

ABSTRACTS

ASN REPORT

on the state of nuclear safety
and radiation protection in France in |2022|



The French Nuclear Safety Authority presents
its report on the state of nuclear safety
and radiation protection in France in 2022.

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

2022

ROLES
OPERATIONS
KEY FIGURES

ASN ORGANISATION CHART

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

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

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



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 authorisation 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 Energy Transition for Green Growth Act of 17 August 2015, known as the "TECV Act", ASN's roles now include protecting ionising radioactive sources against malicious acts. Inspection is ASN's primary monitoring activity. More than 1,900 inspections were thus performed in 2022 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.

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.

INFORMING

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

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

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

IN EMERGENCY SITUATIONS

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

REGULATION AND MONITORING OF DIVERSIFIED ACTIVITIES AND FACILITIES

Nuclear power plants, radioactive waste management, fabrication and reprocessing of nuclear fuel, packages of radioactive substances, medical facilities, research laboratories, industrial activities, etc. ASN monitors and regulates an extremely varied range of activities and 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;
- 35 facilities which have been finally shut down or are being decommissioned;
- several thousand facilities or activities using sources of ionising radiation for medical, industrial or research purposes;
- several hundred thousand shipments of radioactive substances performed annually in France.

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	Sylvie CADET-MERCIER ^(*) Commissioner	Géraldine PINA JOMIR Commissioner	Laure TOURJANSKY ^(*) ^(**) Commissioner	Jean-Luc LACHAUME ^(*) Commissioner
from 13 november 2018 to 12 november 2024	from 21 december 2016 to 9 december 2023	from 15 december 2020 to 9 december 2026	from 21 april 2021 to 9 december 2023	from 21 december 2018 to 9 december 2026
↓ APPOINTED BY the President of the Republic			↓ APPOINTED BY the President of the Senate	↓ APPOINTED BY the President of the National Assembly

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

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

IMPARTIALITY

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

INDEPENDENCE

The Commissioners perform their duties on a full-time basis. Their mandate is for a six-year term. It is not renewable. The duties of a Commissioner can only be terminated in the case of impediment or resignation duly confirmed by a majority of the Commissioners.

The President of the Republic may 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 the *ASN Report on the State of Nuclear Safety and Radiation Protection in France* to Parliament. 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.

KEY FIGURES 2022

PERSONNEL



516
staff members

85%
management

48%
women

329
inspectors

ASN ACTIONS



1,868
inspections of which 4%
were carried out remotely

239
technical opinions
sent to ASN by IRSN

19
plenary sessions of the
Advisory Committees
of Experts

2,161
individual licensing
and registration
resolutions issued

28,508
inspection follow-up
letters available
on *asn.fr* as at
31 December 2022

BUDGET



€ **68.30 M**

budget for ASN
(programme 181)

€ **85.5 M** IRSN budget devoted
to expert assessment
work on behalf of ASN

INFORMATIONS



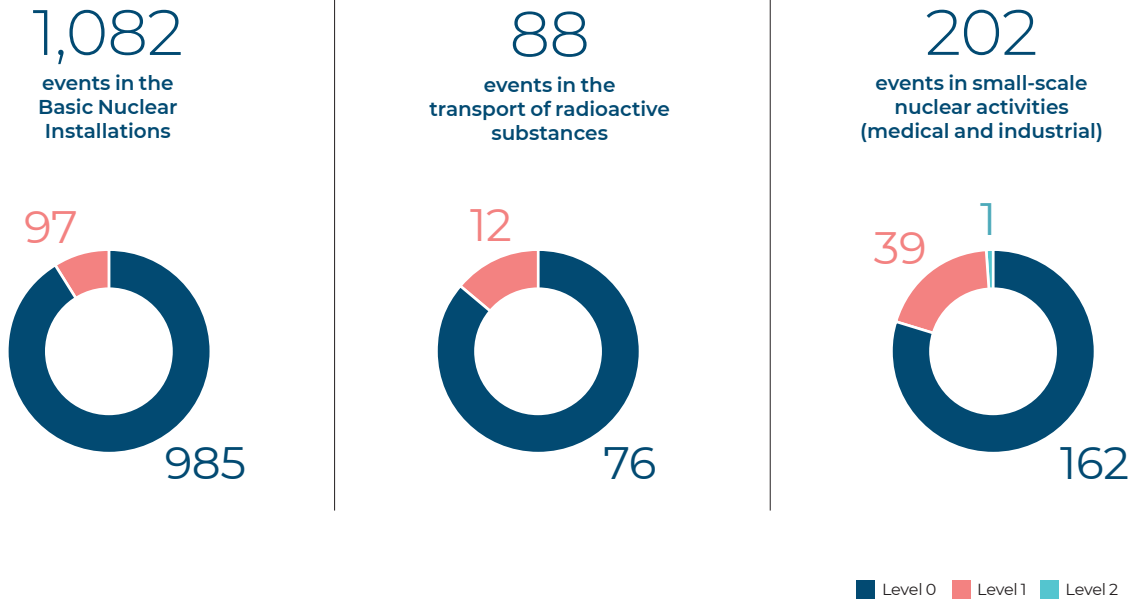
600
replies to queries
from the public and
the stakeholders

81
information
notices

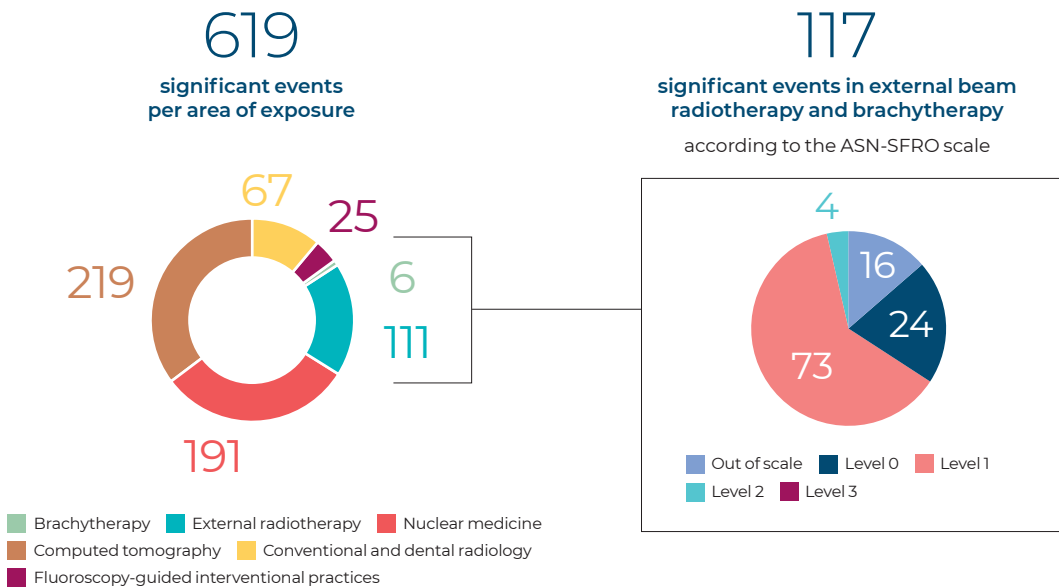
11
press
conferences

KEY FIGURES 2022

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



NUMBER OF SIGNIFICANT EVENTS IN THE MEDICAL FIELD^(*)



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

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

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

ORGANISATION CHART^(*)

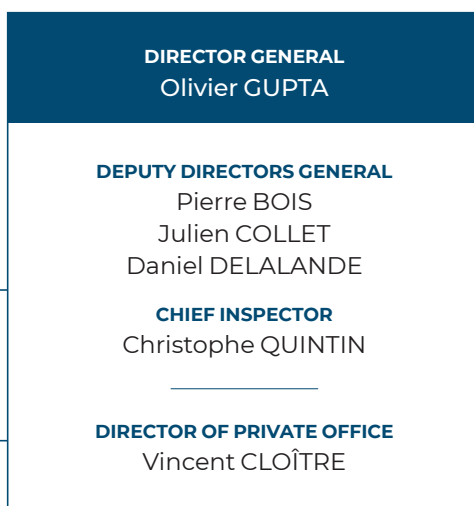
COMMISSION



HEAD OF PRIVATE OFFICE
Sylvie RODDE



GENERAL DIRECTORATE



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
Corinne SILVESTRI

WASTE, RESEARCH, FACILITIES AND FUEL CYCLE
Cédric MESSIER

TRANSPORT AND SOURCES
Fabien FÉRON

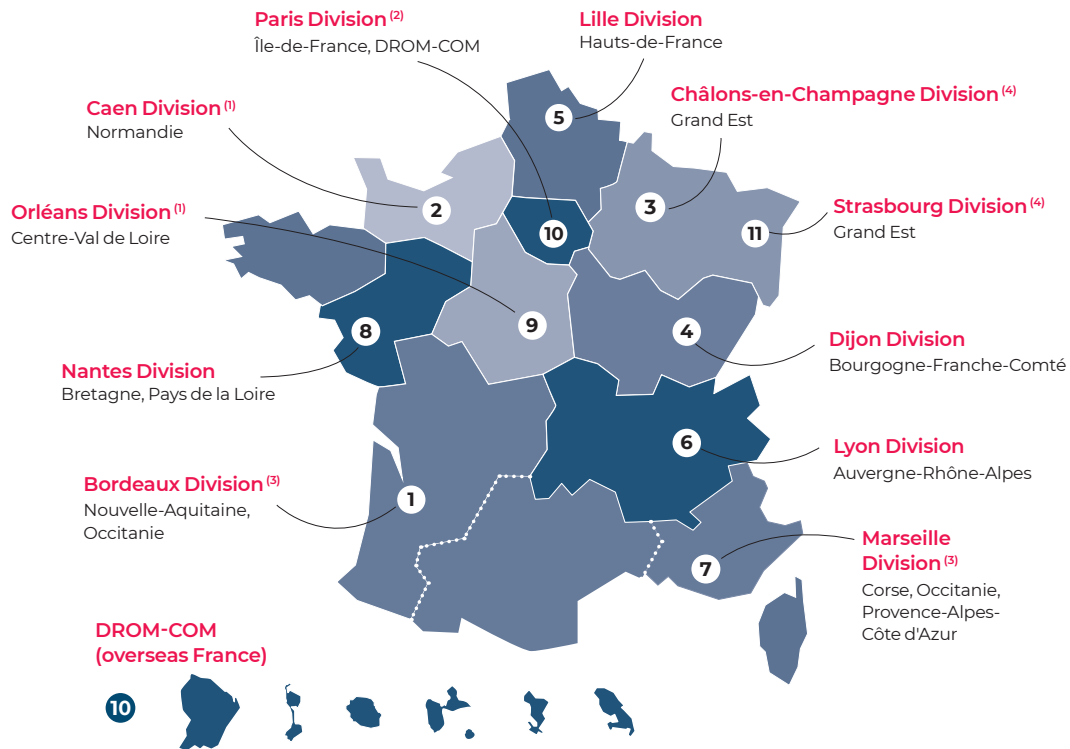
IONISING RADIATION AND HEALTH
Carole ROUSSE

ENVIRONMENT AND EMERGENCY SITUATIONS
Olivier RIVIÈRE

INTERNATIONAL RELATIONS
Luc CHANIAL

LEGAL AFFAIRS
Olivia LAHAYE

INFORMATION, COMMUNICATION AND DIGITAL USAGES
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
Alice-Anne MÉDARD
REGIONAL HEAD
Simon GARNIER

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

7
MARSEILLE
REGIONAL REPRESENTATIVE
Sébastien FOREST
REGIONAL HEAD
Bastien LAURAS

10
PARIS
REGIONAL REPRESENTATIVE
Emmanuelle GAY
REGIONAL HEAD
Agathe BALTZER

2
CAEN
REGIONAL REPRESENTATIVE
Olivier MORZELLE
REGIONAL HEAD
Gaëtan LAFFORGUE

5
LILLE
REGIONAL REPRESENTATIVE
Julien LABIT
REGIONAL HEAD
Rémy ZMYSLONY

8
NANTES
REGIONAL REPRESENTATIVE
Anne BEAUVAL
REGIONAL HEAD
Émilie JAMBU

11
STRASBOURG
REGIONAL REPRESENTATIVE
Hervé VANLAER
REGIONAL HEAD
Camille PERIER

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

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

9
ORLÉANS
REGIONAL REPRESENTATIVE
Hervé BRÛLÉ
REGIONAL HEAD
Arthur NEVEU

* As at 1 March 2023.

Competence
Independence
Rigour
Transparency



asn.fr



info@asn.fr

You can also follow ASN on social media



SUMMARY

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i **ADVICE TO THE READER**

FIND THE FULL ASN REPORT on the state of nuclear safety and radiation protection in France in 2022 on asn.fr.

Only regulatory news for the year 2022 is present in this report.
All the regulations can be consulted on asn.fr, under the heading "L'ASN réglemente".

2022, AN EXCEPTIONAL YEAR AND CONTEXT

Montrouge, 7 March 2023

In 2022, the level of safety in the nuclear installations remained at a satisfactory level, as did radiation protection in the industrial, medical and radioactive substances transport sectors. However, the year 2022 was marked by issues in the nuclear installations hitherto never encountered, as well as by a period of intense heatwave. These events once again highlighted the need to maintain safety margins and to anticipate the challenges ahead, including dealing with exceptional situations linked to climate change.

The year 2022 was also the year of debate on the French energy mix and the new prospects for nuclear energy, whether the continued operation of the existing installations or the construction of new ones. These come against the backdrop of the war in Ukraine and international tensions, which accentuate the issues of energy sovereignty and re-industrialisation.

Given this context, the French Nuclear Safety Authority (ASN) considers that the discussions being held in preparation for the next Multi-year Energy Programme (MEP) should tackle the nuclear sector as a system (nuclear power generation, operation and future of the “fuel cycle”, management of the associated wastes). This nuclear system has to be taken in an holistic way, in order to be able to anticipate the safety, radiation protection and environmental protection issues as a whole, including those linked to climate change, with a medium and long term vision, thereby ensuring that these issues are at the heart of public decisions-making process.

From left to right:

Géraldine PINA JOMIR, Commissioner
Jean-Luc LACHAUME, Commissioner
Sylvie CADET-MERCIER, Commissioner
Bernard DOROSZCZUK, Chairman
Laure TOURJANSKY, Commissioner



An unexpected stress corrosion phenomenon on the nuclear fleet which recalls the need for safety margins

In 2022, the number and duration of reactor outages were unprecedented. This situation was partly foreseeable given the operations involved in the “major overhaul” of the nuclear fleet decided on by EDF and the consequences of the postponement of certain maintenance operations as a result of the health crisis. It was made worse by the detection, during periodic inspections, of a phenomenon of stress corrosion on the welds of the safety injection system, something never before encountered on the international Pressurised Water Reactors fleet.

Faced with this unexpected phenomenon EDF, which has prime responsibility for safety, decided to shut down, or extend the outage of about fifteen reactors

from all plant series, in order to perform additional inspections and initiate a major investigation plan. This identified the main factors in the onset of stress corrosion and determined which reactors were most sensitive to this phenomenon, that is the four N4 type reactors and the twelve P4 type reactors. On this basis, EDF proposed a prioritised inspection strategy to be gradually deployed on all operating reactors in the fleet. ASN considered this strategy to be appropriate and underlined that it could be revised in the light of any new knowledge.

