waste management strategy.

The facility decommissioning file, submitted in 2018, was supplemented in 2021.

In view of the conclusions of the examination of the facility's safety review, ASN has also set new technical requirements aiming to regulate its continued operation through resolution CODEP-CLG-2021-013405 of 15 March 2021.

The operations to retrieve the waste contained in the recent pits, to remove the waste that is stored in the hangars and to put in place the static containment of trench T2 continued. The waste retrieval and repackaging targets for the year 2021 were broadly achieved. ASN will however remain attentive to the schedule shift for performing certain decommissioning preparation operations.

ASN considers that the level of nuclear safety and radiation protection of the CEA Cadarache storage area in 2021 is broadly satisfactory, particularly with regard to pollution prevention, control of nuisance factors and waste management. Improvements have more specifically been observed in the facility's stormwater management, but these actions must be taken through to completion. The licensee must continue its studies to identify and open disposal routes for waste that does not have a disposal route at present.

Phébus research reactor *– CEA centre*

The Phébus reactor (BNI 92) is an experimental pool-type reactor with a power rating of 38 MWth which functioned from 1978 to 2007. Phébus was designed for the study of serious accidents affecting light water reactors and for defining operating procedures to prevent core melt-down or to mitigate its consequences.

The licensee submitted its decommissioning file to the Minister in February 2018 and its periodic safety review report to ASN in October 2017. The Environmental Authority issued its opinion on the decommissioning file in July 2021 and the CEA submitted its memorandum in response in November 2021.

One of the priorities of the decommissioning preparation operations was the removal of the irradiated fuel from the reactor, and this was completed in January 2019. The decommissioning preparation operations continued in 2021, in particular with the removal of used radioactive sources and the characterisation of certain equipment items. The last non-irradiated fuels were removed in December 2021.

ASN considers that the CEA's organisation for performing the periodic inspections and tests and for occupational radiation protection is satisfactory on the whole.

Laboratory for research and experimental fabrication of advanced nuclear fuels
– CEA centre

Commissioned in 1983, the Laboratory for Research and Experimental Fabrication of Advanced Nuclear Fuels (Lefca –BNI 123) was a laboratory tasked with conducting studies on plutonium, uranium, actinides and their compounds with the aim of understanding the behaviour of these materials in the reactor and in the various stages of the "fuel cycle". In 2018, Lefca finalised the transfer of part of its research and development equipment to the Atalante laboratories (BNI 148), at Marcoule.

The CEA submitted the final shutdown declaration for the facility in April 2019. However, in December 2021, the CEA informed ASN of its decision to keep the Lefca facility in

operation and conduct new activities in it. An action plan with a schedule for this industrial and strategic change of direction was submitted to ASN on 28 January 2022. The forthcoming periodic safety review must integrate this change of strategy.

ASN considers that the level of nuclear safety and radiation protection of the facility in 2021 is broadly satisfactory, particularly as regards meeting commitments and external hazards. ASN has nevertheless found a need for improvements in the conformity and integrity of the piezometers of the water table verification system.

Chicade laboratory – *CEA centre*

Since 1993, the Chicade facility (BNI 156) has been conducting research and development work on low and intermediate-level objects and waste, chiefly involving:

- **the destructive and non-destructive characterisation of radioactive objects, waste sample packages and irradiating objects;**
- **the development and qualification of nuclear measurement systems;**
- **the development and implementation of chemical and radiochemical analysis methods;**
- **the expert assessment and inspection of waste packages packaged by the waste producers.**

On the basis of the inspections carried out in 2021, ASN considers that the facility broadly meets its commitments, ensures good traceability of its modifications, and that the action plan following the conclusions of the safety review is progressing. Improvements are required in the collection of radioactive waste and the management of the radioactive samples produced by the facility.

With regard to environmental protection, the CEA has undertaken to submit, by the end of 2022, a request to modify the facility's DAC, to take into account gaseous discharges of tritium, not provided for in its current baseline requirements.

Cedra storage facility – *CEA centre*

Since 2006, the Cedra facility (BNI 164) is used to store ILW-LL waste pending the creation of appropriate disposal routes. The CEA forecasts that this facility will be filled to capacity by 2027. The studies concerning a project to double the storage capacity began in 2020.

ASN considers that the main steps of this project need to be better defined and that CEA must look ahead to all the procedures in order to have the necessary storage capacities for overall management of its waste.

The CEA put the package examination unit into operation in 2021. This allows the inspection of packages and the overpacking of any damaged or contaminated packages.

ASN considers that the licensee's verifications for package acceptance in the Cedra facility, the management of modifications and the meeting of its commitments are satisfactory on the whole.

