AUTORITÉ
DE SÛRETÉ
NUCLÉAIRE

ABSTRACTS

ASN REPORT

on the state of nuclear safety and radiation protection in France in 2023

The French Nuclear Safety Authority presents its Report on the state of nuclear safety and radiation protection in France in 2023.

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

2023

ROLES
OPERATIONS
KEY FIGURES
ASN ORGANISATION CHART

Created by the 13 June 2006 Nuclear Transparency and Security Act, ASN 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.

Roles

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 license applications for nuclear facilities. It grants 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 Act of 17 August 2015 on energy transition for green growth, known as the "TECV Act", ASN's roles now include protecting ionising radioactive sources against malicious acts. Inspection is ASN's primary monitoring activity. In 2023, 1,790 inspections were thus performed by ASN 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 set up around the nuclear installations. 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 installations.

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;
- 36 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, 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 seven Advisory Committees of Experts (GPEs), from a variety of scientific and technical backgrounds.

Operations

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	Stéphanie GUÉNOT BRESSON (*) Commissioner	Géraldine PINA (*) Commissioner	Olivier DUBOIS (*) Commissioner	Jean-Luc LACHAUME (*) Commissioner
from 13 November 2018 to 12 November 2024	from 10 December 2023 to 9 December 2029	from 15 December 2020 to 9 December 2026	from 29 January 2024 to 9 December 2029	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.*

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 terminate the duties of any member of the Commission in the event of a 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, so as to cover the entire country and the overseas territories. The regional divisions conduct most of the oversight in the field on the 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 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.*

ASN in 2023

PERSONNEL

521 staff members

48% women

86% management

307 inspectors

ASN ACTIONS

1,790 inspections

398
IRSN deliverables submitted to ASN, including 183 expert assessment opinions

26
plenary sessions of the Advisory Committees of Experts

1,940
individual licensing and registration resolutions issued

30,022
inspection follow-up letters available on *asn.fr* as at 31 December 2023

BUDGET

€71.62 M
budget for ASN (programme 181)

€85.1 M
IRSN budget devoted to expert assessment work on behalf of ASN

INFORMING

656 replies to queries from the public and the stakeholders

84
information notices

11
press conferences

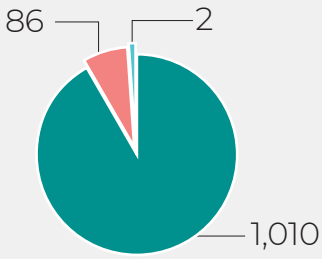
NUMBER OF SIGNIFICANT EVENTS IN 2023

RATED ON THE INES SCALE (*)

BASIC NUCLEAR INSTALLATIONS

1,098

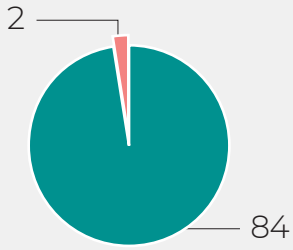
events



TRANSPORT OF RADIOACTIVE SUBSTANCES

86

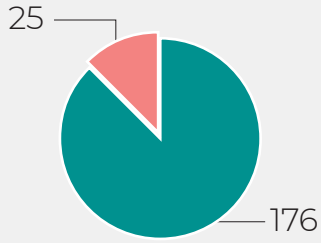
events



SMALL-SCALE NUCLEAR ACTIVITIES (medical and industry)

201

events



Level 0 Level 1 Level 2

** The INES scale (International Nuclear and Radiological Event Scale) was developed by the International Atomic Energy Agency (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.*

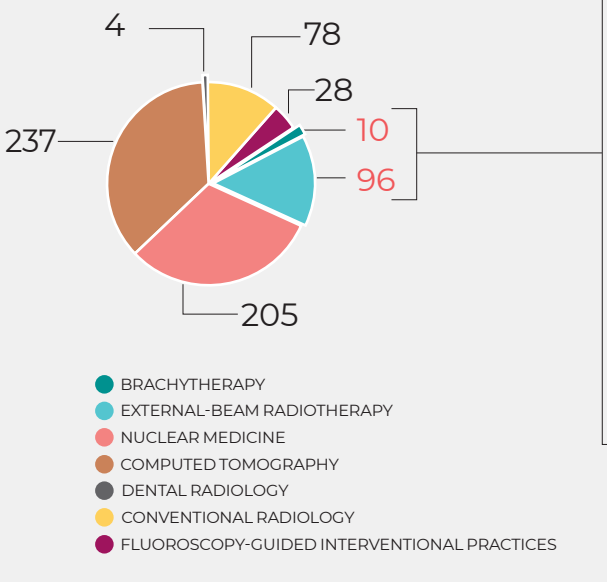
As it was pertinent to be able to inform the public of radiotherapy events, ASN – in close collaboration with the French Society for Radiotherapy and Oncology – developed a scale specific to radiotherapy events (ASN-SFRO scale).

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

IN THE MEDICAL FIELD

658

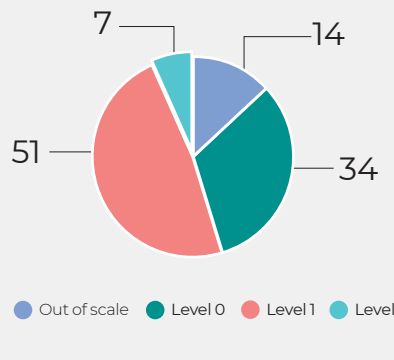
significant events per area of exposure



106

significant events in external beam radiotherapy and brachytherapy

according to the rating on the ASN-SFRO scale



Organisation Chart(*)

COMMISSION

CHAIRMAN
Bernard DOROSZCZUK

COMMISSIONERS
Olivier DUBOIS
Stéphanie GUÉNOT BRESSON
Jean-Luc LACHAUME
Géraldine PINA

HEAD OF PRIVATE OFFICE
Sylvie RODDE

ADMINISTRATIVE ENFORCEMENT COMMITTEE
CHAIRMAN
Maurice MÉDA

GENERAL DIRECTORATE

DIRECTOR GENERAL
Olivier GUPTA

DEPUTY DIRECTORS GENERAL
Pierre BOIS
Julien COLLET
Daniel DELALANDE

CHIEF INSPECTOR
Christophe QUINTIN

TECHNICAL ADVISER
Sylvie CADET-MERCIER

DIRECTOR OF PRIVATE OFFICE
Vincent CLOÎTRE

ETHICS OFFICER
Alain DORISON

INNOVATIVE REACTORS MISSION
Philippe DUPUY

MANAGEMENT AND EXPERTISE OFFICE
Adeline CLOS

REGULATION AND OVERSIGHT SUPPORT MISSION
Julien HUSSE

GENERAL SECRETARIAT
Jean-Patrick GOUDALLE

DEPARTMENTS

NUCLEAR POWER PLANTS
Rémy CATTEAU

NUCLEAR PRESSURE EQUIPMENT
Flavien SIMON

WASTE, RESEARCH FACILITIES AND FUEL CYCLE
Cédric MESSIER

TRANSPORT AND SOURCES
Fabien FÉRON

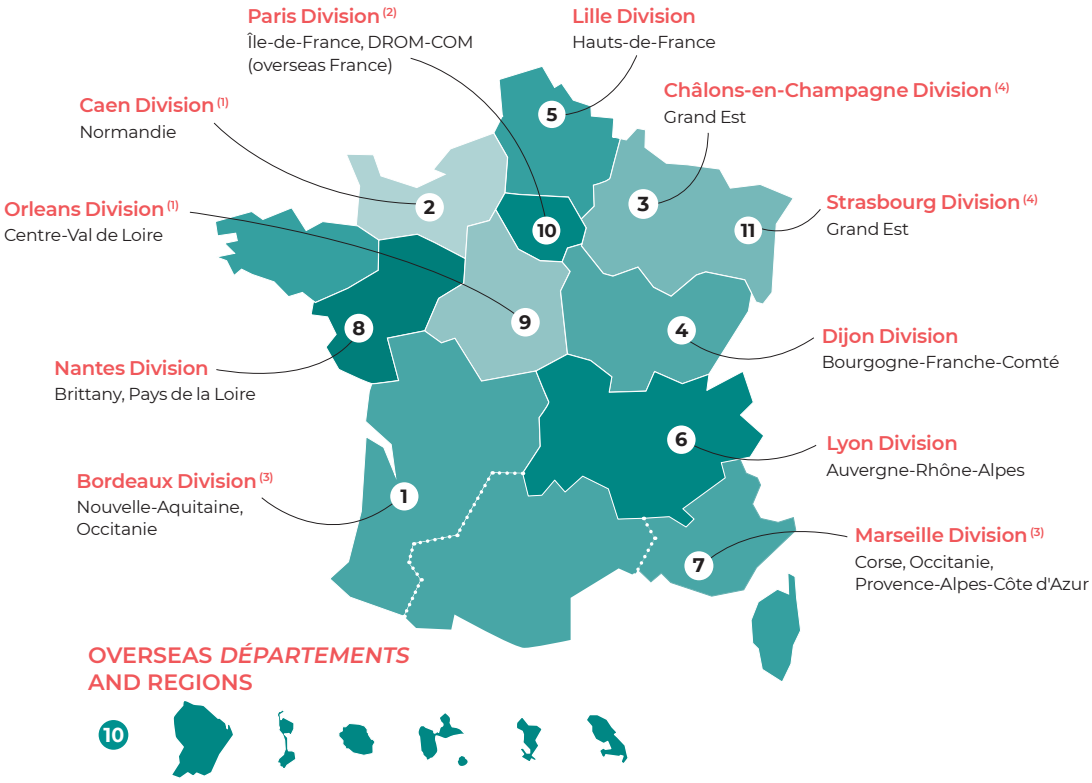
IONISING RADIATION AND HEALTH
Carole ROUSSE

ENVIRONMENT AND EMERGENCY SITUATIONS
Olivier RIVIÈRE

INTERNATIONAL RELATIONS
Luc CHANIAL

LEGAL AFFAIRS
Andy CONTESSO

INFORMATION, COMMUNICATION AND DIGITAL USAGES
Clémence PICART



(1) For BNI 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
Vincent JECHOUX
REGIONAL HEAD
Paul de GUIBERT

2 CAEN
REGIONAL REPRESENTATIVE
Olivier MORZELLE
REGIONAL HEAD
Gaëtan LAFFORGUE

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

4 DIJON
REGIONAL REPRESENTATIVE
Olivier DAVID
REGIONAL HEAD
Marc CHAMPION

5 LILLE
REGIONAL REPRESENTATIVE
Julien LABIT
REGIONAL HEAD
Rémy ZMYSLONY

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

7 MARSEILLE
REGIONAL REPRESENTATIVE
Sébastien FOREST
REGIONAL HEAD
Mathieu RASSON

8 NANTES
REGIONAL REPRESENTATIVE
Anne BEAUVAL
REGIONAL HEAD
Émilie JAMBU

9 ORLÉANS
REGIONAL REPRESENTATIVE
Hervé BRÛLÉ
REGIONAL HEAD
Albane FONTAINE

10 PARIS
REGIONAL REPRESENTATIVE
Emmanuelle GAY
REGIONAL HEAD
Agathe BALTZER

11 STRASBOURG
REGIONAL REPRESENTATIVE
Hervé VANLAER
REGIONAL HEAD
Camille PERIER

*As at 1 March 2024.

Competence
Independence
Rigour
Transparency

asn.fr

info@asn.fr

You can also follow ASN on social media

CONTENTS

ADVICE TO THE READER

FIND THE FULL ASN REPORT on the state of nuclear safety and radiation protection in France in 2023 on ***asn.fr***.

Only regulatory news for the year 2023 is present in this Report.
All the regulations can be consulted on ***asn.fr***, under the heading *"L'ASN réglemente"*.

ABSTRACTS – ASN REPORT
ON THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN FRANCE IN 2023

EDITORIAL BY
THE COMMISSION

2023, a key year marked by new nuclear ambitions

Montrouge, 1 March 2024

The safety level of the nuclear facilities was satisfactory in 2023, with less pressure on the "fuel cycle" facilities than in 2022 and with implementation by EDF of a strategy that ASN considered to be appropriate for dealing with and remedying the stress corrosion phenomenon that had appeared on some of its reactors. Radiation protection performance remained at a good level despite an increase in the number of level 2 significant events in the medical sector. This mixed picture recalls the importance of conducting radiotherapy risk assessments.

At a time of new nuclear ambitions, ASN underlines three topics that deserve particular attention:

1. The more ambitious aims by the licensees, for the continued operation of the existing nuclear facilities, requires that the measures to be implemented without delay in order to safely achieve these new objectives be identified. They also require that forward planning for the long-term issues regarding the reactors must be continued and reinforced with a view to operation beyond 60 years, in coordination with the new "fuel cycle" facilities being envisaged, while clarifying future reprocessing solutions.

2. The enthusiasm for the Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs) which have potentially promising intrinsic safety characteristics, should not eclipse the technical and societal issues that they raise. These issues are notably linked to the preliminary work to be done to demonstrate their dependability, to all the safety/security and non-proliferation issues to be considered upstream, and to the acceptability of the siting of these reactors outside dedicated nuclear sites.

3. The numerous new nuclear projects require an exceptional effort in terms of expertise, project management and industrial rigour, which concerns the entire sector. Despite the progress made in technical expertise and management of activities, the checks carried out by ASN along the procurement chain for the equipment intended for nuclear facilities still highlight a recurring lack of industrial rigour. Over and above these shortfalls, against the backdrop of a significant increase in workload, preventing falsification and counterfeiting at all levels along the subcontracting chain must remain a major point of focus across the sector.

From left to right:

Stéphanie GUÉNOT BRESSON, Commissioner
Olivier DUBOIS, Commissioner
Géraldine PINA, Commissioner
Bernard DOROSZCZUK, Chairman
Jean-Luc LACHAUME, Commissioner

ANTICIPATING TECHNICAL QUESTIONS RAISED BY THE OPERATING LIFE OF THE REACTORS REMAINS A PRIORITY

The law requires that every ten years, following the periodic safety review, ASN issue a position statement regarding the conditions for the continued operation of the nuclear facilities. Concerning the reactors, the fourth periodic safety review for each individual reactor is underway for the 900 Megawatts electric (MWe) reactors, and the generic review phase for the 1,300 MWe reactors has been started.

As the fifth periodic safety review is too far into the future for any fundamental operating lifetime hypotheses to be incorporated into the energy policy for the 2040 time-frame and beyond, ASN asked EDF to conduct preliminary analyses of the ability of the reactors to continue to function beyond 50 years. At the Government's request, ASN issued an opinion on June 2023 on the conclusions of EDF's analysis, underlining the major technical subjects associated with an operating life of up to 60 years, along with the subjects to be addressed as priorities.

Finally, going beyond this time-frame and on the basis of the work initiated by EDF, the main technical subjects requiring particular analysis, or even research and development, ahead of the periodic safety reviews, were identified in 2023, enabling continued reactor operations beyond 60 years to be envisaged. In 2026, ASN will issue a position statement on the conclusions of these EDF analyses which are expected at the end of 2024.

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SATISFACTORY DEPLOYMENT OF THE STRESS CORROSION TREATMENT STRATEGY

Following the discovery of stress corrosion cracking on the safety injection system of the main primary systems of some reactors at the end of 2021, EDF proposed a strategy involving the systematic replacement in 2023 of the lines considered to be susceptible to the phenomenon on those reactors liable to be the most severely affected, with inspection of all reactors by 2025.

In 2023, EDF implemented the proposed replacement strategy. The inspections carried out revealed the fact that certain weld repair processes during manufacturing were a factor liable to influence the appearance of stress corrosion, even on lines considered not to be susceptible to the problem. This enabled EDF to revise its inspection strategy, giving priority to the welds which had been repaired during manufacturing. EDF also decided to extend its spot-check inspection programme to all stainless steel lines connected to the primary system.

ASN considered this strategy to be appropriate, while pointing out that it might need to be revised in the light of the lessons learned from the ongoing programme of investigations. ASN also asked EDF to already take account of these lessons in the design of new reactors.

ASN is working in close collaboration with its foreign counterparts on this subject. Following the presentation of the findings made in France on the EDF fleet, the Western European Nuclear Regulators' Association (WENRA) issued recommendations concerning monitoring of the stress corrosion phenomenon for the reactors in operation, along with prevention of this phenomenon at the design stage.

PRESSURE ON THE "FUEL CYCLE" FACILITIES IS EASING BUT THIS SHOULD NOT MASK THE NEED TO PREPARE FOR THE FUTURE

The pressure identified in recent years in the "fuel cycle" eased in 2023, in particular due to improved Melox plant production.

These improvements and the prospect of a new Multi-year Energy Programme (PPE) could lead to the saturation time-frame for the Orano pools at La Hague being reconsidered. ASN nonetheless considers that new safe storage capacity will eventually be needed, in compliance with current standards, to ensure margins to deal with any contingencies affecting the facilities.

Generally speaking, ASN considers that the entire chain of back-end fuel management facilities and units must urgently be made more resilient so that the 2040 target set in the current PPE can be reached in safe conditions. This entails measures to be implemented without delay in order to meet this target, such as consolidation of MOX fuel production, developing interoperability between the reprocessing lines, the performance of considerable renovation and safety improvement works identified during the periodic safety reviews. The work undertaken on densification of the existing pools at the La Hague plant, along with dry storage, as means of dealing with the saturation risk, shall be continued.

ASN FINALISES THE TECHNICAL EXAMINATION PROCESS AND CHECKS THE LICENSEE'S PREPAREDNESS FOR EPR COMMISSIONING

The year 2023 was devoted to finalising the examination of technical subjects still open (design of primary system safety valves and performance of the internal water tank filtration system in particular), incorporating the latest modifications, and the performance of hot tests to ensure the overall qualification of the installation.

In May 2023, ASN carried out an in-depth inspection involving a large number of inspectors and experts, to check the licensee's preparedness for commissioning of the installation. ASN noted that the overall level of preparedness was good but it did underline that significant work was still required to ensure that the operational documentation was available and had been assimilated by the operating and maintenance personnel.

In 2023, ASN continued with its technical examination of certain topics, notably those linked to Operating Experience Feedback (OEF) from EPR reactors abroad, as well as the conformity assessments of the nuclear pressure equipment.

THE EPR 2 PROGRAMME MUST TAKE ADVANTAGE OF LESSONS LEARNED FROM THE EPR

In August 2023, EDF submitted the creation authorisation application for two EPR 2 reactors in Penly, for which the safety options had been the subject of an ASN opinion in 2019. The Penly reactors are the first ones in the EPR 2 programme, the aim of which is to incorporate the lessons learned from the design, construction and operation of the EPR reactors in France and abroad, along with feedback from operation of the existing reactors.

The lessons learned by ASN and the French Institute for Radiation Protection and Nuclear Safety (IRSN) on the Flamanville EPR project led to reinforced oversight being adopted for the examination of the creation authorisation application. ASN and the IRSN defined their examination strategy, identifying the schedule,

the milestones and the deliverables required of EDF. ASN underlined the points requiring particular attention in the light of the operating lifetime envisaged for these new reactors, such as taking into account the effects of climate change between now and the end of the century.

ASN STRESSES THE ISSUES RELATED TO THE SMR AND AMR PROJECTS AND TAKES INITIATIVES TO ANTICIPATE THE EXAMINATION PROCESS

In the context of decarbonised industrial production targets, there is considerable enthusiasm for SMRs and AMRs and many start-ups are developing such projects. This will lead to the arrival of new players, new reactor technologies and new uses for nuclear power (production of steam, heat, or hydrogen) which will entail siting of reactors near the user industrial installations, potentially close to densely populated areas. For ASN, this means that the safety objectives associated with these reactors will have to be adapted in order to guarantee negligible releases, even in the event of a major accident.

In 2023, ASN expanded its discussions with several French companies developing these projects. Faced with these innovations, ASN modified its organisation and its working methods, notably with new types of technical dialogue, which are more interactive than at present and better-suited to the needs of start-ups while their projects are maturing and the envisaged technological options are being validated. ASN thus defined project maturity criteria to be met before entering the pre-authorisation process, in order to optimise its resources.

ASN recalls how important it is for project sponsors to develop a systemic approach including the industrial chain, the supply of nuclear fuel, spent fuel management, management of the risks of malicious acts and the proliferation of nuclear materials. Mitigating the consequences of accidents within the perimeter around these reactors and the management of waste will be essential pre-conditions for the deployment of these new reactors and for their acceptability.

In 2023, the French, Finnish and Czech nuclear regulators concluded the preliminary examination of the main safety options of the Nuward project sponsored by EDF. This examination enabled the regulators to identify the safety advantages of SMRs, as well as some issues they raise, while helping the project sponsor identify ways of developing a more standardised design. It also enabled the various requirements, practices and experiences of the regulators to be compared. In 2024, the joint review of the Nuward reactor project will continue and cover new topics, expanding it to include three other European safety regulators (Netherlands, Poland, Sweden). This initiative confirms ASN's position regarding the benefits to be gained from multilateral cooperation when reviewing sufficiently mature reactor projects, in an international context of standardisation.

INDUSTRIAL RIGOUR IS STILL A CHALLENGE FOR THE NUCLEAR INDUSTRY'S SUPPLY CHAIN

France's nuclear ambitions, both for reactors and for the "cycle" industry and waste management, will require an exceptional effort in terms of skills, industrial rigour and project management.

ASN considers that it will take at least a generation to address the sector's attractiveness challenge, notably given the dwindling interest in France for technological and scientific training and for the industrial professions. This challenge also concerns the nuclear safety and radiation protection inspection professions.

The difficulties and the occurrences of non-quality observed in the projects over the past twenty years are mainly the result of a lack of experience and professional rigour. The steps taken by the French Nuclear Energy Industry Players Group (GIFEN) and the deployment of EDF's nuclear sector Excellence plan (EXCELL) reflect active collective mobilisation around these challenges, with the aim of "getting it right first time". ASN considers that these are steps in the right direction and are to be encouraged.

From the safety viewpoint, and as of the moment of project launch, the ordering customers must ensure that the chain of contractors is competent to manage the technical, regulatory, standards-based and contractual requirements resulting from the detailed design studies.

In this context, ASN has in recent years strengthened its oversight of the procurement chain for equipment intended for nuclear facilities, through inspections of suppliers and of their subcontractors. The lessons learned from these inspections were sent out to the licensees in mid-2023. On the whole, the inspections demonstrated technical competence in the activities carried out by the suppliers, but revealed recurring shortfalls in industrial rigour across the nuclear sector, which must be corrected. These shortfalls primarily result from supplier unfamiliarity with requirements specified as being important for safety, competence in certain special processes, and monitoring rigour and performance.

Over and above these shortfalls, it also appears that the lessons learned from irregularities detected in the nuclear sector and in its supply chain in France and

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abroad, need to be better taken into account. ASN considers this situation to be unacceptable. At a time of an unprecedented increase in workload, the sector must meet a major challenge in the fight against falsification and counterfeiting, at all levels along the subcontracting chain, involving prevention, detection and dealing with the cases identified.

RADIATION PROTECTION CULTURE MUST BE MAINTAINED IN THE MEDICAL SECTOR

In 2023, the level of radiation protection in this sector is satisfactory, but prior weaknesses still persist with no notable improvement.

For a number of years now, ASN has observed that the radiation protection culture for fluoroscopy-guided interventional practices in the operating theatre has been improving too slowly. In 2023, this led ASN to enforce measures to ensure the compliance of premises and the radiation protection training of personnel. ASN notes the efforts made by the professionals to provide training appropriate to the specific issues of each discipline, which must continue to guarantee that skills further improve and that these issues are correctly understood.

In addition, and even if the radiation protection culture appears to be mature, implementation of the quality assurance approach needs to be re-examined and fully taken on board. This is the case in radiotherapy, where an unprecedented number of undesirable target error events occurred in 2023 (wrong-side or positioning errors). ASN recalls the importance of an advance risk assessment, evaluation of the effectiveness of the barriers put in place and consideration of both local and national OEF. In this respect, the principles of a risk assessment methodology were presented in the “Patient safety” bulletin in October 2023.

ASN also observes weak signals which, although not directly linked to significant or serious undesirable events, indicate conditions that are prejudicial to radiation protection.

By means of inspections and the whistle-blower system, ASN thus notes an increase in reports of internal conflict situations. The “radiation safety culture trait talk” in medicine proposed by the International Atomic Energy Agency (IAEA) include a respectful work environment, that is necessary for effective communication and guaranteeing that all personnel are able to report their concerns, question a decision or organisation and thus exercise their individual responsibility.

Furthermore, the lack of resources, shortness of staff and resorting to temporary workers or outside contractors, the rising use of teleradiology, or the sharing of resources, against a backdrop of healthcare authorisation reforms, are leading to new and often complex organisations, which can result in a certain dilution of responsibilities. In the face of these organisational changes, ASN is remaining attentive – whether during oversight activity, inspections or the issue of licenses and authorisations – to compliance with the regulatory obligations. It draws the attention of the decision-makers to the need to evaluate the impact of these changes on the organisation and on the work of individuals and the need for a precise definition of the roles and responsibilities of all players in order to guarantee that the radiation protection culture is maintained and indeed developed.

THE PROTECTION OF RADIOACTIVE SOURCES AGAINST MALICIOUS ACTS NEEDS TO BE IMPROVED

The protection of radioactive sources against malicious acts was an unregulated subject in France just a few years ago. Increased awareness of this aspect is required on the part of all those concerned.

It also requires the adoption of technical, organisational and human measures designed to protect sources of ionising radiation, but also the “sensitive information” concerning them.

In addition to these specific means, this above all implies that their potentially malicious use must be considered, which is sometimes hard to reconcile with the culture of establishments that are public access and/or devoted to health care.

ASN has been monitoring source security since 2019, and in 2023 it reviewed the results achieved. These results show that the level of competence of the players and implementation of the measures have progressed but remain insufficient. Many challenges are still to be met in order to guarantee the security of sources, in particular when they are being moved, which can then create points of vulnerability at the interfaces. ASN recalls the importance of progress in the security culture, which implies better information, especially in distributing OEF to the users (increased threat awareness, dissemination of event reports, participation in anti-malicious acts networks, etc.).

THE QUESTION OF WASTE, WHICH LIES AT THE HEART OF PUBLIC CONCERNS, IS THE SUBJECT OF SPECIFIC DISCUSSIONS

Radioactive waste management remains the most controversial subject with regard to risk management, as shown by the latest survey conducted in 2023 by the Kantar company, at ASN's request. At present, there is a management solution for 90% of the volume of the waste, although this represents only 10% of the radioactivity contained. Pending the arrival of dedicated management routes, this means that there must be safe storage solutions for significant periods of time.

Radioactive waste management in France does however benefit from internationally recognised advantages such as the National Radioactive Materials and Waste Management Plan (PNGMDR), an agency dedicated to waste management (Andra), well-operated disposal facilities and the *Cigéo* geological disposal project, now recognised as being in the public interest.

For the purposes of examining this project, ASN launched a specific and voluntary consultation process in 2023, designed to ensure participation by the stakeholders. Two workshops were thus held in preparation for referral to the IRSN and then to the advisory committee, in order to enrich the content of these referrals and structure the public information process.

ASN RAMPS UP ITS INTERNATIONAL ACTIVITIES

At a time of renewed enthusiasm for nuclear energy, international relations are continuing at a steady pace, leading to the signing of a large number of cooperation agreements between ASN and its counterparts, leading to the development of exchange programmes on high-stakes issues. This intense international activity was also an opportunity to go into greater depth on subjects of common interest for the safety regulators, such as the continued operation of reactors beyond their envisaged design lifetimes, or the management of radioactive waste.

This intensification also allowed the definition of common international positions. For example, various initiatives were launched internationally to promote the standardisation and harmonisation of regulatory approaches for the SMRs. ASN participates actively in this, notably by promoting cooperation between regulators. ASN considers that international harmonisation of the authorisation processes, often underlined by the developers of these projects as a pre-requisite for the deployment of SMRs, is in fact an illusion, given the specific nature of each country. On the other hand, ASN does consider that the joint review by several regulators of the design options for a given project, upstream of the authorisation process, would be such as to facilitate the development of a standardised design.

The conflict in Ukraine, which is one of the topics dealt with by WENRA and by the Heads of the European Radiological Protection Competent Authorities (HERCA), remains a subject of concern and of particular vigilance for the regulators. In this respect, WENRA issued a position statement in June 2023 indicating that the destruction of the Khakovka dam did not represent a threat to the safety of the reactors of the Zaporizhzhia Nuclear Power Plant (NPP). HERCA continued its work to harmonise the population protection measures for Ukraine's European neighbours in the event of an accident in the Zaporizhzhia NPP.

ASN is also continuing its involvement in the international bodies. It is acting as HERCA Chair for three years, with the aim of helping to achieve a high level of radiation protection in Europe. ■

EDITORIAL BY
THE DIRECTOR GENERAL

Maintaining a high level of regulation and oversight in an unprecedented context

Montrouge, 1 March 2024

The context in which ASN performs its regulation and oversight is unprecedented in more than one respect. The combination of continued operation of older installations and the construction of new installations at a pace not seen for several decades is creating pressure on the resources available in the nuclear industry. The medical nuclear sector is also experiencing pressure on its workforce. Finally, innovations are emerging, both in the industrial field, with Advanced Modular Reactors (AMRs) and in the medical use of ionising radiation with new treatment techniques.

ASN is preparing to deal with this new context: it is maintaining a high level of oversight, adapting it to the priority issues; it is preparing to support a significant workload on a long-term basis; it is relying on its in-house culture to ensure the robustness of its examination work and the pertinence of its oversight and decisions. At the same time, further to the Government's submission of a bill reforming the organisation of regulation and oversight, ASN – together with the French Institute for Radiation Protection and Nuclear Safety (IRSN) – has initiated preparatory work to ensure the implementation of this bill if enacted.

Olivier GUPTA

MAINTAINING A HIGH LEVEL OF OVERSIGHT

Throughout the year 2023, the ASN teams remained fully mobilised in the performance of their duties to protect people and the environment. They maintained both the level of rigour and the level of oversight, while adapting priorities. ASN identifies and reassesses its regulation and oversight priorities on the basis of the challenges defined on the one hand by the risks for people and the environment inherent in nuclear activities and, on the other, by the behaviour of those in charge of the activities, in particular through the means they deploy to manage these risks. The following example illustrates this point.

The present context of the nuclear industry is characterised by pressure on the energy markets, by the need for investment in infrastructure and thus large-scale financing, and by the fact that the nuclear sector needs to further consolidate its ability to support the needed revival process. This context is a challenge for the licensees and industrial firms, with the resulting increased risk regarding the quality of project performance. The lessons learned from the building of the Flamanville EPR also highlighted these construction quality issues. To address this situation, ASN has in recent years reinforced its oversight of the procurement chain for equipment intended for nuclear facilities: 53 inspections were thus performed on this topic in 2023. These inspections will be increased in the coming years, to keep pace with the development of new nuclear projects.

HANDLING A GROWING WORKLOAD

The nuclear sector revival is resulting in an increasing number of new projects on which ASN must adopt a stance, with the support of the IRSN, as well as in the appearance of new players. Examination of the creation authorisation applications for the three pairs of EPR 2 planned for Penly, Gravelines and Bugey, monitoring of the manufacture of their large components (reactor vessel, steam generators, piping, etc.) and then oversight of the corresponding worksites will thus gradually increase ASN's workload in the coming years. To this can be added the projects to replace or expand the fuel fabrication and reprocessing plants, as well as the technical questions raised by the continued operation of the existing installations and the corresponding periodic safety reviews. Finally, technical dialogue with the sponsors of AMR projects, some of which include projects for specific fuel plants, is intensifying and will continue to do so in the coming years. This will demand far more resources than are currently available.

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To be able to handle this workload, ASN has received authorisation to increase its workforce by 12 staff for 2024, and is also relying on internal redeployments that will be made possible by the end of construction of the Flamanville EPR. Further increases in staffing and budget will nonetheless still be needed in the coming years.

In the medical nuclear sector, the persistence of events – with seven events rated level 2 on the ASN-SFRO scale in 2023 – underlines the fact that the challenges remain high and justifies maintaining ASN's level of oversight. The development of innovative high-stakes medical techniques, for nuclear medicine, or flash radiotherapy, is extensively mobilising the ASN teams in contact with the departments sponsoring the projects.

PROMOTING AND DEVELOPING ASN'S SAFETY CULTURE

The competence of the ASN personnel, as well as the rigour and collective nature of its decision-making process, are key factors in enabling ASN to correctly carry out its duties and are the focus of permanent attention. However, the pertinence of oversight is also heavily dependent on the "safety culture".

In 2023, ASN started work to identify which practices, which working and organisational methods and which attitudes enable ASN to effectively monitor nuclear safety and radiation protection, and then subsequently enhance and develop them. This work, entrusted to a researcher, consists in identifying the formal frameworks governing oversight actions and the managerial communications guiding these actions and then in observing the practices actually implemented, in order to determine the fundamental principles which encourage or impede the correct exercise of oversight aimed at protecting people and the environment.

The interim results highlight a number of key aspects of ASN's internal culture, which promote correct prioritisation and appropriate handling of high-stakes nuclear safety and radiation protection subjects: the importance of the collective, the benefits of comparing well-argumented opinions, respect for the responsibilities and scope of the duties of each party, intellectual curiosity, listening to different points of view, the sense of public service and rigour. The robustness of the examination process and the pertinence of oversight and decisions owe more to these practices and attitudes than to organisational methods. This culture thus constitutes a solid foundation for meeting the current challenges and it must be promoted and developed.