EDF decided to opt for the systematic replacement of the lines considered to be more sensitive to the phenomenon on the sixteen reactors likely to be the most severely affected, by the end of 2023. This choice is positive with regard to safety, but it does however come at a time of workload pressure in the industrial segments concerned.





A summer marked by an exceptional heatwave and drought which had no impact on nuclear safety

The summer of 2022 was marked by an exceptional heatwave and drought which, for the first time since 2003, obliged ASN to issue resolutions waiving thermal discharge requirements and keeping five reactors in operation. This situation had no consequences for nuclear safety. Environmental monitoring was specifically strengthened so that any deterioration of the environment could be rapidly detected. The initial results of this monitoring, produced at the end of 2022, revealed no impact on the environment downstream of the facilities.

According to the Intergovernmental Panel on Climate Change (IPCC), the frequency of this summer's extreme episodes could double or even triple by the year 2050. The management of their consequences will require consolidation of scientific knowledge on the environmental consequences of water intake and discharge, along with forward planning concerning the long-term global issues.

A backdrop of war in Ukraine that is undermining safety responsibilities

With regard to the situation of the nuclear facilities in Ukraine, ASN together with its European counterparts conducted a joint assessment of the radiological consequences of a possible accident scenario. The work to reinforce nuclear facilities in the wake of the accident on the Fukushima Daiichi Nuclear Power Plant – NPP (Japan) led to an increase in the robustness of the Zaporizhzhia NPP (Ukraine), notably regarding the loss of off-site power risk. However, nuclear facilities are not designed to withstand acts of war.

ASN considers that it is fundamental that the licensee of a facility can in all circumstances exercise its prime responsibility for safety, notably by maintaining control of the decision-making chain, and that the operators can act without being subjected to physical and psychological pressure, whether for day-to-day management of safety or in the event of a possible accident situation. ASN also recalls that Ukraine's State Nuclear Regulatory Inspectorate of Ukraine (SNRIU), which is legally responsible for the oversight of nuclear safety, should be able to carry out its duties without hindrance.

EPR commissioning which remains conditional on the final milestones to be reached

In 2022, EDF devoted major efforts on the Flamanville site to carry out the final activities required prior to commissioning, to requalify the facility following the modifications and repairs made. ASN however underlines that significant work is still to be done ahead of commissioning, to carry out the final hot testing campaign on the site and also to complete the conformity justifications of the nuclear pressure equipment.

At the request of ASN, EDF conducted in-depth analyses to identify the causes of the anomalies affecting the fuel and the core, which had been observed in the first EPR reactors abroad, along with their consequences for safety. EDF in particular learned the lessons regarding the design of the fuel assemblies which will be incorporated as from the first loading into the reactor, to prevent the risk of loss of fuel integrity. EDF is also examining the design of a system to prevent the hydraulic phenomena observed in the first reactors.

ASN recalls that analyses are still needed to substantiate the design of certain safety-related equipment, notably the reliability of the pressuriser valves and the performance of the filters for the water reinjected from the bottom of the reactor building in an accident situation.

Innovative small reactor projects which raise unprecedented safety issues

In a context where the aim is decarbonised energy production, there is considerable interest worldwide in Small Modular Reactors (SMR), more particularly in those countries with no NPPs. This interest should not however overshadow the nuclear safety and security issues raised by these reactors. They should be accorded just as much importance as the decarbonised electricity generation concerns. The deployment of these small reactors for various uses could in particular lead to them being sited in industrial or built-up areas, raising specific questions such as the licensee's capacity to control the risk of malicious acts or the proliferation of nuclear materials.

Moreover, the deployment of these small reactors will not only require an industrial chain for their construction, but also the development and implementation of specific management for spent fuel and waste which do not yet exist.

Finally, the level of safety to be set in the context of the strong call for international harmonisation is a subject of debate. For ASN, the level to be adopted should not simply aim to equal that of the existing generation 3 reactors (Evolutionary Power Reactors – EPR – in France) but should exploit the potential for improvement offered by this type of reactor.

In 2022, ASN continued its discussions with several French companies developing SMR projects involving different technologies. At the initiative of ASN, the French, Finnish and Czech regulators and their respective technical support organisations, initiated a preliminary examination of the main safety options of the Nuward project sponsored by EDF. The conclusions of their joint evaluation will be shared with the European safety authorities under the Community SMR development initiative launched by the European Union in 2021. For ASN, this type of concrete initiative on sufficiently mature reactor designs constitutes a crucial step towards greater convergence of safety requirements for SMR.

Vulnerabilities in the “fuel cycle” facilities which remain a concern for ASN

The vulnerabilities found in 2021 in the “fuel cycle” facilities remain a concern for ASN despite the progress observed. The operators must continue their actions to enhance the operational robustness of their units, each being often unique in the “fuel cycle” process.

In the light of this situation, ASN recalls the importance of rapidly obtaining new spent fuel storage capacity meeting the most recent safety standards, in order to address the problem of saturation of the existing capacities. Over the long term, the densification of the existing pools could not be considered an alternative to the centralised storage pool project presented by EDF.

Generally speaking, spent fuel management raises questions of short-, medium- and long-term forward planning, each of which has major safety implications. ASN reaffirms that, in the short term, the question of whether or not to continue with the existing reprocessing strategy must be settled so that there are sufficient margins for safety with respect to the choice to be made. Whatever the decision taken, the consequences will have to be anticipated at least a decade in advance.

This decision should be preceded by a strategic review on the future of the “fuel cycle” as a whole. In this respect, ASN suggests that a pluralistic review be undertaken of the possible futures of the “fuel cycle” and the corresponding waste, similar to that performed by the *Réseau de transport d’électricité* (RTE) grid utility on future energy scenarios in their “Energy Pathways 2050 study”.

Decommissioning and waste retrieval and conditioning operations which must be more transparent

Decommissioning is a complex operation which generally takes several decades. ASN remains vigilant with regard to the progress made for the successive milestones to be reached in the coming years and aims to enhance the visibility of these milestones. As part of its oversight of complex projects, it has set up an “observatory of waste retrieval and conditioning (RCD) and decommissioning” which it now includes in this report. This observatory presents the priority projects: for RCD, these are operations concerning waste with the highest source term or with specific safety implications; for decommissioning, this concerns the facilities for which important milestones are to be reached in the coming five to ten years. These priority projects will now be subject to a monitoring approach by project phase or milestone.

An important step in the Cigéo project which opens up a period of examination during which the consultative process must continue

The *Cigéo* project for the geological disposal of high and intermediate level long-lived waste has reached an important milestone with the submission of the creation authorisation application for the facility by the French National Radioactive Waste Management Agency (Andra), in January 2023.

In 2022, ASN continued the detailed technical work prior to the submission of this file which is of considerable scope. It also played an active role in the work done under the aegis of the High Committee for Transparency and Information on Nuclear Safety (HCTISN) to define the arrangements for continued consultation on the project over the coming years: it will include workshops with the stakeholders most concerned by the project, in order to guarantee that all technical issues that raise concerns are taken into account.





A medical and industrial radiation protection culture that must be nurtured

In 2022, the level of radiation protection remained at a satisfactory level in the medical field. This field, in which the radiation protection issues are particularly high, is under significant pressure, in particular with regard to human resources, a problem that has been exacerbated over the past two years. This has led to the implementation of new work organisations, notably multi-site or calling on outside contractors. ASN remains particularly vigilant in ensuring that these new organisations do not lead to any impairment of worker radiation protection. These unprecedented situations, such as a complete change in the medical team, must be anticipated, notably regarding change management and professional qualification procedures.

Knowledge of and commitment to radiation protection requirements are well established in teams specialising in techniques using ionising radiation. However, the observations made over the past four years show that this radiation protection culture could still be improved in the field of fluoroscopy-guided interventional practices, for which staff training in patient and worker radiation protection is struggling to progress. In addition, the lessons learned from previous events are sometimes forgotten. External radiotherapy calibration errors were once again observed in 2022, despite the fact that similar events had been the subject of ASN *Feedback* sheets shared within the profession. The same observation can be made in other fields, such as industrial gamma radiography, where there have been further cases of poor practices in the management of source blockages. These events remind us that the radiation protection culture can never be taken for granted, but must be maintained in order to avoid the loss of the competence and experience needed to deal with unexpected or undesirable events.

As part of the 2018-2022 action plan for control of the doses delivered to patients, ASN is promoting all measures liable to contribute to the implementation of the justification and optimisation principles, both for routine activities and for the introduction of technological innovations or new practices. In accordance with these principles, ASN stresses the importance and added value of external clinical peer audits, in particular in areas where the risks are high. Similarly, given the significant percentage of radiotherapy treatments in oncology and the improved survival rates, ASN recalls the need to set up follow-up registers for patients who received radiotherapy treatment, to allow improved assessment of the long-term radiation induced effects, in particular for the new practices (hypofractionation, flash-radiotherapy).

Codirpa's innovative and partnership-based approaches which are continuing

The Steering Committee for the Management of the Post-Accident Phase (Codirpa) published its report to the Prime Minister containing recommendations on foodstuffs in an area contaminated by a nuclear accident around an NPP, recommendations which are backed up by field work carried out with a panel of local residents. It also continued its work on the management of post-accident situations around facilities other than NPPs, as well as its work on waste management.

As part of the work done under the mandate given to Codirpa by the Prime Minister regarding the safety and radiation protection culture among the population, its members were involved on 13 October 2022 in the United Nations International Day for Disaster Risk Reduction. The aim of this was to prepare the populations for the appropriate reflexes to deal with in the event of nuclear emergency. ASN, together with the National Association of Local Committees and Commissions (Anccli) and the Institute for Radiation Protection and Nuclear Safety (IRSN), coordinated the actions of the various stakeholders within Codirpa.

A new Strategic Plan⁽¹⁾ for ASN which takes account of a changing context

The year 2022 was marked by ASN's adoption of a new five-year Strategic Plan.

After a decade that could be characterised as “post-Fukushima”, new long-term prospects are emerging for the nuclear sector. They are primarily driven by the need to accelerate the decarbonisation of the economy and by sovereignty issues. This new context is accompanied by innovations and initiatives to develop new types of reactors, which are forcing the regulators to take a fresh look at how they work together.

Safety questions will lie at the heart of the debate and will need ASN to be able to explain matters and ensure that the safety and radiation protection issues are anticipated by all stakeholders, both for new constructions and for the continued operation of the reactors, management of the “fuel cycle”, or waste management, in the nuclear system taken as a whole.

The new prospects will make it even more necessary for ASN to cultivate consultation and pluralism and, in addition to its oversight and regulation duties, to contribute to the development of a safety and radiation protection culture within the population.

In the coming period, ASN will have to work on an unprecedented number of new facility applications in recent years, while remaining mobilised on the facilities in operation or being decommissioned, as well as on medical, industrial and transport of radioactive substances activities.

In this general context, ASN has defined four points that will underpin its strategy for the next five years:

- 1/ **state and share its short-, medium- and long-term vision of the challenges relating to nuclear safety, radiation protection and environmental protection**, for the nuclear system as a whole;
- 2/ **enhance knowledge of the risks and, together with the other stakeholders concerned, promote a safety and radiation protection culture** to meet the expectations and demands of society;
- 3/ **adapt our regulation and oversight to a new context**, reaffirming our refocusing on high-stakes activities and installations and reinforcing our project management actions;
- 4/ and finally, **make a success of the internal transformations in order to be more attractive and efficient.**

Faced with these challenges, ASN will need additional and appropriate resources, along with a greater capability for independent management of these resources, in a manner comparable to its counterparts abroad. ■

1. The 2023-2027 multi-year strategic plan is available on [french-nuclear-safety.fr](https://www.french-nuclear-safety.fr).

REGULATION AND OVERSIGHT EQUAL TO THE CHALLENGES AHEAD

Montrouge, 7 March 2023

2022 was a pivotal year for the nuclear sector in France, with the President of the Republic's announcement of a programme to build new reactors and the desire to see the existing Nuclear Power Plants (NPPs) to continue to operate. It was more generally a pivotal year on an European scale, with an unprecedented energy crisis which completed the process of ushering in a new era for the nuclear industry.

In a joint declaration, the heads of Europe's nuclear safety regulators recalled the importance of nuclear safety in this new context. They urge all the stakeholders to fully exercise their responsibilities in this field, whether Governments, industrial firms or the regulatory authorities themselves.

It is up to these latter to take balanced decisions. To this end, the in-depth technical dialogue between the French Nuclear Safety Authority (ASN), with the support of the Institute for Radiation Protection and Nuclear Safety (IRSN) when necessary, and industry, is the best guarantee for obtaining a high level of safety while taking account of industrial realities.

In the current period, more than ever, it is essential for the regulation and oversight of nuclear safety and radiation protection to be independent and equal to the challenges.

Olivier Gupta



The importance of nuclear safety in the current energy crisis context: a call for collective vigilance

The energy crisis that we are currently experiencing in France, along with many other countries, notably in Europe, merits particular attention from the nuclear safety viewpoint. This question was discussed within the WENRA association, which brings together the heads of Europe's nuclear safety regulators.

With the growing concerns regarding the balance between electricity supply and demand, and the need to combat climate change, many countries are once again turning to nuclear energy, whether by extending the service life of existing NPPs or by building new reactors.

Given the urgent need for electricity production capacity, this situation could place pressure on a number of stakeholders, in particular industry or the nuclear safety regulators, to the detriment of project quality. In a joint declaration, these regulators, including ASN, issued a number of recommendations aimed at mitigating this risk:

- first of all, energy policy decisions must be taken sufficiently well in advance, taking account of the time needed to carry out industrial projects, and must be stable over time. These two aspects are important, because a lack of visibility and stability is prejudicial to safety;
- then, the Governments and all the stakeholders must recognise that the licensees have prime responsibility for nuclear safety: they must not be stripped of this responsibility. It is therefore up to them to construct safety cases for the operation of their facilities or their new projects and to do so

within the time allowing examination by the safety regulators in good conditions;

- finally, the independence of the safety regulators is essential in this current period. They must work efficiently and issue their resolutions within an appropriate time.

As we can see, each of these stakeholders has a role to play in obtaining the high level of safety that the citizens are entitled to expect as a new nuclear programme dawns.

Striking the right balance in the resolution through in-depth technical dialogue

As is often the case in a context of nuclear development – this was already the case at the end of the 1970s when the existing reactors were being built – questions were heard in 2022 regarding the potentially excessive level of stringency shown by the safety authorities in general, and ASN in particular. At the same time, some expressed the fear that ASN was “under pressure”.

In this context, it is important to recall how ASN issues its resolutions: this is done by a Commission – in other words not by a single person – and following





an examination process which allows broad scope for technical dialogue with industry and the nuclear activity licensees.

During this technical dialogue, the possibilities for improving safety are explored in the light of what is reasonably achievable. The state of the art regarding the subject in question, including international experience feedback, is examined. Dialogue covers not only questions of nuclear safety, radiation protection and environmental protection, but also technical and industrial feasibility and the implementation lead-times.