The year 2021 was marked by the reporting of significant events of level 1 concerning:

- exceeding of the authorised mass of fissile material in a package stored in the BNI, further to an error in the composition of a waste package in the producing facility;
- the fall of a waste package, an event that has already occurred several times on the Cadarache site, in BNI 37-A and BNI 56.

ASN considers that the licensee must draw all the necessary conclusions from these events, particularly regarding integration of the feedback from preceding events, the monitoring of waste producers and management of the interfaces between the various people likely to use the transport packages.

One significant event concerning damage to the metallic casing of a package was also reported by the facility. ASN has asked the CEA to conduct the necessary expert assessments to determine the cause and mechanism of the damage to this package.

Magenta storage warehouse – *CEA centre*

The Magenta facility (BNI 169), which replaces the MCMF currently being decommissioned, has been dedicated since 2011 to the storage of non-irradiated fissile material and the non-destructive characterisation of the nuclear materials received.

The licensee submitted its safety review conclusion report in February 2021. ASN has started the examination of this file and will focus in particular on the impact that pushing back glove box commissioning has on the maintenance operations of certain primary material containers.

One significant event rated level 1 on the INES scale was reported to ASN on 5 February 2021. This event concerned the unauthorised storage of material in the form of a uranium/aluminium alloy in one of the facility's storage blocks. The licensee is currently deploying corrective measures to prevent the causes of such events. In the interim, the storage block in question has been padlocked.

ASN considers that the operational management of the facility in 2021 is generally satisfactory.

Effluent advanced management and processing facility – *CEA centre*

The Effluent Advanced Management and Processing Facility (Agate –BNI 171), commissioned in 2014 to replace BNI 37-B which is now shut down, uses an evaporation process to concentrate radioactive liquid effluents containing mainly beta- and gamma-emitting radionuclides.

ASN considers that the licensee's verifications for the acceptance of effluents in the facility and the meeting of the commitments it has taken are on the whole satisfactory in the Agate facility. The evaporator has been out of service since December 2020 following a failure on the superheated

water system. The evaporator's return to service is planned for the first quarter of 2022. The facility's activity in 2021 consisted chiefly in collecting the producers' effluents in buffer tanks upstream of the facility and repairing the failure of the superheated water system. ASN will be attentive to the conditions of resuming the operations and the filling status of the effluent storage capacities prior to their processing.

ASN underlines that this facility plays a central role in the management of the CEA effluents and as such constitutes a sensitive facility in the CEA's decommissioning and material and waste management strategy.

Jules Horowitz Reactor project – *CEA centre*

The Jules Horowitz Reactor (JHR –BNI 172), under construction since 2009, is a pressurised-water research reactor designed to study the behaviour of materials under irradiation and of power reactor fuels. It will also allow the production of artificial radionuclides for nuclear medicine. Its power is limited to 100 MWth.

The construction activities continued in 2021 on the work site and on the suppliers' sites, with the supply of handling equipment, hot cell equipment and the manufacture of pool equipment. The lining of the pools and channels of the nuclear auxiliaries building is well advanced. The hot cell windows have been installed and their leak-tightness has been tested.

The JHR project reorganisation, initiated in 2020, is now effective and raises no particular remarks from ASN.

The excessive vibrations encountered in 2020 during the qualification tests of certain equipment items inside the reactor pile block are still being studied and analysed by the CEA, in order to determine appropriate technical solutions to limit the equipment wear rates.

Signs of corrosion were detected in 2021 on one of the reactor pool welds. Analyses were carried out to identify the potential causes of this deviation and determine the appropriate corrective action. The progress of these actions was verified in the course of several inspections and additional data are to be received in 2022. ASN has asked to be kept regularly informed by the CEA on this subject.

ASN considers that the organisation in place for construction of the JHR is satisfactory and that technical problems are followed up rigorously, with a commitment to transparency.

Assessment of the CEA Cadarache centre

ASN considers that the level of nuclear safety of the CEA Cadarache centre in 2021 is on the whole satisfactory.

ASN considers that the BNIs are operated satisfactorily on the whole, especially the control of the condition of the equipment, the meeting of commitments and modifications management. Improvements are nevertheless required in the sharing of operating experience feedback, notably concerning the risk of heavy objects falling during handling operations.

The monitoring of outside contractors, whose contracts are followed up by the centre's technical service, hasimproved, with a more clearly defined division of responsibilities between the centre's services and the BNIs, and more rigorous formalising of the monitoring plans. The CEA must periodically assess the appropriateness andeffectiveness of its monitoring of outside contractors.

With regard to the containment of radioactive substances, the monitoring of the first containment barrier is well ensured on the whole. Monitoring of the other barriers highlighted in the safety cases of the BNIs (walls of premises, ventilation and filtration systems) must be stepped up, in order to ensure their good performance.