PREPARING FOR A POSSIBLE GRAND AUTHORITY

The Government has decided to change how the governance of nuclear safety and radiation protection is organised, by merging ASN and most of the IRSN in a new authority, which would then have its own expert assessment capability, as well as the research roles that underpin it. The two organisational options, with or without integrated technical support, are possible and have proven themselves. It is now up to Parliament to make a decision regarding the corresponding Bill.

The responsibility of the teams at ASN and IRSN is to perform their duties within the specified framework, both before and after the date on which the new group is created, if such is the decision. They have therefore started working together to define the possible functioning and organisation of the future authority, in which the personnel will become involved as and when the general frameworks are defined. This work is being carried out with the common goal of ensuring that the new group works, that the personnel find their place in it and that the future authority makes the most of the potential created by the merger, with a more efficient and more attractive organisation preserving the values of excellence and transparency of the two existing entities. In addition, a specific social dialogue body bringing together the management and trades union organisations of ASN and IRSN is holding monthly meetings.

To make time for the preparation and then implementation of the oversight organisation reforms, if passed, while preserving the resources assigned to operational duties, ASN has postponed those actions which can be put off and which do not affect its core duties.

*

Whatever the regulatory organisation finally chosen, the personnel at ASN at IRSN will continue to work together, in pursuit of the same goal of protecting people and the environment. I know that I will be able to count on their commitment to continuing the mission our fellow citizens expect of them. ■

NOTABLE EVENTS 2023

The safety challenges for the new nuclear programme

Launching a new large-scale nuclear programme is a challenge for the French nuclear industry, which needs to rebuild its capacity, notably in terms of skills and expertise. ASN draws attention to the need to control the quality of construction and manufacturing given the rapid start-up of the EPR 2 nuclear power programme and takes account of this in its regulation and oversight.

At the same time, Small Modular Reactor (SMR) projects are multiplying, with ambitious objectives, including with regard to nuclear safety. Most of these innovative reactor projects, sponsored by new players, require the construction of experimental mock-ups before an industrial product can be envisaged. It will also be necessary to design new "fuel cycle" facilities, suited to the needs of these new technologies. Given the number and diversity of these projects, which raise new questions or require a fresh look at the safety doctrines currently in force, ASN is adapting, without in any way reducing its demands in terms of safety, and has set up procedures for exchanges and for work appropriate to these new players.

THE EPR 2 PROGRAMME

The design of the EPR 2 reactor differs from that of the EPR, with a number of simplifications to facilitate construction and operation. With regard to safety, it is a third-generation pressurised water reactor, which takes account of Operating Experience Feedback (OEF) from the EPR.

The plan is for these reactors still to be in service at the end of the 21st century, a time-frame by when the effects of climate change should be far more significant than today. Major uncertainties persist, notably regarding the temperatures to be considered when designing the equipment. Given this situation, ASN considers that quite apart from ambitious climatic resilience objectives, a certain level of adaptability should be designed into the facilities, so that certain critical equipment can be resized if necessary.

Controlling the quality of construction and manufacturing remains the main challenge EDF has to face. The EPR 2 programme is starting at the rate of one pair of reactors every three years. This situation is creating considerable pressure on the industrial stakeholders, with the risk being that faced with unrealistic objectives, deadlines compliance takes precedence over quality.

ASN observes that for several years now, the sector has been preparing for the arrival of this new nuclear power programme. The question of skills, considered by ASN to be primordial, is the subject of multiple actions together with the State and the regional authorities.

In this context, ASN adapts its oversight to these new challenges. Since 2016, legislation has expanded its competence to activities performed outside nuclear installations, in particular in the plants of the suppliers and subcontractors. ASN is gradually expanding its checks beyond the manufacture of Nuclear Steam Supply System (NSSS) equipment alone, with 53 supplier inspections performed in 2023.

ASN observes that although the tier 1 suppliers are closely involved, considerable work remains to be done with regard to

Penly (Seine-Maritime département[1]*) site on which EDF intends to build two EPR 2 type reactors.*

their subcontractors. ASN regularly finds situations in which these latter are unaware of the applicable requirements, or even that their product is intended for use in the nuclear industry. ASN will shortly be issuing an educational brochure intended for these stakeholders, so that they can gain a clearer understanding of the regulatory requirements applicable to their activities. It also shared the findings of its inspections with the main ordering customers, who it asked to improve their management of the procurement chains.

ASN regulation and oversight entered a new phase when in the summer of 2023, EDF submitted its creation authorisation application for two reactors in Penly. ASN is conducting the technical examination of this file on behalf of the Government, with a view to creation authorisation towards the end of 2026.

SMALL MODULAR REACTORS

Following the call for proposals issued by the Government for innovative reactors, new designers of SMRs of a few tens to a few hundred megawatts emerged, banking on the fact that a significant reduction in power will drastically reduce their complexity and enhance the mass production effect through manufacturing in the factory.

The term "SMR" covers a variety of technologies and applications. A number of projects to supply energy directly in the form of heat at temperatures of several hundred degrees thus represent an alternative to fossil fuels for many industrial processes.

In terms of technology, even if some reactor projects opt for light water, the same technology as that used in the reactors currently in operation in France, the vast majority of the new players have chosen to develop reactors using different technologies.

In 2015, the French Institute for Radiation Protection and Nuclear Safety (IRSN) had examined the level of maturity of the various reactor technologies and concluded that usable OEF only existed for Sodium Fast Reactors (SFR) and High-temperature Gas-cooled Reactors (HTGRs). For each technology, IRSN had also identified the additional scientific and technical knowledge that needed to be acquired before being able to envisage industrial demonstrators. Most of the technologies still require considerable development work.

Initial discussions with a project sponsor allow a review to be made of their technological choices, as well as their research and test programme leading to the definition and justification of the safety case for an industrial reactor or a first experimental prototype.

Over and above the technical aspects specific to the development of each project, SMRs raise new questions or lead to a fresh look at certain practices. In this respect, ASN participates in several international working groups for discussions with its foreign counterparts aiming to promote the creation of ambitious international baseline requirements.

The first subject concerns the definition of safety objectives for these SMRs. The project sponsors for these new reactors are looking to deploy them on a large number of industrial sites which could be located close to urban areas. ASN thus set up a pluralistic working group to consider the safety objectives to be defined before envisaging such siting choices.

Given the large number of emerging projects, ASN defined appropriate methods for discussions and work with these new stakeholders, so that on the one hand the mobilisation of its resources and those of IRSN can be tailored to the level of maturity of the projects and, on the other, so that it can adapt to the reactivity of the project sponsors. The exchanges during the first phases are in particular more informative and iterative, in order to provide rapid feedback on questions or problems arising from the envisaged design choices.

A few projects should be entering a new phase in 2024, with examination of the first files stipulated by the regulations (ASN opinion on the safety options or creation authorisation application).

THE "FUEL CYCLE" FACILITIES

The development of a new-technology reactor is not a stand-alone project. It is necessarily part of a whole range of inter-dependent projects for new nuclear facilities, with a front-end for producing its specific nuclear fuel, and a back-end for managing its spent fuel and operating waste and, eventually, its decommissioning.

The question is that the existing "fuel cycle" facilities were designed to meet the needs of a nuclear fleet consisting of reactors of the same technology, using relatively similar fuels. These facilities were also commissioned several decades ago and their continued operation for the medium or even long term, beyond 2040, as had previously been envisaged, implies major safety issues which must be examined in the light of the most recent standards. The decision to build new facilities must thus be made rapidly, so that they can be designed and built in controlled conditions of safety and radiation protection. Given the needs involved in the fabrication, and possibly the reprocessing of the fuels needed for the reactors of a new nuclear programme or for SMRs, ASN stresses the fact that these future facilities must have the necessary capacity margins and use technologies that are ambitious enough to achieve them in the best conditions of safety and management of the inventories of radioactive materials and waste. With the same goal, forward planning is also required concerning the necessary storage facilities and means of transport. ■

1. Administrative region headed by a Prefect.

Flamanville EPR reactor

Conclusion of examination of the commissioning authorisation application

Major difficulties affected the construction of the Flamanville EPR reactor, which began in 2007. Throughout the project, ASN carried out its oversight duties, sometimes requiring that EDF modify the planned provisions. Based on the steps taken by EDF, ASN considers that the reactor can be commissioned in good conditions of safety. As at the time of approving this report, ASN is preparing to conclude the final examinations prior to issuing the reactor commissioning authorisation.

A DESIGN CAPABLE OF ACHIEVING AMBITIOUS SAFETY GOALS

ASN examined the design of the installation and its safety case. Discussions were held with EDF throughout the construction of the reactor. Between 2007 and 2023, ASN convened its Advisory Committees of Experts (GPEs) 28 times and asked the Institute for Radiation Protection and Nuclear Safety (IRSN) for more than a hundred opinions, in order to complete its examination. This regularly drew on data from the oversight and inspections on the site, in the supplier plants or within the EDF engineering bodies. As a result of this examination, EDF sometimes had to modify the design of its installation and reinforce its safety case.

Throughout the project, ASN maintained close ties with its foreign counterparts also overseeing an EPR reactor project. These discussions were used to share the conclusions of safety assessments and the lessons learned from each project. That was particularly the case regarding the various anomalies found on the cores of the Taishan reactors (China), including the fuel cladding bursts observed in 2021. As a result of these anomalies, EDF notably modified the fuel assemblies.

The design of the Flamanville EPR reactor enables the ambitious safety objectives set for the third-generation reactors to be met. By comparison with the second-generation reactors, it results in a significant reduction in the probability of core melt and radioactive releases in the event of an accident. The EPR reactor design in particular includes systems for managing severe accidents and is able to withstand extreme

external hazards. This design only required very minor changes to take account of the lessons learned from the accident at the Fukushima Daiichi Nuclear Power Plant (NPP – Japan).

DIFFICULTIES ENCOUNTERED DURING MANUFACTURE OF EQUIPMENT AND CONSTRUCTION OF THE REACTOR

ASN carried out nearly 600 inspections during construction of the EPR reactor. These inspections were primarily carried out on the Flamanville site, within the EDF head office departments and in the manufacturing plants.

ASN thus checked the activities involved in civil engineering, manufacturing and equipment assembly, installation testing and preparation for operations. ASN also carried out labour inspectorate duties on the construction site.

Throughout the project, ASN carried out its oversight duties and sometimes required that EDF modify its project when the safety issues so warranted.

In 2008, a series of anomalies found during concrete pouring and rebar installation led ASN to tell EDF to suspend concrete pouring operations for the safety-important structures. Similarly, in 2011, ASN told EDF to suspend concrete pouring activities on the inner containment as a result of pre-stressing duct positioning anomalies.

Between 2015 and 2018, ASN asked EDF for in-depth justification data concerning the reactor vessel, for which there was a manufacturing anomaly in the steel of the bottom head and closure head. Following its examination, ASN considered that this anomaly was not such as to compromise the commissioning of the reactor pressure vessel, provided that specific checks are carried out during operation of the installation. Owing to the difficulties involved in performing these checks on the vessel head, ASN decided to limit its service life and it will have to be replaced.

In 2019, ASN considered that the nature and the particularly large number of deviations that occurred at the design stage and during manufacture of the main steam line welds on the containment penetrations represented a major obstacle to maintaining these welds "as is", and that their repair before commissioning of the reactor should be the reference solution. Finally, a large number of welds on the main secondary system lines had to be repaired.

Various irregularities were also brought to light in the equipment manufacturing plants during the course of the project, both in France and abroad. This situation shows that neither the monitoring and inspection chain, nor the high level of quality demanded in the nuclear industry, were able to completely rule out the risk of counterfeit, fraud and falsification. It is notably at the urging of ASN that Framatome, called Areva NP at the time, brought irregularities to light in its Creusot Forge plant in 2016.

Each irregularity detected requires that specific investigations be carried out by EDF and its subcontractors. ASN checks the robustness of these investigations by means of technical exchanges and inspections, while sometimes calling in qualified organisations for the purpose of inspections. These verifications concern the causes, the identification of the scope of the irregularities, the action plans implemented, as well as the consequences for equipment conformity and the safety of the facility. ASN oversight is carried out in parallel with any legal action being taken.

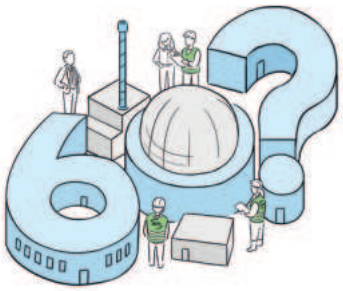
More generally, ASN asked EDF to carry out an overall review of the quality of the reactor equipment, notably by means of additional checks on the main equipment items with safety implications.

The commissioning authorisation will enable EDF to initiate fuel loading into the reactor. EDF will then conduct a programme of tests to verify the reactor's safety and performance. This is scheduled to last about eight months. This programme was examined by ASN with the support of IRSN. ASN will monitor the performance of the programme, as it will do throughout the operating life of the reactor.

Many lessons were learned from the construction of the Flamanville EPR reactor, by both EDF and its suppliers. For its part, ASN adapted its oversight methods for the construction of future reactors (see notable event "The safety challenges for the new nuclear programme"). ■

Prospects for continued operation of EDF's nuclear reactors

ASN considers that the continued operation of EDF's existing reactors must be planned well in advance, so that it can be envisaged with no compromises on safety and so that it does not constitute a variable in the adjustment of energy policy. ASN therefore asked EDF to provide advance justification of the hypothetical continued operation of the current reactors up to and beyond 60 years.

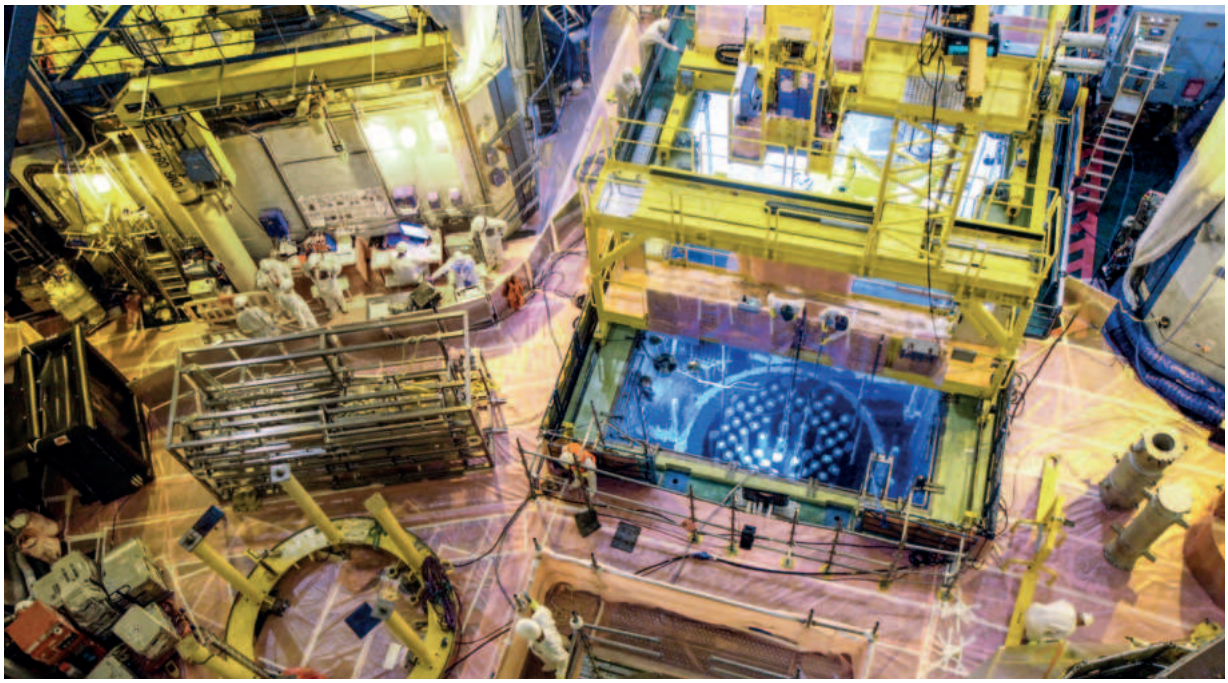


The French nuclear power reactors were commissioned to a very tight schedule, mainly in the 1980s. Despite the specific aspect of each reactor, this situation could lead to them all being shut down for ageing-related reasons, over a relatively short period of time. Given the time needed to build new electrical production capacity, scheduling their final shutdown takes on particular importance.

ASN therefore asked EDF to provide advance justification of the hypothetical continued operation of the current reactors up to and beyond 60 years, by the end of 2024, to allow an in-depth examination leading to an ASN position statement by the end of 2026.

Without waiting for this deadline and at the request of the Government, ASN issued an opinion on 13 June 2023 concerning the prospects for the continued operation of EDF's nuclear reactors up to their 60th year.

This opinion covers a preliminary analysis by EDF of the ability of its reactors to continue to function beyond 50 years, along with the corresponding technical issues and challenges.



Check on fuel assemblies in the reactor building. Golfech NPP.

In this opinion, which does not pre-empt the position that ASN will adopt on the occasion of their fifth periodic safety review, regarding the conditions for continued operation of the reactors beyond 50 years, ASN identifies two subjects requiring priority analysis by EDF:

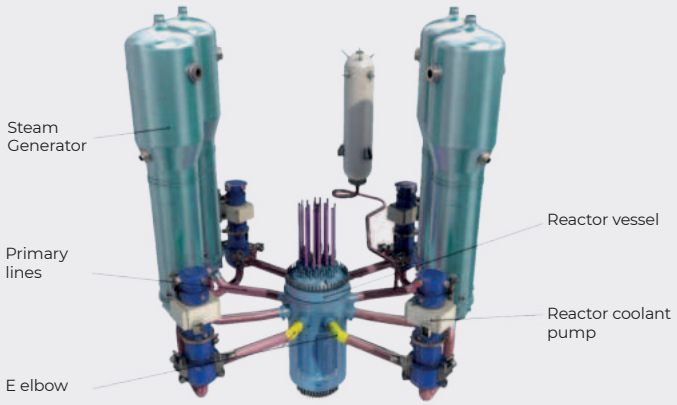
- the mechanical strength of certain portions of the primary system main lines of several reactors, called "E elbows" (see opposite);
- for the reactors of the Cruas-Meysse Nuclear Power Plant (NPP), taking account of the lessons learned from the earthquake that occurred in Le Teil on 11 November 2019 (see box below).

In addition to these two technical subjects, other factors such as considering the expected effects of climate change, or the functioning of the "fuel cycle" facilities in satisfactory conditions of safety, must also be given particular attention with a view to possible operation up to 60 years.

Finally, the extensive standardisation of the French NPP fleet, which is a particularity of the French electrical grid, implies the risk of a serious generic defect leading to simultaneous suspension of operation by several reactors, as was recently the case when stress corrosion cracks were discovered on the auxiliary lines of the primary system of several reactors. ASN considers that the possible occurrence of this type of event must be taken into account when checking compliance with security of electricity supply criteria.

MECHANICAL STRENGTH OF THE E ELBOWS

The E elbows are a part of the main primary systems of the reactors. They are shown in yellow on the figure below.



Position of E elbows on the reactor primary system

The E elbows for the older reactors (900 and 1,300 Megawatts electric – MWe) are manufactured from cast stainless steel. They are considered by EDF to be very hard to replace, because often located in a zone subjected to levels of irradiation making human intervention difficult.

There are particular problems with the steel used in the elbows. On the one hand, the casting process for these elbows is liable to generate manufacturing flaws. On the other, it is subject to a thermal ageing phenomenon. The mechanical strength of the cast elbows on the primary system must thus be demonstrated, taking account of the presence of potential flaws and the reduced tensile strength as a result of ageing.

For most of these elbows, EDF demonstrated that their lifetime is greater than 60 years and considers that operation up to 80 years is possible. However, the analyses on the E elbows of five reactors at the time of drafting of the ASN opinion, could not demonstrate continued operation up to 60 years.

EDF presented possible avenues to supplement these analyses. ASN considers that the various avenues studied by EDF to operate the elbows up to 60 years are credible, but that they still require work in order to lead to acceptable demonstrations and be implemented.

Lessons learned from the earthquake at Le Teil (Ardèche *département*) on 11 November 2019

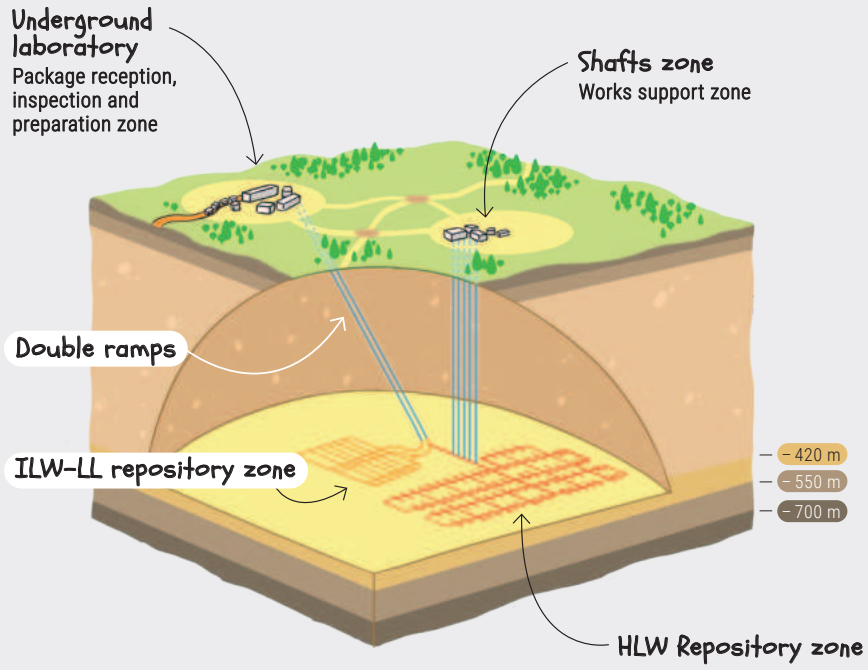
The fault that caused this earthquake led to a surface fracture over several kilometres, with soil uplift and shift of several centimetres.

This phenomenon is extremely rare in mainland France. Work is in progress to characterise the scope of the network of faults. If the existence of a fault capable of leading to a surface fracture were to be confirmed under the Cruas-Meysse site, it would then be complicated to produce the safety case for this NPP. It could require significant work, or even compromise the continued operation of its reactors.

Cigéo

A review involving all the stakeholders

In order to address society's strong desire to take part in the radioactive waste deep geological disposal facility project, and consistently with the measures stipulated in this respect by the 5th National Radioactive Materials and Waste Management Plan (PNGMDR), ASN is implementing an unprecedented system of consultation and discussion around the technical review process.



The Bure (Meuse *département*) underground laboratory, situated at a depth of 490 metres, is a unique research tool for the *Cigéo* project.

Its underground drifts allow *in-situ* study of a layer of clay 160 million years old, along with various concepts and techniques that could be used to construct the *Cigéo* facility.

Following several decades of research and development, the National Radioactive Waste Management Agency (Andra) submitted a creation authorisation application file in January 2023 for a deep geological waste disposal facility. This facility, called "Cigéo" is intended for the disposal of high-level waste (HLW) and intermediate-level, long-lived waste (ILW-LL).

Before this major step, Andra had submitted a Safety Options Dossier (DOS) for this facility in April 2016, which signalled the start of a process governed by regulatory requirements. Following review of this dossier, ASN considered that the project as a whole had reached a satisfactory level of technical maturity and that it represented a significant step forward in relation to the previous dossiers on which ASN had issued an opinion. ASN also made recommendations regarding the safety options, such as to prevent or mitigate the risks in the envisaged facility, and asked Andra for additional studies and justifications on subjects such as corrosion phenomena, low pH concretes, the representative nature of the hydrogeological model or the monitoring strategy.

Review of the *Cigéo* DOS also highlighted several important subjects such as the choice of the repository architecture, the definition of contingencies and post-accident management. The facility's creation authorisation application file submitted in January 2023 was produced taking account of the requests and recommendations made by ASN.

ASN was tasked by the Ministry for Energy Transition with conducting the technical review of this creation authorisation application and, after considering the file to be acceptable, began its examination in 2023. In so doing, it called on the expertise of

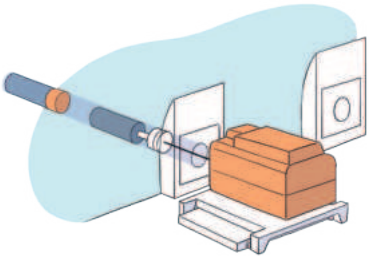
ASN visit during the excavation of the network of drifts in the Bure underground laboratory.

the Institute for Radiation Protection and Nuclear Safety (IRSN) and on its Advisory Committees of Experts (GPEs), more particularly that devoted to the topic of radioactive waste (GPD). This technical review, the duration of which is estimated at about three years, is built around the assessment of three topics: the basic data adopted for the *Cigéo* safety assessment, notably regarding the choice of the site, the safety of the surface and underground installations during the operational phase, and the long-term safety after closure. Following the technical review, ASN will issue an opinion on the application submitted by Andra, as stipulated by Article L. 542-10-1 of the Environment Code. At the same time, the National Review Board (CNE2) will submit an opinion on the scientific underpinnings of the file as compared with the state of the art. The duration of the entire authorisation process is estimated at about five years. Apart from the technical review phase, it includes a consultation phase (local authorities, Environmental Authority, etc.), as well as a public inquiry, prior to starting the drafting of any decree to finalise the procedure.

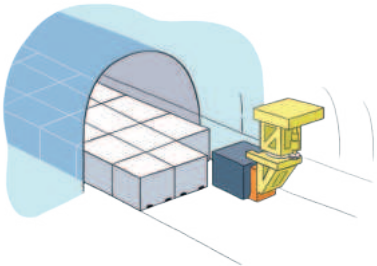
In order to address society's strong desire to take part in the *Cigéo* project, and consistently with the measures stipulated in this respect by the 5th PNGMDR, ASN is implementing an unprecedented system of consultation and discussion around the technical review process. Various stakeholders (about twenty organisations, including Local Information Committees (CLIs), the National Association of Local Information Committees and Commissions (Anccli), and environmental protection associations) were thus consulted as part of IRSN's review of the *Cigéo* creation authorisation application, with the aim of identifying their expectations and concerns as related to nuclear safety and radiation protection, so that they could be taken into account when framing the assessment of the file.

Following this exercise, the IRSN referral project was modified, for example, to incorporate aspects related to addressing climate change issues. To guarantee the continuity of participation by society throughout the technical review process, consultation measures will also be taken when drafting the GPE referrals on the three previously mentioned topics, and the public will be regularly informed, notably after each meeting of these GPEs, the first of which is scheduled for April 2024. This information, which is structured consistently with the referrals, will provide answers to the expectations and questions incorporated therein. ■

Cigéo project disposal vaults



HLW waste packages will be emplaced in vaults about a hundred metres long and about 70 cm in diameter, with a metal liner.



ILW-LL waste packages will be emplaced in horizontal disposal vaults a few hundred metres long and a few tens of metres in diameter.

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

ASN considers that the quality of operation of the Nuclear Power Plants (NPPs) remained satisfactory in 2023.

2023 was marked by the restart, following lengthy outages, of a large number of reactors in which certain lines, affected by stress corrosion cracking, had to be replaced.

REACTOR IMPROVEMENTS AND CONTINUED OPERATION

The modifications made to the facilities and operational methods by EDF within the framework of the reactor periodic safety reviews are significantly improving the safety of the facilities and enabling 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. For a number of years now, ASN has seen that the volume of studies and modifications required is leading to saturation of EDF's engineering capacity. At EDF's request, which highlighted considerable pressure on its engineering teams, changes to reactor outage scheduling and the safety benefits to be gained from limiting the number of different reactor configurations, ASN in 2023 adjusted the deadlines for the requirements it issued in 2021 following the generic phase of the fourth periodic safety review of the 900 Megawatts electric (MWe) reactors.

ASN considers that EDF must take steps to ensure that the implementation and operation of the modifications can be guaranteed in good conditions despite the considerable workload on the engineering teams and the sometimes short amount of time the operating teams have in which to assimilate these modifications. Attention must also be given to right training of the parties concerned, so that they can correctly operate the new systems and maintain them.

In this context, ASN takes a positive view of the action taken by the in-house inspection bodies set up by EDF for the design of the noteworthy modifications to its installations.

THE CONFORMITY OF THE FACILITIES

As in previous years, ASN considers that EDF must continue the targeted inspection actions it has been deploying over the last few years. The specific inspections implemented during the fourth ten-yearly outages are enabling a large number of deviations to be detected.

The organisation adopted by EDF to process the deviations detected has improved in recent years and is satisfactory. EDF notably reinforced the dedicated teams, both in its head office departments and in the NPPs, notably with respect to reactor outages.

Overall, EDF is processing deviations within a time-frame that is acceptable. However, ASN considers that analysis of the potentially generic nature of a deviation affecting several plants after detection on one particular site should be carried out more rapidly.

MAINTENANCE

As a general rule, the organisation in the NPPs for large-scale maintenance operations was again relatively satisfactory in 2023.

However, in 2023 as in previous years, ASN found certain points needed to be improved, such as the coordination between the disciplines and the projects, or within the maintenance departments, the quality of the documentation made available to the parties concerned, or management of spare parts. With regard to the numerous maintenance activities resulting from the continued operation of the reactors and the "major overhaul" programme, 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.

Improvements were observed in 2023 regarding management of the quality of subcontracted activities, notably thanks to the provision of a growing number of spaces for preparation on mock-ups of the work to be done, and increased monitoring by EDF of the technical procedures. EDF's monitoring of manufacturing operations for safety-important equipment in supplier plants is however unsatisfactory.

OPERATION

In terms of reactor operation and control, ASN considers that performance improved in 2023. The actions plans covering operational rigour initiated in recent years by certain NPPs are appearing to bear fruit. However, the number of significant events related to control room monitoring faults further increased this year. This subject must be a priority for EDF in the coming years.

In 2023, ASN observed improvements in the working of the operating teams training departments. Persistent weaknesses in the skills acquisition process for operating personnel were however still observed during the inspections or during analysis of significant events, which raises questions regarding the effectiveness and scope of the training.

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. With regard to firefighting, and at the request of ASN, EDF has been working for several years on the deployment of a new organisation on its sites and on improving its response capacities, together with the Departmental Fire and Emergency Services (SDIS).

The ASN inspections focusing on the emergency organisation and resources confirmed that the organisation, preparedness and management principles for emergency situations have been correctly assimilated. EDF must nonetheless continue with its efforts to maintain the operational condition of certain resources that could be called on in an emergency situation and must increase its vigilance regarding work done in the emergency management rooms or close to equipment needed for emergency management.

The analyses carried out by the sites following significant events are generally pertinent, but must go further in identifying human failures, and in investigating the work situations and organisational processes involved. The assessment of corrective action effectiveness must also progress.

Finally, ASN again observed a shortage of personnel in the teams in charge of conducting independent evaluations of reactor safety in certain NPPs. EDF intends to remedy this situation by increasing the staff numbers dedicated to this activity.

ENVIRONMENTAL PROTECTION

ASN considers that the management of intakes and discharges into the environment of the various NPPs is on the whole satisfactory. Certain events however reflect the weaknesses indicative of operating faults or ageing of certain equipment, which can have consequences in terms of availability and the effectiveness of treatment prior to discharge.

In 2023, the inspections carried out by ASN showed that EDF is improving its management of non-radiological hazards with potential consequences outside the sites, a subject for which the inspections conducted in 2022 had revealed a situation that was unsatisfactory.

ASN considers that waste management is also continuing to improve. Progress is however still needed, notably with regard to duration of storage, inventory-keeping and the conformity of storage facilities.

WORKER RADIATION PROTECTION AND OCCUPATIONAL SAFETY

ASN considers that the radiation protection expertise centres created at the end of 2022 are functioning satisfactorily. The approach used in preparing for work and optimising doses is also considered to be satisfactory on most of the NPPs. However, on several sites, ASN found deviations in compliance with reinforced rules specific to apprentices under 18 years of age and personnel on fixed-term contracts, which EDF must remedy. ASN also notes the persistence of problems with management of industrial radiography worksites observed in 2022.

With regard to occupational health and safety, the number of accidents with time lost is up on 2022. Progress is needed to improve the management of situations presenting risks for the workers, notably with regard to lifting work, asbestos and electrical hazards.

Individual nuclear power plant assessments

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

With regard to safety, the NPPs at Chinon and Tricastin stood out positively in 2023. The NPP at Dampierre-en-Burly and, to a lesser extent that of Le Blayais, under-performed by comparison with the other NPPs operated by EDF.

With regard to radiation protection, the Penly NPP stands out positively. ASN considers that the NPPs of Cattenom, Gravelines, Saint-Laurent-des-Eaux and, to a lesser extent, Bugey, under-performed.

With regard to environmental protection, the NPPs of Chooz B, Civaux, Penly and Saint-Laurent-des-Eaux stood out positively. On the other hand, the Bugey NPP under-performed.

New reactor projects

In 2023, EDF completed the hot requalification tests of the Flamanville EPR reactor and prepared for its commissioning.

The work to repair the secondary system welds was carried out rigorously, with a good level of monitoring by EDF, leading to confidence that a high level of production quality will be achieved. More generally, ASN considers that significant work has been done in recent years to obtain a satisfactory level of completion of the installation.

In 2023, EDF submitted the creation authorisation application for two EPR 2 reactors on the Penly site. ASN considers that the design of the EPR 2 reactor is more advanced than the Flamanville EPR reactor at the same stage, which is a positive point.

EDF also sent ASN a safety options file for its Nuward Small Modular Reactor (SMR) project.