Over and above dialogue with industry, the licensees or the nuclear activity managers, the ASN resolutions process includes wide-ranging consultations. On the more important subjects, ASN may call on the opinion of its Advisory Committees of Experts (GPEs). They comprise experienced experts from French and foreign safety organisations, but also from industry, universities, as well as non-institutional experts, and allow a rich debate offering a degree of perspective with respect to the conclusions of the expert assessments – whether from ASN or the IRSN – and the arguments put forward by industry. Barring a few rare exceptions, the opinions issued by the GPEs are the result of a consensus by all members.

The use of this in-depth technical dialogue is of benefit both for safety and for the development of innovative technologies, such as the Small Modular Reactors (SMR) or Advanced Modular Reactors (AMR). As this dialogue takes place well upstream of the regulatory procedures, it enables ASN to inform the project sponsor of the choices made in terms of safety, as of the first discussions concerning a new installation project. Dialogue is iterative, in other words, the industrial firm presents initial options at the preliminary design studies stage. Very early upstream in the process, it is possible to state whether such or such an option envisaged is likely to lead to a dead-end, thus helping the industrial concern to avoid wasting time. This dialogue also helps the industrial firms by giving them visibility regarding the applicable baseline safety requirements. Above all, it helps ensure that safety issues are correctly taken into account at each step in the projects.

A nuclear safety and radiation protection regulation and oversight organisation equal to the challenges

In the current context, independent regulation and oversight based on technical dialogue is of particular importance.

ASN already has a solid in-house skills base enabling it to carry out this technical dialogue. Competence – one of ASN's four values – is acquired through high-level recruitment, a systematic initial training programme such as very few institutions possess, and career paths enabling the personnel to commit to the long-haul and develop their experience of regulation and oversight.

These skills, some of which are expert assessment skills, enable ASN to issue a significant percentage of its resolutions without having recourse to its external support organisations. It is important to preserve and even reinforce this capacity because the very credibility of ASN's resolutions is based on science and technology: the existence of a continuum between expert assessment and resolution is therefore already in reality an essential component of the existing regulation and oversight system.

At the beginning of February 2023, the Government announced its intention to change the regulation organisation to reinforce its independence and the competence of ASN. At the time I am writing these lines, this proposal is still being debated by Parliament.

Whatever the regulatory organisation finally chosen, the personnel at ASN and the personnel 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 2022

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the French nuclear power reactors**

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Stress corrosion phenomenon affecting the French nuclear power reactors

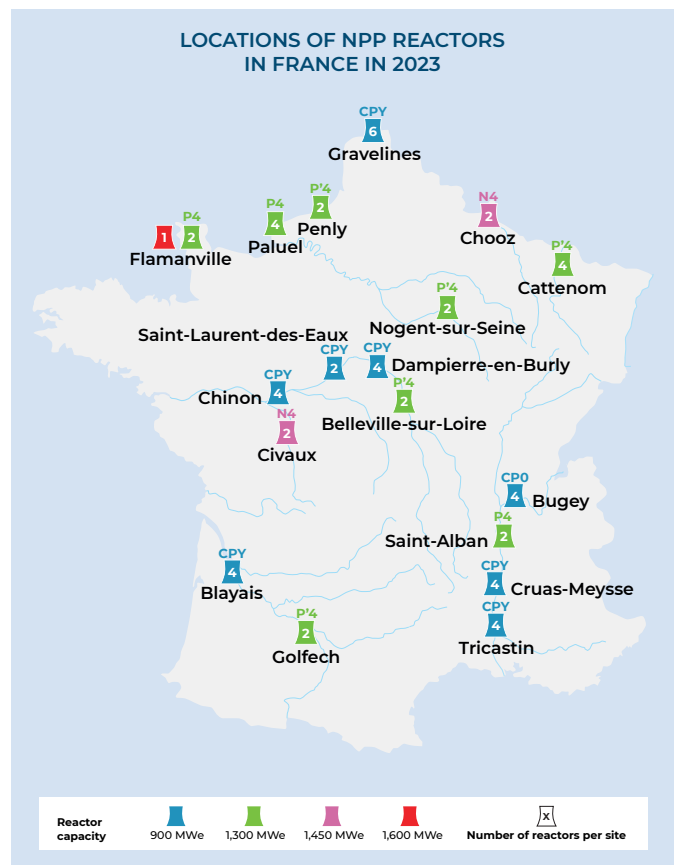
The presence of stress corrosion cracking was the major event encountered by the French Nuclear Power Plant (NPP) fleet in 2022. This unexpected event led EDF to mobilise significant resources to identify the causes and carry out repairs. ASN considers that EDF was reactive and responsible in response to this event with significant safety implications and affecting a large percentage of its reactors. This situation illustrates the electricity supply problems that could arise in the event of a generic problem concerning several reactors on the same time. As early as 2013, ASN had underlined the need for sufficient margins in the electrical system in order to deal with an event of this type.

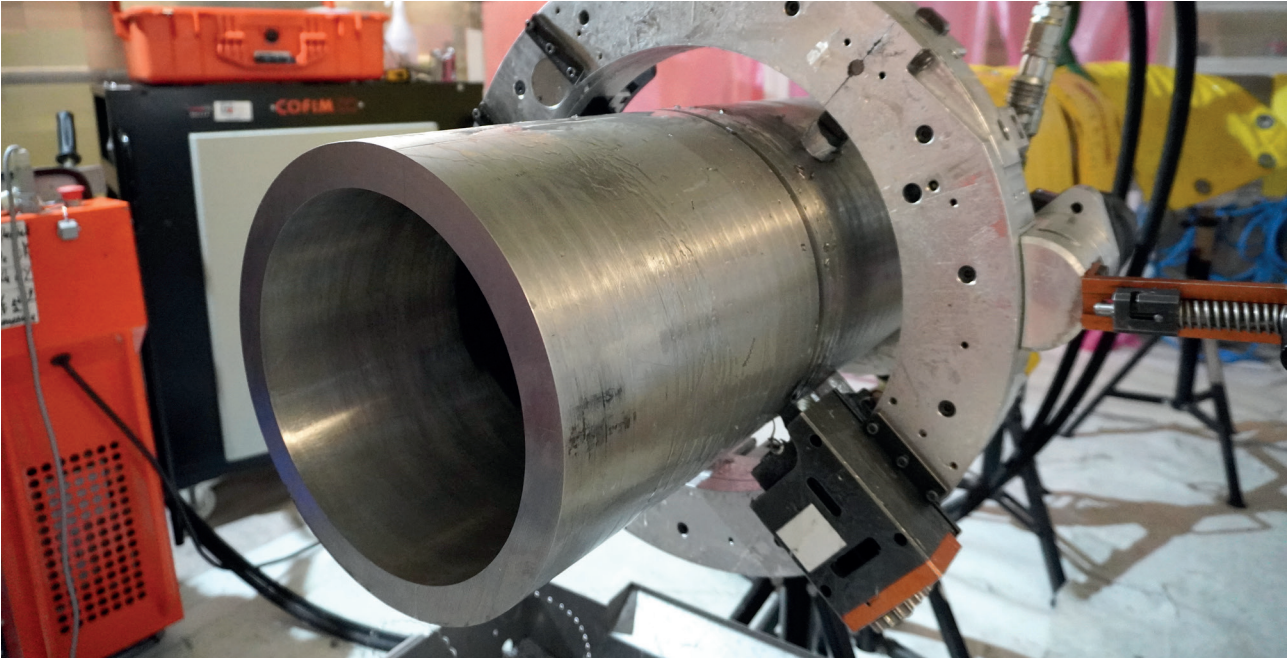
At the end of 2021, EDF informed ASN that it had discovered cracks resulting from a stress corrosion phenomenon on the lines of the Safety Injection System (SIS) of the main primary system of Civaux NPP reactor 1 (N4 type reactor), and then on that of Penly reactor 1 (P'4 type reactor). Although stress corrosion is a known phenomenon and one that had already occurred on other components of the French NPP fleet, this type of crack had not been expected on these lines. This is because they are made of stainless steel, which is considered to be resistant to this type of damage.

By leading to cracking of the material on the inner wall of the lines, this phenomenon weakens them mechanically. It is thus liable to lead to rupture of the SIS or Residual Heat Removal System (RHRS) in the event of major mechanical stresses. As a result of this situation, EDF shut down its four N4 type reactors, which were considered to be the most susceptible, and brought forward the outage of several reactors in order to carry out inspections.

These cracks are particularly hard to detect. In 2022, EDF developed a new inspection process, notably using ultrasounds, capable of measuring the depth of the cracks.

During the first half of 2022, EDF initiated an in-depth programme of inspections and expert assessments⁽¹⁾ on the various types of reactors⁽²⁾. This programme enabled it to identify the geometry of the lines and the thermomechanical stresses to which they are subjected as being the main factors liable to influence the appearance of stress corrosion and thus identify the reactors most susceptible to the phenomenon. EDF defined an inspection strategy, which was validated by ASN on 26 July 2022.





Preparation of the line before installation on the auxiliary system

The second half of 2022 was devoted to repairing several reactors and completing the investigations on those most susceptible.

This problem justified close monitoring by ASN, in close collaboration with the Institute for Radiation Protection and Nuclear Safety (IRSN), which enabled rapid and informed decisions to be made.

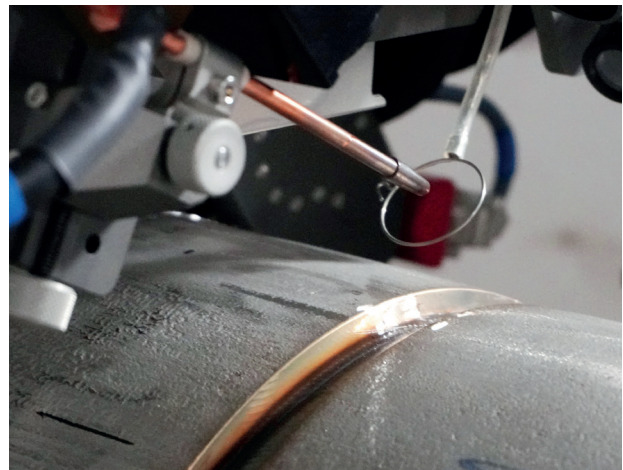
ASN considers that the choices made by the licensee are appropriate, whether regarding the reactor outages or the in-depth investigations.

ASN considers that EDF acted as a responsible licensee given the safety issues related to the cracks revealed on equipment for which the integrity must be guaranteed.

ASN carried out more than 40 dedicated inspections. These inspections notably took place as part of the lines verification or replacement operations in the EDF engineering departments, in the NPPs and at the subcontractors.

The High Committee for Transparency and Information on Nuclear Safety (HCTISN), the Local Information Committees (CLIs) and, more broadly, the public – through information meetings and notices – were informed of the important stages of this dossier. ASN held regular discussions with its foreign counterparts, some of whom intend to request inspections on this same subject.

The reactors of the French NPP fleet will be inspected using the new inspection system developed by EDF, by the end of 2025. In 2023, EDF will carry out preventive replacement of the areas of interest on the susceptible lines of the P4⁽³⁾ type reactors.



Welding training

The Flamanville EPR reactor is also undergoing analysis and checks with regard to this issue.

With the technical support of the IRSN, ASN will remain focused on this dossier in 2023 and will closely monitor the results of the checks carried out by EDF. It will examine any EDF strategy changes that could result from this.

For the latest information on the subject:
asn.fr/l-asn-controle/corrosion-sous-contrainte

1. More than 110 metallurgical expert assessments have been performed in the laboratory, after cutting of the welds on several reactors. Further assessments are to be carried out in order to consolidate the data acquired.

2. The reactors are classified according to their model – or “plant series” – and according to the electrical power they deliver: 900 Megawatts electric (MWe), 1,300 MWe and 1,450 MWe.

There are **32 reactors of the 900 MWe type**: 4 reactors of the CP0 plant series (4 at Bugey) and 28 reactors of the CPY series (4 at Tricastin, 6 at Gravelines, 4 at Dampierre-en-Burly, 4 at Le Blayais, 4 at Chinon, 4 at Cruas-Meysses and 2 at Saint-Laurent-des-Eaux).

The **20 reactors of 1,300 MWe** can be subdivided into two plant series: the P4 series with 8 reactors (4 at Paluel, 2 at Saint-Alban and 2 at Flamanville) and the P4 series with 12 reactors (2 at Belleville-sur-Loire, 4 at Cattenom, 2 at Golfech, 2 at Nogent-sur-Seine and 2 at Penly).

There are **4 reactors of the 1,450 MWe type**, in the N4 plant series (2 at Chooz and 2 at Civaux).

3. With the exception of those of Cattenom NPP reactor 4, on which the expert assessments carried out in 2022 revealed no stress corrosion cracks. EDF will define the strategy concerning this reactor following the inspections scheduled for 2023.

Impact of the summer of 2022 heatwave and drought on the nuclear power plants



Saint-Alban NPP (Isère)

In France, the year 2022 was marked by several episodes of intense heatwave, a historic drought and unprecedented pressure on the energy resources.

In this context, the flow discharge of many watercourses in France fell, while their temperature rose.

ASN made sure that this situation had no consequences for the safety of the Nuclear Power Plants (NPPs) and the environmental monitoring results, produced at the end of 2022, revealed no impact downstream of the installations. The frequency of this type of extreme episode could increase in the coming years. The management of their consequences will require consolidation of scientific knowledge on the environmental impact of water intake and discharge, along with forward planning concerning the long-term global issues.

A period of heatwave and drought has three main consequences for the operation of nuclear reactors.

Operation of equipment participating in reactor safety during a heatwave

The heatwaves led to high air temperatures, causing an increase in the temperature in the NPP premises. Within these premises, the correct working of the equipment contributing to the safety of the nuclear reactors is guaranteed up to a certain ambient temperature. Ventilation and air-conditioning equipment is needed to prevent this temperature from being exceeded. During the heatwaves of 2003 and 2006, EDF reinforced the ventilation and air-conditioning capacity of the premises containing the safety systems. The temperatures that nuclear reactors are required to deal with are defined in the safety case at the end of 2022; they are regularly reassessed, notably during the periodic safety reviews. These reassessments take account of climate change.

During the heatwave episodes of the summer of 2022, the maximum temperatures recorded in the NPP premises remained below the temperatures considered in the safety case.

ASN noted that these high temperatures had no consequences for reactor safety.

The power produced by the reactors in a situation with high watercourse temperatures

To contribute to cooling its reactors, a NPP takes water from a watercourse or from the sea. This water is then returned to the watercourse or the sea at a higher temperature, either directly ("once through" reactor), or after cooling in cooling towers ("closed loop" reactor), enabling the dissipation of some of the heat into the atmosphere.

This water discharged by the NPP leads to an increase in the temperature of the watercourse between the upstream and downstream of the discharge point. Depending on the reactor, this increase ranges from a few tenths of a degree (closed-loop) to several degrees (once-through). In order to manage the consequences for the environment, the thermal conditions of these discharges are regulated by ASN resolutions specific to each NPP. The prescriptions set apply limit values concerning the temperature of the cooling water discharged into the natural environment and the heating downstream of the NPP, along with the environmental monitoring procedures. Thus, when the temperature of the watercourse upstream of the NPP is too high, EDF must reduce the power output by the reactors, or even shut them down, in order to meet the limit values associated with the downstream temperature.

Between July and September 2022, the heatwave and drought episodes led to a rise in the temperature of certain watercourses used to cool the NPPs, in particular the Rhône and Garonne rivers and the estuary of the Gironde. However, the security of the electricity grid and the preservation of natural gas and hydroelectric dam water in order to meet the needs of next autumn and winter, led EDF to ask for a temporary modification of the thermal discharge specifications for these NPPs.