The commitments made by the facilities and the centre, further to the inspections and significant events, are broadly met.

ASN notes progress in deviation management for the centre as a whole. Improvements are however required in certain services in the analysis of the causes or trends relating to recurrent deviations of similar types.

ASN considers that the organisation put in place to conduct the reassessment and conformity check of the facility periodic safety reviews is satisfactory, but, where action plans are implemented, that the scheduling of the actions and their traceability must be further improved.

With regard to emergency situation management, ASN considers that the overall organisation of the centre has improved, particularly in view of the conclusions of the inspection of 10 October 2018. A large amount of work nevertheless remains to be done in the facilities to define the functions of the emergency situation responders. Greater rigour is required in the activation of the On-site Emergency Plan (PUI) and the alerting of the public authorities. ASN underlines that the compensatory measures proposed by the CEA pending the availability of an emergency centre that is robust to extreme hazards will have to be kept operational. Complementary elements concerning the qualification of some of these measures are still to be received.

ASN considers that the radiation protection situation of the CEA Cadarache centre is satisfactory. It notes positively the putting in place of internal self-checks, which allow thesharing of best practices and have also enabled the vulnerability of the operational radiation protection documents to falsification to be analysed.

ASN observes that the standard of environmental protection has progressed. Improvements are nevertheless still required in the monitoring of the industrial effluents network, in rendering compliant the centre's piezometer base, in the storage of hazardous products and the management of the centre's stormwater, particularly regarding network maintenance and discharge monitoring.

ITER

The ITER installation (BNI 174), under construction on the Cadarache site since 2010 and adjacent to the CEA facilities, will be a fusion experimental reactor used for the scientific and technical demonstration of the control of thermonuclear fusion energy, obtained by magnetic confinement of a deuterium-tritium plasma during long-duration experiments with a significant power level (500 MW developed for 400 seconds). This international project enjoys financial support from China, South Korea, the United States, India, Japan, Russia and the European Union, who make in-kind contributions by providing equipment for the project.

The large quantities of tritium that will be brought into play in this installation, the intense neutron flow and the resulting activation of materials have serious implications regarding radiation protection and will represent true challenges for the safe management of waste during the operation and decommissioning of the installation.

The works on the site and the manufacture of equipment are continuing, having pushed back the previously announced objective of deploying the first hydrogen plasma by 2025. The revised schedule, integrating the assessment of the impact of the Covid-19 pandemic, has not yet been received and should be formalised in the course of 2022.

The year 2021 was marked in particular by the preparation of the first sector of the vacuum chamber, with the installation of its equipment and thermal protections in the assembly hall, so that it can be subsequently transferred to the well of the Tokamak building. A second sector has arrived on site and must also be equipped.

ITER organisation requested approval to start the vacuum chamber assembly phase in March 2020, in accordance with the requirement of the amended ASN resolution of 12 November 2013. On completion of the technical examination, ASN found that the state of progress of the vacuum chamber design and the associated equipment did not yet enable this assembly phase to be started.

ASN draws up a relatively satisfactory overall assessment of the construction site, but underlines the potential impact of the nonconformities concerning the vaccum chamber sector welds and weld inspections. These nonconformities had not been reported to ASN, which moreover noted difficulties during one inspection in obtaining all the requested documents.

The complexity of this project and the regular developments of the facility make it necessary to ensure great rigour and transparency in the development of the technical configuration and the demonstration of effective compliance with the planned criteria for protection of people and the environment.

Gammaster ioniser

Since 2008, the company Steris has been operating an industrial irradiator called "Gammaster", situated on the land of the municipality of Marseille. Gammaster treats products by ionisation (emission of gamma radiation) with the aim of sanitising, sterilising or improving the performance of materials. The facility is made up of an industrial bunker and houses sealed sources of cobalt-60, which provide the radiation necessary for its activity.

The licensee was served formal notice through resolution CODEP-MRS-2021-020797 of 5 May 2021 to comply with Regulation (EC) 1005/2009 of the European Parliament and Council of 16 September 2009 relative to substances that deplete the ozone layer. The licensee possessed and was using a fire extinguishing gas whose use has been prohibited since 2020. The licensee has brought the facility into conformity and the compliance notice was lifted following an ASN inspection carried out on 5 July 2021.

ASN considers that the organisation of Steris for radiation protection and meeting its commitments is relatively satisfactory. The management of radioactive sources must be improved and the licensee must remain attentive to the waste management operations and to deviations.

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15 rue Louis Lejeune – 92120 Montrouge – France
Public Information Centre
Tel: 33 (0)1 46 16 41 46 – E-mail: info@asn.fr

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