Nuclear power plants being decommissioned and waste management facilities

INSTALLATIONS SHUT DOWN OR UNDERGOING DECOMMISSIONING

The reactors finally shut down or undergoing decommissioning operated by EDF (Brennilis, Chooz A, Fessenheim, Superphénix, Gas-Cooled Reactors – GCRs) no longer contain any spent 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.

Generally speaking, ASN considers that the EDF facilities undergoing decommissioning or being prepared for decommissioning are well managed and that the licensee is correctly meeting its commitments. With regard to radiation protection, the organisation put into place by EDF in its radiation protection expertise centres is satisfactory. With respect to these projects, EDF gives priority to risk mitigation in its facilities.

ASN considers that the decommissioning or decommissioning preparation operations on the facilities other than the GCRs is progressing at a satisfactory pace. Significant milestones were reached in 2023 for these installations, notably with completion of the decontamination of the primary system of Fessenheim NPP reactor 2 and finalisation of the operations in preparation for the dismantling of installation EL4-D (Brennilis NPP).

ASN will be vigilant with respect to the decommissioning of EDF's reactors, notably the operations involved in cutting up the reactor vessel of the Chooz A NPP, from which Operating Experience Feedback (OEF) should help to determine similar operations for decommissioning of the Fessenheim NPP.

With regard to the GCRs, EDF continued "out of vessel" decommissioning work in 2023 on the reactors of Saint-Laurent A, Bugey 1 and Chinon A3 in satisfactory conditions of safety, more specifically completing the decommissioning work on the heat exchangers of Chinon A3. However, the progress of these projects is significantly slower and the completion deadlines for the decommissioning operations envisaged by EDF remain a subject of concern for ASN. During the 2024 examination of the decommissioning files for these reactors, ASN will pay particular attention to the robustness of the graphite waste management strategy.

During its examination of the modifications to the operating baseline requirements of EDF's installations, ASN noted in 2023 that these documents were sometimes overly generic. ASN will thus be vigilant in ensuring that the specific aspects of each installation are taken into account in these baseline requirements.

THE SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT FACILITIES

With regard to its facilities in operation, EDF is carrying out numerous equipment upgrades in the Superphénix spent fuel storage unit (Apec), which is satisfactory. ASN is particularly attentive to implementation of EDF's action plan for managing the obsolescence of certain equipment important for protection, adopting regular and joint monitoring with the licensee.

Improvements are however required in waste management in the Activated waste conditioning and interim storage installation (Iceda).

ORANO

In 2023, Orano continued its work to enhance the security of the management of radioactive materials and waste on the La Hague and Tricastin sites. In addition, the wide-ranging action plan designed to overcome the production difficulties at the Melox plant is beginning to bear fruit, with a significant improvement in the quantity of MOX (Mixed OXides) fuel fabricated and the volume of waste generated. ASN considers that these factors are helping to stabilise the "fuel cycle", even if this still offers little margin for contingencies and the countermeasures to be put into place to counter the risk of saturation of the spent fuel storage pool are yet to be deployed.

ASN also considers that Orano must continue and intensify the work to review the issues related to the ageing of all the facilities at La Hague, in terms of both the safety and the robustness of the "cycle", in order to produce a general review of the site and consolidate the prospects for operation of its various units in the medium and long term, in the light of ambitious safety standards. This issue is all the more important in the current context, in which current thinking on the future of the "cycle" does not rule out operation of these facilities well beyond the 2040 time-frame previously defined.

Installations in operation

ASN considers that the La Hague site operates its various functioning facilities in a satisfactory manner. With regard to nuclear safety, ASN notes good management of control and operations, as well as the involvement of the personnel in the organisational and operational changes implemented on the site since 2022 ("Convergence" project).

ASN considers that the level of safety of the Orano site at Tricastin, where the main facilities are considerably more recent than those of the La Hague site, is satisfactory.

With regard to the Melox plant, ASN considers that its level of safety is satisfactory, and sees in a positive light the efforts made by the licensee to catch up on required maintenance work. The new emergency management building was commissioned in June 2023, in accordance with ASN's requirement.

PERSONNEL RADIATION PROTECTION

With regard to radiation protection, the radiation protection centres of expertise were created in a satisfactory manner in early 2023, even if a number of documentary and operational adjustments still need to be finalised.

The modernisation work carried out by Orano, notably with changes to the dosimetry system, dematerialisation and increased robustness of the controlled zone access systems, is beginning to bear fruit, with the number of Significant Radiation Protection Events (ESRs) down in 2023. These measures must be continued.

ASN remains vigilant with regard to the Melox facility, owing to the high number of preventive and corrective maintenance operations carried out on the facility's equipment, against a backdrop of a major maintenance programme intended to enhance the availability of the facilities. These operations entail dosimetric risks that are often significant.

ENVIRONMENTAL PROTECTION

ASN welcomes the action taken by the La Hague site to ensure regulatory conformity of the facilities and the operational implementation of the requirements governing discharges from the plant, as set out by ASN in June 2022 and applicable as from 1 January 2023.

In 2023, ASN continued to monitor the steps taken by the Tricastin site to reduce the releases of coolant fluids into the atmosphere and notes the efforts made by the licensee to mitigate these losses resulting from mechanical failures.

The safety reassessments of the facilities

ASN considers that the organisation put into place by Orano for evaluating the conformity of its facilities and for reassessing their safety during the periodic safety reviews, is satisfactory. It nonetheless urges Orano to increase its vigilance concerning the implementation of the action plans drawn up during each periodic safety review and compliance with the deadlines for the regulatory requirements and the commitments made.

Generally speaking, the measures designed to counter the effects of equipment ageing in the facilities, some of which is nearing an operating life of 40 years, or its replacement by new equipment, is still a major issue. ASN stresses the need for greater forward planning for equipment repair or replacement as a result of ageing, in order to avoid the risk of situations that could block operations, or of long-term outage of the facilities. ASN underlines that Orano must also examine the medium and long-term prospects for operation of its various units in the light of the most ambitious safety standards.

Facilities planned or under construction

ASN considers that the commissioning of the New Fission Products Concentration (NCPF) units in the T2 facility on the La Hague site, to replace the existing equipment which was more severely corroded than anticipated in the design, is a significant step forward. The project was deployed on-schedule and the operational results from the new units following commissioning are as expected.

On 19 June 2023, Orano submitted an application for modification of the creation decree in order to increase the production capacity of the Georges Besse II plant (Basic Nuclear Installation – BNI 168) by about 30%. The application is currently being examined by ASN and will be the subject of a public inquiry in 2024. ASN underlines the quality of the file submitted by Orano and of the technical discussions during the course of its examination. Orano shall ensure that the resources committed to the new projects, such as this one, shall not be to the detriment of other projects to improve support functions or process legacy radioactive substances stored on the site, which are just as high priority.

Legacy waste retrieval and conditioning and decommissioning on the La Hague site

Large quantities of legacy waste at La Hague are not stored in accordance with current safety standards and present major risks. The Legacy Waste Retrieval and Conditioning (WRC) is a key step in the progress of decommissioning of definitively shut down plants. ASN therefore welcomes Orano's decision at the beginning of 2023 to build new silos to significantly improve the storage conditions for the sludges from the former effluent treatment station (BNI 38) without waiting for a final conditioning process for these sludges.

With regard to the organisation and management of these complex projects, ASN notes the progress made, such as acceptance of the objectives of immediate dismantling, the use of project maturity assessments, or the development of project progress management tools. ASN considers that Orano must make progress concerning the robustness of the waste retrieval and processing scenarios and in ensuring the reliability of the operational waste retrieval processes, in order to guarantee the schedules for the various WRC and dismantling projects announced

Individual facility assessments

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

CEA

Most French nuclear research facilities have been historically operated by the Alternative Energies and Atomic Energy Commission (CEA). Although some are still contributing to CEA's scientific and technical research programmes, a good number of them have been shut down and CEA is faced with major challenges in order to decommission them and manage the legacy waste satisfactorily. ASN considers that the safety of the facilities operated by CEA is still under control but that the results of the decommissioning and WRC projects differ widely and are still exposed to major contingencies.

Despite the gradual reinforcement of the project management practices, performance remains limited by the resources available and by the operational capacity of the contractors in the sector. In addition, the operational reality of the worksites is nearly always more complex than anticipated, to the extent that an entire project is sometimes called into question, or the at the very least the deadlines are significantly pushed back. In this respect, ASN considers that management of these projects remains a point warranting particular attention.

Finally, ASN considers that the emergency situations management organisation and the monitoring of outside contractors require further improvement.

CEA's decommissioning and materials and waste management strategy

In order to keep track of the progress of the projects with the highest priority for safety, the authorities and CEA set up regular and high-level reporting of the deadlines with the greatest safety implications; ASN underlines the commitment by the CEA managers in the oversight and monitoring of these milestones. In 2023, CEA notably continued with the removal of a certain number of radioactive substances (effluents and spent fuels) from its facilities that had been definitively shut down, which helped substantially reduce the residual risks. ASN nonetheless finds that, despite CEA's clear intention to carry out facilities decommissioning and WRC operations, this licensee is experiencing major difficulties in meeting the deadlines initially set.

These delays are notably caused by technical or contractual difficulties. ASN also regularly draws CEA's attention to certain shortcomings in its waste and effluent management strategy. This is to large extent based on unique facilities, for which there is no operational alternative, and which therefore determine the satisfactory performance of the numerous projects using them. Moreover, for several of these facilities, there are serious risks in terms of the time required for commissioning (Diadem), for refurbishment (BNI 37-A) or for storage capacity extension (Cedra), which all constitute risks for the project that depend on them.

Facilities in operation

ASN considers that the safety of the facilities in operation is satisfactory. During the course of the inspections carried out in 2023, it nonetheless identified certain topics which require improvements. This mainly concerns management of the fire risk, but also waste management, safety commissions and on-site permits, periodic checks and tests, organisational and human factors, as well as the prevention of pollution and management of detrimental effects.

The main new facility project sponsored by CEA, the Jules Horowitz Reactor (JHR), is being carried out satisfactorily and transparently.

RISK CONTROL AND EMERGENCY MANAGEMENT

The significant delays in constructing more robust emergency management buildings, taking account of the lessons learned from the accident at the Fukushima Daiichi NPP (Japan), are undermining emergency management in several centres. With regard to the new emergency management premises on the Saclay site, ASN set a new deadline for commissioning the emergency management premises of 31 December 2024. Concerning the Marcoule centre, additional justifications are required regarding the operability and accessibility of the emergency management building. A number of emergency exercises carried out in 2023 jointly with the public authorities, also revealed that CEA needs to supplement its organisation in order to provide an effective response to operational requirements, notably regarding the exchange of information with the other emergency management players.

PERSONNEL RADIATION PROTECTION

The organisation put into place by CEA for radiation protection of workers is satisfactory. ASN has no remarks concerning the working of the CEA radiation protection expertise centres. The inspections performed by ASN in 2023 on the CEA sites revealed radiological zoning anomalies that CEA will have to correct. ASN will be vigilant on this point, as well as on monitoring of outside contractors in terms of radiation protection.

The number of ESRs reported by CEA is slightly down in 2023. However, more than one third are linked to failure to wear dosimeters (whether passive or active), mostly by outside contractors. CEA must take steps to raise the awareness of these personnel and ensure that this is effective. This will then be checked by ASN.

Individual facility assessments

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

ENVIRONMENTAL PROTECTION

For the year 2023, control of the detrimental effects and impact of the CEA facilities on the environment is on the whole satisfactory. The number of deviations (Significant Environmental Protection Events – ESEs) in 2023 is of the same order of magnitude as in previous years, with no notable events (only events rated level 0 on the International Nuclear and Radiological Event Scale – INES, or out of the INES scale).

ASN however considers that CEA must step up its efforts to take measures on several subjects associated with environmental protection and in particular bringing the network of piezometers back into compliance, the positioning of sampling devices in the gaseous discharge outlets and, more generally, management of the discharges continuous monitoring devices, notably with regard to pollution of soil and groundwater.

Performing consolidated impact assessments, for those centres that are home to several facilities operated primarily by CEA but also by other licensees (such as Marcoule or Cadarache) should enable the main risks to be better identified, with subsequent prioritisation of the corresponding applicable requirements.

SAFETY REASSESSMENT OF FACILITIES

ASN considers that the organisation put into place by CEA to evaluate the conformity of its facilities and reassess their safety during the periodic safety reviews, is appropriate. The inspections carried out by ASN on the topic of the periodic safety reviews identified some points for improvement which must be addressed by CEA, notably concerning monitoring of the action plan as a result of the periodic safety review. CEA will also have to continue its efforts in the coming years in order to comply with the schedule for implementation of the compliance and safety improvement work defined by these periodic safety reviews, so that in all cases a new review can be started once the deployment of the action plan from the previous review has been completed.

ANDRA

2023 was marked by the start of the examination of the creation authorisation application for the *Cigéo* deep geological repository, submitted on 16 January 2023.

Cigéo project

Following the acceptability analysis of the *Cigéo* creation authorisation application file, ASN began its technical examination in June 2023. ASN notes a positive dynamic within the project owner's team and correct working by the governance bodies set up to identify, prioritise and rule on the most important technical choices regarding the project. These points confirm the demonstration that the French National Radioactive Waste Management Agency (Andra) has the technical capabilities needed to successfully complete the *Cigéo* project.

Operation of Andra's existing facilities

ASN considers that operating conditions in Andra's facilities remained satisfactory in the areas of nuclear safety, radiation protection and environmental protection in 2023. It also underlines the good quality of the safety assessments produced by Andra and the fact that the periodic safety reviews of the disposal facilities are carried out satisfactorily. The evaluation of the long-term impacts of the radiological and chemical substances in the disposal facilities on the flora and fauna nonetheless remains a subject for which management must be consolidated by Andra.

ASN assessments **by activity sector**

THE MEDICAL SECTOR

On the basis of the inspections carried out in 2023 and an analysis of the period 2019-2023 enabling the entire fleet of facilities to be covered, ASN considers that the state of radiation protection in the medical sector is being maintained at a satisfactory level, relatively comparable from one year to the next, although with a number of persistent shortcomings which in 2023 led to an enforcement approach being adopted in the field of Fluoroscopy-Guided Interventional Practices (FGIPs).

It underlines the advances made in the field of clinical audits, with the first experiments launched in 2023 in radiotherapy and radiology, but is urging that they be extended to higher-risk activities, radiosurgery in particular, as well as to therapeutic nuclear medicine.

However, ASN identifies a number of signals which could indicate that the current situation could deteriorate:

- a finding that resources are on the whole shrinking, with pressure on Medical Electroradiology Manipulator (MERM), medical practitioner, medical physician staffing levels, with the expansion of temporary work and the postponement of tasks;
- in imaging, the use of insufficiently well-understood services to assist the Radiation Protection Experts-Officers (RPE-Os) and the medical physicians in the plants, liable to lead to a loss of radiation protection expertise and a lack of flexibility in implementing the regulation radiation protection requirements (training, verifications, etc.);
- the emergence of mobile radiology and constant growth in teleradiology with the technical and organisational constraints linked to this organisation method that are under-estimated by the facilities (communication problem, software interfacing);
- increasingly complex organisations, with sharing of resources and the risk of dilution of responsibilities, against a backdrop of health care authorisation reforms and buy-out of centres;
- conflict situations in a context of pressure on human resources or organisational changes of which it became aware during inspections or through the whistle-blower reporting system.

In this context, ASN draws the decision-makers' attention to the need to assess the impact of these changes on the organisations and on the work of the participants and to precisely define the roles and responsibilities of all parties involved, so that the radiation protection requirements are met.

In radiotherapy, even if the safety fundamentals are in place, the OEF process is running out of steam and less detailed ESR analyses and less frequent OEF committee meetings underline the need to restore some meaning to this approach in order to maintain the interest of the professionals and retain a collective dynamic attitude. The repetition of target errors (in particular wrong-side

or positioning errors), reported in 2023, once again recalls the need for regular evaluation of the barriers put into place, taking greater advantage of national OEF. ASN stresses the importance of the advance risk assessment when technical and organisational changes are made. In this respect, ASN shared a risk assessment methodology in its "Patient safety" bulletin of September 2023.

In brachytherapy, the inspections confirm that the radiation protection rules are well taken into account, but the enhanced training effort for emergency situations in the event of a source blockage must be maintained on a long-term basis. ASN underlines the challenges in the coming years linked to maintaining the resources and skills needed for this activity.

In nuclear medicine, the inspections show that radiation protection is satisfactorily addressed, while underlining the need to deploy quality assurance procedures to secure the drugs administration process, in particular for therapeutic procedures as well as for those concerning children, in the light of the ESRs reported. In addition, formalised coordination of prevention measures with outside contractors (for maintenance, upkeep of the premises, the intervention of private practitioners, etc.), personnel training and analysis of the Diagnostic Reference Levels (DRL) are still areas in which progress could be made.

In the field of FGIPs and more particularly in the operating theatre, regulatory nonconformities persist as the years go by, whether the technical rules for the layout of installations, radiation protection training requirements (worker and patient training) and coordination of prevention measures during concomitant activities, notably for interventions by private practitioners. As a result of these deviations, ASN served formal notice on one facility requiring that they comply with the rules regarding radiation protection of professionals and the layout of rooms in which interventional procedures are carried out. ASN also observed that the centres are increasingly calling on Radiation Protection Organisations (OCR), either as specialists for internal RPE support missions, or as Radiation Protection Adviser (RPA), and that if insufficiently well managed, this subcontracting leads to a dilution of the responsibilities of the person/entity Responsible for a Nuclear Activity (RNA) with less consideration for and even deterioration of radiation protection.

In 2024, ASN will continue its inspections in the priority sectors such as radiotherapy, radiosurgery, nuclear medicine, FGIP and computed tomography, following on from the checks carried out in 2023. Particular attention will be paid to the weak signals previously mentioned and to the weak points identified in 2023 (training, OEF approach and lessons learned from reported ESRs, coordination of prevention measures during concomitant activities, work to ensure compliance of installations with layout rules, maintenance), as well as implementation of the quality assurance and change management obligations. If necessary, unannounced inspections will be carried out.

In radiotherapy and in nuclear medicine, on the basis of the lessons learned from the ESRs reported in recent years, specific inspections will be carried out by ASN in 2024 on the accelerators calibration programme and verification of non-contamination, in collaboration with the French Institute for Radiation Protection and Nuclear Safety (IRSN). With regard to FGIPs, ASN will carry out targeted inspections on the private practice physicians who, although not RNA, and not owners of the equipment on which they work, do have radiation protection obligations both for themselves and as an employer of personnel classified in terms of exposure to ionising radiation.

In regulatory terms, ASN will in 2024 revise resolution 2019-DC-0667 of 18 April 2019 setting DRL values to update the values for mammography procedures and will continue the work to prepare for revision of resolution 2008-DC-0095 of 29 January 2008 setting the technical rules to be met for elimination of effluents and wastes contaminated by radionuclides.

Finally, the deployment of new techniques and practices in therapy (radiotherapy, Internal Targeted Radiotherapy – ITR) remains a subject of particular attention for ASN, which will aim to promote all actions designed to improve assessment of the radiation protection issues and allow a better demonstration of their advantages over the existing techniques. On this point, ASN will continue its work with the various institutional players in the health field and the learned societies, and will call on the Advisory Committees of Experts (GPEs), in particular the Committee for the analysis of new techniques and practices using ionising radiation (Canpri), notably flash radiotherapy and adaptive radiotherapy.

In nuclear medicine, against the backdrop of the emergence of new vectors and radionuclides for therapeutic purposes, and the projected growth in the number of patients eligible for these new treatments, with limited out-patient treatment resources and infrastructures, ASN underlines the importance of anticipating the radiation protection issues for the patient and their entourage, the workers, as well as in terms of layout of the facilities and effluent and waste management. To this end, it referred the matter to the Advisory Committee for Radiation Protection (GPRP), and is following European work being done under the SimpleRad[1] project and maintains dialogue with the nuclear medicine players to recall the regulatory framework and examine that it is keeping pace with the changes made.

1. *SimpleRad – EANM EARL – Research4Life: earl.eanm.org/simplerad/*

THE INDUSTRIAL, VETERINARY AND RESEARCH SECTOR

The licensees of the industrial, veterinary and research sector are characterised by their diversity: they are numerous and carry out their activities in structures of widely varying size and status; they also use ionising radiation sources for a wide variety of applications. With regard to radiation protection, ASN's assessment of these licensees is to a large extent comparable to that of previous years.

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 observes that the vast majority of companies maintained the necessary degree of rigorousness to meet the regulatory obligations concerning the organisation of radiation protection, training and dosimetric monitoring of the workers, the use of operators holding the required Certificate of proficiency in handling industrial radiology devices (CAMARI) and maintaining gamma radiography devices. However, significant efforts are still required on the part of many companies to correctly define the programme of verifications required by the Labour Code, implement it, correct any nonconformities found on this occasion and ensure the traceability of the corrections made. If the risk of incidents and the doses received by the workers are on the whole well managed by the licensees when this activity is performed in a bunker in accordance with the applicable regulations, ASN is still concerned by the observed shortcomings in the signalling of the operations area during on-site work, even if a slight improvement in relation to 2022 is observed. ASN underlines that the lack of preparation and cooperation ahead of the work, between the ordering customers and the radiography contractors, is frequently one of the causes of these nonconformities. Progress is in particular needed regarding the content of the prevention plans, and familiarity with and implementation of the provisions contained in them. More generally, ASN considers that the ordering parties should, whenever possible, 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. With regard to suppliers, ASN considers that 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, are areas in which practices progressed by comparison with 2022, but still need to improve further. As for the distributors of accelerators or X-ray emitting devices, the monitoring tools that they put into place to identify the devices distributed and who acquired them often need to be reinforced, to avoid compromising any recall or OEF processes.

The actions carried out by the licensees in recent years are continuing to improve radiation protection within the **research laboratories**. This is to a large extent based on the involvement of the RPAs and depends on the resources placed at their disposal. It should be recalled that the radiation protection issues in many research laboratories tend to be small or are decreasing owing to the use of techniques other than those using ionising radiation.

The conditions for the storage and elimination of waste and effluent remain the primary difficulties encountered by the research units or universities, including with regard to the performance and traceability of checks prior to elimination, the recovery of "legacy" unused sealed radioactive sources or the regular elimination of stored radioactive waste. On these latter points, the lack of forward planning for the funding needed to manage "legacy" sources or waste and their prior characterisation if necessary, is often observed. Finally, the facilities are also still experiencing difficulties in taking on board and correctly implementing checks on equipment, workplaces and instrumentation, as a result of changes to the Labour Code and Public Health Code in 2018, in particular in the case of joint research units.

With regard to the **veterinary uses of ionising radiation**, ASN can see the results 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 people 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 gradually implementing the measures needed to comply with the requirements set out in the Order of 29 November 2019. Thus, on the basis of the inspections performed in 2023:

- source categorisation, an essential step in identifying the applicable requirements and implementing an approach proportionate to the risks, was carried out by the vast majority of facilities;
- in half of the industrial facilities and one third of the medical facilities, ASN has no comments regarding the source protection policy, supported by the facility's general management and promoting the concrete measures to be taken;
- if all the facilities inspected have taken steps to protect the sources, about one third of them had not formally identified the physical barriers guaranteeing this protection, or demonstrated that they offered adequate intrusion resistance;
- in half of the cases, no preventive maintenance programme is defined for the equipment designed to detect intrusions;
- the issue of nominative permits for access to sources has barely progressed by comparison with 2022 and still needs to be implemented in nearly half the facilities;
- half of the facilities do not take steps to identify and protect sensitive information concerning source security.

ASN therefore considers that considerable progress is still needed.

In 2024, ASN will continue its actions to raise licensee awareness on these subjects.

TRANSPORT OF RADIOACTIVE SUBSTANCES

The Transport of Radioactive Substances (TSR) involves numerous players, the carriers of course, but also the consignors, the package designers and manufacturers, etc. The vast majority of shipments is linked to the needs of the non-nuclear industry, the medical sector or research.

ASN considers that in 2023, the safety of TSR is on the whole satisfactory, as in previous years. 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 affecting TSR on the public highway is stable by comparison with 2022, with a handful of events rated level 1 on the INES scale, which is an appreciable fall in relation to 2022. The events chiefly consist of:

- material nonconformities 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 contamination of a package;
- errors or omissions in package labelling, mainly for transports concerning small-scale nuclear activities;
- delivery errors concerning radiopharmaceutical products. As these products are often similar from one hospital unit to another, most of them could be used for patient treatment without any impact.

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 transports for BNIs, ASN finds that the licensees carry out numerous checks and are therefore better able to detect any deviations. For BNIs performing research programmes, 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, notably when this demonstration is carried out by a third-party company. An incident involving non-compliance with a criticality risk control limit, rated level 1 on the INES scale, during on-site transport operations, recalls the importance of such provisions.

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 content and actual implementation of the worker radiation protection programme, the quality management system, and actual compliance with the procedures put into place. The checks to be carried out prior to shipment of a package must therefore be improved. For example, the inspections concerning the transport of gamma ray projectors regularly reveal inappropriate stowage or tie-down.

At a time when the uses of radionuclides in the medical sector are generating a high volume of transport traffic, progress is still needed regarding 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. The quality management systems have not yet been formally set out and deployed, more specifically with regard to the responsibilities of each member of staff involved. ASN considers that the radiation protection of carriers of radiopharmaceutical products, who are significantly more exposed than the average worker, remains a point warranting particular attention.

For transport operations involving packages that do not require ASN approval, progress continues to be observed with by comparison with 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 per 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.

Finally, ASN points out that TSR may be a limiting factor for certain projects, concerning both BNIs and small-scale nuclear activities. With regard to forward planning, ASN therefore asks the licensees to exercise vigilance regarding packaging availability, if necessary, ensuring that they are available in sufficient numbers, and the existence of other package models which could replace those normally used in the event of any problem affecting them.

Regulatory News

The year 2023 was marked by the publication of Act 2023-491 of 22 June 2023 concerning the acceleration of the procedures linked to the construction of new nuclear facilities close to existing nuclear sites and to the operation of the existing facilities. It also saw the completion of a certain number of important texts, in particular those concerning protection against ionising risks and nuclear security.

This year also saw continuing work to revise the Order of 7 February 2012 laying down the general rules relating to Basic Nuclear Installations (known as the "BNI Order").

National news

Acts and ordinances

- **Act 2023-491 of 22 June 2023 relative to the acceleration of the procedures linked to the construction of new nuclear facilities close to existing nuclear sites and to the operation of the existing facilities**

This Act is in line with the President of the Republic's speech in Belfort on 10 February 2022, which underlined the need to move away from fossil fuels by lowering energy consumption, combined with a massive acceleration in the production of decarbonised energy, electrical energy in particular: renewable energies, which are the subject of a specific Act, and nuclear energy, notably with the creation of six new pressurised water reactors (Evolutionary Power Reactor – EPR) by 2035.

This concern comes against the backdrop of a climate emergency threatening ecosystems and future generations, on the one hand, and a crisis of energy sovereignty and security of supply in 2022 following the Ukraine conflict, on the other.

The more precise aim of the Act is to simplify and accelerate construction projects for new nuclear power reactors in France, close to existing nuclear sites, by clarifying the interfaces between the various procedures (urban planning, nuclear power reactor creation authorisation and environmental permit), while guaranteeing protection of all the interests mentioned in Article L. 593-1 of the Environment Code (public health and safety, protection of nature and the environment) and full compliance with the principle of public participation enshrined in the *Charte de l'environnement* (Environment Charter).

During the Parliamentary debate, provisions regarding energy policy were added to the bill. Parliament also asked that several reports be submitted to it by the Government in the coming months or years.

The Act also enabled the procedures for periodic safety review of nuclear power reactors in operation for 35 years or more to be clarified, and the management of extended outages of the Basic Nuclear Installations (BNIs) to be improved. These measures help to provide a secure legal framework for the long-term operation of the nuclear power plant fleet.

Some provisions of the Act require implementing decrees, which are either being drafted or have already been published.

Decrees and Orders

- **Decree 2023-489 of 21 June 2023 relative to the protection of workers against ionising radiation risks**

This Decree draws the consequences of the modifications introduced by Act 2021-1018 of 2 August 2021 aiming to reinforce occupational health prevention. The provisions of the text mainly concern the skills of the occupational health professionals carrying out reinforced individual monitoring of workers exposed to ionising radiation, under the authority of the occupational physician, and their access to the Ionising radiation monitoring information system (Siseri). The text adapts the conditions of training and delivery of the certificate of proficiency in handling industrial radiological equipment to the new professional training

framework. It reforms the certification of external contractors working in areas where there are significant risks of exposure to ionising radiation, using the graded approach. It takes account of the observations of the European Commission (EC) on the transposition of Directive 2013/59/Euratom of 5 December 2013 concerning the continuity of service by radiation protection experts and the training of occupational health professionals. It classifies as category A those workers exposed to a dose to the eye lens higher than 15 millisieverts (mSv) over 12 consecutive months. Finally, it clarifies the procedures for application of certain rules, notably those concerning the dose constraints, the use of operational dosimeters, periodic checks on means of transport or on measuring instruments.

- **Decree 2023-722 of 3 August 2023 relative to Installations Classified for Protection of the Environment (ICPEs) operating on the basis of acquired rights and subject to Directive 2010/75/EU of the European Parliament and Council of 24 November 2010 concerning industrial emissions (integrated pollution prevention and control)**

This Decree is in response to the formal notice served on France by the EC, reference INFR(2022)2057 C (2022)3978 relative to "vested rights" with respect to ICPEs, in which the EC considered that for installations benefiting from acquired rights, French regulations did not stipulate that they required a permit with prescriptions compliant with the requirements of the Directive.

- **Decree 2023-1104 of 28 November 2023 containing various provisions regarding the periodic safety reviews of nuclear power reactors and shutdown of Basic Nuclear Installations (BNIs)**

The purpose of this Decree is to improve access to information by the public and by foreign States during the periodic safety review of a nuclear power reactor after the 35th year of operation and to enable the licensee to postpone transmission of the data associated with this process for all the periodic safety reviews in the event of difficulties with performing some of the planned activities. It also updates the provisions concerning the final shutdown of an installation in the light of the changes introduced by the Act of 22 June 2023 concerning the acceleration of the procedures linked to the construction of new nuclear facilities close to existing nuclear sites and to the operation of the existing facilities.

- **Order of 16 January 2023 amending the Order of 12 January 2017 defining the template form for the "case by case examination request" pursuant to Article R. 122-3-1 of the Environment Code**

This Order modifies the form for the "case by case examination request" as part of the environmental assessment system.

- **Order of 28 February 2023 relative to activities subject to authorisation set out in Article R. 1333-4 of the Defence Code, concerning category III nuclear materials in installations or which are imported and exported, outside a point of vital importance designated under the energy sector national security Directive (civil nuclear sub-sector) and Order of 13 April 2023 with regard to activities subject to authorisation set out in Article R. 1333-4 of the Defence Code, concerning category I and II nuclear materials in installations, which are imported and exported, or present in a point of vital importance designated under the energy sector national security Directive (civil nuclear sub-sector)**

These two Orders specify the nuclear security obligations for the persons concerned (those carrying out an activity, except for transport, associated with nuclear materials in the stated categories).

They supplement two Orders published at the end of 2022: the Order of 27 December 2022 relative to activities subject to authorisation set out in Article R. 1333-4 of the Defence Code concerning category IV nuclear materials in installations or which are imported and exported, outside a point of vital importance in the energy sector (civil nuclear sub-sector) and the Order of 27 December 2022 relative to physical monitoring, nuclear materials accounting, implementing Articles R. 1333-3-2 and R. 1333-11 of the Defence Code, for activities not subject to authorisation set out in Article R. 1333-4 of the same Code.

- **Order of 16 June 2023 defining the national template for the environmental permit application**

This Order modifies the national template for the environmental permit application set out in the Order of 28 March 2019.

- **Order of 20 June 2023 relative to the analysis of per- and polyfluoroalkyl substances (PFAS) in aqueous discharges from Installations Classified for Protection of the Environment (ICPEs) subject to the authorisation system**

This Order defines the procedures for a campaign to identify and analyse the PFAS substances to be found in the aqueous discharges of certain ICPEs subject to authorisation. Twenty PFAS substances targeted by the European Directive on waters intended for human consumption will have to be analysed. It should be noted that other substances that could be analysed are also mentioned. In order to adapt the conduct of the analysis campaigns to the availability of the laboratories, they will be staggered over a period of time according to the activity sectors and the corresponding number of installations in them.

- **Order of 23 June 2023 relative to the procedures for registration and access to the "Siseri" ionising radiation exposure monitoring information system and amending the Order of 26 June 2019 relative to the individual monitoring of worker exposure to ionising radiation**

This Order defines the new procedures for registration and access to "Siseri" by authorised persons (workers, occupational physicians and occupational health professionals, radiation protection advisers, inspectors or inspection staff). It repeals the relevant Articles of the Order of 26 June 2019 (Art. 2 to 8, 10 to 15 and 19 to 22). The other provisions of the Order of 26 June 2019 remain in force.

The main modifications made concern:

- **direct access by the worker to "Siseri"** *via* the *France Connect+* web portal as of 1 July 2024 (option added to the existing possibility of a direct request to the French Institute for Radiation Protection and Nuclear Safety – IRSN);
- **on 1 July 2024, extension of access to "Siseri" to the other health professionals** liable to intervene, under the responsibility of the occupational physician, as part of the reinforced individual monitoring of an exposed worker;
- **the period for retention of the various data** by the accredited organisations and by IRSN, in accordance with the proportionality principle defined by the European General Data Protection Regulation (GDPR);
- clarification of **access to the results of individual dosimetric monitoring** in "Siseri" by prevention engineers, intervening in support of the labour inspectorate system's inspection staff.