After examining the environmental protection questions, ASN adopted four resolutions in turn, setting temporary requirements for the thermal discharges of the NPPs at Golfech, Bugey, Saint-Alban, Blayais and Tricastin, for the period from 15 July to 11 September. ASN also instructed EDF to conduct reinforced monitoring of the aquatic environment, by means of sampling and measurements.

These NPPs only resorted to the temporary provisions for a total of 24 days (9 days for Tricastin, 8 days for Bugey, 6 days for Golfech and 1 day for Saint-Alban). The Blayais NPP was able to maintain its electricity production without having to resort to these temporary provisions.

The initial results of the reinforced environmental monitoring stipulated by ASN show no impact between the upstream and downstream of the NPPs concerned, whether in terms of physical-chemical parameters, or microbiology values (bacteria). No fish mortality or alteration of the health of the environment was identified between the upstream and downstream of the NPPs concerned.

ASN also carried out inspections with respect to the implementation of these resolutions. It found no deviations from the provisions it had prescribed.

Management of radioactive effluents during periods of drought

The discharge flow of the watercourse can also prevent EDF from discharging the liquid effluents from the nuclear reactors. In order to limit the impact of these discharges on the receiving medium, ASN determined a minimum watercourse discharge flow value, for each riverside NPP, below which no radioactive effluent discharge is permitted. Below these values, EDF must store this effluent until the return of favourable watercourse discharge flow conditions. The NPPs have emergency tanks with additional effluent discharge capacity in order to deal with exceptional situations. Their use requires prior approval from ASN.

During the course of 2022, ASN granted EDF permission to use one or two emergency tanks for the NPPs at Belleville-sur-Loire, Cattenom, Chinon, Dampierre-en-Burly, Nogent-sur-Seine and Saint-Laurent-des-Eaux, during periods in which the watercourse discharge flow levels were lowest, thus preventing it from discharging radioactive effluents.

ASN will analyse the consequences of climate change on the safety of the NPPs and on protection of the environment, as part of the approach it has initiated with regard to continued operation of these installations up to and beyond 60 years.

ASN mobilises against the backdrop of the war in Ukraine

The war in Ukraine is weakening the safety of the nuclear installations, some of which are within actual combat zones. Although these installations generally offer significant levels of robustness to external natural or industrial hazards, they are however not designed to withstand the full range of weapons and ammunition to be found in an armed conflict.

Although no radioactivity release accident has as yet been observed, 2022 saw a series of events which lastingly and worryingly affect the safety of the country's four nuclear sites, more specifically that of the Zaporizhzhia Nuclear Power Plant (NPP). As early as the month of February, ASN and its counterparts came together to ensure that, in the case of an event on a Ukrainian nuclear installation, they would be able to provide the public authorities with coordinated assistance.

The war in Ukraine is weakening the safety of the nuclear facilities

As of the beginning of the war, in February 2022, the Ukrainian nuclear installations found themselves at the centre of the conflict and were lastingly affected.

Damage from shelling was observed very early on, at the Kharkiv site, on a radioactive waste disposal site near Kyiv and at the Zaporizhzhia NPP.

Loss of electrical power⁽¹⁾ affected the Chernobyl NPP in March and then since August has repeatedly affected the Zaporizhzhia NPP, which is home to six of the country's fifteen nuclear power reactors.

Nuclear safety is not purely a technical issue, depending solely on the condition of the installations: it is also built around people and organisations. At the beginning of the conflict, the shift rotation for the Ukrainian personnel present on the Chernobyl site only took place after more than two weeks of Russian occupation; this absence of shift rotation is in itself a factor that weakens safety.

Current preoccupations surrounding the Zaporizhzhia NPP also concern organisational and human issues, following the capture of the site by the Russians and the replacement of several Ukrainian managers with personnel they appointed themselves.



Zaporizhzhia NPP – september 2022

This situation raises questions concerning the clarity of the chain of responsibility and decision-making, which is essential in situations where several options are possible and where a decision must be taken quickly and executed reliably.

Furthermore, in the current context of fighting close to the plant, the teams are subjected to permanent stress and – according to the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) –



The IAEA Director General, Rafael Mariano Grossi, inspects the damage from shelling during his visit to Zaporizhzhia in september 2022

to physical and psychological pressure from the Russian occupiers. These conditions are thus far from being the best for a calm response to any incident and for correct performance of the day-to-day activities.

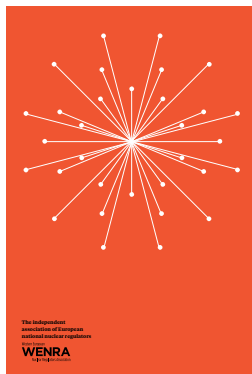
The SNRIU is also finding it increasingly difficult to conduct oversight of the Zaporizhzhia NPP, because it no longer has access to the site since its occupation by the Russians and it receives little direct information from the site.

Finally, the uncertainty regarding the ability of the licensee and the SNRIU to manage any accident on the NPP is compounded by the question of the ability of the authorities to take any population protection measures that would be needed.

ASN mobilisation and actions

As of the beginning of the conflict, the nuclear safety authorities took preventive action, notably at a European level, so that in the case of an event at a Ukrainian nuclear installation, they could provide the public authorities with coordinated assistance. Various initiatives were carried out to recall the international principles of nuclear law, produce situation briefings, share analyses of the possible safety developments and provide the SNRIU and the Ukrainian Government with material or human assistance.

ASN assisted the European Nuclear Safety Regulators Group (ENSREG) with its analyses of the situation and its position statements.



It also coordinated the national response drawn up under the Response Assistance Network (RANET) to meet the needs for individual protection and radiation protection resources expressed by Ukraine.

As Chair of the Western European Nuclear Regulators' Association (WENRA) the ASN Director General took the initiative of creating an expert group specifically mandated to carry out activities related to the war in Ukraine.

This expert group regularly performed technical analysis of situations with safety implications and published its resulting position statements.

These position statements, based on the potential consequences of any worsening of the situation, express the joint view of the regulators regarding the safety of the installations concerned, the time available for a response and the possible impacts of a deterioration of the situation.

In addition, in order to harmonise the recommendations in the event of an accident, this expert group identified the capacity available in Europe for modelling the progress of an accident and the dispersal of releases, and compared the results to a test case, which enabled the various models to be readjusted to ensure consistency.

This action will continue until such time as the nuclear safety situation in Ukraine has returned to normal.

1. The power lines take away the current generated by the NPPs but also enable the fuel to be cooled when the plant is shut down or enable facilities other than NPPs to function correctly.

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 operations in the Nuclear Power Plants (NPPs) was maintained at a satisfactory level in 2022. However, improvements to the quality of operations in the underperforming NPPs are often proving to be a lengthy process.

The year 2022 was marked by the prolonged outage of numerous reactors following the discovery of stress corrosion-related cracks in the systems connected to the main lines of the primary system. ASN considers that the steps taken by EDF following this discovery were appropriate in terms of nuclear safety and that cutting sections of pipes to carry out expert assessments was essential for the definition of a pertinent inspection and treatment strategy.

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 the engineering capacity. EDF therefore regularly has to postpone the transmission of certain studies to ASN. This situation also requires that EDF deploy a number of modifications within a very

tight time-frame. EDF must ensure that this situation does not lead to these deployments being made in degraded conditions.

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

The public inquiries concerning the provisions planned by EDF for the periodic safety reviews of Tricastin NPP reactors 1 and 2 took place in 2022.

THE CONFORMITY OF THE FACILITIES

As in previous years, ASN considers that the conformity of the facilities with the rules applicable to them needs to be improved. EDF must continue the targeted inspection actions it has been gradually deploying over the last few years. More particularly, the specific inspections implemented during the fourth ten-yearly outages are enabling a large number of deviations to be detected.

The organisation adopted by EDF to process deviations has been improved in recent years and is now 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.

Following the discovery of stress corrosion cracking at the end of 2021, EDF implemented a wide-ranging programme of inspections and repairs. This will continue in the coming years (see “Notable events” in the introduction to this report).

MAINTENANCE

As a general rule, the organisation implemented in the NPPs for large-scale maintenance operations was again relatively satisfactory in 2022, notably in the light of the disruptions caused by discovery of the stress corrosion cracks.

However, as in previous years, ASN again in 2022 found points to be improved regarding reactor maintenance, such as the quality of the operational documentation placed at the disposal of the personnel for performance of the activities, or the 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.

A number of improvements were observed in 2022 in the field of subcontracted activities quality control, notably through the use of a new tool used to monitor the contractors. However, difficulties continue with regard to the quality of the monitoring carried out by EDF.

OPERATION

Although unauthorised operating range excursion situations fell in 2022, significant events linked to poor monitoring of the control room increased. ASN also notes an increase in systems configuration deviations and continues to observe shortcomings in communication or positioning with the operating teams.

The training of the operating teams in charge of operating the reactors is satisfactory, even if particular attention must be paid to the attractiveness of the training professions and the time given to the trainers and staff being trained.

No major fire occurred in an EDF NPP in 2022. However, to control the fire risk, EDF must further improve management of equipment temporary storage sites and warehouses, which represent significant calorific potential, along with management of sectorisation in order to contain any outbreak of fire.

The ASN inspections focusing on the emergency organisation and resources confirmed that the organisation, preparedness and management principles for emergency situations covered by an On-site Emergency Plan (PUI) have been correctly assimilated. However, EDF must continue its efforts concerning training of the personnel in reorganising the emergency response following an external hazard of extreme intensity.

The analyses conducted by the sites further to significant events are generally relevant and the identification of organisational causes continues to progress.

Finally, ASN observes a shortage of personnel in the teams in charge of conducting independent evaluations of reactor safety in certain NPPs. EDF plans to remedy this situation.

ENVIRONMENTAL PROTECTION

ASN considers that the management of discharges into the environment of the various NPPs is on the whole well controlled. During the heatwave episodes of the summer of 2022, EDF implemented appropriate reinforced monitoring of the environment downstream of the NPPs concerned.

In 2022, the ASN inspections with situational exercises demonstrated that the organisation of the response in the event of a non-radiological accident with potential consequences off the sites should be improved and that material measures designed to prevent or mitigate the effects of these accidents must be reinforced.

ASN considers that corrective measures must be taken regarding waste management, notably in terms of signage, inventory-keeping and traceability.

WORKER RADIATION PROTECTION AND OCCUPATIONAL SAFETY

In 2022, ASN observed continued improvement in how worker radiation protection issues are addressed on several NPPs, after a clear deterioration seen in 2019 and 2020. EDF must continue with the steps taken to improve the way in which radiation protection is handled. There are continuing anomalies notably with the management of industrial radiography work.

With regard to occupational health and safety, the number of accidents with time lost is down on 2021. However, progress is still needed to improve the management of situations presenting risks for the workers, notably with regard to the quality of risk assessment, electrical lock-outs and the handling of concomitant activities within the same location.

INDIVIDUAL NPP ASSESSMENTS

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

With regard to safety, the NPPs at Saint-Alban and Tricastin stand out positively in 2022, whereas, the NPP at Dampierre-en-Burly and, to a lesser extent, at Bugey, Cruas-Meysses, Golfech and Gravelines under-performed by comparison with the other NPPs operated by EDF. The reactors of the Chooz B and Civaux NPPs not having operated in 2022 owing to repair work on the lines

with stress corrosion cracks, ASN was unable to compare their safety performance with that of the other NPPs.

With regard to radiation protection, the NPPs of Civaux and Paluel stood out positively. However, ASN considers that the NPPs of Dampierre-en-Burly and Gravelines had under-performed.

With regard to environmental protection, the Saint-Laurent-des-Eaux NPP stood out positively, whereas, the NPPs at Cattenom and Golfech under-performed.

The Flamanville EPR reactor under construction

In 2022, EDF continued with work to complete the installation, to make modifications to certain equipment and to draw up the various documents needed for the future operation of the reactor. EDF also continued to analyse and process anomalies, notably those affecting the welds on the main secondary systems, along with three main primary system nozzles.

The equipment conservation strategy implemented by EDF is satisfactory, provided that EDF can set up a programme to inspect the equipment at the end of the conservation phase.

EDF also continued to conduct the reactor start-up test programme and initiated preparations for the requalification phase for all equipment, scheduled in 2023 in preparation for commissioning.

Certain important technical subjects still need to be dealt with in full before the reactor can be commissioned.

This is in particular the case with the design of the primary system safety valves, Instrumentation and Control (I&C) upgrades, the performance of the containment internal water tank filtration system, the general operating rules that will be applicable as of commissioning and incorporation of the lessons learned from the commissioning of the first EPR reactors abroad, in particular the various anomalies found on the cores of the EPR reactors in Taishan (China), including the fuel clad perforations observed in 2021.

Nuclear power plants being decommissioned and waste management facilities

FACILITIES UNDERGOING FINAL SHUTDOWN

The EDF reactors finally shut down (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 also 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 2022 for these facilities, in particular regarding the preparation of Fessenheim for decommissioning. With regard to the GCRs, EDF continued with decommissioning work outside the pressure vessel on the Saint-Laurent A, Bugey 1 and Chinon A3 reactors in satisfactory conditions of safety. However, the progress of these projects is significantly slower and the decommissioning completion deadlines envisaged by EDF remain a subject of concern for ASN.

Finally, the conclusions reached this year regarding the Chooz A review demonstrate the same methodological weaknesses as the previous reviews performed on the facilities undergoing decommissioning. ASN will be vigilant in ensuring that EDF takes account of these conclusions when performing its future reviews, notably with regard to the condition of floors or the conformity check.

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. Improvements are however required in waste management in the activated waste packaging and interim storage installation (Iceda). Finally, concerning the centralised storage pool that EDF intends to build at La Hague, ASN considers that EDF must take all necessary steps to submit the creation authorisation application (DAC) file for this new facility no later than the end of 2023, with a view to commissioning in 2034. ASN recalls the importance of having new spent fuel storage capacity compliant with the most recent safety standards in order to deal with the problem of saturation of the existing capacity.

ORANO

The facilities operated by Orano, on the La Hague, Tricastin and Marcoule sites, all have major safety implications, but of different types, both chemical and radiological.

Despite the progress made in 2022 in terms of materials and waste management on the La Hague and Tricastin sites, and a wide-ranging action plan aiming to overcome both Melox production difficulties and the risks of saturation of radioactive materials storage capacity, ASN considers that there is very little room for manoeuvre in the operation of the “fuel cycle” and that this remains a point requiring particular attention.

Once again ASN stresses the need for significant improvement in forward planning and in the quality of the files submitted, to allow calm preparation and on-time implementation of the provisions needed to prevent the risk of situations that block the cycle and the production of nuclear electricity.

ASN also considers that Orano must undertake work to review the issues related to the ageing of all the facilities at La Hague, in terms of both 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, up to and indeed beyond the 2040 time-frame.

From this viewpoint, ASN sees as positive the good progress of the work to replace six evaporators in the La Hague plants in 2022. It will remain vigilant with regard to the correct performance of the operations to connect the first three evaporators in 2023, followed by their actual commissioning.