● **Order of 26 June 2023 containing procedures for the approval of laboratories performing analysis of water and aquatic environments pursuant to the Environment Code**

This Order defines the conditions in which a laboratory performing physico-chemical, chemical, hydrobiological or ecotoxicological analyses of water, sediments, or biota in water and aquatic environments can be approved by the Minister for the Environment.

● **Order of 30 June 2023 relative to restriction measures – during periods of drought – on the intake of water and water consumption by Installations Classified for Protection of the Environment (ICPEs)**

This Order defines the restriction measures on water intake and consumption by industrial sites, as well as the exemption conditions for certain installations. It applies consistently with the catchment area guideline Orders, the departmental and inter-departmental framework Orders as well as with the prefectural Orders applicable to ICPEs. When the local context so warrants, these Orders may notably stipulate any provisions more restrictive than those set out in this present Order, in order to protect the interests mentioned in Article L. 511-1 of the Environment Code. These Orders may also be revised in order to take account of the provisions of this Order.

● **Order of 16 November 2023 defining the methods for calculating effective doses and equivalent doses resulting from human exposure to ionising radiation**

This Order sets the methods for calculating effective doses and equivalent doses resulting from human exposure to ionising radiation pursuant to Article R. 1333-24 of the Public Health Code. It is applicable as of 1 January 2024 and on this date repeals the Order of 1 September 2003 (same title):

- for the calculation of effective doses, the tissue and radiological weighting factors take account of publication 103 from the International Commission on Radiological Protection (ICRP);
- for workers, the effective dose coefficients per unit of activity ingested or inhaled are taken from ICRP publications 134, 137, 141, 151.

The coefficients for the public, taken from publication 119, are maintained, except for radon.

With regard to workers, two radon coefficients are proposed:

- for indoor workplaces in which the activity of the workers is primarily **sedentary** (service sector, offices, etc.): 3 Sv/m.d.m^{-3};
- for indoor workplaces in which the activity of the workers is primarily **non-sedentary** (significant physical activity: works, maintenance, servicing, etc.): 6 Sv/m.d.m^{-3}.

● **Modification of the Order of 7 February 2012 setting the general rules concerning Basic Nuclear Installations ("BNI Order"): the work to revise this Order continued in 2023.**

ASN resolutions

Resolutions issued pursuant to the Public Health Code

● **Resolution CODEP-DIS-2023-014569 from the ASN Chairman of 16 March 2023 approving the Guide for continuing training in radiation protection of persons exposed to ionising radiation for medical purposes, intended for neurosurgeons performing intra-cranial radiosurgery procedures in stereotactic conditions**

In accordance with Decree 2018-434 of 4 June 2018, ASN determines the objectives of continuing training in the radiation protection of patients and, along with the health professionals, establishes the programmes, teaching methods and evaluation procedures. The guides, approved by ASN, are then published. All the guides are available on *asn.fr*.

Summary of two resolutions issued in 2022 (included in the 2022 Annual Report), but approved in 2023:

● **ASN resolution 2022-DC-0747 of 6 December 2022 setting the rules to be verified by the party responsible for the nuclear activity pursuant to Article R. 1333-172 of the Public Health Code *(approved by the Order of 18 January 2023 approving ASN resolution 2022-DC-0747 of 6 December 2022 setting the rules to be verified by the party responsible for the nuclear activity pursuant to Article R. 1333-172 of the Public Health Code)***

Resolution 2022-DC-0747 supplements the Order of 24 October 2022 relative to the procedures and frequency of the checks on the rules put into place by the party responsible for the nuclear activity, implementing III of Article R. 1333-172 of the Public Health Code, in its version derived from Decree 2018-437 of 4 June 2018 relative to the protection of workers against the hazards of ionising radiation. With regard to the provisions relative to the Public Health Code, this resolution – as at its date of entry into force – repeals ASN resolution 2010-DC-0175 of 4 February 2010 which previously regulated the technical inspections both for the Public Health Code and for the Labour Code.

● **ASN resolution 2022-DC-0748 of 6 December 2022 setting the conditions and procedures for the approval of organisations responsible for the checks mentioned in Article R. 1333-172 of the Public Health Code *(approved by the Order of 18 January 2023 approving ASN resolution 2022-DC-0748 of 6 December 2022 setting the conditions and procedures for the approval of organisations responsible for the checks mentioned in Article R. 1333-172 of the Public Health Code)***

Resolution 2022-DC-0748 is in response to Article R. 1333-174 of the Public Health Code, which requires an ASN resolution for organisations approved to conduct checks in the field of radiation protection concerning the detailed list of information to be enclosed with the approval and approval renewal applications mentioned in II of Article R. 1333-172 and the procedures for the issue, renewal, verification and suspension of approvals.

Basic Nuclear Installations

● **ASN resolution 2023-DC-0770 of 7 November modifying ASN resolution 2017-DC-0616 of 30 November 2017 concerning noteworthy modifications to Basic Nuclear Installations – BNIs** ***(approved by the Order of 9 February 2024 approving ASN resolution 2023-DC-0770 of 7 November modifying ASN resolution 2017-DC-0616 of 30 November 2017 relative to noteworthy modifications to Basic Nuclear Installations)***

This resolution defines the requirements applicable to noteworthy modifications made during the construction phase of a BNI. Prior to this modification, resolution 2017-DC-0616 was in fact only applicable to modifications made after commissioning of the installations.

This resolution in particular defines the list of modifications requiring notification during the construction phase and those requiring authorisation by ASN. It also adapts certain criteria for activating the notification system, to take account of the lessons learned from application of resolution 2017-DC-0616 since it entered force on 1 July 2019.

Summary of a resolution issued in 2022 (included in the 2022 Annual Report), but approved in 2023:

● **ASN resolution 2022-DC-0749 of 29 November 2022 amending ASN resolution 2015-DC-0508 of 21 April 2015 relative to the waste management study and the inventory of waste produced in the Basic Nuclear Installations (BNIs) and ASN resolution 2017-DC-0616 of 30 November 2017 relative to noteworthy modifications to Basic Nuclear Installations** ***(approved by an Order of 16 February 2023 approving ASN resolution 2022-DC-0749 of 29 November 2022 amending ASN resolution 2015-DC-0508 of 21 April 2015 relative to the study of waste management and the inventory of waste produced in Basic Nuclear Installations and ASN resolution 2017-DC-0616 of 30 November 2017 relative to noteworthy modifications to Basic Nuclear Installations)***

All waste produced in a BNI, whether or not radioactive, must undergo rigorous management appropriate to its characteristics. In this respect, the regulations stipulated that the BNI commissioning authorisation application must comprise a "waste management study", presenting and justifying the waste management procedures in this installation and the corresponding management means, in order to reduce the quantity and harmfulness of the waste produced.

Decree 2019-190 of 14 March 2019 codifying the provisions applicable to BNIs, the transport of radioactive substances and transparency in the nuclear field modified the regulations. The impact assessment, transmitted with the BNI creation authorisation application and updated at each major stage in its life, must now demonstrate waste management optimisation, notably in the light of the effects of the installation on the environment and health.

On this occasion, the waste management study was cancelled as a stand-alone document and its content was to a large extent incorporated into the impact assessment. The parts of the study not incorporated into the impact assessment and concerning the operational waste management procedures, will be taken up in the BNI General Operating Rules (RGEs).

In order to take account of these regulatory changes, this resolution modifies:

- ASN resolution 2015-DC-0508 of 21 April 2015 relative to the study of waste management and the inventory of waste produced in the BNIs;
- ASN resolution 2017-DC-0616 of 30 November 2017 relative to noteworthy modifications to BNIs.

The modifications made are of several types:

Firstly, the resolution divides the content of the waste management study between the impact assessment – which is to present the waste produced in the BNI and demonstrate that the objectives set by the Environment Code, such as the hierarchy of waste management methods or compliance with the guidelines of the national and regional waste management plans, have actually been taken into account – and the RGEs, which contain the provisions relating to the routine operation of the BNI and may change more frequently.

Secondly, they reinforce certain waste management requirements, to ensure better control of the duration of waste storage in the installations, guarantee a periodic reassessment of the optimisation of waste management and allow improved coordination between the various radioactive or conventional waste management plans.

Finally, the resolution makes provision for improved management of waste from a conventional waste area but with radioactive contamination, which is an abnormal situation needing to be dealt with as such.

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 2023, the ASN regional divisions totalled 218 employees, of whom 157 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 (TSR) 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 (RNA) within their regions. The regional divisions check, for these activities and within these installations, application of the regulations relative to nuclear safety and radiation protection, to Pressure Equipment (PE) and to Installations Classified for Protection of the Environment (ICPEs). They ensure the labour inspection in the Nuclear Power Plants (NPPs).

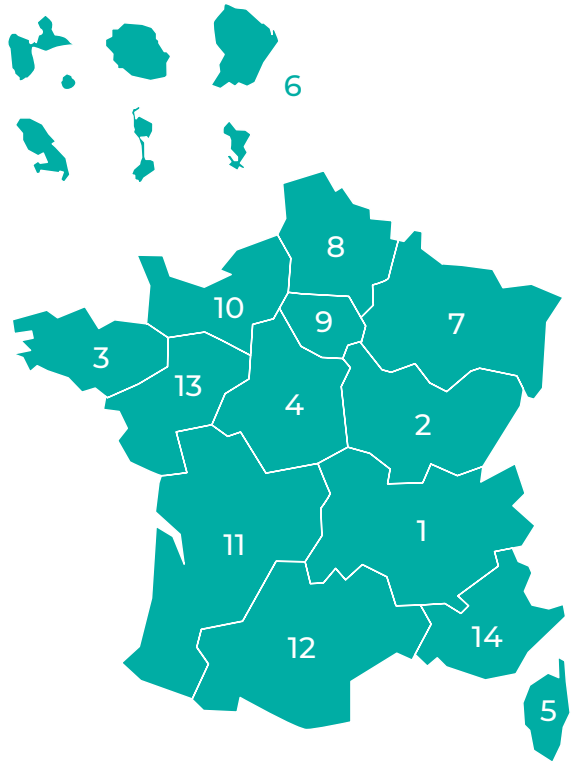
In radiological emergency situations, the ASN regional divisions check the on-site measures taken by the licensee to make the installation safe and assist the Prefect of the *département*[1], who is responsible for protection of the population. To ensure emergency situation preparedness, they help draw 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. 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 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.

1. *Administrative region headed by a Prefect.*



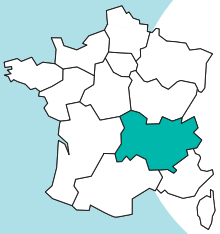
IMPORTANT

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 SECTOR > Chapter **07**

RESEARCH AND INDUSTRY > Chapter **08**

TRANSPORT SECTOR > Chapter **09**



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 2023, ASN carried out 309 inspections in the Auvergne-Rhône-Alpes region, comprising 111 in the Bugey, Saint-Alban, Cruas-Meysse and Tricastin Nuclear Power Plants (NPPs), 96 in plants and installations undergoing decommissioning, 90 in small-scale nuclear activities and 12 in the Radioactive Substance Transport (TSR) sector.

ASN also carried out 22 days of labour inspections in the four NPPs and on the Creys-Malville site.

In 2023, ASN was notified of 24 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 one in TSR and two in small-scale nuclear activities.

Furthermore, two events were rated level 2 on the ASN-SFRO scale (scale specific to radiation protection events affecting patients undergoing a radiotherapy procedure).

Lastly, in the context of their oversight duties, the ASN inspectors issued two violation reports.

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.

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 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 performance of the Bugey NPP with regard to nuclear safety and, to a lesser extent, radiation protection, is in line with ASN's general assessment of the EDF plants. Its environmental protection performance however is considered to be below the average for the EDF plants.

With regard to nuclear safety, ASN considers that the NPP's performance has improved slightly, but in an industrial context with lower workloads than in the preceding years. Configuring the systems and managing the periodic tests and requalification tests are still areas displaying weaknesses. In addition, ASN expects to see improvements in the control of fire risks, having noted breaks in sectorisation and unauthorised storage of fire loads during its inspections.

There are improvements in maintaining the first barrier, that is to say the fuel cladding, in good condition, but shortcomings are still observed in the management of the risk of introducing foreign objects into the systems. Lastly, ASN is waiting for EDF to analyse the causes and potential consequences of the two internal floods of the site's underground galleries which occurred in autumn 2023 and to take appropriate measures to prevent this recurring.

With regard to radiation protection, although occupational exposure is well managed, ASN notes persistent weaknesses in the culture of worker radiation protection, radiological cleanliness of the installations and containment on work sites with contamination dispersion risks. During the tightened inspection it carried out in 2023, ASN noted deviations in the upkeep of the installations, in the management of controlled zones and the personal radiation monitoring devices.

Concerning environmental protection, several events and problems of retention structure leakages in 2023 led to bypassing of the normal discharge routes, without harming the environment. ASN considers that the overall standard of waste management remains satisfactory.

With regard to health and safety at work, ASN considers that appropriate measures have been put in place reactively to take account of the accident levels, particularly in lifting operations. Nevertheless, measures must be taken with outside contractors to improve the management of storage areas and the upkeep of work sites, particularly during reactor outages.

Reactor 1 undergoing decommissioning

Bugey 1 is a Gas-Cooled Reactor (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.

ASN considers that the Bugey 1 reactor decommissioning and vessel characterisation operations are proceeding with a satisfactory level of safety.

ACTIVATED WASTE CONDITIONING AND INTERIM STORAGE FACILITY

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

- low-level long-lived graphite waste (LLW-LL) 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;
- 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 Radioactive Waste Management Agency (Andra).

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 Tricastin Operational Hot Unit (BCOT) of EDF, undergoing decommissioning;**
- **the High Flux Reactor (RHF) operated by the Laue-Langevin Institute in Grenoble;**
- **the Activated waste conditioning 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 and its auxiliary installations;**
- **the Ionisos irradiator in Dagneux;**
- **the international research centre of the European Organisation for Nuclear Research (CERN), situated on the French-Swiss border;**
- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 23 external-beam radiotherapy departments,
  - 6 brachytherapy departments,
  - 23 nuclear medicine departments,
  - 122 facilities using fluoroscopy-guided interventional procedures,
  - 164 computed tomography scanners in 109 facilities,
  - some 10,000 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - 1 synchrotron,
  - about 490 veterinary practices (surgeries or clinics),
  - 33 industrial radiography agencies,
  - about 600 users of industrial equipment,
  - about 75 public or private research units;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 3 organisations and 8 agencies approved for radiation protection controls,
  - 11 organisations approved for taking radon activity concentration measurement.

By letter of 5 May 2021, EDF submitted to the Minister responsible for nuclear safety a request to amend the Iceda Creation Authorisation Decree (DAC), to allow the acceptance of decommissioning waste from the Fessenheim NPP, which is currently being examined by ASN.

Regarding conditioning of the waste, ASN authorised EDF to condition its waste in the C1PGSP package through resolution CODEP-DRC-2021-013808 of 19 July 2021. The validity of this conditioning authorisation was limited to 31 December 2023. After examining complementary studies submitted by EDF, ASN authorised the continuation of waste conditioning through resolution CODEP DRC-2023-68099 of 18 December 2023.

Further to the inspections carried out in 2023, ASN considers that the licensee's organisation and management of the waste induced by the process have 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.

ASN conducted an inspection of the fuel reception process in 2023. The organisation of this process was considered robust, but ASN has asked for improvements in fire detection training and management.

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 performance of the Saint-Alban NPP with regard to nuclear safety, radiation protection and environmental protection is in line with the general assessment of EDF plant performance.

With regard to nuclear safety, ASN finds that the site's facilities are operated and maintained satisfactorily despite disruptions in the industrial programme in 2023. Reactor 1 was shut down for its refuelling and maintenance outage. EDF had difficulties in managing the outage activities schedule and several deviations from the safety requirements were highlighted during ASN's work site inspections. As far as reactor operation is concerned, control room monitoring and management of the operating team's skills are deemed satisfactory.

With regard to occupational radiation protection, ASN considers that the control of occupational exposure is satisfactory. However, with regard to the Significant Radiation Protection Events (ESRs) reported in 2023, ASN is still waiting for improvements in the radiation protection culture and rigour in the marking out of work sites and the management of tools and radioactive waste.

As far as environmental protection is concerned, the NPP's results are satisfactory but ASN wants to see faster responses to the technical problems impacting the environmental protection systems.

With regard to health and safety at work, ASN observes that the site is continuing the deployment of the national EDF actions, particularly regarding the electrical risks and lifting. Specific actions relating to the electrical risk have been satisfactorily implemented on the site. Although the level of accidents is broadly under control, particular vigilance must be maintained during the reactor outages.

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

With regard to nuclear safety, ASN expects an improvement in operating rigour and activity preparation. The measures deployed in 2023 under the operating rigour improvement plan to limit maintenance non-qualities in particular (training sessions, supervision, assistance in activity preparation) must be continued. Furthermore, the occurrence of several significant events relating to inappropriate operating actions reveals difficulties in normal operational management, the preparation of activities and monitoring. ASN also observed maintenance problems during the reactor outages in 2023. ASN considers it essential for the site to improve control of the maintenance activities before starting the site's fourth ten-yearly outages, which will begin in summer 2024 on reactor 3.

Improvements in radiation protection compared with the preceding years were observed in 2023, notably with a reduction in occupational contamination events. Nevertheless, a tightened inspection on the subject revealed deviations in the upkeep of the facilities, management of the work site zone containment airlocks and management of the controlled areas.

The situation regarding environmental protection has improved compared with 2022. More specifically, the means implemented to avoid the overflow of the cooling tower ponds prevented overflows similar to those that occurred in the preceding two years. ASN notes a reduction in the number of Significant Environmental Events (ESE), but considers that the licensee must remain attentive to the control of containment of pollutions by liquids.

The site's results in occupational health and safety are satisfactory. The accident levels remain controlled, particularly during reactor outages. A handling accident occurred when carrying out work on the polar crane during the reactor 1 outage, without causing injury.

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 nuclear power plant comprising four 900 MWe reactors, "nuclear fuel cycle" facilities, and a facility which fulfilled maintenance and storage functions and is now undergoing decommissioning.

TRICASTIN NUCLEAR POWER PLANT

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

ASN considers that the nuclear safety performance of the Tricastin NPP stands out positively with respect to its general assessment of the EDF plants, and that its radiation protection and environmental protection performance is in line with the ASN's general assessment of the EDF nuclear fleet.

As regards nuclear safety, ASN considers that the plant's performance remains satisfactory, but has not improved with respect to 2022. With regard to maintenance, the second batch of modifications planned for under the fourth periodic safety review has been satisfactorily integrated on reactor 1. ASN considers that EDF satisfactorily carried out the planned activities for the three reactor outages of 2023 and complied with the corresponding safety requirements. Weaknesses in operating rigour were nevertheless observed, with several significant events linked to failure to apply the work error-reduction practices.

With regard to radiation protection, ASN considers that the performance of the NPP has deteriorated slightly. Eight ESRs were reported compared with three in 2022, and deficiencies in the control of the radiological cleanliness of the work sites were identified during the reactor outages. The tightened inspection carried out in 2023 also revealed deviations in the upkeep of the facilities and the management of controlled areas.

ASN considers that the environmental protection performance of the NPP has improved and on the whole is in line with the general assessment of the EDF plants. Although several ESEs were reported in 2023, ASN notes the efforts the site has made in this area. Furthermore, the ASN resolutions governing the site's discharges were revised in 2023, in particular to adapt the environmental monitoring programme and to reassess the methods of controlling certain substances further to changes in the operating conditions.

As far as occupational safety is concerned, ASN considers that the site's results are satisfactory and stable with respect to the preceding year. Accident levels, particularly during the reactor outages, remain under control despite a slight increase.

THE "NUCLEAR FUEL CYCLE" FACILITIES

The Tricastin "fuel cycle" facilities mainly cover the upstream activities of the "fuel cycle" and are operated by Orano Chimie-Enrichissement, 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 uranium hexafluoride (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 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, 179 and 180) for storing uranium in the form of oxides or UF_6;
- the Maintenance, liquid effluent treatment and waste conditioning 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 areas and a liquid effluent treatment unit.

Following the inspections it conducted in 2023, ASN considers that the level of safety of the Orano facilities on the Tricastin site is satisfactory. In 2023, ASN noted an improvement in the organisation for analysing conformity with the regulatory texts and implementing the necessary compliance work.

In 2023, ASN conducted a campaign of simultaneous unannounced inspections on BNIs 105, 138, 155, 168 and 176 focusing on waste management, to verify Orano's organisation in this area. In this context, the inspectors visited the waste production, sorting and collection sites. These inspections showed that the licensee has made improvements in this area.

ASN also conducted inspections in 2023 on the theme of criticality risk prevention on several of the platform's facilities and at platform level. ASN considers the results of these inspections to be broadly satisfactory, even if for the facilities undergoing decommissioning the licensee must improve knowledge of the stored legacy waste and the quantities of residual materials in certain items of equipment.

To check the progress of treating the backlog of diverse radioactive substances stored on the site, ASN asked Orano to present an annual statement on the progress of its action plan for the treatment of these substances.

In 2024, following numerous inspections and exchanges in 2023, ASN will check the progress of the decommissioning operations and the gradual emptying of areas 61 and 79 of BNI 105.

The Tricastin site has two main liquid effluent management facilities: the Chemical Effluents Treatment Station (STEC – DBNI) and the Uranium-containing Effluents Treatment Station (STEU – BNI 138). Orano is considering reorganising all the effluent movements on the Tricastin platform – DBNI included – and had to provide a Safety Options Dossier (DOS) for this project in 2023. ASN was not convinced by some of the project's preliminary orientations, obliging the licensee to modify its project which is now expected for 2024.

With regard to projects, Orano has started operating the first two buildings of the new reprocessed uranium storage facility called "FLEUR" (BNI 180), whose commissioning was authorised by ASN in January 2023.

Furthermore, in mid-2023 Orano started work on the AMC2 project which consists in adding a new facility for washing and rinsing containers dedicated to the transport of UF_6. This facility was authorised by Decree 2023-1220 of 19 December 2023.

Orano also started the work on building 57L of BNI 138 in mid-2023, which will enhance the safety of certain storage areas.

Lastly, to increase its enrichment capacities, Orano initiated the project to extend the Georges Besse II (GB II) North enrichment plant in 2022, which underwent a prior consultation in 2023. In June 2023, Orano submitted the application for a substantial modification to the facility authorisation decree in order to build this extension.

The ASN Chairman accompanied by two Commissioners visited the site in July 2023. On this occasion, the licensee presented the progress of the projects mentioned in 2019 during the ASN Chairman's previous visit. An interim assessment of the GB II enrichment plant extension project was carried out. Lastly, the ASN Commission reiterated that ASN expects Orano to commit the necessary resources to the new projects, as much to increase its production capacities as to improve certain support functions, such as the new container maintenance facility (AMC2), or the treatment of the backlog of radioactive substances stored on the site. The discussions also focused on the overall view of the impacts of the site, including the strategy for managing liquid effluents in the short and medium term.

ORANO'S URANIUM CHEMISTRY PLANTS TU5 AND W

The "TU5" plant can handle up to 2,000 tonnes of uranium per year, enabling it to reprocess all the uranyl nitrate ($UO_2(NO_3)_2$) produced by the Orano plant at La Hague, converting it into U_3O_8, a stable solid compound guaranteeing safer uranium storage 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 GB II enrichment plant, to stabilise it as U_3O_8.

ASN considers that the facilities situated within the perimeter of BNI 155 are operated with a satisfactory level of safety. The drop in the number of significant or notable events, already observed in 2022, continued in 2023. ASN will nevertheless be attentive in 2024 to ensure that the licensee maintains the rigour of operation of the facilities.

ASN expects the files associated with the consequences of the project to increase the capacity of the GB II North plant on the activities of the W plant to be submitted in 2024.

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 being decommissioned.

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, as well as exposure of the workers to ionising radiation and the criticality risk, on account of the residual uranium-bearing substances present in some items of equipment.

ASN notes that the decommissioning operations on the BNI part were suspended in mid-2023 due to operational difficulties linked to waste management. Further to ASN's requests, the licensee undertook actions aiming to improve, in the short term, the safety of storage of the radioactive and hazardous substances of areas 61 and 79, which will more specifically require a transfer of these storage areas on the site. A number of new difficulties, such as prevention of the criticality risk for a portion of these materials, arose in 2023, after conducting new analyses of the stored substances. In 2024, ASN will check the progress of the decommissioning operations and the gradual emptying of areas 61 and 79.

After the technical difficulties experienced by the Philippe Coste plant in 2022, ASN considers that the licensee has stabilized its functioning and that this plant is operated satisfactorily with regard to nuclear safety. In 2024, ASN will ensure that the licensee maintains a good standard of operating rigour, and also expects the licensee to accomplish its project to design treatment units for non uranium-bearing effluents and the on-line treatment of potassium diuranate (KDU).

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 using the gaseous diffusion process.

After this plant stopped production in May 2012, the licensee implemented the "intensive rinsing followed by air venting" operations (Prisme operation) from 2013 to 2016. These operations allowed the extraction of virtually all the residual uranium deposited in the diffusion barriers. 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 installation. At the end of the periodic safety review of the yards, ASN ordered complementary measures in its resolution CODEP-CLG-2023-012727 of 8 March 2023. These yards should in the short term be attached to the Tricastin uranium storage yards (BNI 178).

The Decree ordering Orano to proceed with the decommissioning of the Georges Besse I 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 is undergoing specific studies. On completion of the periodic safety review of the facility, ASN sent its conclusions to the Minister of the Energy Transition on 13 July 2023, without issuing further requirements. ASN underlines that the action plan involving the management of large quantities of legacy operational waste must be strictly followed and implemented, and that attention must be paid to the facilities in service within the perimeter of the installation. ASN considers that in 2023 the monitoring operations and the progress of the decommissioning project are satisfactory, but there is room for improvement in operational rigour. ASN is expecting the detailed decommissioning scenario studies for the diffusion cascades to be completed in 2024.

GEORGES BESSE II ENRICHMENT PLANT

The Georges Besse II (GB II) plant, which constitutes BNI 168, has been the site's enrichment facility since the Georges Besse I plant was shut down. It separates uranium isotopes using the centrifugation process.

The standard of safety of the plant's facilities in 2023 was satisfactory. The technologies used in the facility enable high standards of safety, radiation protection and environmental protection to be achieved. ASN considers that the licensee is duly following its commitments to ASN.

The examination of the concluding report of the first periodic safety review of BNI 168 is continuing. ASN conducted a dedicated inspection on this subject in June 2023 which underlined the good organisational setup put in place for the safety review and led to the formulation of demands concerning regulatory conformity and the action plan.

In 2022, Orano began the project to extend the GB II North enrichment plant in order to increase its production capacities by adding centrifuge modules. The GB II North plant extension project underwent a prior consultation from 1 February to 9 April 2023, organised by the French National Public Debates Commission (CNDP). In June 2023, Orano submitted the substantial modification application file in order to build this extension. This project will undergo a public consultation in 2024.

MAINTENANCE, EFFLUENT TREATMENT AND WASTE CONDITIONING 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.

Concerning the periodic safety review, every six months the licensee sends a statement of the commitments made to ASN. The progress of the action plan and commitments is considered satisfactory despite some delays. ASN takes positive note of the start of work on building 57L in 2023, which will improve the safety of certain storage areas.

The results of the inspections carried out in 2023 on the themes of commitment follow-up, civil engineering monitoring, criticality safety, modification management and waste management are satisfactory. In 2023, ASN also checked the progress of the site's new linen room project, situated outside the BNI perimeters, which will improve fire risk prevention in BNI 138.

TRICASTIN URANIUM-BEARING MATERIAL STORAGE YARDS, P35 AND FLEUR

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 facilities and the platform's new emergency management premises.

Following on from this delicensing process, facility "P35" (BNI 179) was created. It comprises ten uranium storage buildings. An additional storage area called "FLEUR" was authorised by a Decree of 18 March 2022. Commissioning of this new BNI (BNI 180) was authorised by ASN resolution 2023-DC-0750 of 3 January 2023.

At the end of the periodic safety review of the yards, ASN ordered complementary measures in its resolution CODEP-CLG-2023-012740 of 8 March 2023. Among these measures figure the emptying or the decommissioning of material packagings.

Further to the three inspections at these facilities on the themes of meeting commitments, control of the criticality risk and civil engineering, ASN considers that the level of safety of the storage yards in 2023 was satisfactory. Nevertheless, with the various past and future movements of material, the way the radiological exposure induced by the yards evolves – both within and outside the site – should be monitored.

Lastly, in mid-2023 Orano started work on the AMC2 project which consists in adding a new facility for washing and rinsing containers dedicated to the transport of UF_6. This facility will replace the existing AMC which is situated in the DBNI. The creation of AMC2 was authorised by Decree 2023-1220 of 19 December 2023 following a public inquiry which ran from 10 December 2021 to 12 January 2022.

Romans-sur-Isère site

FRAMATOME NUCLEAR FUEL FABRICATION PLANTS

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 old 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).

The fabrication of fuel for nuclear power plant reactors involves transforming UF_6 into uranium oxide powder. The pellets fabricated from this powder in Framatome's Romans-sur-Isère plant are placed in zirconium metal clads to constitute the fuel rods, then brought together to form the fuel assemblies to be used in the NPP reactors. In the case of experimental reactors, the fuels are more diverse, with some of them using, for example, highly-enriched uranium in metal form. These fuels are fabricated in the Romans-sur-Isère plant called "Cerca".

The Cerca plant features a "uranium zone" in which the compacted powder cores placed in aluminium frames and plates to form the fuel elements are produced, as are the irradiation targets for the production of medical radionuclides. 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 existing uranium zone. Due to technical problems and the impact of the Covid-19 pandemic, the NZU construction work has fallen significantly behind schedule. In 2022, Framatome applied to ASN for a partial commissioning authorisation for the NZU to enable it to transfer materials between the existing buildings and the NZU. ASN issued this authorisation in October 2022. Difficulties with the tests of certain equipment items arose in 2023, leading Framatome once again to postpone commissioning of the NZU until 2024. ASN expects increased mobilisation on the part of Framatome in order to effectively commission the NZU, and points out that the level of safety of the existing uranium zone does not permit continued long-term operation.

In 2023, Framatome conducted a fuel production campaign with Enriched Reprocessed Uranium (ERU). An application for a substantial modification to the unit fabricating nuclear fuels for PWRs, with the aim of increasing the production of fuels based on enriched reprocessed uranium, is currently being examined by ASN and will undergo a public inquiry in 2024.

The results of the inspections carried out at Romans-sur-Isère in 2023 are satisfactory, particularly regarding implementation of the new environmental monitoring plan, control of the criticality risk, restarting of production of fuels based on ERU, radiation protection and emergency management. A week-long in-depth inspection was carried out in March 2023 on the themes of operating rigour and prevention of fraud: the inspection result was broadly positive.

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. 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.

In view of the oversight actions it conducted in 2023, ASN considers the safety of the RHF to be satisfactory. After carrying out substantial works to renovate the RHF and enhance its safety in 2022, no significant difficulties were encountered with the restarting of the reactor and its cycles in 2023.

In 2023, the ILL continued progressing with the action plan established for its third periodic safety review and enriched by the commitments made further to the expert assessment associated with this review. The year also saw intensive discussions during the examination of modifications to be implemented as of mid-2024 to comply with ASN resolution 2022-DC-0738 of 28 July 2022 validating the conclusions of the periodic safety review.

In July 2022, the ILL also submitted a "public information notice" file aiming to establish new technical requirements for discharges and environmental monitoring. Elements were added to this file in 2023 and ASN is continuing to examine it.

ASN will be particularly attentive in 2024 to the preparation of the next activities with safety implications for ILL, notably the pre-clean-up operations of the former detritiation facility and the polar crane renovation. Lastly, the revision of the ASN requirements regulating discharges will be continued in 2024.

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, prosthesis) and polymerising plastic materials.

ASN considers that the operational safety of the facility was satisfactory in 2023. However, ASN has also noted the simultaneous departure of the safety manager and the safety engineer, which is a source of organisational vulnerability for safety management. In view of the ongoing projects, ASN considers that the licensee must lastingly reinforce its team and its skills with regard to safety.

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 for 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 inspections by the Swiss and French authorities were held in 2023 on the themes of the management of high-activity sources and the transport of radioactive substances. These inspections 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.

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.

In this context, ASN inspected the end of the reactor core closure plug cutting operations. The large rotating plug was cut into three pieces stored on specific storage platforms. The reactor vessel was covered by a containment structure to seal it pending its decommissioning. This containment structure shall also be used to permit the extraction of the first internal components of the vessel in 2024.

In 2023, ASN also inspected the preparation operations for construction of the D4 tunnel facility in which the most highly activated internal parts of the reactor vessel will be cut up by remote operation.

In view of the inspections conducted in 2023, ASN considers that the safety of the Superphénix reactor decommissioning operations and of operation of the fuel storage facility is ensured satisfactorily.

Tricastin Operational Hot Unit

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.

Decree 2023-1049 of 16 November 2023 authorises decommissioning of the BCOT, for which the public inquiry ran from 15 February to 17 March 2022.

ASN considers that the level of safety of the BCOT is satisfactory. In 2024, ASN will be particularly attentive to compliance with the steps of the decommissioning decree and the requirements introduced by the associated new baseline requirements for carrying out the decommissioning and the structure and soil clean-up operations.