Finally, in a geopolitical context marked in 2022 by the war in Ukraine, Orano has launched a project to significantly increase the production capacity of the Georges Besse II plant to separate uranium isotopes using the centrifuge process (BNI 168). In 2023, ASN will issue an opinion on the safety options selected by Orano.

LONG TERM COSTS AND PROVISIONS FOR DECOMMISSIONING AND FOR WASTE MANAGEMENT

In its opinion submitted to the General Directorate for Energy and Climate (DGEC) on Orano’s three-year report regarding the creation of financial provisions for decommissioning and waste management for the period 2022-2024, ASN considers that Orano’s decommissioning and spent fuels and radioactive waste management strategy is consistent with the safety and radiation protection requirements. However, improvements are needed if ASN is to be able to verify that the hypotheses adopted to justify the amount of the long-term costs are prudent. Orano shall in particular fine-tune the costs relating to the future post-operational clean-out of polluted soils on its sites and the long-term management of the waste resulting from this clean-out.

THE SAFETY OF FACILITIES IN OPERATION

ASN considers that La Hague’s management of the safety of its facilities is satisfactory. However, this site must make progress in complying with the deadlines in the regulatory requirements and with its undertakings. The La Hague site must also boost its vigilance with regard to the performance of periodic inspections and management of deviations. Finally, 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 for its continued safe operation.

Following the inspections it conducted in 2022, ASN considers that the level of safety of the Orano facilities on the Tricastin site is satisfactory. In 2022, the Tricastin site improved its organisation for analysing the conformity of the facilities with the regulations and made progress in its follow-up of the commitments made to ASN.

With regard to the Melox plant, ASN considers that the level of safety is satisfactory in the field of fire risk management and satisfactory overall in the fields of operations and waste management. ASN also observes an improvement in the extent to which the regulatory baseline requirements in the field of pressure equipment are assimilated.

Generally speaking, ASN considers that the organisation put into place by Orano for evaluation of the conformity of its facilities and for reassessment of their safety during the periodic safety reviews, is satisfactory. It finds that the licensee’s action plan for the periodic safety review of the uranium storage areas at Tricastin is very well followed. However, the La Hague site must reinforce its vigilance with respect to compliance with the deadlines in the regulatory requirements and the undertakings made, notably those made following the periodic safety reviews of the facilities.

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 requirements and present major safety risks. This legacy Waste Retrieval and Conditioning (RCD) is a key step in the progress of decommissioning in the definitively shut down plants.

With regard to the organisation and management of these complex projects, ASN regrets that, despite the progress made, such as the adoption of immediate dismantling objectives, the creation of the major projects department, the evaluation of the maturity of the projects, or the development of progress management tools, Orano has once again revised a number of waste retrieval and processing scenarios. In order to reinforce the transparency and legibility of these projects and of their main challenges for the coming years, ASN has set up an observatory for these projects (see chapter 13 on the full ASN report).

MATERIALS AND WASTE STORAGE CAPACITY

ASN considers that the creation of additional uranium storage capacity on the Tricastin site and the commissioning of a new vitrified waste storage pit on the La Hague site in 2022 contribute to improved management of materials and waste.

However, inadequate forward planning of the consequences of the malfunctions encountered by the Melox plant concerning the plutonium materials storage capacity at La Hague led Orano to belatedly transmit the extension application files for this capacity, and they are also incomplete. This situation is prejudicial to the degree of calm needed to examine them. ASN therefore considers that Orano must reinforce its forward planning regarding management of the materials and spent fuel storage facilities, along with its project management, in order to produce safety files with a satisfactory level of maturity, and submit them sufficiently in advance of the target date for their implementation.

PERSONNEL RADIATION PROTECTION

With regard to radiation protection, the year 2022 was marked by the creation of radiation protection expertise centres. Numerous significant radiation protection events reported for the Orano group sites are linked to anomalies in the annual inventory of sealed sources and to the validity date for the periodic inspections on the atmospheric monitors being exceeded, as well as non-compliance with limited access area access conditions.

Although ASN considers that the level of radiation protection on the Tricastin site is satisfactory, the year 2022 was marked by an upturn in the number of significant radiation protection events

at La Hague. ASN considers that the licensee must continue with and intensify its action plan to prevent this type of event from happening again.

Finally, ASN remains particularly vigilant with regard to the Melox facility, owing to the increase in the number of preventive and corrective maintenance operations carried out on the facility's equipment, against a backdrop of a major maintenance programme intended to enhance the availability of the facilities. This situation leads to an increase in the average exposure of a large number of personnel and in the collective dose for this facility.

ENVIRONMENTAL PROTECTION

ASN welcomes the steps taken by the La Hague site to ensure the regulatory conformity of the facilities, with occasional additional measures to control fluorinated greenhouse gases.

In 2022, ASN continued to monitor the actions taken by the Tricastin site to reduce coolant fluid releases into the atmosphere and considers that the licensee has maintained its efforts to mitigate this type of release.

The Orano group's sites reported 33 significant environmental events in 2022 (as against 11 in 2021). ASN considers that Orano needs to reinforce its vigilance with regard to authorised discharge limits being exceeded and non-compliance with measurement monitoring frequencies.

INDIVIDUAL FACILITY ASSESSMENTS

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

CEA

The vast majority of the nuclear facilities operated by the Alternative Energies and Atomic Energy Commission (CEA) are concerned by the decommissioning and radioactive materials and waste management strategy implemented by this licensee. ASN considers that the safety of these facilities remains under control, but finds that the results of the decommissioning and RCD projects differ widely and remain vulnerable to major contingencies. In this respect, it considers that CEA must reinforce its management of these projects. This reinforcement should also concern the construction of emergency management buildings, which is significantly behind schedule.

Regarding the Jules Horowitz Reactor (JHR) under construction, ASN observes that progress was made in 2022 in understanding certain phenomena with an impact on safety.

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

MANAGEMENT OF NUCLEAR SAFETY AND RADIATION PROTECTION

In 2022, CEA presented the steps taken to promote the incorporation of nuclear safety and radiation protection issues into the operational practices of the facilities for which it is the nuclear licensee. More specifically, CEA clarified the latest organisational changes, succession planning in order to guarantee the availability of rare skills that are vital to the safety issues, as well as training arrangements, in particular training related to the safety culture. During a dedicated inspection, ASN was able to observe that fundamental actions are being

taken in this direction at the national level and it will remain vigilant with regard to their implementation in the field in the coming years.

ASN also considers that the implementation of the "major safety commitments", managed at the highest level of CEA, is improving the monitoring of the most important nuclear safety and radiation protection issues. More particularly in 2023, it will be necessary to ensure that the potential reduction in resources available to CEA, as a result of inflation, has no consequences on CEA's ability to meet its other commitments.

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 monitoring of the deadlines with the greatest safety implications. For the period 2019-2022, ASN thus observes that the strategy defined by CEA and approved by ASN in 2019 is producing results. In recent years, CEA has notably removed a certain number of spent fuels from its definitively shut down reactors, which helps reduce the potential risks from the facilities it operates. ASN nonetheless finds that, despite CEA's clear intention to carry out facilities decommissioning and RCD operations, this licensee is experiencing major difficulties in meeting the deadlines initially set. For many situations, these delays are caused by technical or contractual difficulties. The implementation of this strategy also remains at the mercy of the financial resources available to this licensee.

MANAGEMENT OF COMPLEX DECOMMISSIONING PROJECTS

In 2021 and 2022, CEA voluntarily embarked on the exploratory approach promoted by ASN for the oversight of complex projects. ASN's inspection of the decommissioning project for BNI 37-B, the former effluent treatment plant on the Cadarache site, took place in good conditions. This approach was a catalyst for CEA's development of improvements to its project management practices, which is satisfactory and should be pursued. In the particular case of BNI 37-B ASN identified three priority areas for improvements:

- contracts management, at a time when contractual difficulties were also observed on priority safety operations conducted in BNIs 72 and 166;
- evaluation of the maturity of the complex projects, in particular those with particular implications for engineering, buying, construction and the preparation for commissioning of equipment;
- the methods for evaluating human resources requirements, to substantiate the sustainability of the schedules.

LONG TERM COSTS AND PROVISIONS FOR DECOMMISSIONING AND FOR WASTE MANAGEMENT

In its opinion submitted to the DGEC on CEA's three-year report on the creation of financial provisions to cover decommissioning and waste management for the period 2022-2024, ASN considers that this report reflects the significant changes resulting from the implementation of CEA's decommissioning and materials and waste management strategy. It is of high quality, but should be supplemented by an improved evaluation of the costs of post-operational clean-out and the management of the resulting pollutions, as well as the uncertainties surrounding the estimates of waste volumes. This is notably the case for BNIs 37-B, 165 and 166. Clarifications are also expected regarding the costs linked to the management of the legacy waste repositories and those concerning the performance of R&D studies into the solutions for reprocessing some or all of the bituminous radioactive waste.

THE SAFETY OF FACILITIES IN OPERATION AND UNDERGOING DECOMMISSIONING

ASN considers that the safety of the facilities in operation is generally satisfactory. During the course of the inspections carried out in 2022, 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, Human and Organisational Factors (HOF), as well as the prevention of pollution and management of detrimental effects. ASN's opinion on each of these topics is detailed in the following sections.

RADIOACTIVE WASTE MANAGEMENT

ASN finds that the management of radioactive waste in the CEA facilities is satisfactory and an improvement on 2021, even though the situation differs from one facility to another.

The traceability of waste monitoring could be improved, notably with regard to legacy waste which cannot be immediately removed from the facilities. The operations to characterise this waste also needs to continue, so that it can be removed through the appropriate routes.

ASN considers that particular attention must be paid by CEA to the management of the storage areas for the waste produced by the facilities, notably with regard to aspects concerning monitoring of the inventories and compliance with the waste storage conditions, the justification of the storage durations, and the existence of storage areas not provided for in the baseline safety requirements of certain facilities. Finally, CEA must remain vigilant with regard to correct forward planning for and performance of very low-level (VLL) waste storage area extension projects, made necessary for the facilities producing large quantities of waste (notably the facilities undergoing decommissioning).

THE CONFORMITY AND REASSESSMENT OF THE SAFETY OF THE 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. Generally speaking, ASN also underline's the licensee's satisfactory follow-up and performance of the actions identified during the reviews. The inspections carried out by ASN on the topic of the periodic safety reviews nonetheless identified some points for improvement which must be addressed by CEA, notably concerning the exhaustiveness of the conformity checks. 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 review can be started once the deployment of the action plan from the previous review has been completed.

MANAGEMENT OF DEVIATIONS

ASN generally finds that the deviations management process has made progress at CEA. It must however continue its efforts, notably with regard to analysis of the causes or trends regarding the repetition of similar deviations, for example those linked to non-compliance with the periodic checks and tests.

CHANGE MANAGEMENT

As in 2021, ASN considers that the quality of the safety analyses sent to ASN when CEA submits an authorisation application for a noteworthy modification is satisfactory and that the modifications made in the field do indeed correspond to the information provided by CEA in its authorisation applications.

MAINTENANCE AND THE SCHEDULING OF PERIODIC CHECKS AND TESTS

As in 2021, maintenance work and the scheduling of the periodic checks and tests, their performance and their follow-up within the CEA facilities are on the whole satisfactory. However, in 2022, during an inspection on the Cadarache site, ASN found shortcomings in the traceability of the technical checks carried out to confirm that the maintenance work performed on the Protection Important Component (PIC) of interests is carried out in accordance with the requirements defined for the PIC concerned.

In addition, as maintenance and periodic checks and tests are generally subcontracted, CEA must at all times remain attentive to the technical expertise of the personnel involved and the traceability of the checks conducted. In this context, the findings made during ASN inspections on the subject of ageing show that CEA monitors, checks and satisfactorily maintains its facilities, even if there are still differences between the facilities.

MANAGEMENT OF IRREGULARITIES AND FRAUD

CEA's organisation for the prevention of the risk of fraud is satisfactory. Since 2018, the licensee has notably implemented a specific policy, a whistle-blower alert procedure and new training in operational safety culture (currently being deployed) part of which is devoted to this topic.

OUTSIDE CONTRACTORS

Although the surveillance of outside contractors had been reinforced in recent years, the inspections carried out by ASN on this topic in 2022 are still highlighting the fact that CEA needs to continue with the measures started in this respect. Furthermore, there are still disparities in the quality of this surveillance between the various facilities operated by CEA, and harmonisation is thus required.

RISK CONTROL AND EMERGENCY MANAGEMENT

As in 2021, ASN considers that CEA must continue its efforts concerning the protection of its facilities against the fire risk. Management of the technical devices (fire doors and dampers, detection systems, etc.), must be improved and fire loads limited, particularly on worksites. CEA must also remain vigilant with regard to adapting the available fire risk control resources to the present uses of the premises, in particular for those facilities undergoing decommissioning.

In 2023, ASN will ensure the participation of the local safety organisation for CEA's Saclay and Fontenay-aux-Roses sites in the emergency exercises and active situational exercises.

ASN also observes significant delays in the commissioning of the emergency management buildings designed to take account of the lessons learned from the Fukushima Daiichi NPP accident in Japan. More specifically, CEA has asked for a postponement to 2027 of the deadlines for commissioning of the new emergency management building for the Cadarache centre. CEA has also announced a postponement for the Saclay site, with commissioning of the new premises scheduled for 2024. With regard to the Marcoule centre, significant delays have also been observed in the transmission of the justification data regarding the operability, accessibility and civil engineering behaviour of the emergency situations management building. ASN considers that CEA must reinforce its management of these construction projects in order to meet the specified deadlines.

PERSONNEL RADIATION PROTECTION

The CEA teams have completed considerable work on creating the radiation protection expertise centres, authorised by ASN at the end of 2022, and this constitutes a positive point. ASN remains vigilant with regard to the performance of worker individual ionising radiation exposure evaluations, and the monitoring of outside contractors (handling of deviations, traceability and application of the ALARA – As Low As Reasonably Approach – approach).

Most of the significant radiation protection events reported by CEA are linked to failure to wear a passive dosimeter, notably by the outside contractors, and inappropriate levels of radiological cleanliness. In 2023, ASN will in particular ensure that CEA ensures compliance with the requirement to wear the dosimeter, notably by licensee monitoring of outside contractors in its facilities.

ENVIRONMENTAL PROTECTION

For the year 2022, 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 events) in 2022 is of the same order of magnitude as in previous years, with no notable events (only events level 0 on the INES scale, 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 ensure the conformity of the network of piezometers, the positioning of sampling devices in the gaseous discharge outlets and the management of contaminated land.

INDIVIDUAL FACILITY ASSESSMENTS

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

ANDRA

The Bataille Act of 1991 set a framework for the management and disposal of high-level (HLW) and intermediate-level long-lived (ILL-LL) waste in France. ASN underlines the importance of the work done for more than 30 years on drafting the Creation Authorisation Decree file for the *Cigéo* deep geological disposal facility, which was submitted on 16 January 2023. The finalisation of this file is a key step in the development of this project and for the creation of a management solution for HLW and ILL-LL waste.

With regard to the other radioactive waste disposal BNIs, for which the French National Radioactive Waste Management Agency (Andra) is the only licensee in France, ASN considers that their operation remains satisfactory.