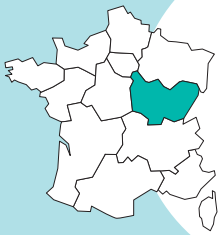
Siloette, Siloé, LAMA reactors and effluents and solid waste treatment station – *CEA Centre*

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 (BNIs 36 and 79) were the STED and the decay storage facility.

Given the final state of the site after decommissioning, ASN made their delicensing conditional upon the application of active institutional controls which enable the future use of the site to be limited to industrial purposes and the residual pollution record to be kept. ASN then declared the delicensing of the CEA Grenoble centre's last two BNIs through ASN resolution 2023-DC-0751 of 13 January 2023.



Bourgogne-Franche-Comté
REGION

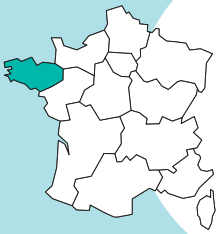
The Dijon division regulates nuclear safety, radiation protection and the transport of radioactive substances in the 8 *départements* of the Bourgogne-Franche-Comté region.

ASN conducted 51 inspections in small-scale nuclear activities in the Bourgogne-Franche-Comté region in 2023, comprising 22 inspections in the medical sector, 16 in the industrial, research and veterinary sectors, six concerning radon exposure, one to monitor approved organisations and laboratories, and six specific to the transport of radioactive substances.

ASN also devoted particular attention to the Framatome nuclear pressure equipment 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. ASN carried out ten inspections in these plants in 2023, of which five were in the Creusot plant and five in the Chalon Saint-Marcel plant.

The installations and activities to regulate comprise:

- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 8 external-beam radiotherapy departments,
  - 4 brachytherapy departments,
  - 14 nuclear medicine departments, of which 3 practise internal targeted radiotherapy,
  - 36 centres performing fluoroscopy-guided interventional procedures,
  - 66 computed tomography scanners for diagnostic purposes in 48 centres,
  - about 800 medical radiology devices,
  - about 2,000 dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - about 180 veterinary practices, of which 4 have a computed tomography scanner and 16 practice equine radiology,
  - about 400 industrial and research centres, including 25 companies with an industrial radiography activity,
  - 1 industrial irradiator using radioactive sources,
  - 1 computed tomography scanner dedicated to research,
  - 2 accelerators, one for the production of drugs for medical imaging and one for industrial irradiation;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 1 organisation approved for radiation protection controls,
  - 6 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 Brennilis Nuclear Power Plant (NPP), currently undergoing decommissioning.

In 2023, ASN carried out 48 inspections, two at the Monts d'Arrée NPP currently being decommissioned, one to monitor an approved laboratory, three in the transport of radioactive substances and 39 in small-scale nuclear activities (22 in the medical sector and 17 in the industrial, veterinary and research sectors).

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 Megawatts electric – 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. Decree 2023-0898 of 26 September 2023, published on 28 September 2023, requires EDF to completely decommission BNI 162 and amends Decree 96-978 of 31 October 1996 authorising the creation of this facility. The Decree sets the radiological cleanliness targets, and future ASN resolutions will govern the methods of post-operational clean-up of the site, which shall be taken as far as is reasonably achievable. The end-of-commissioning date is set at 2041.

In April 2023, ASN issued the authorisation to stop the lowering of the water table underneath the effluent treatment station. During 2023, ASN also continued the revision of the resolutions governing discharges and water intakes and the examination of the general operating rules and the on-site emergency plan for the complete decommissioning.

During the same year, EDF continued its preparatory work for complete decommissioning, in particular with the removal of asbestos from the accessible places and the civil engineering work to enlarge the existing accesses and demolish bunkers. EDF also started the work to treat the water infiltrations in the facilities, which concern the "G7" gallery in particular.

Alongside this, EDF has started execution studies for certain complete decommissioning operations (such as the decommissioning of the peripheral circuits) and for upgrading the support functions that are absolutely necessary for complete decommissioning (handling cranes, ventilation in the reactor containment, etc.).

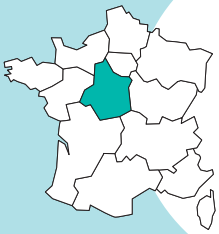
The installations and activities to regulate comprise:

- **the Basic Nuclear Installation::**
  - the Monts d'Arrée (Brennilis) NPP, undergoing decommissioning;
- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 10 external-beam radiotherapy departments,
  - 5 brachytherapy departments,
  - 10 nuclear medicine departments,
  - 38 centres performing fluoroscopy-guided interventional procedures,
  - 63 computed tomography scanners for diagnostic purposes,
  - some 2,500 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - 1 cyclotron,
  - 16 industrial radiography companies, including 3 performing gamma radiography,
  - 25 research units,
  - about 400 users of industrial equipment;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 8 organisations approved for measuring radon,
  - 3 head-offices of laboratories approved for taking environmental radioactivity measurements.

ASN notes that the November 2023 storm "Ciaran" had no impact on the safety of the NPP. The decommissioning operations were stopped on 2 November 2023 due to an outage of the site's main electrical power supply, and resumed on 6 November 2023.

ASN considers that the management of the NPP decommissioning project is satisfactory. ASN notes positively the management of the interfaces between the project and the site, in particular with the planned reinforcement of the project team within the NPP. Nevertheless, with regard to the monitoring of the facilities, EDF must ensure that it meets the prescribed deadlines for carrying out all the periodic checks and ensures the traceability of the characteristics of the materials with a view to their reuse or the future delicensing of the facility.

As from 2024, ASN will be particularly attentive to the application of the new baseline requirements for the complete decommissioning of the facility and to the maintenance of the equipment required for the decommissioning operations, especially the handling equipment. ASN will also maintain its vigilance regarding the radiation protection plan, particularly concerning compliance with the controlled area entry rules.



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.

In 2023, ASN conducted 166 inspections in the Centre-Val de Loire region, of which 116 were in the nuclear installations of the EDF sites of Belleville-sur-Loire, Chinon, Dampierre-en-Burly and Saint-Laurent-des-Eaux, 39 in small-scale nuclear activities, five in the transport of radioactive substance and six concerning approved organisations or laboratories.

ASN also carried out 38 days of labour inspections in the four Nuclear Power Plants (NPPs) of the region.

In 2023, ASN was notified of 16 significant events rated level 1 on the International Nuclear and Radiological Event Scale (INES scale).

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 has two 1,300 Megawatts electric (MWe) reactors commissioned in 1987 and 1988, which constitute Basic Nuclear Installations (BNIs) 127 and 128 respectively.

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

From the nuclear safety aspect, ASN considers that with regard to management of the facilities, operational rigour in the control room was maintained at a satisfactory level. The site must continue its efforts in the management of system configurations (alignments, padlocking, administrative lockouts) through the action plan it has applied since early 2023. ASN notes positively the reinforcing of the action plan initiated in 2022 to address the fire sectorisation anomalies.

As far as the maintenance of the facilities is concerned, the performance of the Belleville-sur-Loire NPP is considered satisfactory. The year 2023 was marked by a particularly intensive industrial programme due to the operations to replace pipe sections linked to the stress corrosion problem. ASN considers that the overall management of these outages is satisfactory in the light of its various inspections, which revealed no major deviations.

In the area of radiation protection, ASN considers that the Belleville-sur-Loire NPP obtained satisfactory results regarding the radiological cleanliness of the premises and occupational exposure, despite large-scale works in the reactor building, which led to a significant increase in the collective dosimetry. It will nevertheless remain attentive in 2024 to the marking out of limited stay areas and to the level of contamination of the workers, a subject in which difficulties were identified during the outage of reactor 1 in 2023.

With regard to environmental protection, ASN considers that effluent management and the monitoring of discharges are satisfactory. It observes a lowering of the copper and zinc discharges in the liquid effluents, and a reduction in the number of legionella colonisation threshold overshoots compared with 2022. A tightened environmental inspection revealed several improvements concerning the control of non-radiological risks and the optimisation of effluent management. In February 2024, ASN revised the resolutions governing the site's discharges in order to take into account the installation of a legionella and amoeba treatment station in 2024.

In the area of labour inspection, ASN notes that the Belleville-sur-Loire NPP's results deteriorated significantly in 2023, particularly regarding outside contractors accident levels. Consequently, while noting that no accidents were serious or related to critical risks, ASN considers that accident prevention must be a major work focus in 2024. Alongside this, while ASN's inspections found improvements in the management of the chemical risk, ASN is still waiting for the site to take strong measures in prevention of the electrical risk, in view of the inspections it carried out on this subject in 2023.

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 nuclear 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 (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 the nuclear safety performance of the Dampierre-en-Burly NPP to be far below the national average. The radiation protection and environmental performance is broadly in line with ASN's general assessment of the EDF plants.

With regard to nuclear safety, the site implemented a plan of rigour following the significant deterioration in operational management performance observed in 2022. Several measures aiming to improve the rigour of the service responsible for operational management, particularly as regards the General Operating Rules (RGEs), were thus applied during 2023. Although management of the periodic tests, which was very poor in 2022, has improved, ASN considers that the plan of rigour is not yet fully effective given that it has not led to a significant improvement in the safety results. In effect, the number of significant events reported during the year was among the highest of the EDF reactor fleet, with causes similar to those observed in 2022 (organisational deficiencies linked to the shortcomings in the documentation and in communication between the operational management teams, inadequate knowledge of the RGEs). ASN will conduct an in-depth inspection in June 2024 in order to carry out a detailed appraisal of the site's safety performance.

With regard to maintenance of the facilities, the site's performance has improved and is now in line with the national average, in a high workload context due to the fourth ten-yearly outages of reactors 2 and 3. The site must nevertheless be particularly attentive to the maintenance of the backup diesel generator sets and the safety injection system, which are subject to regular equipment failures.

Radiation protection performance, a recurrent weakness at the Dampierre-en-Burly NPP, improved in 2023 and is now in line with the national average. Although the site has one of EDF's lowest rates of worker contamination, progress must still be made in the management of the radiological work regimes, in the performance of the radiological checks of equipment leaving controlled areas (numerous hot spots were detected in 2023 on the site's roadways) and in the management of the marking out of limited-stay areas. ASN will keep a close track on these points in 2024.

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 Fresh Fuel Warehouse (MIR);
- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 8 external-beam radiotherapy departments,
  - 3 brachytherapy departments,
  - 11 nuclear medicine departments,
  - 32 centres using interventional procedures,
  - 38 computed tomography scanners,
  - some 2,700 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - 10 industrial radiography companies,
  - about 330 industrial, veterinary and research radiography devices;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 2 organisations approved for radiation protection controls,
  - 4 laboratories approved for taking environmental radioactivity measurements.

The environmental protection performance of the Dampierre-en-Burly NPP significantly improved in 2023, particularly in the management of the microbiological risk and the discharges of copper and zinc in the liquid effluents. The site must nevertheless continue its work to improve the containment of hazardous substances and undertake the necessary studies to increase the number of effluent storage tanks to take into account the effects of climate change and the problems of ageing of the existing tanks.

The year 2023 saw significant labour inspection demands in the social field due to an apparently deteriorated social dialogue between management and the personnel representative bodies, in view of the safety alerts filed by members of the NPPs social and economic committee.

ASN also notes the persistence of significant deviations in the area of electrical risks, particularly concerning the performance of the regulatory verifications and taking any measures found necessary when these verifications are carried out. Lastly, concerning the EXplosive ATmospheres (ATEX) risk, ASN considers that the correction of the identified anomalies must be improved, as the scheduling of their correction is not always effective.

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 undergoing decommissioning. On the south side of the site, the Chinon B NPP comprises four in-service reactors of 900 MWe; the first two commissioned in 1982 and 1983 constitute BNI 107, while the second two commissioned in 1986 and 1987 constitute BNI 132. 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), currently being decommissioned, whose former expert assessment activities have been entirely transferred to a new laboratory called the "Lidec" and to 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 stands out positively with regard to safety and is in line with the general assessment of EDF in the areas of radiation protection and the environment. The progress noted in 2022 in the area of safety was consolidated in 2023.

With regard to safety, ASN observes that operational management performance has remained satisfactory in a particularly busy industrial context, with periods of simultaneous outages of several reactors. A number of events nevertheless revealed a lack of rigour on the part of the workers or in the organisation and distribution of roles within the operational management teams. These situations rapidly led to corrective actions, the effectiveness of which must be monitored over time.

As far as maintenance of the installations is concerned, the site's performance remains satisfactory. A few areas for improvement emerge nevertheless, notably in activity preparation and worker monitoring. The year 2023 was marked by the fourth ten-yearly outage of reactor 1, during which substantial maintenance operations were carried out, including the replacement of two sections of the primary cooling system.

ASN considers that the radiation protection performance of the Chinon NPP remains in line with the average for the EDF plants. Nevertheless, the performance is variable, with a worker contamination level that is among the lowest of EDF, but persistent shortcomings in industrial radiography work. ASN considers that the areas for progress identified for 2023 concerning industrial radiography work and effective application of the chosen prevention measures with regard to radiation protection and radiological work regimes remain applicable for 2024.

The environmental protection performance of the Chinon NPP is stable. ASN considers that the NPP manages its discharges and the containment of hazardous liquid substances proficiently. However, the management of waste, and waste removal in particular, must be improved. 2024 must be used to eliminate the waste resulting from reactor maintenance which has been accumulating on the site for several years.

With regard to labour inspections and in view of the inspections conducted in 2023, ASN considers that the Chinon NPP must take better account of the electrical and ATEX risks, whether in the exhaustiveness of the checks or the correction of the anomalies detected. Furthermore, although the absence of any serious accidents is to be underlined, ASN considers that the site must make further progress in accident prevention, particularly in the activity preparation phase. Lastly, the site's responsiveness regarding its exchanges with the labour inspectors is to be underlined.

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, until the end of 2022, housed GIE Intra (robots and 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 involves decommissioning "in air"[1] and the Chinon A2 reactor pressure vessel would be decommissioned first (see chapter 14 of the full ASN Report). In this context, ASN has analysed the periodic safety review concluding reports submitted by EDF concerning the six GCRs,

1. Among the possible scenarios for decommissioning the highly activated or contaminated structures, we find decommissioning "in air" and decommissioning "under water". In the case of the GCRs, the "under water" approach consists in filling the reactor core (reactor pressure vessel) with water in order to benefit from the protective effect of a layer of water with respect to the radiation-related risks, but it is more complicated to implement than the "in air" approach. In view of the major technical difficulties (sealing of the reactor pressure vessel and treatment of the contaminated water), but also the technological advances bringing other solutions, such as remote operation, EDF has finally adoptyed the decommissioning "in air" scenario, which overcomes the problems linked to the use of water.

supplemented further to the request from ASN. On completion of its analysis, ASN indicated in December 2021 that it has no objection to the continued operation of BNIs 133 (Chinon A1 reactor), 153 (Chinon A2 reactor) and 161 (Chinon A3 reactor). It will verify during the examination of the decommissioning files for these reactors, submitted by EDF at the end of 2022 and still being examined, that the decommissioning operations will be 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. The shells of two of the four heat exchanger premises have been removed. EDF also continued the decommissioning of the Chinon A3 heat exchangers. After completing the decommissioning work in the South heat exchangers room in 2022, the decommissioning work in the North heat exchangers room, which started in June 2022, was completed in 2023. All the cylinders have been transferred to the Cires facility (Industrial centre for collection, storage and disposal).

The storms of June and September 2023 led to the infiltration of several hundred cubic metres of water into the premises adjacent to the Chinon A1 turbine building and into various premises of Chinon A3. ASN conducted an inspection on this subject, which concluded on the importance of implementing preventive and corrective actions to remedy this situation (pumping the water, conducting surveillance rounds after storms, waterproofing work on walls and slabs, repair and/or tilting of the storm water downpipes).

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 2023 highlighted in particular the quality of the inventory of waste with no disposal route which is currently being drawn up, the good preparation of the various decommissioning work sites and the work carried out on the identification of the causes and the immediate corrective measures further to the water infiltrations. However, the notification of four significant events relating to radiation protection must be noted, particularly concerning entries into controlled areas without wearing an active dosimeter.

The actions implemented and checked during inspections are expected to limit the recurrence of such deviations. Improvements are expected in subcontractor tracking and monitoring, whether in radiation protection or the monitoring of work sites or in the depth of the analyses of important radiation protection events.

"NUCLEAR FUEL CYCLE" FACILITIES

Inter-regional fresh fuel warehouse

Commissioned in 1978, the Chinon Inter-Regional Fresh 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. During its inspection in 2023, ASN found that the level of safety could be improved, despite the good upkeep of the premises. Indeed, ASN considers that the MIR management teams need to improve the assimilation of the documentation system and associated baseline requirements.

RESEARCH FACILITIES UNDERGOING DECOMMISSIONING

Irradiated materials facility

The Irradiated Material 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 intended essentially for performing examinations and expert assessments on activated or contaminated materials from pressurised water reactors.

The expert assessment activities were completely transferred in 2015 to a new facility on the site, the Integrated Laboratory (Lidec) of the Construction and Operation Expert Appraisal and Inspection Centre (Ceidre).

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. ASN also subjected the starting of several future decommissioning operations to its approval.

Further to the updating of the resolution regulating the installation's discharge limits in July 2022, a new discharge monitoring system has been put into service and decommissioning operations have started that include equipment cutting-up and interventions in several facilities.

The legacy magnesian waste from the expert assessments of certain parts requires inerting operations[2] in order to meet the disposal criteria of the French Radioactive Waste Management Agency (Andra). As the characterisation results differed from what was expected, the necessary waiver was obtained from Andra in late 2022, thereby allowing the waste to be accepted. A work school was set up in early 2023.

2. Inerting in this instance is a process enabling the radiological activity of the magnesian waste to be contained in an enclosure of specific materials to allow risk-free transportation and storage.

The inerting and removal of magnesian waste should resume in 2024. ASN granted a decommissioning authorisation for the highly active liquid effluent systems in August 2023. Given that EDF reported technical and contractual difficulties as of April 2022, these operations – which were initially planned as of 2023 – have been rescheduled for 2024. The treatment of the legacy chemical products present in controlled areas continued and the transfer of this nuclear waste to facilities that can accept them has begun. Lastly, the year 2023 was marked by the resuming of "Thermip" pollution monitoring (non-radiological pollution by hydrocarbons and naphthalene), for which the management plan must be supplemented by technical elements expected in 2024.

Through the checks made during its inspections, ASN considers that the safety management applied at the AMI is satisfactory. The work sites inspected are well kept and suitably monitored. The monitoring of discharges and the environment is well managed, as is equipment qualification, examined by random checks. The alpha emitter contamination risk indicators are correctly tracked. Particular attention must nevertheless be paid to the monitoring of the buildings and the water infiltrations in the basement acting as a retention area. An improvement in the depth of analysis of important radiation protection events is also expected.

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 has two 900 MWe reactors in operation, 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 safety performance is in line with the general assessment of the EDF plants, and has improved compared with 2022. The radiation protection performance, however, is below the national average. The environmental performance is satisfactory and stands out favourably compared with the general assessment of the EDF plants.

ASN considers that the site's nuclear safety performance improved in 2023. There is still room for progress, however, in operational management, particularly regarding monitoring in the control room. Lastly, ASN considers that the site's fire risk management has significantly regressed, with numerous shortcomings detected during the inspections carried out in 2023, particularly in the management of fire loads, in fire sectorisation and the management of hot work permits. ASN will monitor this subject particularly closely in 2024, in order to check the progress of the action plan deployed by the site.

The maintenance performance of the Saint-Laurent-des-Eaux NPP remains at a level deemed relatively satisfactory. The year 2023 saw a significant increase in maintenance activities, notably with the fourth ten-yearly outage of reactor 2. Few significant events are caused by maintenance deficiencies, even if ASN expects improvements to be made in activity preparation and monitoring.

The radiation protection performance of the Saint-Laurent-des-Eaux NPP deteriorated in 2023. Work site preparation and the monitoring of radiological cleanliness must be improved.

The organisation of the site to meet the regulatory requirements in the area of environmental protection is considered satisfactory. ASN underlines the site's commitment in the performance and analysis of situational exercises on the theme of environmental protection, whether organised internally or carried out without prior notice at the request of ASN. Management of the storage of non-radiological hazardous substances however must be improved, and will be closely watched by ASN in 2024.

ASN notes a deterioration in occupational safety at the Saint-Laurent-des-Eaux NPP in 2023, particularly regarding outside contractor accident levels. Progress has been observed in prevention of the electrical risk. The site must nevertheless further improve its management of the ATEX risk.

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 were submitted by EDF in late 2022 to set out the new "in air" decommissioning strategy, that the decommissioning operations will be carried out under suitable conditions of safety and radiation protection, within controlled time frames.

ASN has finalised the examination of the management plan for the soils polluted with hydrocarbons in the zone of the old transformers of the Saint-Laurent A2 reactor and has authorised EDF to proceed with the soil clean-up operations by a resolution of 10 February 2023.

EDF continued the decommissioning work sites in 2023, particularly the decommissioning work outside the reactor pressure vessel (Saint-Laurent A2). ASN considers that the level of safety of the Saint-Laurent-des-Eaux A reactors is satisfactory. During its inspections, ASN noted 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. Waste management, however, must be more rigorous, even if no significant deviations were discovered.

The decommissioning work was suspended in July 2023 following the discovery of lead in the dust on the worksites concerned. ASN conducted specific actions on this subject as part of its labour inspection duty. Nevertheless, even though the worksite demobilisation operations were carried out satisfactorily, ASN considers that the monitoring of outside contractors must be improved and that the traceability of decisions concerning certain modifications in the scheduling of the decommissioning operations and the associated impact studies must be reviewed.

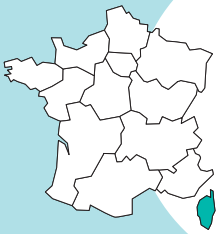
SAINT-LAURENT-DES-EAUX SILOS

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. 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 installation 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 definitive 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.

The final shutdown notification for the facility was sent by EDF in March 2022. At the end of 2022, EDF submitted the silo decommissioning file, integrating the silo emptying operations for the recovery and repackaging of the graphite waste and creation of the future graphite waste package storage facility. Based on current assumptions, silo emptying should begin in the early 2030's.



Corse (Corsica)

COLLECTIVITY

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

In 2023, ASN carried out five inspections in the Corse collectivity, four in the medical sector and one in the industrial sector.

The installations and activities to regulate comprise:

- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 2 external-beam radiotherapy departments,
  - 2 nuclear medicine departments,
  - 8 centres performing fluoroscopy-guided interventional procedures,
  - 8 computed tomography scanners,
  - about 330 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - 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;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 3 organisations approved for measuring radon.

Overseas

DÉPARTEMENTS AND REGIONS

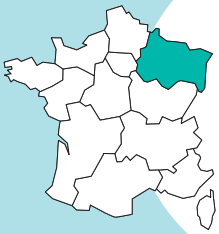
The regulation of radiation protection and the transport of radioactive substances in the 5 overseas *départements* and regions (Guadeloupe, Martinique, Guyane, La Réunion, Mayotte) and in certain overseas collectivities is ensured by the Paris division. It also acts as expert to the competent authorities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

In 2023, 14 inspections were carried out in the small-scale nuclear activities sector in the French Overseas *départements*, regions and collectivities. Three on-site inspection campaigns were carried out by ASN.

One significant event in small-scale nuclear activities was rated level 1 on the International Nuclear and Radiological Event Scale (INES scale).

The installations and activities to regulate comprise:

- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 4 external-beam radiotherapy departments,
  - 1 brachytherapy department,
  - 4 nuclear medicine departments,
  - 23 centres performing fluoroscopy-guided interventional procedures,
  - about 30 centres holding at least 1 computed tomography scanner,
  - more than 50 medical radiology practices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - 3 industrial radiology companies using gamma radiography devices,
  - 1 cyclotron;
- **activities associated with the transport of radioactive substances.** Chapter 9



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 2023, ASN conducted 180 inspections in the Grand Est region, of which 63 were in the Nuclear Power Plants (NPPs) in service, 12 in radioactive waste disposal facilities and on the sites of the Fessenheim and Chooz A NPPs currently being decommissioned, 93 in small-scale nuclear activities, eight in the transport of radioactive substances and four concerning approved organisations or approved laboratories.

ASN also carried out 17 days of labour inspections in the NPPs.

During 2023, 11 significant events reported by nuclear installation licensees in the Grand Est region were rated level 1 on the International Nuclear and Radiological Events Scale (INES scale), and one significant event was rated level 2.

In small-scale nuclear activities, three significant events were rated level 1 on the INES scale (two in the industrial sector and one in the medical sector) and two significant events concerning patients were rated level 1 on the ASN-SFRO scale.

Lastly, in the context of their oversight duties, the ASN inspectors issued one violation report.

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 1,300 Megawatts electric (MWe) Pressurised Water Reactors (PWRs) commissioned between 1986 and 1991. Reactors 1, 2, 3 and 4 constitute Basic Nuclear Installations (BNIs) 124, 125, 126 and 137 respectively.

ASN considers that the performance of the Cattenom NPP with regard to nuclear safety and environmental protection is in line with ASN's general assessment of the EDF plants. The radiation protection performance of the Cattenom NPP is considered to be below the average for the fleet. The year 2023, like 2022, was a rather particular year given the long outages to address the problem of stress corrosion in the safety injection systems.

With regard to operation and reactor operational management, ASN considers that the performance remains satisfactory, as in the preceding years. The level of skills management and reactivity control is considered to be very good. However, weaknesses were noted in system configuration management and the associated padlocking operations, and in monitoring in the control room.

With regard to maintenance, 2023 was marked by relatively long and often concomitant reactor outages. ASN notes positively the monitoring of the maintenance activities, particularly in relation with the stress corrosion issue, along with the sound proper management of the unscheduled interventions carried out during the outages. Nonetheless, a few maintenance non-qualities were noted and some events call into question the adequacy of the post-maintenance tests conducted on certain items of equipment, which do not detect all the operating faults.

The area of fire risk prevention, in which weaknesses have been noted for several years, is addressed by specific measures on the site, but which are nevertheless not preventing new deviations, particularly relative to interim storage management.

The site made progress in environmental protection in 2023, with a reduction in the number of events relating to this subject. Weaknesses nevertheless persist in liquid pollution containment and in the monitoring of specific installations, particularly the oil separators, which caused a hydrocarbon spillage in 2022. Refrigerant emissions and the consumption of biocides are still high, generating large discharges. On the other hand, despite a hot and dry summer, the low water level of the Moselle river was well managed and had no impact on the site.

With regard to radiation protection, ASN considers that the site is below average, particularly in the control of contamination and industrial radiography work. Improvements were nevertheless noted in the access to limited stay areas and prohibited areas in 2023, and in radiation protection as a whole over the second half of 2023, showing that the site is well aware of its weaknesses.

Lastly, with regard to safety at work, ASN notes positively the efforts made in terms of conformity and awareness-raising, particularly regarding working time and work on Sundays, even though further progress is still expected.

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 performance of the Chooz B NPP with regard to nuclear safety and radiation protection is in line with ASN's general assessment of the EDF plant performance. It moreover stands out positively with regard to the environment.

ASN considers that the safety of operation of the facilities is satisfactory. Particular attention must nevertheless be paid to ensuring strict compliance with the reactor operational management documents and the checking of the activities carried out, as these two points have caused significant events.

With regard to maintenance, ASN underlines the satisfactory management of the activities, which represented a lower work load than in the preceding years, given the restarting of the reactors after the repair of the pipes displaying stress corrosion cracking.

With regard to occupational radiation protection, although the number of significant events remains low, ASN detected several weaknesses in the course of the year. They concern the monitoring of outside contractors, rigour in the implementation and monitoring of radiological protections, and the management of inspections involving industrial radiography. Furthermore, shortcomings in control of radiological cleanliness resulted in the contamination of several rooms. ASN noted the implementation of immediate corrective actions, but nevertheless urges the licensee to maintain its vigilance in view of the activities scheduled in 2024.

ASN considers that the site's environmental protection organisation is satisfactory, as in the preceding year. The licensee has in particular demonstrated a robust organisation for identifying, analysing and monitoring the few deviation situations encountered in 2023, notably in the areas of liquid pollution containment and control of discharges.

Lastly the labour inspections revealed no problem situations. The subjects addressed are taken seriously by the employer, with the intention to make them progress.

Reactor A undergoing decommissioning

The work undertaken in 2023 was chiefly devoted to the treatment of contamination and removal of the waste present at the bottom of the reactor building pool, and the cleaning of the walls of said pool. Renovation work on the polar crane also began at the end of 2023. These activities are prerequisites for the reactor vessel lifting operations, scheduled as of 2024, followed by the vessel cutting up operations. The decommissioning work on the effluent treatment station equipment moreover continued.

With regard to radiation protection, the inspection conducted in 2023 confirmed that the measures taken over the last few years to control the radiological cleanliness of the facilities and to protect the workers continue to improve the level of radiation protection on the site.

Lastly, in December 2022 and July 2023 EDF submitted to ASN for approval the clean-up methodology files for the facility's civil engineering structures in order to achieve the "final decommissioning state" required by the Decree of 27 September 2007. These files are currently being examined by ASN.

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 (LL/ILW-SL) located in Soulaines-Dhuys in the Aube *département*;
- **the *Cigéo* geological disposal project for long-lived high- and intermediate-level radioactive waste (HL/ILW-LL);**
- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 14 external-beam radiotherapy departments,
  - 5 brachytherapy departments,
  - 21 nuclear medicine departments,
  - 97 computed tomography scanners,
  - 80 centres performing fluoroscopy-guided interventional procedures,
  - some 2,100 medical and dental radiology centres;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - about 280 industrial and veterinary activities coming under the licensing system,
  - 24 companies exercising an industrial radiography activity,
  - about 50 research laboratories situated primarily in the universities of the region;
- **activities associated with the transport of radioactive substances.** Chapter 9

FESSENHEIM NUCLEAR POWER PLANT

The Fessenheim NPP is situated 1.5 km from the German border and about 30 km from Switzerland. Its two reactors, which were commissioned in 1977 and definitively shut down in 2020, are currently undergoing preparation for decommissioning.

ASN considers that the site is continuing to operate the facilities and prepare for decommissioning conscientiously, particularly by adhering closely to the decommissioning preparation work schedule.

In 2023, the site underwent a profound organisational change, with its transfer within EDF from the "Nuclear Power Production" Division to the "Dismantling Wastes Projects" Division. This organisational change came with a substantial reduction in the workforce, matching the change in the activities on the site. ASN considers that the change was well managed, preparing optimally for the organisational transition.

The decommissioning preparation work also continued, in particular with the decontamination of the primary system of reactor 2, marked by a number of unforeseen events; preparation for the transportation of the lower sections of the site's old steam generators for their future decontamination and recycling by a fusion process in the Cyclife facilities in Sweden; transformation of the turbine hall into a waste management and storage zone; continuation of the treatment and removal of boron and activated operational waste. ASN considers that, apart from the unforeseen events observed during the decontamination operation, these various activities were carried out as expected.

With regard to radiation protection, the site's performance is considered to be broadly satisfactory, particularly in the context of the decontamination operation. As for safety at work, the change in the types of activities and workers must be examined in order to guarantee that the protective measures are appropriate.

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, radiation protection and the environment.

With regard to nuclear safety, ASN considers that the results are satisfactory on the whole, except in the management of equipment padlocking operations and of conformity deviations, areas in which progress must be made. The licensee must also continue its efforts to maintain an adequately sized workforce and skills in the areas of operational management and maintenance of the reactors.

The maintenance operations during the outages of the two reactors went satisfactorily on the whole.

As far as occupational radiation protection is concerned, ASN observes that the management of worksite radiological cleanliness and the number of worker internal exposures remain satisfactory. However, deficiencies in the radiation protection culture and rigour of the workers were again noted on several occasions, particularly concerning the conditions of access to controlled areas. The licensee must remain particularly vigilant on this subject, as it must with the inspection of radiation protection equipment, which showed some weaknesses in 2023.

With regard to protection of the environment, ASN considers that the licensee's organisation is satisfactory. Nevertheless, improvements are expected in the integration of Operating Experience Feedback (OEF) from certain maintenance operations and in the management of discharges and the containment of liquid pollutions.

Inspections by the labour inspectors confirmed the restoring of conformity of certain working equipment items, such as lighting and lifting equipment, further to the action plan initiated in 2022.

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 (CSM) which ceased its activities in July 1994, while benefiting from the OEF gained from 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.

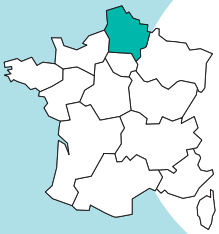
At the end of 2023, the volume of waste in the facility had reached about 378,500 m^3, or 38% of the authorised capacity. According to the estimates made by the French Radioactive Waste Management Agency (Andra), in 2016 in the concluding report on the periodic safety review of the CSA, the repository could be completely filled by 2062 rather than 2042 as initially forecast. This can be explained by having better knowledge of the future wastes and their delivery time frames, as well as by an optimisation of waste management through the compacting of certain packages.

ASN considers that the CSA is operated satisfactorily in the areas of safety, radiation protection and the environment. The inspections conducted in 2023 found that the organisation for monitoring discharges into the environment and tracking and inspecting the civil engineering operations was appropriate, and more broadly that safety management was satisfactory.

DEEP GEOLOGICAL DISPOSAL PROJECT

ASN considers that the scientific experiments and work conducted by Andra in the underground laboratory at Bure continued in 2023 with a good standard of quality, comparable with that of the preceding years.

Andra filed the Creation Authorisation Application for the *Cigéo* project with the Minister responsible for nuclear safety on 16 January 2023. ASN considered it admissible and has started the examination process (see chapter 15 of the full ASN Report).



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.

In 2023, ASN carried out 94 inspections in the Hauts-de-France region, of which 37 were in the Gravelines Nuclear Power Plant (NPP), 50 in small-scale nuclear activities and 7 in the transport of radioactive substances.

ASN also carried out 18.5 days of labour inspection in the Gravelines NPP.

During 2023, the Gravelines NPP notified ASN of four significant events rated level 1 on the International Nuclear and Radiological Event Scale (INES scale).

In small-scale nuclear activities, two events were rated level 1 on the INES scale. In radiotherapy, two 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 Pressurised Water Reactors (PWRs) – each of 900 Megawatts electric (MWe) – representing a total power of 5,400 MWe. Reactors 1 and 2 constitute Basic Nuclear Installation (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 environmental protection is in line with ASN's general assessment of the EDF plants. ASN considers that the radiation protection performance remains sub-standard compared with its general assessment of the EDF plants.

The nuclear safety performance improved slightly in 2023, particularly as regards the NPP's operational management activities. The "plan of rigour" deployed by the licensee has renewed the emphasis on presence on the ground, refocused attention on the fundamentals and enabled the actions to be adapted according to the services. Despite the measures in place, ASN has again noted a number of inappropriate practices or behaviours, particularly failure to comply with procedures. The licensee must therefore continue its efforts to federate all the protagonists. At the end of the third quarter of 2023, ASN conducted an interim assessment of the measures implemented by the licensee through an inspection focusing on organisational and human factors and deployment of the plan of rigour. ASN's inspection found the management of the plan to be satisfactory and results to be improving on the whole.

The year 2023 saw fewer significant events notified to ASN than in 2022, but still above the average for the preceding years and the national average for the EDF reactors. The number of events rated level 1 on the INES scale dropped substantially. These drops constitute an improvement which must be maintained over time to confirm a real improvement in the site's performance.

With regard to maintenance, 2023 was again marked by the substantial extensions in the reactor outage durations, largely due to social movements which disrupted the first outage of the 2023 campaign. At least three reactors were in outage at the same time, from mid-June to early November, putting an unusual amount of pressure on the services in mid-summer. This increase in activity came on top of an already very full industrial programme, including the fourth ten-yearly outage of reactor 2, work on the peripheral protection against external flooding and the creation of ultimate water makeups further to the lessons learned from the Fukushima Daiichi NPP accident in Japan. This situation led in particular to inadequately prepared maintenance activities. ASN thus observed maintenance non-qualities and work postponements due more specifically to the unavailability of spare parts.

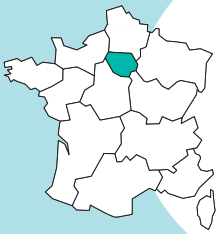
In the area of environmental protection, ASN conducted a tightened inspection of the site relating to the implications of continued operation beyond the fourth ten-yearly outages. ASN considers that the organisation and performance of the Gravelines NPP are broadly satisfactory, even if a number of deviations must be corrected, such as alerting the site personnel in the event of toxic gas emissions and the conservation of effluent samples. The efforts made over the last few years brought an improvement in the management of equipment using SF_6 (a powerful greenhouse gas) in 2023.

ASN notes some progress in occupational radiation protection. The licensee has taken into account the difficulties encountered in the previous years and the measures deployed are starting to show results that can be measured in the field. The number of significant events is slightly down compared with the preceding period and no level-1 events were reported, although the activity programme remained identical. This assessment nevertheless remains contrasted due to persistent shortcomings, notably in the application of the optimisation approach in work preparation and the coordination of radiation protection measures with outside contractors. ASN also observes an increase in deviations linked to deficiencies in the radiation protection culture or rigour of the workers, particularly regarding the conditions of access to controlled areas and taking regulatory zoning into account.

The labour inspection actions carried out in 2023 were divided between inspections on facility maintenance and modification worksites, performed jointly with the nuclear safety inspections, and theme-based inspections on lifting or the prevention of risks associated with the work carried out by outside contractors. ASN notes positively the site's prevention actions regarding safety further to the poor results of previous years, even though the number of workplace accidents remains high. Deviations were observed in the regulatory verifications of equipment used for lifting operations, some of which have been the cause of incidents. Improvements are also expected in the coordination of the prevention of risks associated with concomitant activities on the site.

The installations and activities to regulate comprise:

- **one Basic Nuclear Installation:**
  - the Gravelines NPP (6 reactors of 900 MWe) operated by EDF;
- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 19 external-beam radiotherapy departments,
  - 3 brachytherapy departments,
  - 30 nuclear medicine departments,
  - 90 centres performing fluoroscopy-guided interventional procedures,
  - 123 computed tomography scanners,
  - some 4,600 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - about 600 industrial and research establishments, including 23 companies exercising an industrial radiography activity, 6 particle accelerators, including one for inspecting freight trains and 2 cyclotrons, 40 laboratories situated mainly in the universities of the region and 11 companies using gamma ray densitometers,
  - 340 veterinary surgeries or clinics practising diagnosticradiology;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 2 agencies approved for radiation protection controls.



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 244 inspections in the Île-de-France region in 2023, of which 90 were in the field of nuclear safety, 132 in small-scale nuclear activities (two of this in the area of polluted sites and soils), 12 in Radioactive Substance Transport (TSR) and ten concerning approved organisations or laboratories.

Seven significant events were rated level 1 on the International Nuclear and Radiological Events Scale (INES scale) in the small-scale nuclear activities sector, eight at level 1 on the INES scale in the Basic Nuclear Installations (BNIs) sector and one at level 1 on the INES scale in the area of TSR.

Lastly, in the context of their oversight duties, the ASN inspectors issued one violation report.

CEA Saclay site

Since 2017, the Alternative Energies and Atomic Energy Commission (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 Nuclear Power Plants (NPPs). Seven 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, which has an authorised power of 70 Megawatts thermal (MWth), 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.

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. In late 2021, the CEA announced a radical change in the decommissioning strategy of BNI 40 with the postponement of commissioning of the equipment for treating and packaging irradiating waste. For the purpose of the examination, further information on the new decommissioning scenario, particularly regarding the management of irradiating waste, had to be provided. The CEA submitted a new decommissioning file at the end of 2023.

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 2021.

ASN considers that the level of safety of BNI 40 is satisfactory, particularly with regard to control of the fire risk and the equipment modifications. Improvements are expected however in the management of the fire load in the premises and the implementation of the periodic inspections and tests of certain items of equipment involved in the control of fire propagation. The organisation in place for tracking the decommissioning preparation operations is appropriate. The licensee's control of the decommissioning preparation operations, the management of waste and the continuation of the studies aiming to reduce the water consumption of the facilities shall be among the themes to which ASN will be attentive in 2024.

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. The continuation of the decommissioning preparation operations and the facility decommissioning scenario were discussed following the CEA's re-prioritising of the decommissioning operations and its consequences on the updating of the decommissioning strategy of BNI 101. A new decommissioning file was submitted at the end of 2023.

Based on the facility inspections and monitoring carried out in 2023, ASN considers that the level of safety of the Orphée reactor is on the whole satisfactory. However, vigilance is required with regard to organisational and human factors and document updating, particularly on the fire theme. The significant events show that greater attention must be paid to waste monitoring and the maintenance of leak detection equipment.

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.

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 UPRA (Artificial Radionuclide Production Plant) 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:** Chapter 7
  - 26 external-beam radiotherapy departments,
  - 12 brachytherapy departments,
  - 48 *in-vivo* nuclear medicine departments and 12 *in-vitro* nuclear medicine departments (medical biology),
  - 148 centres practising fluoroscopy-guided interventional procedures,
  - more than 200 centres possessing at least 1 computed tomography scanner;
- **small-scale nuclear activities in the industrial, veterinary and research sectors under the oversight of the Paris division:** Chapter 8
  - 8 industrial radiology companies using gamma radiography devices,
  - about 160 authorisations and 25 registrations relative to research activities;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 3 organisations approved for radiation protection controls.

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 licensee has requested pushing back of the deadlines for removal of the radioactive substances whose utilisation cannot be justified, and 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. The examination of the provisions relating to fire led ASN to decide to issue a compliance resolution to regulate performance of the works initially expected for the end of 2019. In view of the risks and the work already undertaken by the licensee's personnel, the corresponding technical requirement must be met before 31 December 2026. ASN will be particularly attentive to the monitoring and implementation of these actions, which are necessary to meet this deadline.

Since the end of 2022, BNI 72 no longer accepts irradiating waste from the CEA Saclay site. Consequently, the CEA has started a new project baptised "GDILE", a French acronym for "Management of irradiated waste from LECI", in order to process, package and remove the irradiating waste (existing and future) without saturating the storage capacities of LECI.

An exercise involving deployment of the Off-Site Emergency Plan (PPI) was carried out in 2023 on the site of the CEA Paris-Saclay centre (see paragraph entitled "Assessment of the CEA Paris-Saclay centre, Saclay site"). This exercise, which simulated an accident situation within the LECI facilities, served to test the deployment of the CEA's means of response and of the departmental fire and rescue service within the BNI perimeter.

The inspections conducted on LECI during 2023 were considered satisfactory, even if the manufacturers' recommendations must be better taken into account in the qualification of new equipment. Moreover, ASN still observes an increase in the times taken to reply to the inspection follow-up letters and to send in significant event reports. The CEA must take the necessary measures to remedy this situation without delay.

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 hazards (snow and wind in particular), 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 correctly monitored. Nevertheless, particular attention must be paid to the revision of the frequencies of some of these inspections relating to radiation protection, and to the management of deviations. With regard to the management of radioactive sources, the licensee has improved the current check of sources aged more than ten years, for which an extension of the Poséidon irradiator service life has been requested, with the setting up of a system for checking sealing by immersion.

SOLID WASTE AND LIQUID EFFLUENT TREATMENT FACILITIES

The CEA operates various 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 (ZGDS – 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 "dispersible 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 14 of the full ASN Report).

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. The CEA also asked for arrangements for the acceptance 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-2022-005822 of 2 February 2022. Decree 2022-1107 of 2 August 2022 requiring the CEA to proceed with the decommissioning of BNI 72 was published in the *Official Journal*. This Decree came into effect on 26 July 2023, the date on which ASN approved the revision of the general operating rules.

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.

ASN considers that the safety of the facility is satisfactory, while at the same time noting numerous delays in the operations to remove the fuel or waste from storage. ASN nevertheless notes with approval the removal of ten fuel cans out of the fifteen present in the pool of a building, which contributes to the gradual reduction of its dispersible inventory.

In 2023, ASN examined the organisation put in place by the facility for the management of deviations, monitoring of the ageing of the pits and the progress in the operations concerning the removal of fuel from the pool and rods of uranium oxide pellets contained in a package called "RCC". Delays are still observed in the removal of the cans contained in the RCC packaging and in the deployment of the "Removal of fuel bins" project (EPOC[2]).

The EPOC project was stopped following the breach of the project management contract. ASN notes with approval the measures taken by the CEA with the aim of taking over the management of this project. Furthermore, the opening of a pit in November 2023 to conduct non-invasive investigations was carried out satisfactorily. These operations help to consolidate the project input data. ASN nevertheless remains vigilant regarding CEA's management of the EPOC project and will monitor the recovery work on the first drum, for which the time frame remains to be consolidated by the licensee.

Alongside this, ASN's inspections find the facility to be in good overall condition. ASN nevertheless expects improvements in the tracking of the deviations observed when monitoring the condition of the waste storage pits, and in the tracking and observance of the frequency of periodic inspections and tests.

Liquid effluents management zone

The Liquid Effluents Management Zone (ZGEL) constitutes BNI 35. Declared by the CEA by letter of 27 May 1964, this facility is dedicated to the treatment of radioactive liquid effluents. The 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 the French National Radioactive Waste Management Agency (Andra).

The evaporation facility used to treat the radioactive effluents has been out of service since 2019 due to technical anomalies on an equipment item. 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 process of encapsulation in cement, 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.

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 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. In 2023, ASN authorised a modification concerning the separator shell, enabling the evaporation campaigns to be restarted.

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, an operation authorised for one of the tanks in 2022 and 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 inspections carried out in 2023 revealed a satisfactory organisational set-up and tools for keeping track of the commitments made to ASN and for managing deviations. During the inspections, the inspectors found the facility and the premises to be in good overall condition and the teams to be duly responsive. Furthermore, the emptying of the pit 99 tank has been started with the tests in inactive and active mode and must be continued. Lastly, the licensee has undertaken to restore the conformity of the facility's piezometers.

Improvements are expected however, particularly regarding the finalisation of the fire-related action plan resulting from the safety review of 2017 and the management of the atmospheric effluents (iodine traps, emission measurements and flow rate). Lastly, ASN observes that the actions prescribed after the periodic safety review of 2007 have not all been completed to date.

FACILITIES UNDERGOING DECOMMISSIONING

The decommissioning operations underway on the Saclay site concern two BNIs (BNIs 49 and 72). Decommissioning preparation operations are carried out in two definitively shut down BNIs (BNIs 40 and 101). Operations are also being carried out on parts of the in-service BNI 35 which have ceased their activity. 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, are also concerned by decommissioning. Their downgrading from BNI to ICPE status in the 1980's, in compliance with the regulations of that time, could not be done today.

2. This project involves a process intended to retrieve and package drums containing a mix of waste and fuel fragments which are currently stored in pits in the facility. The retrieval of these drums requires specific equipment, given the uncertainties concerning their integrity.

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 – which have been in progress for several years now – continued in 2023.

The decommissioning preparation operations and the decommissioning work are continuing for the BNIs concerned. Managing work progress and keeping to the associated schedules remain a major challenge for CEA Saclay. This area, which forms the subject of regular ASN inspections and meetings, must be improved, given the drifts observed over the years. ASN does however note the entry into application of the BNI 72 decommissioning decree in 2023 and the CEA's decision to internalise management of the EPOC project (project to recover drums stored in BNI 72 using equipment specially produced for the purpose) further to the defaulting of the initially selected contractor.

On another note, further to the Fukushima Daiichi NPP accident (Japan), 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. The failure to deploy the new premises, which was contrary to a requirement of ASN resolution 2016-DC-0537 or 12 January 2016, was noted during an inspection conducted in 2022. A contradictory report was therefore drawn up in early 2023 to which the CEA replied. After examining the reply and on account of the reduction in the nuclear risk of the Saclay site following the shutdown of BNIs 40 and 101, the requirement in question was repealed and a new technical requirement now regulates finalising of the construction of robust emergency situation management premises, which are expected to be commissioned by the end of 2024. An inspection was carried out in 2023 to check that the construction work had resumed.

With regard to the emergency organisation and resources, an update of the On-Site Emergency Plan (PUI) submitted by the CEA in late 2021 was discussed to clarify the chosen provisions. In May 2023, ASN authorised the modification of the PUI, retaining the provisions proposed by the CEA, with the exception of the new residual scenarios for BNIs 40 and 101, whose decommissioning files are currently being examined.

In 2023, an exercise involving activation of the large-scale PPI was carried out, simulating the accidental crash of an aircraft into the centre, causing a fire and dispersion of radionuclides into the environment. This exercise was intended to evaluate the collaboration between the security actors, their coordination in managing the victims and securing the site, and decision-making between CEA Saclay, the Prefecture's services, the CEA head office and the State authorities, including ASN. Areas for improvement in the CEA's emergency organisation and in the exchanges of information with the other emergency management actors were identified.

With regard to the environment, two ASN resolutions dating from 2009 and regulating all the discharges from the CEA's BNIs were updated. This update enabled the extremely low carbon-14 emissions induced by some of the waste stored in BNI 72 to be taken into account, and to regulate the additional discharges of carbon-14 resulting from forthcoming works necessary for the continuation of the BNI 49 decommissioning operations. These modifications do not change the total maximum value of the carbon-14 discharges set for the Saclay site as a whole, while at the same time regulating continuation of the decommissioning operations.

Lastly, ASN conducted several inspections on the Saclay site in 2023. One followed on from a significant event notified by BNI 50 and rated level 1, concerning the incorrect positioning of the emergency brakes on three lifting units. ASN thus conducted a specific inspection focusing on the maintenance of the lifting means and the monitoring of the associated outside contractors. This inspection confirmed the substantial work carried out by the CEA in bringing certain cranes into conformity following the discovery of asbestos in the linings and lagging, but it also revealed shortcomings in the application of the manufacturer's instruction manuals when performing maintenance work on the Saclay site's cranes. ASN will be attentive to the resolving of the deviations observed during this inspection. In addition, improvements were found in the monitoring of the Pressure Equipment (PE) and the electrical generator sets, even though further improvements are expected in each of the inspected BNIs on specific aspects observed during inspection. These improvements will be monitored on a case-by-case basis.

The year 2023 was also marked by the notification of one significant event for safety rated level 1 on the INES scale. This event was reclassified further to a repeat finding of bags of nuclear waste in a conventional waste production zone within BNI 101. At the same time, ASN underlines a reduction in significant event notifications in 2023 compared with the previous year.

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 chapters 14 and 15 of the full ASN Report).

High-Activity Laboratory (LHA)

The High-Activity Laboratory (LHA) comprises several laboratories intended for research work or the production of various radionuclides. It constitutes BNI 49. On completion of the decommissioning and clean-out work authorised by Decree of 18 September 2008, only 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 in the ongoing examination of this file.

The year 2023 was marked primarily by the investigations and studies allowing the management of unidentified waste discovered in late 2022 in the set of structures constituting the TOTEM shielded process line after resuming the shielded process line decommissioning operations, which had been suspended since late 2018.

ASN considers that the level of safety of BNI 49 undergoing decommissioning is on the whole satisfactory. The inspections highlighted the good upkeep of the premises and the CEA's determination to move forward with finalising the decommissioning of the TOTEM shielded process line despite being behind schedule. Particular vigilance is expected in monitoring the condition of the ventilation ducts, particularly the internal sections which are inaccessible or display defective areas.

ASN remains vigilant with regard to the management of the very low level waste zones of BNI 49, particularly on account of the future decommissioning work which will produce additional waste. Consequently, the adequacy of the existing waste storage areas for the future needs is of major importance for the conduct of the decommissioning operations in accordance with the planned schedule.

ARTIFICIAL RADIONUCLIDE PRODUCTION PLANT OF CIS BIO INTERNATIONAL

The Artificial Radionuclides Production Facility (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. They are manufactured using a cyclotron installed on the site or using radionuclides produced by outside suppliers or other facilities of the Curium group. 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 potential consequences of accident situations on the site.

After observing improvements in the safety of the facility between 2019 and 2021, the slowing of this trend observed in 2022 got worse in 2023, particularly in view of the notified significant events, be it in the number or the types of events. This observed deterioration in the general level of safety is moreover combined with substantial lateness in sending the replies to ASN follow-up letters or to significant event reports.

CIS bio international, which has been capable of mobilising its resources on new projects and large-scale actions associated with its operational services and radiopharmaceutical production, must today focus its efforts on the actions necessary to improve safety in general and the drafting of the justification documents expected by ASN. The company reorganisation initiated in late 2023 should allow the necessary means to be assigned to the departments in charge of these safety-related subjects. The inspections, including one carried out reactively following the notification of a significant event, found margins for improvement in the management of nuclear waste within the facility. Operational management of the facility's transport operations is efficient, but deviations in the documents are still observed, as they have been over several inspections now. With regard to the overshoots of the annual and monthly gaseous iodine discharge limits at the end of 2022 and beginning of 2023, which gave rise to significant event notifications, one of which was rated level 1, CIS bio international conducted an in-depth deviation analysis and established a detailed action plan which was checked by ASN during an inspection. This action plan was found to be appropriate. As a general rule and in particular further to the inspection conducted on the theme of "meeting commitments", ASN notes the difficulties CIS bio international has in meeting the deadlines associated with the action plans decided upon further to inspections or significant events.

Lastly, the inadequate responses provided after making priority corrective action requests concerning pressure equipment have led ASN to serve CIS bio international with a compliance notice on this subject. The compliance deadline has been set for 2024.

The number of significant events again shows a significant increase, with 22 notifications in 2023. As in the preceding year, human or organisational causes are predominant in these events, which concern diverse areas. Compliance with the operational management rules and the operating range, alarm management, maintenance operations and the integration of lessons learned remain the main areas for improvement. Some recurrence of nonconformities is observed in the effectiveness of the facility's ventilation system filtration levels. Certain events have led to production operations in degraded situations with the application of compensatory measures. The technical causes of these deviations must be determined and they must be prevented from recurring. Lastly, despite the considerably late submission of significant event reports, it is noted that they are always drafted to a high standard and this must be maintained.

With regard to the periodic safety review, the licensee has put in a lot of work to allow its examination. CIS bio international must continue to implement the associated action plans. Delays are nevertheless announced in the updating of the baseline requirements in order to take this examination into account. Particular efforts must be made on this file. A large number of projects, studies and works undertaken by CIS bio international were completed in 2023. In some cases, these projects help to improve the safety of the facility or to reduce the source term with the finalising of removal of disused high-activity sealed sources. Broadly speaking, the large-scale projects undertaken by CIS bio international require better scheduling so that they can be examined appropriately for the risks they represent as a whole.

To conclude, ASN observes a deterioration in CIS bio international's performance in 2023, despite the improvement process applied since 2019. Operating rigour, maintaining the safety culture and the oversight of operations remain the areas on which CIS bio international must focus its efforts. Particular attention must also be paid to the human and technical resources deployed on the themes of safety and radiation protection.

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 chapters 14 and 15 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. These two projects are currently being examined. The new decrees will set the future decommissioning characteristics, and 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.

In the light of the inspections carried out in 2023, several positive points can be underlined, such as the management and monitoring of the PE present on the site, the installation of new aerosol sampling devices and the conditions of response of the local safety organisation on site in situational exercises. Nevertheless, the need to be particularly vigilant on the fire theme identified in 2022 was confirmed in 2023. Work has started on bringing the fire doors of a building in BNI 165 into conformity, on putting the fire extinguishing systems of the shielded process lines of that BNI back into service, and replacing the fire control panel. The efforts put into these projects and works must continue in 2024 to achieve the required level of safety.

An unannounced inspection confirmed that waste management still needs to be improved in both BNIs of the site. A change in the baseline requirements of these facilities is also required to allow methods of storage that are appropriate for the CEA's operating risks and constraints.

The licensee has made strong commitments regarding the implementation and scheduling of the corrective actions, including the creation of a role of scheduler. This project should allow the meeting of the CEA's commitments to be tracked more effectively.

With regard to the significant events notified in 2023, the number has increased with respect to the preceding years and they chiefly concern the fire theme, the storage of nuclear waste and the conditions of personnel access to areas presenting a radiological risk. Broadly speaking, the causes have to be analysed in greater depth and particular attention must be paid to the time frames for submitting the definitive significant event reports. Whatever the case, ASN notes that the CEA's significant event detection capability is satisfactory.

With regard to the periodic safety reviews of the facilities, the licensee has an organisational set-up that enables the associated actions to be implemented; in 2023, ASN signed the resolution setting the technical requirements stemming from the conclusions of the safety review of BNI 165. Examination of the periodic safety review of BNI 166 continued satisfactorily.

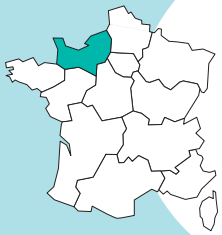
After delays identified in the preceding years in the performance of the studies, in project programming and in the decommissioning schedule of the nuclear installations of Fontenay-aux-Roses, two of the CEA's major decommissioning-related worksites were stopped for contractual and technical reasons in 2023. Resuming of these worksites will require changes in technical choices or modifications in certain aspects of the projects which could have an impact on the overall decommissioning strategy for BNI 166. The CEA must detail the expected consequences on the elements already transmitted. The CEA must 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.

The polluted sites and soils in Île-de-France

In Île-de-France, the Paris division oversees the depollution activities for polluted radiological sites, and can for example intervene to give technical opinions on site pollution management measures envisaged by the site owners (see chapter 15 of the full ASN Report, part 4). In this context, it carried out two inspections in 2023 on the site of the old Fort of Vaujours and the site of a former Marie Curie laboratory in Arcueil (near Paris), and participated in the site monitoring commissions for these two sites.

By virtue of its expertise in these risks, the ASN Paris division also:

- **helped to define the measures to take to manage identified or potential cases of radiological pollution discovered in the operation of a gypsum quarry on the municipalities of Vaujours and Coubron;**
- **issued three opinions concerning the measures to manage the radiological pollution of three sites: the land of a private individual in the Essonne *département*, an industrial site in the Seine-et-Marne *département* and the Curie Institute in the 5th *arrondissement* of Paris;**
- **created and updated Soil hazard Information Sectors (SIS) concerning radiological pollutions;**
- **monitored the diagnostic studies of three polluted sites in the Seine-Saint-Denis *département* with a view to their clean-up.**



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 2023, ASN carried out 217 inspections in Normandie, comprising 68 in the Nuclear Power Plants (NPPs) of Flamanville, Paluel and Penly, 14 on the Flamanville 3 EPR reactor construction site, 69 on "fuel cycle" facilities, research facilities and facilities undergoing decommissioning, 46 in small-scale nuclear activities, 11 in the transport of radioactive substances and nine in ASN-approved organisations and laboratories.

In addition to this, 26 days of labour inspection were carried out on the NPP sites and the Flamanville 3 construction site.

In 2023, ASN was notified of 11 significant events rated level 1 on the International Nuclear and Radiological Event Scale (INES scale), of which ten occurred in Basic Nuclear Installations (BNIs) and one in small-scale nuclear activities.

Lastly, in the context of their oversight duties, the ASN inspectors issued one violation report.

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 Pressurised Water Reactors (PWRs), each of 1,300 Megawatts electric (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, radiation protection and environmental protection is in line with the general assessment of EDF plant performance.

In the area of nuclear safety, ASN observes that the measures taken by the site after being placed under tightened surveillance in 2019 are still being applied and form the subject of a satisfactory improvement process as regards keeping the facilities up to standard and the dissemination and application of the safety fundamentals by the EDF personnel and outside contractors.

With regard to reactor management and operation, ASN considers that the site's performance has been consolidated. The restarting of reactor 1 after replacing the Steam Generators (SGs) went well on the whole. The site coped satisfactorily with the various management operations required on the two reactors linked to equipment deficiencies. Nevertheless, the year 2023 was again marked by a large number of significant events linked to noncompliance with the baseline operating requirements. In 2024, ASN will remain vigilant regarding the improvement in the rigour of reactor operational management and the measures the site has undertaken to implement concerning system and equipment configuration management.

As a general rule, ASN considers that the licensee carried out the maintenance operations competently. ASN notes positively the durability and robustness of the site's action plan concerning the risk of equipment corrosion.

The licensee's system monitoring tools are of good quality and provide a faithful representation of the condition of the systems. ASN will be attentive to the licensee's coordination and monitoring of risky worksites in 2024, particularly during the two scheduled reactor outages.

The site's radiation protection performance improved slightly in 2023. ASN underlines that the identification and notification process for significant radiation protection events is effective. Improvements are nevertheless required in the management of waste zoning and the risk of contamination dispersion.

ASN observes a slight improvement in environmental protection. ASN underlines the observance of discharge limits and control of the conditions of storage and use of substances dangerous for the environment. However, the licensee must be particularly attentive to maintaining the mineralisation station and the oil filter in their present condition. With regard to on-site and off-site transport operations, despite the improvement in organisation observed during 2023, further progress is still to be made, particularly in the monitoring of subcontracted activities.

With regard to labour inspection, ASN considers that the licensee must be vigilant regarding the working conditions close to the new steam generators of reactor 1 and must anticipate the changes in space requirement for the future replacement of the reactor 2 steam generators. Improvements are also required in the content and depth of the analysis of workplace accidents and near-accidents to prevent their recurrence.

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 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 performance of the Paluel NPP with regard to nuclear safety, radiation protection and environmental protection is on the whole in line with the general assessment of EDF plant performance.

With regard to nuclear safety, ASN considers the performance of the NPP to be satisfactory. Progress is nevertheless required in system configuring in order to comply with the operating instructions and error-reduction practices. The year 2023 was marked by several situations of out-of-service equipment necessitating reactor shutdowns and reflecting a problem of reliability of these equipment items. Furthermore, following two inspections which found shortcomings in the functionality of the emergency equipment utilisation sequences, ASN wants to see significant improvements in the management of their deployment in emergency situations.

With regard to maintenance, ASN has noted that the three reactor outages for maintenance and refuelling went smoothly on the whole. ASN does however note that the site's organisation for characterising deviations when carrying out works is not sufficiently robust and must be improved. Incorrect or incorrectly applied operational documents are also the cause of inappropriate maintenance operations or maintenance quality deficiencies. The site must intensify its efforts to get the personnel to take on board the safety issues before starting work operations, and must improve work monitoring.

With regard to radiation protection, ASN notes good control of the radiological cleanliness of the facilities and of the upkeep of worksites with a dosimetric risk. ASN nevertheless considers that the site must continue the action undertaken to correct the recurrent problems of personnel failing to comply with procedures for accessing limited-stay (orange) areas and the lack of radiation protection culture.

As for environmental protection, ASN considers that the Paluel NPP has obtained satisfactory results in environmental monitoring and notes an improvement following the measures taken to reduce discharges of ozone-depleting gases. ASN has nevertheless noted shortcomings in waste management and the licensee must be particularly attentive to the management of on-site transport of hazardous materials.

The installations and activities to regulate comprise:

- **Basic Nuclear Installations:**
  - the Flamanville NPPs (2 reactors of 1,300 MWe), Paluel (4 reactors of 1,300 MWe) and Penly (2 reactors of 1,300 MWe) operated by EDF,
  - the Flamanville 3 EPR reactor construction worksite,
  - the Orano spent nuclear fuel reprocessing plant at La Hague,
  - the Manche repository (CSM) of the National Radioactive Waste Management Agency (Andra),
  - the National Large Heavy Ion Accelerator (Ganil) in Caen;
- **small-scale nuclear activities in the medical field:** Chapter 7
  - 8 external-beam radiotherapy departments (27 devices),
  - 1 proton therapy department,
  - 3 brachytherapy departments,
  - 12 nuclear medicine departments,
  - 50 centres performing fluoroscopy-guided interventional procedures,
  - 70 computed tomography scanners,
  - some 2,100 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - about 450 industrial and research centres, including 20 companies with an industrial radiography activity,
  - 5 particle accelerators, including 1 cyclotron,
  - 21 laboratories situated mainly 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 linked to the transport of radioactive substances;** Chapter 9
- **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 labour inspection, ASN observes that the workers know and comply with the safety requirements. The site must continue the work it has started on this subject, particularly with regard to management of the risk of falling from height and the management of pressurised gas cylinders. ASN's inspections have also revealed deviations in the application of the regulations concerning young workers.

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 nuclear safety performance of the Penly NPP is broadly in line with its general assessment of the EDF plants, and that its radiation protection and environmental protection stand out positively with respect to ASN's general assessment of the EDF nuclear fleet.

With regard to nuclear safety, ASN considers that operating rigour is improving slightly, despite a few persistent weaknesses. In effect, the reactor restarting phases have been the subject of several notifications of significant safety events due to shortcomings in the alignment operations, deficiencies in the analysis of periodic tests or shortcomings in the exhaustiveness of the operating documents. ASN considers that particular attention must be paid to the quality of preparation of the activities and the associated documents, particularly the routine operation activities (periodic tests, alignments, etc.), and to taking better account of social, organisational and human factors.

In 2023, the licensee finalised the programme of checks and expert assessments and the repairs on the systems concerned following the detection of cracks linked to stress corrosion. 2023 also saw the end of the ten-yearly outage of reactor 1, with the performance of the hydrostatic test of the main primary system and the reactor building containment test, both of which went well. The maintenance operations carried out during the reactor 2 outage were well managed on the whole. ASN nevertheless found shortcomings in the traceability of maintenance operations, which had not been detected during the internal checks. Greater rigour is expected on this subject. Consequently, ASN considers that the NPP must continue its efforts to avoid maintenance non-qualities due to deficiencies in the ergonomics or completeness of the documents, or to organisational weaknesses.

In the area of radiation protection, ASN considers that progress has been made in organisational aspects, particularly with the setting up of centres of competence in radiation protection. The inspections confirmed the good upkeep of the work sites and, more generally, satisfactory management of the contamination risk. Improvements are nevertheless required in the conformity of zone transition areas and activity preparation.

As for environmental protection, ASN considers that the Penly NPP has obtained satisfactory results in waste management and notes an improvement in the measures taken to control discharges of ozone-depleting gases. Monitoring of the rod control cluster guide tube storage area must nevertheless be improved. In an unannounced exercise, ASN observed that the organisation of the NPP teams for managing a non-radiological emergency situation was satisfactory.

With regard to labour inspection, ASN observes that the workers generally know and comply with the safety requirements. However, inspections have occasionally revealed deviations in the prevention of life-endangering risks (anoxia, lifting, etc.), and the prevention of fire risks.

FLAMANVILLE 3 EPR REACTOR CONSTRUCTION WORKSITE

Following issuing of the Creation Authorisation Decree (DAC) 2007-534 of 10 April 2007 and the building permit, the Flamanville 3 EPR reactor has been under construction since September 2007. Since December 2023, the site has been working on the preparation for reactor fuel loading.

Broadly speaking, ASN notes that a substantial amount of work was carried out in 2023, be it towards the completion of the facility, the preparation and performance of the hot requalification tests, or the deployment of operating organisations and the building of personnel skills. ASN will nevertheless remain attentive to the completion of the pre-commissioning activities, particularly regarding completion of the facility, the startup tests and drafting of the operational operating procedures.