SUBMISSION OF THE *CIGÉO* CREATION AUTHORISATION APPLICATION FILE

In 2022, dialogue continued between ASN, Andra and the Institute for Radiation Protection and Nuclear Safety (IRSN) on the technical subjects identified following examination of the *Cigéo* Safety Options Dossier (DOS). On the basis of this dialogue and the work done since the examination of the DOS by ASN in 2017, ASN considers that submission of the *Cigéo* DAC file to the Minister responsible for nuclear safety on 16 January 2023 is a key milestone for the management of HLW and ILL-LL waste. In preparation for this examination, ASN together with IRSN in 2022 defined the methods to be used for the technical examination of this dossier, which will take at least three years.

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

The discussions between ASN and Andra concerning the low-level, long-lived waste (LLW-LL) disposal facility project continued in 2022. ASN considers that this positive dynamic must be maintained in order to meet the deadlines defined in the fifth National Radioactive Materials and Waste Management Plan (PNGMDR), and which notably aims for the submission of a file in mid-2023 presenting the technical safety options selected, with a level of maturity corresponding to a preliminary design document, for disposal on the site of the Vendeuve-Soulaines municipal federation.

OPERATION OF ANDRA'S EXISTING FACILITIES

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

Finally, ASN considers that the provisions adopted by Andra concerning the review of the conditioning agreement applications and the radioactive waste packages disposal approval and acceptance applications are satisfactory.

ASN Assessments – BY ACTIVITY SECTOR –

THE MEDICAL SECTOR

On the basis of the inspections carried out in 2022 and an analysis of the period 2018-2022 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 good level, relatively comparable from one year to the next, although with a number of persistent shortcomings.

In nuclear medicine and for Fluoroscopy-guided Interventional Practices (FGIPs), deviations persist as the years go by, in terms of radiation protection training of the professionals and the coordination of prevention measures during concomitant activities, notably during interventions by private practitioners. In radiotherapy, the evaluation of the effectiveness of the corrective measures taken is still the weak point of the Operating Experience Feedback (OEF) approaches and the preliminary risk assessments remain insufficiently updated ahead of an organisational or technical change, or following OEF from events that have occurred in the profession. In the field of FGIPs, and more particularly in the operating theatre, work to bring the premises into conformity with the technical design rules and steps to optimise the doses received both by the workers and the patients are progressing too slowly and the awareness of non-specialists in ionising radiation, such as surgeons, needs to be increased to ensure a clearer perception of the issues and enhance the assimilation of radiation protection measures.

Although the fundamentals of quality assurance are today well-established in the radiotherapy departments, they are still being gradually deployed in the other sectors, in particular concerning the requirements for internal reporting of events and formalisation of the procedures for qualifying professionals for the particular positions.

The events reported to ASN underline the fact that the training of professionals, management of maintenance work and the implementation of technical barriers controlling the use of medical devices, which constitute the fundamental basis of safety, are areas for improvement in order to make practices safer. ASN also observes that the lessons learned from past event reports are forgotten.

In 2023, ASN will continue its inspections in the radiotherapy, nuclear medicine, FGIPs and computer tomography sectors, following on from the checks carried out in 2022, with particular attention being paid to the weak points identified in 2022, as well as to implementation of the quality assurance obligations.

From the regulatory viewpoint, ASN will in 2023 continue revising resolution 2008-DC-0095 of 29 January 2008 setting out the technical rules for the elimination of effluents and waste contaminated by radionuclides. ASN will also continue to contribute to the regulatory work conducted by the Ministry responsible for health concerning the organisation of medical physics and the deployment of clinical audits, which could be a pertinent means of ensuring progress with regard to the justification of procedures.

Finally, ASN will maintain its commitment to subjects linked to the spread of new techniques and practices, jointly with the various institutional players in the health sector and the learned societies, while calling on its expert groups, in particular the Committee for the analysis of new techniques and practices using ionising radiation (Canpri), in order to promote and facilitate safe working frameworks and improve the evaluation of long-term radiation induced effects for therapeutic procedures. As part of the 2nd National imaging dose management plan (2018-2022), ASN will aim to encourage all actions to promote implementation of the justification principle, access to the least irradiating imaging techniques and the automated collection and analysis of doses for the purposes of optimisation and monitoring of exposure from medical imaging among the French population.

In radiotherapy, the inspections carried out by ASN in nearly one quarter of the radiotherapy units in 2022, in conjunction with those carried out over the period 2018-2021, enabling the entire fleet to be covered, confirm that the safety fundamentals are in place: organisation of medical physics, equipment verifications, training in the radiation protection of patients, deployment of quality assurance procedures, recording and analysis of events. However, the analysis of the period 2018-2022 confirms that evaluation of the effectiveness of the corrective actions is still the weak point of the OEF approaches and is struggling to become more widely adopted. Although the preliminary risk assessments are inadequately updated ahead of an organisational or technical change or following OEF from events, ASN sees as positive the voluntary development of peer review practices in medical physics, when new equipment is installed. ASN underlines that the buy-outs of centres are situations entailing considerable disruptions that lead to risks if the impact on the working activity of the professionals is not analysed and if these changes are not prepared for with all the teams. ASN also observes that the formalisation of the position qualification procedures, which have been mandatory since August 2021, is being deployed although with differences between the professional categories. Finally, the occurrence of events such as patient identification errors, delineation of organs at risk and/or target organs, and once again calibration, still reveals organisational weaknesses and the need to regularly assess practices. ASN also observes that the lessons learned from past Significant Radiation protection Events (ESR) are forgotten, along with a regular fall in the number of ESR reported to ASN since 2015. Although this can be partly ascribed to safer treatments, a drop in the internal events reporting culture is perceptible with less numerous significant event reports and less detailed analyses. The occurrence of cyber-attacks also underlines the new changes faced by radiotherapy professionals at a time of increasing digitisation of data. Finally, the new techniques and practices, which are constantly evolving, are not always sufficiently evaluated to allow an assessment of the long-term radiation induced effects (adaptive radiotherapy, hypofractionation, flash-radiotherapy, etc.).

In brachytherapy, the inspections carried out in 2022 in nearly one quarter of the brachytherapy units, in conjunction with those carried out over the period 2018-2021, enabling the entire fleet to be covered, reveals no breach of the radiation protection rules. The radiation protection of the professionals and the management of high-level sealed sources are thus considered to be satisfactory. The training effort for professionals in possession of a high-level source must be maintained and reinforced for certain centres. ASN notes that the new requirements relative to safeguarding access to high-level sources, which fully came into force in 2022, are continuing to be gradually deployed, in particular regarding measures to prevent unauthorised access to these sources. However, some centres are faced with conformity difficulties when this demands significant work. The events reported in 2022 underline the importance of having an active events recording system so that malfunctions can be identified as rapidly as possible, equipment quality controls can be formalised, performed and recorded, while ensuring that these latter comply with professional standards and the manufacturer's recommendations.

In nuclear medicine, the inspections in 2022, in conjunction with those performed over the period 2018-2021, enabling the entire fleet to be covered, reveal that radiation protection is correctly taken into account in the vast majority of the departments, with improvements observed for those departments inspected in the past two years, in particular for radiation protection of patients. Nonetheless, improvements are required in three fields: effluent management, in order to control discharges into the sewage networks, formalising the coordination of prevention measures with outside contractors (for maintenance, cleaning of premises, intervention by private practitioners, etc.) and radiation protection training of professionals. Similarly, the organisation of medical physics was felt to be inadequate in 20% of the units inspected in 2022, notably with respect to the radiation protection issues associated with the therapeutic treatments; its improvement is an area for progress at a time new therapies based on innovative radiopharmaceuticals are being deployed. The engagement by the nuclear medicine units in the deployment of quality management systems is continuing and ASN notes progress in the formalisation of the procedures for qualifying professionals for the positions. Even if the undesirable events reporting culture is indeed present in most of the units inspected in 2022, it must continue to be developed further. The reported events again reveal that the drug administration process must be regularly evaluated in order to control it, particularly for therapeutic procedures, due to the potentially serious consequences of a drug administration error.

In the FGIPs field, the 2022 inspections, in conjunction with those performed over the period 2018-2021, allowing coverage of all the facilities considered to have radiation protection risk implications, reveal the fact that radiation protection makes very little progress from one year to the next, with a situation that is still better in the intervention rooms than in the operating theatres, along with persistent shortcomings. Thus, in most facilities, the premises are slowly being brought into conformity to comply with the technical design rules, even though these modifications are essential in order to prevent the occupational risks. Even if the appointment of radiation protection expert-officers, the marking out of regulated areas, the performance of technical checks and quality controls of medical devices are considered to be satisfactory, deviations from the regulations are still frequently observed, both for radiation protection of the professionals and for that of the patients, with unsatisfactory situations concerning the radiation protection training of workers and patients and the coordination of prevention measures during concomitant activities, in particular with private practitioners. Although the use of medical physicists and formalisation of the medical physics organisation plans appear to be gaining ground, progress must be made in the implementation of the optimisation procedure, particularly in the operating theatres where doses are still insufficiently analysed and inappropriate or non-existent protocols can still be observed. The reporting culture, however, has been spreading in the past four years, with the deployment of events recording systems. The reporting of ESRs underlines that maintenance operations, which can have consequences on the delivered doses, must be correctly supervised and that the training of practitioners in the use of medical devices is crucial for control of the doses. Extensive work to raise the awareness of all the medical, paramedical and administrative professionals in the centres is still necessary to give them a clearer perception of the risks, especially for operating theatre staff.

In computed tomography, ASN's oversight mainly concerns actual implementation of the requirements of its resolution 2019-DC-660 of 15 January 2019 notably concerning the formalisation of the justification principle, in order to avoid unnecessary doses for the patients, along with qualification of the professionals for the position. During its inspections in 2022, ASN again observed differing deployments of the quality assurance system concerning the traceability of examinations justification in the centres, with practices that are satisfactory in some units and far less so in others. Progress is also required in the formalisation of qualification of the professionals for the position.

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 rigorously 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. Although 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 terms of the signalling of the operations area during site work. More generally, ASN considers that the ordering parties should give priority to industrial radiography services in bunkers and not on the worksite. Furthermore, unlike in recent years, in the few situations in which the radioactive source could not be returned to the safe position in the gamma ray projector, inappropriate actions and handling were undertaken by the operators in the majority of cases, although without generating exposure of the operators or their hands beyond the regulation limits. ASN considers that the reoccurrence of such cases, albeit few in number, is a subject requiring particular attention because inappropriate actions can lead to significant over-exposure, as is shown by international operating experience feedback every year.

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 the areas in which practices still need to be improved are advance preparations for the expiry of the sources administrative recovery period (which by default is 10 years), information for the purchasers regarding future source recovery procedures, and the checks prior to delivery of a source to a customer.

The actions carried out by the licensees in recent years are continuing to improve radiation protection within the **research laboratories**. The conditions for the storage and elimination of waste and effluent remain the primary difficulties encountered by the research units 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. It would appear to be necessary for the licensees to reinforce the organisational provisions designed to ensure compliance with the prescriptions of their licenses, notably that regarding the maximum activity they possess, or to perform all the technical checks required by the regulations, and that they anticipate the costs related to the handling of "legacy" sources or waste.

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

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

With regard to the **protection of sources of radiation against malicious acts**, more particularly when high-level radioactive sources or batches of equivalent sources are used, the inspections conducted by ASN show that the licensees are gradually implementing the measures needed to comply with the requirements set out in the Order of 29 November 2019. Thus, the categorisation of sources, an essential step in identifying the applicable requirements and in implementing an approach proportionate to the risks, has been done by the vast majority of the facilities concerned. Similarly, the issue of nominative permits for access to sources is progressing, even if it still needs to be implemented in nearly half the facilities. ASN therefore considers that significant progress is still needed, in particular because, since mid-2022, the requirements regarding the presence of physical systems to prevent unauthorised access to sources have become applicable, offering intrusion resistance compliant with that stipulated by the Order. In 2023, 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 2022, 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 TSR events on the public highway (88 events reported to ASN in 2022) is slightly up on 2021, with an increase in the number of events rated level 1 on the INES scale. The number of events concerning transports of radiopharmaceutical products also rose appreciably. The events mainly comprise:

- material non-conformities affecting a package (notably damaged packaging) or its stowage on the conveyance, thereby weakening the strength of the package (whether or not an accident occurs). These cases do not concern transports of spent fuels or highly radioactive waste and primarily concern transports for small-scale nuclear activities;
- exceeding of the limits set by the regulations, usually by a small amount, for the dose rates or 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 basic nuclear installations and research facilities, ASN finds that the licensees carry out numerous checks and are therefore better able to detect any deviations. It considers that the consignors must further improve how they demonstrate that the contents actually loaded into the packaging comply with the specifications of the package model approval certificates and the corresponding safety files. In addition, if this demonstration is performed by a third-party company, it is up to the consignor to check that it is appropriate and to monitor the third-party company *via* the usual methods of a quality assurance system, which is not always the case.

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, needs to be improved.

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

REGULATORY NEWS

The year 2022 was marked by the publication of important texts, notably concerning whistle-blowers, the environmental assessment, nuclear civil liability, the creation of a new nuclear interministerial programme delegation, radioactive waste, radon and radiation protection. This year also saw continued 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

- **Constitutional Act 2022-400 of 21 March 2022 aiming to reinforce the role of the Defender of Rights regarding whistle-blowing and Act 2022-401 of 21 March 2022 aimed at improving whistle-blower protection**

Before the so-called “Sapin 2 Act” 2016-1691 of 9 December 2016, seven sectoral Acts comprised measures to protect whistle-blowers, notably the “Blandin Act” 2013-316 of 16 April 2013 “relative to the independence of expert assessment in the field of health and the environment and the protection of whistle-blowers⁽¹⁾”.

Incorporating the recommendation of a study from the *Conseil d'État*⁽²⁾ on the adoption of a common core, Act 2016-1691 of 9 December 2016 “relative to transparency, the fight against corruption and the modernisation of economic life⁽³⁾” comprises a common definition of a whistle-blower and implements a common and graded alert procedure.

Constitutional Act 2022-400 of 21 March 2022 and Act 2022-401 of the same date⁽⁴⁾ reinforce the whistle-blower protection system⁽⁵⁾

and transpose EU Directive 2019/1937 of 23 October 2019 which defines a common framework for this protection⁽⁶⁾. A broader definition of whistle-blower, simplification of the alert procedures, reinforcement of the whistle-blower protections, a new status for the entourage of the whistle-blower and an expansion of the roles of the Defender of Rights with regard to whistle-blowing are the main contributions of these Acts.

- **Ordinance 2022-582 of 20 April 2022 adapting French law to regulation (EU) 2017/745 of the European Parliament and Council of 5 April 2017 regarding medical devices**

The European regulations concerning medical devices were modified in 2017 by European regulation (EU) 2017/745, adopted by the European Parliament and the Council of the European Union (EU).

The purpose of this new regulatory framework is to take account of a certain number of changes, based on experience, in order to guarantee patient safety, and technological developments in the medical devices sector.

1. Initial Act 2013-316 of 16 April 2013 in force. Before its modification by the “Sapin 2 Act” of 2016, the “Blandin Act” comprised a sectorial definition of whistle-blower, in the field of public health and the environment. Other provisions of the “Blandin Act”, still in force: the obligation to keep a registry of external alerts for expert assessment or research organisations in the field of health or the environment, which include the Institute for Nuclear Safety and Radiation Protection - IRSN (see Decree 2014-1628 of 26 December 2014); the creation of an administrative commission: the national Commission for ethics and alerts concerning public health and the environment (cnDAspe).