In 2023, EDF continued the analysis and correction of deviations, including finalising of repairing welds on the main secondary systems, with completion of pipe welding, performance of non-destructive tests, stress-relief heat treatments and the hydrostatic tests of these systems. In addition to the inspections of the manufacturer and the mandated organisation, ASN conducted a campaign of four inspections of EDF in 2023, focusing on these activities and their monitoring by EDF. ASN considers that the activity organisation and monitoring set up by the various parties involved is satisfactory with respect to the high standard of quality targeted for these welds, thereby making it possible to meet the break preclusion baseline requirements.

ASN observed in 2022 that work was still required in many areas to finalise the setting up of the facilities, (notably addressing deviations, performing certain start-up tests, making several equipment modifications and finishing activities). In this respect, ASN has asked EDF to submit periodic progress reports on the completion of the facilities and has initiated a verification campaign through six dedicated inspections. Furthermore, part of the in-depth inspection of May 2023 was devoted to this subject to check that EDF had taken into account the tasks still to be carried out and ensure that their completion was scheduled for before reactor commissioning. ASN noted that EDF had implemented a dedicated organisation and taken appropriate corrective actions in response to its requests. ASN thus considers that a lot of work has been carried out on the subject over the last few years, enabling a satisfactory finished state to be achieved. It will nevertheless remain attentive to the completion of the tasks that need to be completed before commissioning.

ASN continued its oversight of the start-up tests, and the equipment hot requalification phase in particular. Two inspections concerned the preparation of this phase and the identification and settling of the last prerequisites for it to be launched. ASN also conducted a three-day tightened inspection during the tests, mobilising eight inspectors and four experts from the Institute for Radiation Protection and Nuclear Safety (IRSN). ASN considers that the preparation, performance and analysis of the tests were carried out satisfactorily. ASN is examining the results of these tests, submitted at the end of 2023, within the framework of the reactor commissioning authorisation application. In 2024, ASN will continue its examination within the framework of performance of the reactor pre-commissioning tests, followed by tests of the behaviour of the reactor core and the associated instrumentation.

Alongside the completion of construction, EDF is preparing for future operation of the reactor with dedicated teams, whether in terms of defining and implementing organisational set-ups, skills management, or the preparation and familiarisation with the documents and equipment necessary for operation. On this subject, ASN has asked EDF to submit a periodic preparation progress report, and carried out two inspections in 2023 in addition to the in-depth inspection of May 2023 on preparation for operation.

During this inspection, which lasted five days and mobilised 15 inspectors and 11 experts from IRSN, ASN noted that operational organisational set-ups were defined and in the majority of cases already deployed, and that the personnel had a sound knowledge of the facility. ASN nevertheless noted that a lot of work remained to be done, particularly on the preparation of the operational documentation for operational control and maintenance of the facility. In 2024, ASN will conduct a follow-up inspection before commissioning to ensure that the actions defined in response to ASN's requests have effectively been carried out and meet the set objectives.

Since 2020, many systems, structures and components have been mothballed during the work on the main secondary systems. After reviewing the approach defined by EDF, ASN conducted several inspections to check its implementation. The inspection conducted by ASN in 2023 confirmed that EDF's strategy proved satisfactory in view of the complementary maintenance actions implemented and the verifications carried out on the items of equipment when they are de-mothballed.

ASN also ensures the labour inspection duties on the Flamanville EPR reactor construction site. In 2023, in addition to checking that the contractors working on the site complied with the provisions concerning labour law, ASN continued examining the conformity of the facilities regarding evacuation and fire risks. ASN considers that the organisation of safety is on the whole appropriate with respect to the regulations and shall allow satisfactory transfer of the facilities to the future licensee.

MANCHE WASTE REPOSITORY

The Manche waste repository (CSM), which was commissioned 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 CSM's periodic safety review guidance file had resulted in ASN formulating specific demands at the end of 2017, concerning in particular the justification of the technical principles of deployment of the long-term cover, the CSM memory system and the updating of the impact study.

ASN is currently examining the periodic safety review report submitted by Andra in 2019. The periodic safety review inspection conducted in this context found that the licensee had conducted the review process in a generally satisfactory manner. Nevertheless, some points require particular attention, namely the replacement of the geomembrane in the event of loss of integrity, formalising of the licensee's in-house check and the action plan (updating and level of detail). A meeting of the Advisory Committee of Experts for Waste (GPD) pertaining to the CSM periodic safety review was held on 1 February 2022 and underlined that the licensee's commitments enable continued operation to be envisaged for ten years following submission of the file. The draft resolution concerning the continued operation of the centre was made available for public consultation in December 2023.

In 2023, ASN considers that the organisation defined and implemented for operation of the CSM facilities with regard to safety, radiation protection and environmental monitoring is broadly satisfactory. More specifically, the licensee deploys an appropriate organization for monitoring the centre and its environment, and for meeting its commitments, whether concerning the inspection follow-ups or the periodic safety review process. The licensee must nevertheless consolidate the practices associated with the new framework of radiation protection competence centres.

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 thus constitutes the main risk created by 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.

A new project is currently underway on the site with the "DESIR" facility, standing for Disintegration, Excitation and Storage of Radioactive Ions. The primary function of the DESIR project will be to create new experimentation areas based on beams of radioactive ions produced by the SPIRAL1 and S3 facilities (experimental area of the SPIRAL2 phase 1 facility).

This project involves modifying the BNI perimeter. Examination of this file continued in 2023 and a public inquiry was held, further to which the inquiry commissioner issued a favourable opinion. Subsequently, the building permit was issued and the works have begun.

Examination of the second periodic safety review of the facility is also in progress. In August, ASN asked the licensee to supplement the safety review concluding report, and the additional elements were provided in December 2023. An inspection of this periodic safety review on 20 December confirmed the Ganil's progress in defining requirements associated with the activities and elements important for the protection of interests, even if the incorporation of these changes into the baseline operating requirements is still to be finalised.

With regard to nuclear safety, ASN considers that the licensee's organisational set-up is satisfactory. The licensee has also been able to render its radiation protection organisation more robust.

However, greater rigour is required in filling out the documents relating to the periodic inspections and tests and increased vigilance regarding strict compliance with the regulatory frequencies.

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. The 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 (t/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 t/year. The limits and conditions for discharges and water intake by the site are defined by ASN resolutions 2022-DC-724 and 2022-DC-0725 of 16 June 2022.

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 then 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.

THE INSTALLATIONS AT LA HAGUE

SHUT DOWN INSTALLATIONS UNDERGOING DECOMMISSIONING

BNI 80 • Oxide High Activity (HAO) facility:

- **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 /storing 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:** Package reception and servicing facility;

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.

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 stable solid compound (U_3O_8) in the TU5 facility on the Tricastin site. The uranium resulting from this process is called "reprocessed uranium".

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 used for the fabrication of MOX (Mixed OXide) 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 metal 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 and 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 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. ASN issued an opinion on the draft decrees in July 2022. Decrees 2022-1480 and 2022-1481 dated 28 November 2022 were published in the *Official Journal* of 29 November 2022.

ASN notes that the schedule push-backs requested are significant and largely due to the delays in legacy Waste Retrieval and Conditioning (WRC). Consequently, ASN will continue to monitor the management of these projects in 2024.

LEGACY WASTE RETRIEVAL AND CONDITIONING OPERATIONS

Unlike the direct on-line packaging of the waste generated by the new UP2-800 and UP3-A plants at La Hague, most of the waste generated by the first UP2-400 plant was stored in bulk without permanent 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 facilities.

NOTABLE EVENTS OF THE YEAR 2023

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 course of this special surveillance, thickness measurements taken in September 2021 on evaporator 4120.23 of the T2 facility had shown that the operational criterion for shutting down the evaporator had been reached, which led Orano to decide not to restart the evaporator.

To replace these evaporators, Orano is building 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.

ASN issued the active commissioning authorisation for the NCPF T2 project on 16 September 2022. The T2 facility was shut down at the beginning of September 2022 in order to connect the new evaporators to the existing facilities and to continue the tests prior to commissioning, which took place in mid-April 2023, not significantly behind the initial schedule. In the context of this project, ASN conducted two inspections in 2022 concerning the tests carried out by the licensee and one inspection in February 2023.

The NCPF R2 project is offset by about one year with respect to NCPF T2, meaning that the first tests were started at the end of 2022. The operations to connect the new evaporators to the existing facilities have been underway since October 2023, with commissioning scheduled for 2024. In the course of this project, ASN carried out one inspection relative to the tests performed by the licensee in 2023, which showed that the NCPF R2 project has effectively integrated the lessons learned from the NCPF T2 project. ASN will continue its inspection actions on the NCPF R2 project in 2024.

Retrieval and conditioning of the STE2 sludges

The STE2 station served to collect the effluents from the UP2-400 plant, to treat them and to store the precipitation sludges resulting from the treatment. The STE2 sludges are 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 conditioning methods for the non-packaged or stored sludges.

The scenario for the retrieval and conditioning of the STE2 sludges presented in 2010 was broken down into three steps:
- retrieval of the sludges stored in silos in STE2 (BNI 38);
- transfer and treatment, initially envisaged by drying and compaction, in STE3 (BNI 118);
- conditioning 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 (DAC) for STE3 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 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.

In 2022, during the technical discussions held between Orano, ASN and IRSN, Orano committed itself to a new roadmap for this project. Orano has thus abandoned the centrifugation scenario and undertaken to conduct new studies in parallel aiming firstly to look into the sludge treatment and conditioning solutions in more detail, and secondly to put in place an intermediate storage facility (new silos) under suitably safe conditions, enabling the retrieval and safe storage of these sludges to be separated from their final packaging. Orano sent ASN the DOS associated with this project to create new sludge storage silos (project called "NABUCO") in December 2023.

Silo 130

Silo 130 is a reinforced concrete underground storage facility, with 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". Furthermore, the civil engineering structure of silo 130 is weakened by ageing and by the 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.

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 WRC scenario comprises four steps:
- retrieval and conditioning of the solid GCR waste;
- retrieval of the liquid effluents;
- retrieval and conditioning of the residual GCR waste and the sludges from the bottom of the silo;
- retrieval and conditioning 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 conditioning operations.

The licensee validated industrial commissioning of the waste recovery process in 2022, further to the tests carried out in 2020 and 2021. Quantitatively speaking, 2023 saw the recovery of some fifty additional drums of waste, bringing the quantity of waste recovered since the start of the operations in 2020 to about 17% of the total.

The licensee has nevertheless had problems with recovery equipment reliability (failure lasting from August 2022 till March 2023) and the recovery rate also remains below the initial target. To increase the rate of waste recovery, the licensee took various measures in 2023, such as setting up a maintenance team dedicated to silo 130, and having the recovery teams work three 8-hour shifts per day instead of two since November 2023. ASN considers these measures to be positive, but it will keep a close track on their effectiveness and impact on the rate of waste recovery. Lastly, in December 2023, ASN issued the authorisation for the second stage of waste recovery from silo 130, corresponding to the liquid effluents.

ASSESSMENT OF THE ORANO SITE

ASN considers that the performance of the Orano Recyclage La Hague site in 2023 is satisfactory in the areas of nuclear safety, radiation protection and environmental protection.

With regard to nuclear safety, ASN found the proficiency of operational management to be satisfactory. ASN thus notes positively the tracking of the skills and staffing levels of the operational management teams in the context of the organisational changes linked to the "Convergence" project. It also noted that the teams were closely associated with the resulting changes and that the management of staff numbers was well anticipated. With regard to operational management of incidents and accidents, ASN considers that the teams concerned have a sound knowledge of the baseline requirements. Particular attention must nevertheless be paid to the training of the teams in the management of rarely encountered facility situations or configurations, which caused several significant events in 2023. Greater rigour is also expected in the tracking of periodic inspections.

The aspects relating to the control of chain nuclear reactions have been examined for several of the site's facilities, and here again ASN considers the organisational set-up to be satisfactory, even if particular attention must be paid to the filling out of the periodic inspection and test documents and compliance with the frequencies.

ASN underlines the generally good organisation of outside contractor monitoring. ASN nevertheless considers that Orano must adapt its functioning to be capable of maintaining an adequate level of monitoring during outages, when the number of work interventions is higher. Orano must also ensure that its 1st-tier contractors monitor its 2nd-tier contractors sufficiently closely. Lastly, the rigour with which the monitoring reports are filled out must be improved in some cases (reference of the monitoring actions, consistency between what is expected and the final results, etc.).

With regard to management of the fire risk, ASN considers that the work programmes to reinforce fire detection and protection are proceeding at a satisfactory pace. ASN also notes positively the responsiveness of the personnel of the facilities when unannounced exercises are initiated, and the way in which the operational management teams and local response groups duly accomplish the majority of the tasks incumbent upon them. With regard to the actions to be taken by the "material safety protection" service, ASN regrets that it was not possible to test them in 2023, as the teams withdrew from the exercise due to the concomitant operational activity. Lastly improvements are necessary in the safety analysis associated with the sectorisation losses, in the management of disabling of the fire detection system, and in the integration of new equipment deployed in the fire risk control management project.

With regard to emergency management, ASN carried out an unannounced exercise involving the activation of an on-site emergency plan and notes with approval the site's ability to deploy its emergency organisation and to feed back the facility's technical data to the ASN's Emergency Centre.

In the area of radiation protection, ASN considers the results from the setting up of radiation protection competence centres to be broadly positive, even if some documentary and operational adjustments are still to be finalised. ASN notes with approval the material and awareness-raising measures taken to reduce cases of personnel entering controlled areas without activating their active dosimeter. These measures must nevertheless be maintained and consolidated.

With regard to environmental protection in 2023, ASN notes that the organisation defined and implemented to apply the updated requirements regulating the site's discharges is satisfactory. This notably results in the operational integration of the new discharge limits which places an operational constraint on effluent management. It will however be necessary to consolidate the submitted regulatory registers and notifications, taking care in particular to ensure their consistency and exhaustiveness. Alongside this, the ongoing momentum must be maintained and materialised in anticipation of the forthcoming submittal of studies to ASN (technical-economic studies aiming to assess the possibilities of reducing discharges, study relating to the conformity of the outfalls and the conditions of dispersion of discharges in the atmosphere).

ASN also considers that as soon as possible Orano must carry out the studies and compliance work on the hydraulic structure of the Moulinets dam, with a view to restoring nominal operation of the facilities, including with respect to the routing of raw water to the site.

With regard to the storage of plutonium-bearing materials, Orano commissioned a second storage area extension within a room of the R4 facility in August 2023. Like the first storage area extension, this project was also examined and implemented in a very short time frame. An application for a third extension was filed in September 2023.

Alongside this, ASN considers that the projects relating to the installation of the new evaporators of the NCPF project ran satisfactorily, which enabled the NCPF project for the T2 facility to enter service in April 2023.

More broadly, ASN examined the organisation defined and implemented for operational application of the safety requirements relating to facility modifications. The operational implementation fits into a structured organisation that is adapted to the scale of the projects. However, this must not lead to shortcomings in the robustness of the verifications or≈in the traceability for demonstrating compliance with the specified requirements, particularly with projects involving more limited risks. This must lead, from time to time, to the reviewing of the organization and level of resources assigned to the monitoring of this type of project.

Lastly, ASN observes that the organisation for the off-site and on-site transport of radioactive substances and for the maintenance of the packagings used on the La Hague site remains satisfactory. ASN does however note an increase in significant events in off-site transport operations, and the occurrence of events on the on-site transport operations linked to deviations from the baseline requirements. Furthermore, in the context of the on-site transport system improvements, ASN – through its resolution of 6 July 2023 – has authorised a further postponement of the deadline for the improvements to the Mobile Material Evacuation Enclosure (EMEM) transport system.

The project monitoring inspections carried out at Orano and the supplier of this transport package confirmed the difficulties encountered; consequently, ASN considers that the licensee has to make a strong commitment with more robust

tracking of project management in order to meet the associated regulatory deadlines.

With regard to the progress of the decommissioning and WRC projects, the work continued in 2023. Orano has also continued to implement the fundamental improvements in the organisation of the decommissioning and WRC projects, which began in 2021, aiming to achieve greater robustness.

ASN nevertheless still observes that several decommissioning and legacy WRC projects continue to encounter problems leading to further delays. As far as decommissioning is concerned, Orano must continue the efforts made to address the issues with major implications for the scenario and hence for the associated time frames.

With regard to silo 130, which is the furthest advanced project and now in the industrial operation phase, the rate of waste retrieval remains below that planned for in the design. ASN nevertheless considers that the technical measures aiming to enhance equipment reliability and the organisational changes put in place by Orano in 2023 (working three 8-hour shifts instead of two 8-hour shifts, setting up a dedicated maintenance team, etc.) are positive and ASN will judge their impact on the project in 2024.

Concerning the project for retrieval and conditioning of the sludge from the STE2 station, ASN notes with approval Orano's commitment to build new sludge storage silos complying with current safety standards. ASN nevertheless considers that the associated implementation schedule should be optimised.

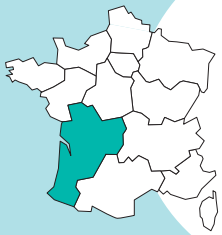
Lastly, ASN notes with approval the measures taken to control the infiltrations in certain buildings and avoid the dissemination of any radioactive materials present in the cells concerned.

HAO silo and organised storage of hulls

The Oxide High Activity – HAO facility (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 2023, the licensee continued the operations prior to retrieval of the waste from the HAO silo and implementation of the physical modifications defined on completion of the analysis of hard spots identified during the functional tests of the waste retrieval system. Through resolution CODEP-DRC-2022-028877 of 15 July 2022, the licensee was authorised to partially commission the unit for retrieving and packaging the waste from the HAO silo and the SOC pools in ECE drums. The licensee nevertheless came across technical difficulties during the tests conducted in 2023, particularly the cementation tests with materials to simulate the waste that is to be retrieved. These difficulties led to test adjustments and repeats which caused schedule slippages.



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 2023, ASN carried out 142 inspections in the Nouvelle-Aquitaine region, comprising 58 in the Blayais and Civaux Nuclear Power Plants (NPPs), 69 in small-scale nuclear facilities, five in the area of radioactive substance transport and ten concerning ASN-approved organisations and laboratories.

ASN also carried out 18 days of labour inspection at the Blayais NPP and nine days at the Civaux NPP.

During 2023, 13 significant events rated level 1 on the International Nuclear and Radiological Events Scale (INES scale) were reported by the NPP licensees in the Nouvelle-Aquitaine region. In small-scale nuclear activities, one significant radiation protection event rated level 1 on the INES scale and 1 event rated level 2 on the ASN-SFRO 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 and comprises four Pressurised Water Reactors (PWRs) with a power of 900 Megawatts electric (MWe), commissioned in 1981 and 1982. Reactors 1 and 2 constitute Basic Nuclear Installation (BNI) 86 and reactors 3 and 4 BNI 110.

ASN considers that the performance of the Blayais NPP with regard to nuclear safety is below ASN's general assessment of EDF plant performance, and that the actions taken to raise this performance must be continued and increased. The radiation protection and environmental protection performance is in line with the general assessment.

With regard to nuclear safety, in 2023 the Blayais NPP did not manage to stop the deterioration in performance already observed in 2022. ASN considers that the licensee's performance in reactor operational management did not meet expectations, despite a plan of operating rigour having been put in place a plan by site senior management. Increasing staff numbers has not yet rectified this situation. ASN noted shortcomings in training and the maintaining of skills, compliance with procedures and activity preparation. Moreover, the ASN inspections focusing on operational management for incidents and accidents and on emergency situation management revealed deficiencies in the documentation and access to certain equipment items. In the area of fire risk control, ASN notes the occurrence of several notable events and still too many shortcomings in the application of the safety rules in the field. Lastly, with regard to maintenance, which was considered to have been reasonably good in 2022, ASN observed difficulties in the tracking and performance of activities in the context of an intense industrial programme on account of the ten-yearly reactor outages, which will be a focal point of vigilance in 2024.

With regard to occupational radiation protection, ASN considers that the performance has improved slightly with respect to 2022. It underlines the licensee's commitment in this area, but notes that it faces chronic difficulties in observing radiation protection fundamentals, such as wearing dosimeters, complying with alarms or the non-crossing of cordoned-off controlled areas. ASN notes with approval the good control of radiation protection during the reactor outages in 2023.

Concerning environmental protection, ASN underlines the licensee's results in improving the functioning of the wastewater treatment station, controlling legacy pollution in the soils and groundwater, and reducing its diffuse discharges of greenhouse gas refrigerants. ASN has nevertheless observed the continuation of inappropriate operating practices (handling acids outside the channels provided for this purpose) having led to non-radioactive pollutions or bypassing of the normal discharge routes. ASN considers that the licensee must improve its operating practices and the maintenance of components important for protection of the environment. ASN also adopted two resolutions in 2023 regulating the water intakes and discharges of liquid and gaseous effluents from the Blayais NPP. These new resolutions update the prescriptions of 2003 in order to integrate the changes in the regulations and the operating experience feedback from liquid and gaseous effluent discharges, leading to the lowering of certain discharge limits.

With regard to labour inspection, ASN notes that the results concerning worker safety are improving. ASN has observed risk situations for workers concerning traffic and the risk of collision between a pedestrian and a vehicle, work at height, and the occurrence of events affecting safety linked to handheld power tools. The procedure for managing the evacuation of injured persons must be improved and taken into consideration as early as possible in worksite preparation.

ASN considers that the relevance of the risk analyses must be improved. It also underlines, despite the efforts made, another occurrence of accidental exposure of employees to asbestos fibres.

CIVAUX NUCLEAR POWER PLANT

The Civaux NPP operated by EDF in the Vienne *département*, 30 km south of Poitiers in the Nouvelle-Aquitaine region, comprises two 1,450 MWe PWRs commissioned in 1997 and 1999. Reactors 1 and 2 constitute BNIs 158 and 159 respectively. 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 performance of the Civaux NPP with regard to nuclear safety and radiation protection in 2023 is in line with the general assessment of EDF plant performance. There is nevertheless a downward trend. The environmental performance stands out positively with respect to this general assessment. The two reactors of the Civaux NPP were restarted at the beginning of 2023 after outages lasting nearly 18 months, linked in particular to the repairs of the pipes presenting stress corrosion cracks.

ASN considers that the nuclear safety performance deteriorated in 2023, particularly concerning the operational management of the facilities. The restarting of the two reactors was particularly affected by errors or difficulties in maintaining the facilities in the required state. Maintenance is also considered to be down compared with the comparable previous years, with in particular a maintenance non-quality that caused the shutdown of one reactor for work, while several events occurred due to poor assimilation of the activities. Maintaining skills in the maintenance services is a point requiring particular attention. Control of the fire risk is considered to be relatively satisfactory. This being said, following the outbreak of a fire due to non-observance of a procedure, the licensee must step up its rigour of operation.

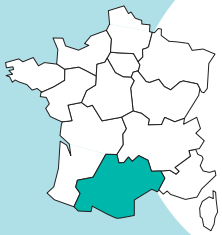
In the area of radiation protection, 2023 was marked by a contamination dispersion event in the reactor building during the outage of reactor 2: numerous malfunctions were characterised, showing a lack of radiation protection culture at the material, organisational and human levels. During the last inspection on this subject, ASN did however find greater awareness on the part of the licensee, who has implemented an action plan in response to this event.

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 field:** Chapter 7
  - 19 external-beam radiotherapy departments,
  - 6 brachytherapy departments,
  - 24 nuclear medicine departments,
  - 90 centres performing fluoroscopy-guided interventional procedures,
  - 116 computed tomography scanners,
  - some 6,000 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - about 940 industrial and research centres, including 59 companies with an industrial radiography activity,
  - 1 cyclotron particle accelerator,
  - 53 laboratories situated mainly in the universities of the region,
  - some 450 veterinary surgeries or clinics practising diagnostic radiology;
- **activities linked to the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 1 organisation approved for radiation protection controls,
  - 12 organisations approved for measuring radon,
  - 8 laboratories approved for taking environmental radioactivity measurements.

With regard to environmental protection, ASN notes that the creation of a retention pond for fire extinguishing water and stormwater is progressing. ASN did however find the demineralisation station facilities to be in poor condition, and this must be corrected.

The occupational safety results have remained at a satisfactory level. The labour inspector conducted an in-depth investigation further to the contamination event in reactor 2 building. ASN noted positively the setting up of an organisation to address dangerous situations. ASN has nevertheless observed delays in ensuring the regulatory compliance of equipment in explosive atmospheres. ASN also notes several events with risks of crushing or impact, as well as situations with risks of workers tripping and falling, and electrical risks.



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 2023, ASN carried out 118 inspections in the Occitanie region, comprising 53 in the Basic Nuclear Installations (BNIs), 53 in small-scale nuclear facilities, nine in the area of Radioactive Substance Transport (TSR) and three concerning ASN-approved organisations and laboratories.

ASN also carried out ten days of labour inspection at the Golfech Nuclear Power Plant (NPP).

During 2023, two significant events rated level 1 on the International Nuclear and Radiological Events Scale (INES scale) were reported by the NPP licensees of the nuclear installations in the Occitanie region. In small-scale nuclear activities, two significant radiation protection events rated level 1 on the INES scale were reported to ASN (one in the industrial sector and one in the medical sector).

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

GOLFECH NUCLEAR POWER PLANT

The Golfech NPP operated by EDF is located in the Tarn-et-Garonne *département*, 40 km west of Montauban. It comprises two Pressurised Water Reactors (PWRs), each of 1,300 Megawatts electric (MWe), commissioned in 1990 and 1993. Reactors 1 and 2 constitute BNIs 135 and 142 respectively.

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

In the area of nuclear safety, ASN considers that the NPP's performance has improved with respect to 2022. The safety rigour plan put in place since 2019 demonstrates senior management's commitment to improving the site's nuclear safety performance. Progress has been observed in operator skills during inspections and through the satisfactory accomplishment of sensitive operating transients. ASN nevertheless observes persistent weaknesses in communication between services, in operating rigour and compliance with procedures. ASN considers that the licensee must continue its efforts in the implementation of the action plan to restore the site's performance in order to consolidate the improvements observed in 2023.

With regard to maintenance, 2023 was marked by the continuation of the ten-yearly outage of reactor 1 and the shutdown of reactor 2 for about six months. In its management of the stress corrosion phenomenon that affected certain pipes connected to the primary system, the Golfech site replaced the pipes of the safety injection system cold leg on both reactors in 2023. The work undertaken by the site to improve the quality of maintenance has stabilised its performance in this area.

ASN notes more particularly improvements in the identification and addressing of deviations and the integration of the positions of the independent safety organisation. ASN nevertheless considers that the site must increase its efforts to improve assimilation of the safety risks prior to work interventions.

ASN considers that the site's occupational radiation protection performance has improved with respect to 2022. ASN notes the strong involvement of the members of the occupational radiation protection skills centre in the training courses and the tightened radiation protection monitoring of outside contractors. The nature of the radiation protection events reported by the licensee reflects this progress. Improvements are nevertheless expected in the control of doses during reactor outages and in the observance of the procedures for accessing limited-stay (orange) areas.

In the area of environmental protection, ASN expects to see improvements in the control of containment and discharges. The year was marked by a relatively large number of events that could have an impact on the environment.

Concerning labour inspection, ASN considers that there is a slight improvement in occupational safety results. However, 2023 was marked by one severe accident. Improvements are expected in the observance of the requirements of the Labour Code, particularly regarding on-site traffic with respect to the risk of collision between a pedestrian and a vehicle. Work at height, handling and lifting are activities that always require particular and continuous attention. The ASN considers that coordination of the risks associated with the interface between different activities must be improved, as must the quality of activity preparations.

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 MOX (Mixed OXides) fuel, the processing of radioactive waste and the irradiation of materials. The majority of the site moreover consists of the Defence Basic Nuclear Installation (DBNI) 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 extend these research activities, activities and equipment from the Laboratory for research and fabrication of advanced nuclear fuels (Lefca), were transferred here from the CEA Cadarache centre in 2017.

ASN published resolution 2022-DC-0720 of 19 April 2022 imposing on the Alternative Energies and Atomic Energy Commission (CEA) the requirements applicable to Atalante and designed to regulate the continued operation of the BNI. ASN is attentive to the traceability of actions from their initiation through to completion. The treatment of radioactive organic liquids has been regulated by a technical requirement. The treatment must be completed before 31 December 2035.

In 2023, ASN authorised commissioning of the seismic cut-off device for the electrical power supply and the water supply, which is also a requirement for the continued operation of the BNI. The purpose of this device is to prevent an earthquake from causing a fire or a criticality accident, and to prevent the consequences of a flood.

ASN considers that the level of safety is satisfactory on the whole, particularly regarding the measure taken to monitor discharges, the emergency preparedness organisation and prevention of criticality risks.

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 "MOX" nuclear fuel production plant,
  - the Centraco facility for processing low-level radioactive waste,
  - the Gammatec industrial irradiator,
  - the Écrin waste storage facility on the Malvési site;
- **small-scale nuclear activities in the medical field:** Chapter 7
  - 14 external-beam radiotherapy departments,
  - 6 brachytherapy departments,
  - 20 nuclear medicine departments,
  - 99 centres performing fluoroscopy-guided interventional procedures,
  - 111 computed tomography scanners,
  - some 5,000 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - about 800 industrial and research centres, including 4 cyclotron particle accelerators, 31 companies exercising an industrial radiography activity and 60 laboratories situated mainly in the universities of the region,
  - some 600 veterinary surgeries or clinics practising diagnostic radiology;
- **activities linked to the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 7 laboratories approved for taking environmental radioactivity measurements,
  - 9 organisations approved for measuring radon,
  - 2 organisations approved for radiation protection controls.

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.

ASSESSMENT OF THE CEA MARCOULE CENTRE

ASN considers that the level of nuclear safety and radiation protection of the CEA Marcoule centre remains satisfactory on the whole.

ASN has noted an improvement in the measures implemented to track the monitoring of outside contractors, whose contracts are managed at the Marcoule centre. The organisation of the CEA Marcoule site response teams dedicated to fire-fighting is also satisfactory. In view of the large number of interventions carried out, ASN has asked the CEA to take measures to maintain a balance between the operational coverage of the centre and the requirements with regard to personnel training and maintaining skills.

Transport preparation operations and maintenance of the packagings are duly carried out and monitored by the CEA.

In 2020, the CEA submitted its study on the sanitary and environmental evaluation of the liquid and gaseous chemical discharges from the Marcoule platform. Through resolution CODEP-MRS-2023-013061 of 9 March 2023, ASN has required the CEA, in association with the other licensees of the Marcoule platform installations, to have an independent organisation perform a third-party assessment concerning the evaluation of the impact on health and the environmental caused by the liquid and gaseous discharges from all the nuclear activities on the Marcoule site. A contract with a third-party expert is currently being concluded.

The technical-economic study of the measures to avoid or reduce the discharge of potentially polluted stormwater, and therefore their impact on the environment, was submitted to ASN in late 2020. The licensee finalised deployment of the measures adopted following the study in 2022. ASN expects the licensee to give it feedback on concerning effectiveness.

With regard to the conformity of the emergency management building - baptised “Centralised Surveillance of Marcoule” (SCM) – with the requirements of the hardened safety core defined further to the accident at the Fukushima Daiichi NPP (Japan) to guarantee the capability of certain items of equipment to fulfil their functions in the face of extreme hazards, a letter requesting complementary information on its accessibility and habitability was sent to the CEA in March 2023.

Removal of the irradiated fuel and equipment continued in 2023 in accordance with the ASN requirements.

Construction of the NOAH facility, which will treat the sodium from Phénix and other CEA installations, progressed in 2023 and the operating tests prior to commissioning, planned for 2028, are continuing.

In 2023, under the optimisation of the waste management routes and pursuant to article 3.1.3 of ASN resolution 2015-DC-0508 of 21 April 2015 amended, ASN authorised the disposal of the two motors taken from potential nuclear waste production zones of the Phénix installation *via* a conventional route as non-radioactive waste. ASN also authorised Phénix to modify its baseline safety requirements to integrate a methodology for the radiological characterisation of the premises with a view to their radiological delicensing.

The reference scenario which is used to set the decommissioning schedule for the facility, defined in the Decommissioning Decree of June 2016, is currently being redefined by the licensee, in line with the decommissioning strategy for all the CEA facilities.

ASN considers that the level of nuclear safety and radiation protection of Phénix is broadly satisfactory, particularly regarding the organisation in place for monitoring occupational radiation protection and the involvement of the facility’s teams to ensure that the commitments made further to inspections, significant events and the previous period safety review are met. The conditions of intervention of the local safety organisation in incident situations must nevertheless be clarified to improve the response times.

Diadem facility – *CEA centre*

The Diadem facility, currently under construction, shall be dedicated to the storage of containers of radioactive waste 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 waste (LL/ILW-SL) whose characteristics – especially the dose rate – mean they cannot be accepted as-is by the existing disposal facilities.

ASN considers that the CEA’s efforts to fulfil its responsibilities as nuclear licensee are effective and satisfactory, particularly through it taking over project management. Changes are currently being made in the project organisation and should be effective in early 2024.

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 the waste packages it is to receive.

The CEA filed a request to modify the Creation Authorisation Decree in 2021 further to change in the package closure technology. It also filed its commissioning authorisation application file for the facility in 2021. These files are currently being examined. The CEA also informed ASN in 2023 that it wishes to file a request to push back the facility commissioning deadline.

The CEA must maintain the efforts it is devoting to management of the worksite and the works still to be carried out.

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 in the areas of nuclear chain reaction control and static and dynamic containment, and broadly satisfactory in the areas of waste management, monitoring of outside contractors, TSR and the monitoring of discharges and the environment.