2. Study of the Conseil d'État: *The whistle-blower right: report, process, protect* of 25 February 2016.

3. Act 2016-1691 of 9 December 2016 (initial version).

4. Act 2022-401 of 21 March 2022 aimed at improving whistle-blower protection and Constitutional Act 2022-400 of 21 March 2022 aiming to reinforce the role of the Defender of Rights regarding whistle-blowing. Also see opinions 404000 and 404001 of 4 November 2021 from the Conseil d'État regarding the Bills.

5. The inadequacies in the protection afforded to whistle-blowers by the “Sapin 2 Act” were notably identified in the Parliamentary information report of July 2021 on the evaluation of the impact of Act 2016-1691 of 9 December 2016 (AN report n° 4325).

6. Directive (EU) 2019/1937 of the European Parliament and Council of 23 October 2019 on the protection of persons reporting violations of EU law.

The scope of application of this regulation includes the medical purpose in the definition of the medical devices and expands the new provisions to certain products with no medical purpose, for which the same safety requirements should apply owing to their operation and their risk profile.

This new regulation notably organises improved regulation of the procedures for designating and monitoring notified organisations, which certify the conformity of medical devices, and sets a more restrictive framework for evaluations and clinical investigations for these products.

It provides for an increase in the general requirements regarding safety and performance, as well as enhancement of the technical documentation, the implementation of traceability and identification of the medical devices.

It also contains provisions on updating of the conformity evaluation procedures, improved information of the patient with regard to implantable devices and the medical devices entailing the highest risks, by providing the patient with an implant card or the publication of a summary of the safety and performance characteristics of these products.

Finally, it organises the structuring and formalisation of European coordination by setting up a coordination group of competent authorities.

The Ordinance adapts national law to these new rules, notably that applicable to the operators, from clinical evaluation up to monitoring of the medical devices market.

DECREES AND ORDERS

● Decree 2022-114 of 1 February 2022 relative to the technical conditions for operation of the nuclear medicine activity

This Decree sets the technical operating conditions for diagnostic and therapeutic nuclear medicine activities.

It creates a sub-section 17 concerning “nuclear medicine” after sub-section 16 of section 1 of Chapter IV of Title II of Book I of the sixth part of the Public Health Code.

This new sub-section contains a certain number of obligations for the licensee of a category “B” nuclear medicine facility. These latter refer to the demarcation of an area with rooms dedicated to the administration of RadioPharmaceutical Drugs (RPD), patient recovery after the administration of RPD, the examinations performed after the administration of RPD, rooms for the preparation and reconstitution of RPD, RPD checks, cellular labelling of blood elements by one or more radionuclides, the storage of contaminated solid waste and radioactive effluents.

Other provisions of this Decree concern the possession of certain equipment, appropriate initial and continuous training in radiopharmacy and radiation protection of personnel, patients, the public and the environment, but also the connection of an image and dose analysis archival and retrieval system.

It also stipulates that the patient shall be informed of the dosimetric data concerning him or her.

Finally, the license is subject to the quality assurance obligation.

● Decree 2022-422 of 25 March 2022 relative to the environmental assessment of projects

This Decree introduces a “safety net clause” in the environmental assessment procedure for those projects below the thresholds of the classification system of projects subject to the environmental

assessment appended to Article R. 122-2 of the Environment Code: in the event of risks with notable impacts on the environment, these projects shall be examined on a case by case basis.

The “safety net clause” does not concern projects for the creation, substantial modification or decommissioning of basic nuclear installations, which admittedly appear in the classification system of projects subject to the environmental assessment, but without thresholds.

In practice, ASN – which is the competent authority responsible for the case by case examination of projects for notable modifications to Basic Nuclear Installations (BNIs), shall check that the project complies with the following principles:

- the question of the risk of notable negative impacts must be posed on receipt of any application for authorisation of a notable modification to a BNI, as set out in the second section of II of Article R. 122-2 of the Environment Code;
- in the more particular cases of creation or extension of Installations Classified for Protection of the Environment (ICPEs) within the perimeter of a BNI, the question of the risk of notable negative impacts should be posed, regardless of whether or not the project is below the thresholds appearing in the line concerning ICPEs in the classification system appended to Article R. 122-2 of the Environment Code.

● Decree 2022-689 of 26 April 2022 relative to the layout conditions of the cancer treatment activity and Decree 2022-693 of 26 April 2022 relative to the technical operating conditions of the cancer treatment activity

These Decrees set out the conditions for the layout of cancer treatment activities (according to the procedures used in the activity concerned: oncological surgery, external radiotherapy, brachytherapy and systemic drug treatments for cancer), the conditions for licensing the activity and its renewal and the technical operating conditions for the cancer treatment activity (such as the organisation off a multi-disciplinary consultation meeting on significant changes in therapeutic orientations, provisions specific to minors and young adults, the definition of a multi-year training plan, or the conditions specific to oncological surgery, external radiotherapy, brachytherapy and systemic drug treatments for cancer).

● Decree 2022-907 of 20 June 2022 relative to the local and inter-municipal safeguard plans, modifying the Domestic Security Code

The purpose of this Decree is to define the procedures set out in the new Articles L. 731-3 and L. 731-4 of the Domestic Security Code regarding the Local Safeguard Plan (PCS) and the Inter-Municipal Safeguard Plan (PICS). The aim is to specify the methods for producing and implementing these plans, in order to manage emergencies at all regional levels.

The PCS is an overall organisational document for management of emergency situations affecting the population, according to their nature, their scale and how they develop. This plan prepares and ensures the operational response for protection and safeguard of the population.

The PICS is an organisational document for the operational response at the inter-municipal level to deal with emergency situations, on behalf of the municipalities affected. It organises inter-municipal coordination and solidarity.

● **Decree 2022-1186 of 25 August 2022 implementing Article L. 597-4 of the Environment Code relative to civil liability in the field of nuclear energy and codifying the provisions applicable to the sites comprising only facilities which represent a lesser risk**

In Chapter VII of Title IX of Book V of the Environment Code (regulatory part) entitled “*Provisions applicable to civil liability in the field of nuclear energy*”, this Decree sets out the characteristics of the facilities with a lesser risk in terms of nuclear civil liability.

It also stipulates the conditions for benefiting from a reduced civil liability ceiling when the site only comprises facilities with a lesser risk as defined in this Decree and appears on a list produced by Ministerial Order.

As an interim provision, the sites listed as presenting a lesser risk and entitling their licensees to a reduced liability amount, pursuant to Decree 2016-333 of 21 March 2016 implementing Article L.597-28 of the Environment Code and relative to civil liability in the field of nuclear energy, as at the date of publication of this Decree, shall remain so without the licensee having to submit a new application.

Finally, it is applicable to New-Caledonia, French Polynesia, Wallis and Futuna and the French Southern and Antarctic Lands.

● **Decree 2022-1165 of 20 August 2022 creating and organising the General Inspectorate for the Environment and Sustainable Development**

This Decree was adopted in accordance with the provisions of Article 17 of Decree 2022-335 of 9 March 2022 relative to the general inspectorate or oversight services and to employment within these services.

It creates the General Inspectorate for the Environment and Sustainable Development (IGEDD) in place of the General Council for the Environment and Sustainable Development (CGEDD).

It defines the organisation and the roles of the IGEDD and specifies the working conditions and methods aimed at guaranteeing the independence and impartiality of the work of its members.

● **Decree 2022-1284 of 3 October 2022 relative to the procedures for collecting and processing alerts submitted by whistle-blowers and setting out the list of external authorities instituted by Act 2022-401 of 21 March 2022 aiming to improve whistle-blower protection**

Constitutional Act 2022-400 of 21 March 2022 aiming to reinforce the role of the Defender of Rights with regard to whistle-blowing and Act 2022-401 of 21 March 2022 aiming to improve whistle-blower protection and amending Act 2016-1691 of 9 December 2016 relative to transparency, the fight against corruption and the modernisation of economic life, known as the “Sapin 2 Act” were adopted in order to transpose Directive (EU) 2019/1937 of the European Parliament and Council of 23 October 2019 on the protection of persons reporting violations of EU law.

Whistle-blowers have a number of possibilities: submit their report internally; send the report to an external authority listed by Decree in the *Conseil d’État*, to the Defender of Rights, to the judicial authority, to a competent European authority.

Decree 2022-1284 of 3 October 2022 sets out the regulatory provisions which, with the above Acts, ensures complete transposition of the above-mentioned Directive into internal law.

It thus contains provisions relative to the internal procedure for collecting and processing whistle-blower alerts and the external

procedure for collecting and processing alerts by the competent authorities designated in a list appended to the Decree.

The text is applicable in French Polynesia, the Wallis and Futuna islands and in New-Caledonia, and also applies in the overseas communities subject to the principle of identical legislation: Guadeloupe, French Guiana, Martinique, Reunion Island, Mayotte, Saint-Martin, Saint-Barthélemy and Saint-Pierre-et-Miquelon.

● **Decree 2022-1411 of 7 November 2022 instituting a new nuclear interministerial programme delegation**

This Decree creates a new nuclear interministerial programme delegation reporting to the Prime Minister.

This delegation supervises the performance of the industrial programmes to build new nuclear power reactors in France.

It carries out its role together with the central administrations and the national departments of the Ministries responsible for energy, the environment, nuclear safety, industry, the economy and the budget and with the Prefects of the regions in which new reactors are to be sited.

● **Decree 2022-1547 of 9 December provided for in Article L. 542-1-2 of the Environment Code and establishing the prescriptions of the National Radioactive Materials and Waste Management Plan**

This Decree sets the requirements of the National Radioactive Materials and Waste Management Plan (PNGMDR).

In addition to the general provisions of this Plan, it contains the provisions applicable to those in possession of radioactive materials and waste regarding the management of radioactive materials and waste storage facilities, the management of radioactive materials, and the long-term management of radioactive waste.

These latter provisions notably concern the ordering of works by the PNGMDR or by the Order mentioned in Article D. 542-74 of the Environment Code, the keeping of an updated statement of the availability of storage capacity for substances, per category of materials and waste, and the identification of future needs, the means for keeping a memory of the legacy radioactive waste disposal sites, the transmission and updating of the cost of managing the substances, notification of the Minister responsible for energy if it is impossible to meet the deadlines set, communication to the Minister responsible for energy of information regarding the costs of the main major projects deployed within the framework of the PNGMDR.

● **Order of 1 February 2022 setting the number of nuclear medicine appliances for an authorised site, pursuant to II of Article R. 6123-136 of the Public Health Code**

The first section of II of Article R. 6123-136 of the Public Health Code contains provisions concerning the licensing of a nuclear medicine activity and the maximum number of nuclear medicine appliances for a licensed site. It refers the determination of this number to an Order of the Minister responsible for health.

This Order therefore sets the maximum number of these appliances at three (Article 1).

The third section of II of Article R. 6123-136 of the Public Health Code states that the Minister sets a higher number for these appliances if the volume of procedures, the specialisation of the activity or the regional situation so warrants.

This number is set by the Order at three times the number set by Article 1 (Article 2).

In practice, the Director General of the competent Regional Health Agency can authorise the licensee to have a number of appliances higher than the maximum authorised number.

- **Order of 24 October 2022 relative to the procedures and frequency of checks on the rules put into place by the party responsible for a nuclear activity**

This Order defines the procedures and frequency of the checks on the rules put into place by the party responsible for a nuclear activity when the activity is subject to the authorisation, registration or notification systems, mentioned in Article L. 1333-8 of the Public Health Code, and generates effluents or waste contaminated by radionuclides or liable to be so contaminated.

Basic Nuclear Installations

- **Order of 7 February 2012 setting the general rules concerning Basic Nuclear Installations (“BNI Order”)**

The work to revise this Order continued in 2022.

ASN RESOLUTIONS

Nuclear Pressure Equipment

- **ASN resolution 2021-DC-0713 of 23 September 2021 relative to Nuclear Pressure Equipment (NPE), regulating the performance of certain tests and analyses (approved by the Order of 6 January 2022 approving ASN resolution 2021-DC-0713 of 23 September 2021 relative to NPE, regulating the performance of certain tests and analyses)**

This resolution sets out a list of tests and chemical analyses that must be performed by accredited laboratories. The list contains the complex tests and analyses for which the results are the most important in demonstrating the conformity of an equipment item, such as the tensile tests, impact strength tests, or the characterisation of certain chemical species used in the composition of alloy parts or which could be harmful to the equipment. For each test and chemical analysis, it specifies the date as of which this test is to be performed by an accredited laboratory. The resolution contains no mandatory application of any standard. The list of tests given in the resolution does however refer to international standards. Accreditation of the laboratories in accordance with these standards will enable the requirements of the resolution to be met. A laboratory will be able to apply for accreditation in accordance with any equivalent standard.

- **ASN resolution 2021-DC-0714 of 23 September 2021 relative to integration within a BNI of certain NPE undergoing conformity evaluation (approved by the Order of 6 January 2022 approving ASN resolution 2021-DC-0714 of 23 September 2021 relative to the integration within a BNI of certain NPE undergoing conformity evaluation)**

This resolution specifies the type of equipment which could be integrated when the equipment is still undergoing conformity evaluation. It also specifies how the conformity evaluation is performed on the integrated equipment as well as permanent integration assemblies.

Radon

- **ASN resolution 2022-DC-0743 of 13 October 2022 relative to the approval conditions for the organisations in charge of the services mentioned in 1, 2 and 3 of I of Article R. 1333-36 of the Public Health Code (approved by the Order of 23 December 2022 relative to the approval of ASN resolution 2022-DC-0743 of 13 October 2022 relative to the approval conditions for organisations responsible for the services mentioned in 1, 2 and 3 of I of Article R. 1333-36 of the Public Health Code)**

Pursuant to II of Article R. 1333-36 of the Public Health Code, this resolution sets the procedures for issuing, checking and revoking approval, the detailed list of information to be enclosed with the approval application and the approval criteria for the organisations.

The prior approval process is retained and takes up the existing provisions of resolution 2009-DC-0134 of 7 April 2009 on the submission of files, their examination by ASN, the issue or refusal of an approval further to the opinion of an approval commission.

The quality management requirements remain identical: the organisations are required to conduct measurements using standardised methods but are under no obligation to have an organisation subject to quality assurance.

What is new in this resolution is that it defines two levels of approval, as against three at present, and updates the regulatory provisions by introducing the drafting and the new regulatory references of the Public Health Code derived from Decree 2018-437 of 4 June 2018 relative to the protection of workers against the hazards of ionising radiation.

Finally an interim provision enables the validity of the existing level 1 option B and level 2 approvals to be maintained until they expire.

- **ASN resolution 2022-DC-0744 of 13 October 2022 relative to the objectives, duration and content of the training programmes for persons carrying out radon activity concentration measurements (approved by the Order of 23 December 2022 relative to the approval of ASN resolution 2022-DC-0744 of 13 October 2022 relative to the objectives, duration and content of the training programmes for persons carrying out radon activity concentration measurements)**

Pursuant to II of Article R. 1333-36 of the Public Health Code, the resolution updates the provisions of ASN resolution 2009-DC-0136 of 7 April 2009 relative to the objectives, duration and content of the training programmes for persons carrying out radon activity concentration measurements.