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.

For several years now the licensee has had difficulties in producing the planned quantities of fuel conforming to the safety specifications of the nuclear reactors. This situation has led to the production of a large quantity of manufacturing rejects, which are sent to the La Hague site for interim storage. This creates a risk of reaching the maximum storage capacity for plutonium-containing materials at the La Hague site in the short term.

In 2022, the licensee qualified a new uranium oxide powder which enabled fuel production to be increased and reduced the quantity of rejects in 2023. This improvement must now be continued over the long term.

The other solutions deployed to lastingly 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. Furthermore, the programme to repair the machines ("PPRM" project) continued in 2023.

The numerous maintenance operations have consequences in terms of radiation protection, with a growing reliance on outside contractors and a high collective dosimetry. They have moreover led to a significant increase in waste production, resulting in a risk of local storage capacities reaching their limit. The licensee has defined an action plan to prevent storage limits being reached. Among the focuses of this action plan is the creation of a new nuclear waste storage area which was authorised by ASN in 2023.

Construction of the emergency centre was completed in 2023. The licensee notified ASN of the commissioning of this building in June 2023, in accordance with the ASN requirement.

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 its process is then routed to the Aube repository (CSA) of the National radioactive waste management agency (Andra). The facility comprises:

- **a melting unit, melting a maximum of 3,500 tonnes (t) of metallic waste per year;**
- **an incineration unit, in which the incinerable waste is burned, with a maximum of 3,000 t of solid waste and 2,000 t of liquid waste per year;**
- **and storage areas.**

ASN considers that the safety of the facility in 2023 is relatively satisfactory on the whole. The findings of the inspections on management of the fire risks and external hazards were below expectations. One waste management inspection was considered relatively satisfactory. Further to these inspections, the licensee had to put in place measures aiming in particular to guarantee fire sectorisation and proper management of the facility's fire loads. The procedures and the operational means that were lacking, called out in the facility's baseline requirements for external hazard events, have also been defined.

Implementation of these actions was checked by an unannounced inspection on this subject held at the end of the year, with a positive conclusion.

ASN also conducted inspections on the pressure equipment and the monitoring of discharges and the environment, with broadly positive results.

The periodic safety review concluding report was submitted on 18 February 2021 in accordance with ASN resolution 2014-DC-0446 of 17 July 2014. This dossier is currently being examined. Monitoring and control of ageing of the facility, particularly as regards the equipment protecting against the fire risk, constitute one of the themes examined for the periodic safety review.

In September 2022, the licensee submitted an application to modify the on-site emergency plan, in order to move its emergency management premises into the perimeter of the BNI, in accordance with section 3.1.3 of ASN Guide No. 9. This modification was authorised in 2023.

Furthermore, ASN is currently revising the resolutions regulating the facility's discharges, in particular to take into account the Industrial Emissions Directive (IED), in order to achieve a high standard of environmental protection.

GAMMATEC IRRADIATOR

The Gammatec irradiator (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 conducted one unannounced inspection in 2023 focusing on the management of deviations, further to which improvements are required. Nevertheless, the level of safety in 2023 remains broadly satisfactory.

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 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. The entire plant is subject to the system governing Seveso high-threshold Installations Classified for Protection of the Environment (ICPEs).

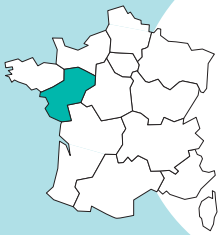
The Écrin facility was commissioned by ASN resolution 2018-DC-0645 of 12 October 2018. The works defined in the Decree of 20 July 2015, which began in 2019, were completed in 2023 with the finalising of installation of the bituminous cover over the zone of the PERLE cell (PERLE is a French acronym standing for "Project for Reversible Lagoon Storage in the Écrin BNI"), excavated to the south of storage basin B2.

The final containment provisions for the storage of waste within the BNI are now in place.

An unannounced inspection was held in July 2023 and served in particular to verify the PERLE cell filling results, the monitoring of the cell remodelling work and the preparation for installation of the bituminous cover.

Alongside this, ASN continued its examination of the report submitted on 12 February 2021 in application of Article 7 of the Decree of 20 July 2015, describing the state of progress of the studies and investigations to assess the feasibility of the disposal options for the waste currently stored in 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 2023, ASN carried out 45 inspections, comprising three in the facilities of the company Ionisos (in the municipalities of Pouzauges and Sablé-sur-Sarthe), one concerning approved organisations, two in the area of radioactive substance transport and 39 in small-scale nuclear activities (14 in the medical sector, 22 in the industrial, research or veterinary sectors, and three in the area of natural radioactivity – radon).

Two significant events in 2023 were rated level 1 on the International Nuclear and Radiological Events Scale (INES scale), one in the industrial sector and one at the Ionisos facility in Pouzauges, and one event in radiotherapy was rated level 1+ on the ASN-SFRO scale.

IONISOS IRRADIATOR

The company Ionisos operates two industrial ionisation installations on the sites of Pouzauges (Vendée *département*) and Sablé-sur-Sarthe (Sarthe *département*) respectively, which use high-activity cobalt-60 sealed radioactive sources. These installations constitute Basic Nuclear Installations (BNIs) 146 and 154 respectively.

The gamma radiation emitted is used for sterilisation purposes or to 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 products for the pharmaceutical and cosmetic industries, packing films) for a pre-determined length of time.

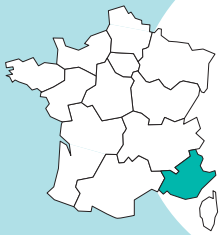
Each installation comprises a pool for underwater storage of the radioactive sources, surmounted by a bunker in which the ionisation operations are performed, premises for storing the products before and after treatment, and offices and technical rooms.

ASN considers that the safety of operation of the Pouzauges and Sablé-sur-Sarthe irradiators has regressed slightly compared with the preceding years. ASN thus expects Ionisos to reinforce its safety management and skills management, and to show greater rigour in the inspections and verifications of activities and safety-important equipment. ASN noted the simultaneous departure of the safety manager and the group safety engineer, and the departure of the Pouzauges site manager, which constitutes a situation requiring vigilance in terms of organisation.

Two modifications concerning the reference "waste" zoning were authorized in May 2023 on each of the Pouzauges and Sablé-sur-Sarthe facilities. An exercise on implementation of the "Organisation of the Civil Security Response relative to the Transport of Radioactive Materials" (Orsec-TMR) of the Vendée *département* was held on the Ionisos Pouzauges site on 12 October 2023.

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:** Chapter 7
  - 7 external-beam radiotherapy departments,
  - 2 brachytherapy units,
  - 11 nuclear medicine departments,
  - 39 centres performing fluoroscopy-guided interventional procedures,
  - 56 computed tomography scanners,
  - some 2,500 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - 1 cyclotron,
  - 29 industrial radiography companies, including 7 performing gamma radiography,
  - 19 research units,
  - about 400 users of industrial equipment;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 8 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 2023, ASN carried out 128 inspections in the Provence-Alpes-Côte d'Azur region, comprising 65 in the Basic Nuclear Installations (BNIs), 57 in small-scale nuclear facilities, four in the area of radioactive substance transport and two concerning ASN-approved organisations and laboratories.

During 2023, two significant events rated level 1 on the International Nuclear and Radiological Events Scale (INES scale) were notified by the nuclear installation licensees.

In small-scale nuclear activities, three significant events in the industrial sector rated level 1 on the INES scale were notified to ASN, and two significant events in the medical sector rated level 2 on the ASN-SFRO scale were notified to ASN.

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. A large part of the centre's facilities are moreover involved in conducting the strategy for decommissioning and management of radioactive materials and waste of the Alternative Energies and Atomic Energy Commission (CEA).

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 Plutonium technology facility (ATPu – BNI 32);
- the Solid Waste Treatment Station (STD – BNI 37-A);
- the Active Effluent Treatment Station (STE – BNI 37-B);
- the Masurca research reactor (BNI 39);
- the Éole / Minerve research reactor (BNI 42-U);
- 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 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.

The CEA Cadarache centre operates numerous installations which vary in their nature and their safety implications. At the Cadarache centre, ten installations are in final shutdown status, nine are in operation and one is under construction. ASN has started or is continuing the examination of the periodic safety review guidance files or the concluding reports for 13 of the 20 installations: Cascad, Cabri, STE, ATPu, Éole / Minerve, MCMF, LPC, LECA-STAR, Phébus, Lefca, Cedra, Magenta and Agate, and has issued its conclusions on the periodic safety review of the STD. 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.

The update of the CEA's decommissioning file was submitted to ASN at the end of 2023, after completion of the assessment of the initial file.

In July 2022, as part of the "DECAP" project for removing the araldite-encapsulated fuels from Pégase, the CEA submitted to ASN a request for authorisation to receive fuel cans stored in the perimeter of the Defence Basic Nuclear Installation (DBNI) of Cadarache, originating historically from the Pégase facility pool. In view of the justifications presented by the CEA concerning the impact on the Pégase facility decommissioning schedule, resolution CODEP-CLG-2017-006524 on the Pégase facility fuel removal operations was modified to allow the reception of these fuels, which took place in 2023.

ASN considers the organisation of nuclear safety and radiation protection at the Pégase-Cascad facility to be satisfactory on the whole. ASN's oversight actions have highlighted that the Pégase shielded cell commissioning tests were correctly carried out and the deviations during this phase were duly remedied. ASN has nevertheless noted shortcomings in the process for reporting deviations by the outside contractors who participate in the manufacture of new Protection Important Components (PICs), particularly for deviations that occurred when performing services outside the BNI.

In 2024, ASN will be particularly attentive to compliance with the commissioning schedule for the DECAP project and to the treatment of the first cans by this process. The implementation of the modifications in the methods of accepting fuels at Cascad, authorised by ASN, will also be examined.

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 Pressurised Water Reactor (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.

The programmes of CIP tests and the electronic component irradiation tests continued in 2023. Alongside these tests, ASN examined the request for underwater repair of the hodoscope, which will finish the complete restoration of the reactor further to the discovery of defects in 2020. This repair will have to be carried out as soon as the ongoing test programme is completed, around the end of 2025.

ASN's examination of the periodic safety review continued in 2023. When compiling its safety review file, the licensee analysed the reactor components identified as requiring specific monitoring with regard to ageing of the facility. In 2024, ASN will be attentive to its operational application. Particular attention shall also be devoted to the long-term retention of the skills of the engineer teams in charge of operation and of the reactor operators.

ASN considers that the level of nuclear safety and radiation protection of the Cabri facility is on the whole satisfactory.

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 (JHR) currently under construction,
  - the ITER installation construction site, adjacent to the CEA Cadarache centre,
  - the Gammaster industrial irradiator;
- **small-scale nuclear activities in the medical sector:** Chapter 7
  - 13 external-beam radiotherapy departments,
  - 3 brachytherapy departments,
  - 16 nuclear medicine departments,
  - 100 centres practising fluoroscopy-guided interventional procedures,
  - 92 computed tomography scanners,
  - some 8,200 medical and dental radiology devices;
- **small-scale nuclear activities in the industrial, veterinary and research sectors:** Chapter 8
  - about 400 industrial and research centres, including 3 cyclotron particle accelerators and 21 companies with an industrial radiography activity,
  - some 600 veterinary surgeries or clinics practising diagnostic radiology;
- **activities associated with the transport of radioactive substances;** Chapter 9
- **ASN-approved laboratories and organisations:**
  - 3 laboratories approved for taking environmental radioactivity measurements,
  - 4 organisations approved for measuring radon,
  - 1 organisation approved for radiation protection controls.

Furthermore, ASN is waiting for information from the CEA on the outlook for the reactor's activity beyond the ongoing test programme.

Rapsodie research reactor – *CEA centre*

The Rapsodie reactor (BNI 25) is the first sodium-cooled Fast-Neutron Reactor (FNR) 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.

The fuel has been unloaded from the core and evacuated from the facility. Furthermore, a large part of the radioactive fluids and 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 Rapsodie Decommissioning Decree was signed on 9 April 2021. This Decree sets the perimeter of the facility and regulates, until 2030, the operations for treating the sodium from the reactor through to introducing air into the vessel containing it. An authorisation application file will be submitted to ASN for the reactor vessel washing operation. The subsequent decommissioning operations, such as decommissioning of the reactor block or of the civil engineering structures, shall be covered by an update of the decommissioning file.

The decommissioning work continued during 2023 and consisted in characterising, repackaging and removing waste packages. The preparation for the treatment of the sodium still held in the facility, called "Recure Na", requires renovation of the reactor building's polar crane. To this end, the old trolleys have been removed to install a new trolley, and the crane has been requalified for a new maximum working load. Operation "Pétole", which consists in placing in final shutdown status and removing the equipment involved in the dynamic containment of the cleaned-out hot cells, has started.

The licensee submitted its periodic safety review guidance file at the end of December 2022. This file is currently being examined by ASN. The periodic safety review file is to be submitted in 2025.

ASN considers that the level of nuclear safety and radiation protection of this facility in 2023 is broadly satisfactory, particularly with regard to the management of waste and effluents and the decommissioning work.

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 radioactive waste (ILW-LL) 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 is conditional on the performance of renovation work – particularly civil engineering works – prescribed by ASN Chairman's resolution CODEP-CLG-2016-015866 of 18 April 2016.

ASN authorised these works on 20 January 2022. The CEA was unable to meet the prescribed work completion deadline in 2021, which has been pushed back to 30 June 2028. The work on this project (called "Pagode") continued in 2023 with the commissioning of the Moderately Irradiating Package Transport Packagings ("ETCMI" in French) and the first civil engineering work.

ASN considers that the level of safety of the facility is satisfactory on the whole, and more specifically as regards management of the emergency resources, the design-construction, and the monitoring of the condition of the systems, equipment and buildings, themes covered by three inspections in 2023. With regard to the follow-up of commitments, a theme that was also inspected in 2023, even if it will not be possible to meet the deadlines for some of the commitments, the schedule slippages seem to be under control and the reasons for them are relevant. ASN is also continuing the examination of the periodic safety review report submitted in 2022.

Active Effluents Treatment Station – *CEA centre*

The Active Effluents Treatment Station (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 Preparation Operations (DECPROs), the licensee is continuing the video examinations of the tanks in order to characterise the substances still present and to determine the works required to ensure accessibility to the tanks in building 322. The characterisation work is a prerequisite for the deployment of processes, which do not yet exist, for treating these effluents. The state of safety of the storage tanks of building 322 and room 22A within building 321 must be improved pending their complete emptying. This action, resulting from the periodic safety review file, should also improve knowledge of the state of the facility, and will be put to good account in the decommissioning preparation operations. The licensee's work has also enabled the study of the fire stability of building 321 to be refined.

The discovery of contaminated stormwater, leading to the presence of artificial radionuclides outside the legacy contaminated zones already identified, continues to form the subject of significant event notifications to ASN, as it has since 2021. This situation persists despite the implementation of a stormwater management action plan, for which ASN is still waiting to receive formal assessment of the effectiveness from the licensee. In view of the successive contaminations, this action plan will continue and will be supplemented in 2024.

In 2023, ASN carried out two inspections on the theme of waste and meeting commitments. Broadly speaking, the follow-up of the action plan resulting from the periodic safety review is satisfactory, as is waste management.

ASN considers that the level of safety of BNI 37-B in 2023 remains broadly satisfactory.

Plutonium Technology Facility and Chemical Purification Laboratory

– CEA centre

The Plutonium Technology Facility (ATPu – BNI 32) produced plutonium-based fuel elements intended for FNRs or experimental reactors as from 1967, then, from 1987 until 1997, for PWRs using MOX (Mixed OXides) 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.

The examination of the periodic safety review files of the two facilities continued in 2023. The operations associated with monitoring, upkeep and operation (SENEX operation), management and monitoring of solid waste and liquid effluents (characterisation, grouping, removal) also continued and enabled the dispersible inventory of the two facilities to be reduced. The cryogenic treatment process removal work also continued.

The inspections conducted by ASN in 2023 focused mainly on the static and dynamic containment, on the management of waste in the ATPu and on performance of the periodic safety review in the LPC. The methods of waste removal were also inspected. ASN considers that the level of nuclear safety of the installation on these subjects is broadly satisfactory.

In October 2023, the licensee reported a significant event rated level 1 on the INES scale that occurred within the LPC, concerning a safety culture deficiency in an employee of the Risks Prevention Service, linked to noncompliance with controlled area access requirements. ASN will check the implementation of the actions proposed by the licensee to prevent the recurrence of this type of event. The methods of controlling access to areas regulated for radiation protection purposes at the CEA shall be examined in particular.

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 FNRs, 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. This decommissioning file is currently being examined and organisation of the public inquiry is in progress. A file concerning the removal of equipment containing sodium was submitted in late 2023.

ASN made a position statement on the safety review guidance file in July 2023. The periodic safety review file is expected in 2025.

ASN considers that the level of nuclear safety, particularly regarding the monitoring of outside contractors and radiation protection – themes that were inspected in 2023 – is satisfactory on the whole.

Éole and Minerve research reactors

– CEA centre

The experimental reactors Éole and Minerve are very-low-power (less than one kilowatt) 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 (BWRs). 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. Decree 2023-1176 of 12 December 2023 brought together the two BNIs 42 and 95 in a single BNI (BNI 42-U) called "Éole / Minerve", and prescribed the decommissioning operations for this facility.

The examination of the decommissioning file for the two facilities ended in 2023. After its referral to the Nuclear Safety and Radiation Protection Mission (MSNR), ASN issued a favourable opinion on the draft decree bringing together BNIs 42 and 95 in a single BNI (BNI 42-U), and requiring the CEA to decommission this facility.

ASN considers that the level of safety of BNI 42-U is satisfactory on the whole, particularly regarding the progress of the latest DECPROs, the organisation of the characterisation and repackaging operations, the radioactive material removal operations and the monitoring of outside contractors. The licensee must however make progress in the monitoring of waste with no immediate disposal route and move forward with the design of containers for removing the start-up sources.

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 Cadarache 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 Decrees in February 2006 and 2021, accompanied by ASN requirements describing the conditions of performance of the future decommissioning operations dated 14 October 2021.

The activities in the facility in 2023 were essentially maintenance and periodic and regulatory inspection operations. The decommissioning operations are currently resuming following the examination of the new baseline requirements submitted in 2022.

ASN considers that the level of safety of BNI 52 (ATUe) in 2023 is satisfactory on the whole.

Most of the actions stemming from the periodic safety review of 2017 have been completed, with the exception of the roof sealing work, the completion of which is pushed back to the end of 2025.

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.

The examination of the decommissioning file ended in 2023. The MSNR submitted the facility's draft decommissioning decree to ASN and consulted the licensee, with the aim of publishing this decree in 2024.

The licensee must also submit its next periodic safety review report to ASN before the end of December 2024.

ASN considers that the DECPROs continued satisfactorily in 2023. The main operations carried out by the licensee were complementary radiological characterisations and removals of equipment and waste.

High-Activity Laboratory LECA-STAR

– CEA centre

BNI 55 combines the Active Fuel Examination Laboratory (LECA) and its extension, the Treatment, Clean-out and Reconditioning Station (STAR). These two units constitute the CEA's expert assessment tools for analysing 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.

The guidance file (DOR) for the next periodic safety review of LECA was submitted by the CEA in January 2022. The examination of this file led ASN to request additional information concerning the conformity check and the re-assessment of the control of risks and drawbacks.

In the context of continued operation of LECA and in compliance with the technical requirements set by the resolution of 10 July 2020 on the completion of the LECA reinforcement works to guarantee that the shielded cells would not be damaged by the main building in the event of an earthquake, the CEA submitted modification requests to ASN and these are currently being examined.

Commissioned in 1999, the STAR facility is an extension of the LECA laboratory, designed for the stabilisation and reconditioning of spent fuel.

ASN is currently finalising its examination of the STAR periodic safety review report submitted in 2018.

In 2023, the CEA reported one significant event involving a load falling onto a fire door situated in the fire sector containing the STAR shielded cells. The damage to the door called into question its two-hour fire-resistance qualification. This event was examined as part of an inspection and was rated level 1 on the INES scale, essentially because of a safety culture deficiency in the way the deviation was addressed.

ASN considers that the level of nuclear safety of the LECA-STAR facility in 2023 is broadly satisfactory, particularly with regard to the prevention of criticality risk and meeting the commitments made in the context of the LECA and STAR periodic safety reviews.

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 three pools, six pits, five 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.

Examination of the facility decommissioning file, which was submitted in 2018, continued in 2023. A meeting of the Advisory Committee of Experts for Decommissioning (GPDEM) to discuss this file is scheduled in April 2024.

The CEA continued its Waste Retrieval and Conditioning (WRC) operations in the BNI in accordance with the schedule presented at the start of the year. The video inspections of pit 1 began. Clean-out work has also been carried out on the extraction cell of trench T2.

ASN considers that the nuclear safety of the facility in 2023 is broadly satisfactory with regard to static and dynamic containment, as is the condition of the systems, themes checked during inspections. ASN has more specifically observed improvements in the tracking and traceability of the modification work procedures. ASN will nevertheless be extremely attentive to compliance with the new deadlines set for retrieval of the stainless steel intermediate level waste packages from pit 6, and to the management of the BNI's stormwater.

Phébus research reactor *– CEA centre*

The Phébus reactor (BNI 92) is an experimental pool-type reactor with a power rating of 38 Megawatts thermal (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.

In 2023, ASN finalised the examination of the decommissioning and periodic safety review files, submitted in 2018 and 2017 respectively.

All the fuel and all the radioactive sources used during operation of the facility the facility have been removed since December 2021, in accordance with the priority objectives of the DECPROs. The start-up neutron source is stored in the reactor building pool pending the identification of a disposal route.

ASN considers that the nuclear safety of the facility in 2023 is broadly satisfactory with regard to management of the fire risk, a theme which was inspected.

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.

In April 2023, ASN transmitted its opinion on the facility's DOR, submitted by the CEA in March 2022. The licensee submitted its periodic safety review concluding report in December 2023, which presents the case for continued operation of the facility. The planned new activities will have to be authorised by decree.

ASN considers that the nuclear safety of the facility in 2023 is broadly satisfactory with regard to control of chain nuclear reactions and the condition of the systems, themes which were inspected. It would nevertheless be advisable to improve the formalisation of many Protection-Important Activities (AIPs), particularly those contributing to the control of chain reactions in order to guarantee that safety is adequately maintained despite the potential personnel movements.

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.**

In 2023, the licensee started the facility for packaging disused sealed sources in the "870L Vrac Source" package authorised by an ASN resolution. The CEA produced the first package on 5 May 2023.

With regard to environmental protection, in May 2023 the CEA submitted a request to modify the facility's Creation Authorisation Decree (DAC), more specifically to take gaseous discharges of tritium into account. A request for a minor modification of the perimeter has also been submitted. These files are currently being examined by ASN.

ASN considers that the level of safety and radiation protection is satisfactory on the whole, particularly with regard to the management of deviations and the measures taken for management of the waste produced by the facility.

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 2030. The studies concerning a project to double the storage capacity began in 2020.

The studies concerning the project to double the facility's storage capacity continued in 2023.

ASN considers that the organisation put in place for the periodic safety review of 2022 is satisfactory. ASN has nevertheless asked for additional information concerning the content of this report.

ASN considers that the level of nuclear safety and radiation protection in the facility is satisfactory on the whole. Improvements are nevertheless required in the monitoring of work carried out in the facility by outside contractors. ASN also remains vigilant regarding the maintaining of operating skills and know-how, in a context of a high turnover of the operational personnel.

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 concluding report in February 2021. In 2023, the licensee supplemented this file at the request of ASN, and an inspection dedicated to the application of the action plan was carried out.

Densification of the storage of certain types of package in the facility was authorised in 2023 in order to optimise the occupied surface area so that new materials can be accommodated.

ASN considers that the nuclear safety of the facility in 2023 is satisfactory, particularly regarding the control of chain reactions. An inspection dedicated to the periodic safety review concluded that the action plan was followed and implemented satisfactorily.

ASSESSMENT OF THE CEA CADARACHE CENTRE

ASN considers that the level of nuclear safety of the CEA Cadarache centre in 2023 remains satisfactory on the whole.

The follow-up of commitments and the responses to ASN further to inspection operations are broadly satisfactory. ASN has however observed that deadlines are not always met, particularly regarding the action plans resulting from the periodic safety reviews of the facilities and certain decommissioning operations.

With regard to the management of deviations relating to nuclear safety, the CEA's quality organisation enables the corrective actions to be carried out. Improvements are required however in the analysis of the causes of certain deviations.

Furthermore, in 2023 ASN focused particular attention on the theme of control of sub-criticality in the centre's facilities. It was noted that the centre has an organisation relating to the control of chain reactions that complies with ASN resolution 2014-DC-0462 of 7 October 2014.

Moreover, in the context of revival of the nuclear sector, ASN will be attentive to the maintaining of skills, as much with the CEA's personnel as≈with the outside contractors performing PIAs.

With regard to the accomplishment of new work projects, ASN notes large disparities depending on the worksites concerned. The JHR construction work is carried out with rigour and diligence, in both its organisation and worksite monitoring, but major shortcomings were noted at the beginning of the year in the general organisation, conducting and monitoring of the construction work of the Cadarache emergency centre, baptised "CIRCE", a French acronym standing for "Response centre withstanding extreme conditions". Progress was nevertheless noted on these themes as of mid-year, although efforts are still≈required in the organisation and quality of performance of the activities on the worksite and the management of deviation processing. ASN will remain particularly attentive to the Cadarache emergency centre construction work, and to the constructions necessary for the decommissioning of the facilities.

With regard to the theme of on-site transport of radioactive substances, improvements are expected in the application of the requirements of the Technical Operating Rules (RTEs) concerning packaging maintenance operations and the checks of packaging-content compatibility.

With regard to emergency situation management, the situational exercise performed during an inspection showed the good coordination between the BNI personnel and the Local Safety Organisation (FLS) of the CEA Cadarache centre. During the 2023 inspection of the FLS, the inspectors noted the quality of its organisation. Improvements are nevertheless required in the traceability of skills currency training.

ASN considers that the radiation protection situation of the CEA Cadarache centre remains at the same level as in the preceding years. The Cadarache centre has set up its radiation protection skills centres under Articles R. 593-112 of the Environment Code and R. 4451-113 of the Labour Code further to the authorisation issued by ASN on 23 December 2022.

Concerning waste management in the BNIs, the management of deviations and the traceability of waste monitoring are adequately ensured. Progress is nevertheless expected in the categorisation of certain wastes currently identified as having no available disposal route, with the aim of reducing the volume of waste stored in the facilities. Particular attention shall be paid to the tracking of the filling dates of drums containing this waste in order to reduce their storage time in the BNIs. ASN will also remain vigilant to the legacy waste characterisation and repackaging operations, and to the prospects of disposal routes for sources surplus to requirements.

ASN observes that the level of environmental protection is relatively satisfactory. Improvements have been made in the analyses carried out in the Environmental Chemistry Laboratory (LCE) of the centre. Areas for progress are still identified in the checks of the industrial effluents network, the compliance work on the installed base of piezometers, and the management of the centre's stormwater.
The management approach for polluted sites and soils is still a subject of discussion at the CEA. ASN is still waiting to receive the update of the centre's impact study, taking into account the summed discharges from the Cadarache platform facilities. ASN is finishing the examination of a first modification to the centre's discharge authorisations to take into account the changes to the BNIs since 2016.

Effluent advanced management and processing facility (Agate) – *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.

In 2023, the CEA filed a request to modify the facility creation decree to enable it to process new types of radioactive effluents. The CEA must submit the concluding report for its first periodic safety review to ASN no later than 29 April 2024.

ASN considers that the standard of safety, radiation protection and operation of the facility are satisfactory and consistent with an objective of continuous safety improvement.

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 equipment construction and manufacturing activities continued in 2023, particularly in the reactor building and the nuclear auxiliary building. The defects observed on the primary/secondary heat exchanges are undergoing expert assessments. The corrective action plan is to be submitted in early 2024.

ASN conducted four inspections in 2023. They focused in particular on the primary cooling system of the reactor for the aspects relating to correction of the deviations detected on the heat exchangers and taking into account the risk of migrating bodies, on the water-proofing of the floors and walls, and correcting the deviation concerning the severing of several reinforcing bars of a slab in the leak collection zone. The assembly of the reactor equipment and of the fluid circuits, the lining of the pools, the treatment of the corrosion at the bottom of the reactor pool and the fire protection of the nuclear buildings also underwent verifications.

Following the submittal in late 2021 of a revision of the facility's safety analysis report taking into account the changes and modifications introduced since the start of construction, ASN – assisted by the Institute of Radiation Protection and Nuclear Safety (IRSN) – continued the technical examination of various themes in 2023 in preparation for the future commissioning.

ASN notes the rigour of the organisation put in place the construction of the JHR and underlines the effective and satisfactory handling of the main deviations detected on the worksite.

A project completion road map has been produced by the CEA, with a new reference schedule for the construction and commissioning of the facility. The Nuclear Policy Council meeting of 19 July 2023 endorsed the continuation of the investments by the State and the nuclear sector to finalise construction of the JHR, with commissioning expected around 2032-2034. In September 2023, the CEA submitted a new request to modify DAC 2009-1219 of 12 October 2009, to set the commissioning date to 14 October 2037 at the latest, taking into account margins for the project.

ITER

The International Thermonuclear Experimental Reactor (ITER – 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.

In 2022, ITER Organization (IO) announced its intention to develop a new "baseline " for the project, and in 2023 it detailed the main directions the baseline would take. These directions take into account in particular the difficulty for the licensee to provide a completed safety case for the project as a whole with its different phases, given that, due to the experimental nature of the facility and its unprecedented scientific ambition, the technical and scientific knowledge expected from its first experimental phases is necessary to prepare the subsequent phases. More specifically, the new baseline would reportedly include a modified scheduling of the "plasma phases", comprising a first phase – without fusion – with an increased technical scope, while a specific hold point would be planned after the first experimental fusion phase at reduced power, before starting the last phase with the power levels planned for in the project objectives. Several technical choices should also be modified, such as the planned replacement of beryllium by tungsten as the lining material for the first wall of the vacuum chamber. The approach proposed by the licensee to establish the safety case for its facility should be revised accordingly, with in particular a "step-by-step" method corresponding to the successive phases of commissioning and operation.

ASN is not opposed to the planned method involving a safety case comprising several steps. ASN does however underline that this approach presents a significant industrial risk, should the technical choices made and the knowledge acquired at a given stage finally not enable the licensee to demonstrate control of the safety and radiation protection risks for the subsequent steps.

Once the IO has finished redefining its experimentation programme and the changes to its facilities, ASN will be able to redefine the examination programme and scheduling accordingly and analyse the impact of the planned modifications.

The works on the site and the manufacture of the equipment continued in 2023, except for the work on the tokamak, stopped on account of construction deviations in the first sectors of the vacuum chamber which necessitate repairs before they are installed and assembled, and the problem of stress corrosion in the thermal shield cooling systems, which also makes it necessary to repair or replace some of the equipment items concerned. Corrective actions for these various problems are currently being defined. The first sector installed in the tokamak pit in May 2022 was removed in 2023 to go back onto one of the Sector Sub-Assembly Tools (SSAT) in the assembly hall. This will allow the necessary repair operations to be carried out. As the vacuum chamber constitutes a Nuclear Pressure Equipment (NPE) item and a PIC, particularly due to the containment of radioactive substances, the sector repair procedures and the qualification of these processes will be carefully verified by ASN.

The revised schedule, including an assessment of the impact of the Covid-19 pandemic and the repair times for the sectors and thermal shields, should be submitted in 2024.

In 2023, IO sent ASN a new authorisation application for water intakes and discharges of non–radioactive effluents for the facility construction phase, and it is currently being examined. A first file on this subject was judged inadmissible in 2022.

Five inspections were carried out on the site in 2023, focusing in particular on the design and construction and the monitoring of outside contractors. These inspections served to verify, for example, the design and installation of components of the Vacuum Vessel Pressure Suppression System (VVPSS), the follow-up of a significant event concerning the use of an X-ray fluorescence device outside the regulatory framework for using this type of device, the construction of a bridge linking the tokamak building to the cryogenic plant, consideration of the hazards in the dimensioning of the building or equipment, the manufacture of the vacuum chamber, the addressing of dimensional nonconformities, and the installation of the fuel systems in the tokamak building, to mention but these.

In the light of the inspections, ASN considers that improvements have been made, but further efforts are needed in the formalising and traceability of the activities and the handling of deviations, or in taking into account the safety issues and the application of the defined requirements.

GAMMASTER IRRADIATOR

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 high-activity cobalt-60 sealed sources which provide the radiation necessary for the facility' operations.

In 2023, ASN carried out two inspections on the organisation of the emergency resources, on radiation protection and the follow-up of commitments. Although some commitments fall behind schedule, the progress of the actions is well tracked and comes with deadlines.

ASN considers that the level of safety and radiation protection in 2023 is broadly satisfactory.

Find the full Report
on the state of nuclear safety and radiation protection
in France in 2023 on

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Editorial by the Commission: p. 3: ASN/J. Grison.
Editorial by the Director General: p. 9: ASN/Sipa/V. Colin.
Notable events: p. 12: EDF/Marc Didier; p. 14-15: ASN/P. Cousin; p. 16: BRIEF/A. Tran Duc; p. 16: EDF – Mission communication Golfech; p. 17-19: ASN; p. 18: Andra/S. Lavoué; p. 18-19: BRIEF/A. Tran Duc.

ASN Report on the state of nuclear safety and radiation protection in France in 2023

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