The content of the training programme takes up that of the existing level 1 option A and level 2, while limiting the scope to the application of the provisions of the Public Health Code. The drafting was revised with regard to the teaching objectives and level of competence to be acquired, expressed in terms of knowledge and know-how. The minimum duration of level 2 training is raised to 14 hours instead of one day (a number of hours was set rather than a number of days). The “concrete cases” are replaced by “a situational exercise inside a building”.

An interim provision enables the validity of the existing level 1 option A and level 2 proficiency certificates to be maintained.

- **ASN resolution 2022-DC-0745 of 13 October 2022 relative to the transmission of the results of radon activity concentration measurements carried out in Public Access Buildings (PAB) mentioned in Article D.1333-32 of the Public Health Code (approved by the Order of 21 December 2022 relative to the approval of ASN resolution 2022-DC-0745 of 13 October 2022 relative to the transmission of the results of radon activity concentration measurements carried out in the PABs mentioned in Article D. 1333-32 of the Public Health Code)**

Article R. 1333-36 of the Public Health Code stipulates that IRSN and the approved organisations must send ASN the results of the radon activity concentration measurements carried out by these establishments and that an ASN resolution defines the nature of the data and how they are transmitted. They are currently set by ASN resolution 2015-DC-0507 of 9 April 2015 concerning the technical rules for the transmission of the radon measurement results produced by approved organisations and the conditions for access to these results.

This resolution sets the information that the radon organisations are required to enter on the *demarches-simplifiees.fr* on-line platform, which replaces the Environmental Health Information System for Public Access Buildings (SISE-PAB) created by the General Directorate for Health (DGS).

Waste

- **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 the BNIs and ASN resolution 2017-DC-0616 of 30 November 2017 relative to notable modifications to BNIs (pending approval by Order of the Minister responsible for nuclear safety)**

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 notable modifications to BNIs.

The modifications made are of several types:

- firstly, they divide 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 organisation 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.

Resolutions issued pursuant to the Public Health Code

- **ASN resolution 2022-DC-0747 of 6 December 2022 setting rules that the party responsible for the nuclear activity is required to have checked pursuant to Article R. 1333-172 of the Public Health Code and 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 (these two resolutions are awaiting approval by Order of the Minister responsible for radiation protection)**

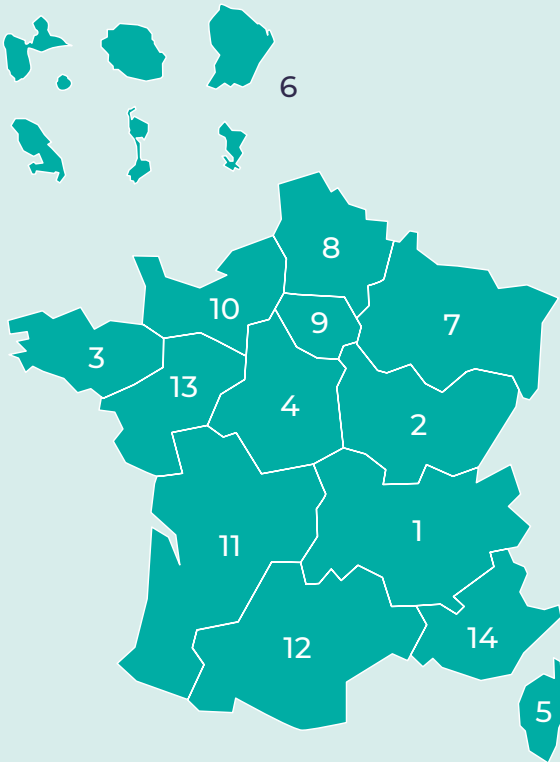
Resolution 2022-DC-0747 supplements the Order of 24 October 2022 relative to the procedures and frequency of the checks on the rules put into place by the party responsible for the nuclear activity, pursuant to III of Article R. 1333-172 of the Public Health Code, in its version derived from Decree 2018-437 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.

Resolution 2022-DC-0748 is in response to Article R. 1333-174 of the Public Health Code, which required 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.

REGIONAL OVERVIEW

of nuclear safety and
radiation protection

The French Nuclear Safety Authority (ASN) has 11 regional divisions through which it carries out its regulatory duties throughout metropolitan France and in the overseas *départements* and regions. Several ASN regional divisions can be required to coordinate their work in a given administrative region. As at 31 December 2022, the ASN regional divisions totalled 217 employees, of whom 172 are inspectors.



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Under the authority of the regional representatives (see chapter 2 of the full ASN Report), the ASN regional divisions carry out on-the-ground inspections of the Basic Nuclear Installations (BNIs), of radioactive substance transport operations and of small-scale nuclear activities; they examine the majority of the licensing applications submitted to ASN by the persons/entities responsible for nuclear activities within their regions. The regional divisions check, 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. They take part, for example, in the meetings of the Local Information Committees (CLIs) of the BNIs and maintain regular relations with the local media, elected officials, associations, licensees and local administrations.

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

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

1. Administrative region headed by a Prefect.

i 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 2022, ASN carried out 330 inspections in the Auvergne-Rhône-Alpes region, comprising 116 in the Bugey, Saint-Alban, Cruas-Meysses and Tricastin Nuclear Power Plants (NPPs), 91 in plants and installations undergoing decommissioning, 107 in small-scale nuclear activities and 16 in the radioactive substance transport sector.

ASN also carried out 19 days of labour inspections in the four NPPs and on the Creys-Malville site.

In 2022, ASN was notified of 36 significant events rated level 1 on the International Nuclear and Radiological Event Scale (INES scale), of which 30 occurred in Basic Nuclear Installations (BNIs) and 6 in small-scale nuclear activities.

Furthermore, one event was rated level 2 on the ASN-SFRO scale (scale specific to radiation protection events affecting patients undergoing radiotherapy procedures).

In the context of their oversight duties, the ASN inspectors issued one violation report. ASN also served formal notice on one nuclear licensee and one head of a nuclear activity to comply with the regulations.

ASN temporarily modified the requirements regulating thermal discharges from the Bugey, Saint-Alban and Tricastin NPPs during the heat waves of summer 2022 (see “Notable events” in the introduction to this report).

BUGEY SITE

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

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

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

Bugey nuclear power plant

Reactors 2, 3, 4 and 5 in operation

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

With regard to nuclear safety, ASN considers that the NPP's performance has deteriorated in 2022, despite an industrial context with lower workloads than in the preceding years. ASN still observes vulnerabilities in the configuring of the systems, the management of the periodic tests, the scheduling and performance of the maintenance activities and requalification tests, and the problems of spare parts. Despite some initial improvements, progress must be made in emergency situation management and the control of fire risks. Progress must also be made in keeping the first barrier, that is to say the fuel containment cladding, in good condition. The management of the modifications associated with the fourth ten-yearly outages now seems to be satisfactory on the whole. Nevertheless, following the detection in 2022 of deterioration of a seal of the system for maintaining dryness, installed between the pool and the vessel mating surface on reactors 2 and 4 during their fourth ten-yearly outages, ASN served EDF formal notice on 3 August 2022 to comply with the applicable provisions of the safety analysis report of reactors 2, 4 and 5 at the

next refuelling outage and by 24 March 2024 at the latest. The restarting phase of reactor 5 after its fourth ten-yearly outage was also marked by unforeseen technical events and numerous significant safety events. Lastly, reactor operation, control room monitoring and management of the operating team are satisfactory on the whole.

With regard to radiation protection, ASN noted positively during its inspections the setting up of radiation protection skills centres. Nevertheless, vulnerabilities persist in the culture of worker radiation protection, radiological cleanliness of the installations and containment on work sites with contamination dispersion risks. ASN expects progress in the prevention of contamination of roadways, which remains a weak spot on the site.

With regard to environmental protection, ASN considers that waste management remains at a generally satisfactory standard. Despite the organisational enhancements observed in 2021 on the handling of deviations affecting retention areas, a number of deviations were again detected in 2022. ASN is awaiting an ambitious plan of action to lastingly restore the sealing of the site's ultimate retention structures.

As far as occupational health and safety are concerned, ASN considers that the site's accident rate results remain satisfactory. The efforts must be maintained to improve the perception and prevention of risks in the planning and conducting of the work interventions and worksite teardown operations, particularly with regard to contractors.

Reactor 1 undergoing decommissioning

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

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

In 2020, the Bugey 1 reactor received ASN authorisation to create a new effluents storage facility, on which work started in 2022, to replace the old facility which will be put out of service, decommissioned and cleaned out.

After analysing the periodic safety review concluding report for the GCR reactors, ASN stated in December 2021 that it had no objection to continuing the decommissioning of this reactor. ASN considers that the Bugey 1 reactor decommissioning and vessel characterisation operations are proceeding with a satisfactory level of safety.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ Nuclear Power Plants operated by EDF:

- Bugey (4 reactors of 900 MWe),
- Cruas-Meysses (4 reactors of 900 MWe),
- Saint-Alban (2 reactors of 1,300 MWe),
- Tricastin (4 reactors of 900 MWe);

■ the nuclear fuel fabrication plants operated by Framatome in Romans-sur-Isère;

■ the "nuclear fuel cycle" plants operated by Orano on the Tricastin industrial platform;

■ the Operational Hot Unit (BCOT) at Tricastin, operated by EDF;

■ The High Flux Reactor (RHF) operated by the Laue-Langevin Institute (ILL) in Grenoble;

■ the Activated waste packaging and storage facility (Iceda) on the Bugey nuclear site and the Bugey Inter-Regional Warehouse (MIR) for fuel storage operated by EDF;

■ reactor 1 undergoing decommissioning at the Bugey NPP operated by EDF;

■ the Superphénix reactor undergoing decommissioning at Creys-Malville and its auxiliary installations, operated by EDF;

■ the Ionisos irradiator in Dagneux;

■ the Effluents and Solid waste Treatment and decay storage Station (STED) of the Alternative Energies and Atomic Energy Commission (CEA) in Grenoble, which is waiting to be delicensed following its decommissioning;

■ 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 field:



- 23 external-beam radiotherapy departments,
- 6 brachytherapy departments,
- 23 nuclear medicine departments,
- 121 facilities using fluoroscopy-guided interventional procedures,
- 157 scanners within 115 facilities,
- some 10,000 medical and dental radiology devices;

■ small-scale nuclear activities in the industrial, veterinary and research sectors:



- 1 synchrotron,
- about 500 veterinary practices (surgeries or clinics),
- 33 industrial radiography agencies,
- about 600 users of industrial equipment,
- more than 70 public or private research units;

■ activities associated with the transport of radioactive substances;



■ ASN-approved laboratories and organisations:

- 3 organisations and 8 agencies approved for radiation protection controls.

Activated waste packaging and storage installation

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

- 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 agency for radioactive waste management (Andra).

On 28 July 2020, ASN authorised the commissioning of Iceda and regulated operation of the facility through requirements relative to the operating range, the maximum storage durations for radioactive waste, the defining of criteria for activating the On-site Emergency Plan (PUI), the content of the end-of-startup file which was submitted on 24 March 2022, compliance with waste package qualification heights, and the conditions of reception of source rods from Chooz A. The first activated waste package was received in late September 2020.

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

Regarding packaging of the waste, ASN authorised EDF to package its waste in the CIPGSP package through resolution CODEP-DRC-2021-013808 of 19 July 2021. ASN nevertheless noted that complementary studies were still in progress and decided, in its authorisation, to limit the thermal power released by each package and within each storage hall and to limit the validity of its packaging agreement to 31 December 2023. The extension of this agreement is conditional upon submittal of the abovementioned additional studies no later than 31 December 2022 and the agreement of ASN following their examination. These studies were submitted to ASN on 19 December 2022 and are currently being examined by ASN.

The inspections carried out in 2022 on the installation revealed weaknesses in the organisation for managing the waste produced by the process on the site. An action plan was submitted by EDF in December 2022 and will undergo examination and oversight by ASN.

Inter-Regional Warehouse

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

MIR presented a satisfactory overall level of safety in 2022, year in which its operating activities resumed following the renovation of various items of equipment.

Saint-Alban nuclear power plant

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

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

With regard to nuclear safety performance in 2022, ASN notes that the Saint-Alban NPP maintains its level. The site installations are operated and maintained satisfactorily. ASN considers that the site must continue the actions undertaken to improve the integration of Social, Human and Organisational Factors (SHOF). With regard to maintenance, reactor 2 was shut down

for its refuelling and maintenance outage. ASN considers that EDF ensured the quality of performance of the planned activities and met the corresponding safety requirements.

With regard to worker radiation protection, ASN considers that the operational results were satisfactory. ASN nevertheless still expects a reinforcement of the radiation protection culture and the rigour in marking out work sites, tools and nuclear waste.

As far as protection of the environment is concerned, ASN wants to see faster responses to the technical problems impacting the environmental protection systems.

With regard to occupational safety, ASN considers the site's results to be relatively satisfactory. There were no serious accidents or accidents related to critical risks. This being said, several “near-accidents” associated with the electrical risk require particular attention.

Cruas-Meyssse nuclear power plant

Commissioned between 1984 and 1985 and operated by EDF, the Cruas-Meyssse NPP is situated in the Ardèche *département* on the municipalities of Cruas and Meyssse 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-Meyssse NPP with regard to nuclear safety is below ASN's general assessment of EDF plant performance. However, it considers that the overall performance of the Cruas-Meyssse NPP with regard to radiation protection and environmental protection is in line with ASN's general assessment of EDF plant performance.

With regard to nuclear safety, in 2022 ASN observed an increase in deviations and non-qualities in the maintenance activities during the four reactor outages carried out in 2022 and considers that the quality of the maintenance activities does not meet expectations. Only the reactor 1 outage went satisfactorily on the whole. Furthermore, the occurrence of several significant events concerning situations of noncompliance with the General Operating Rules (RGEs) shows that the operating rigour must also be improved. In addition, ASN's inspection campaign on the theme of the operating team's skills management revealed shortcomings leading ASN to ask EDF to implement corrective actions.

ASN therefore expects the site to increase rigour in its operation and maintenance activities before the first of the site's fourth ten-yearly outages, which concerns reactor 3 and will start in 2024.

As far as radiation protection is concerned, 2022 is in line with the preceding years, with controlled collective exposure of workers but difficulties in obtaining satisfactory levels of radiological cleanliness during the reactor outages and maintaining the containment air locks of the worksite areas in good condition. These situations still lead to worker contamination events – without exceeding the authorised doses, and to contaminations of the roadways.

With regard to environmental protection, ASN notes that the management of waste and the storage areas is now satisfactory. Progress is nevertheless required in the containment of effluents. As in 2021, ASN notes shortcomings in the control of the risk of dispersion and proliferation of legionella in the tertiary circuit where progress must be made.

The site's results in occupational health and safety are satisfactory. The accident rate remains under control, although efforts must nevertheless be made in controlling the risk of falling from height and when using construction machinery and lifting equipment. A serious accident occurred during the use of an aerial work platform.

TRICASTIN SITE

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

Tricastin nuclear power plant

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

ASN considers that the 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.

With regard to nuclear safety, ASN considers that the performance of the NPP has improved. The site has made progress in equipment maintenance and operation of the facilities. In 2022, the four reactors of the Tricastin NPP were shut down for scheduled maintenance and partial refuelling. Reactor 3 underwent its fourth ten-yearly outage and the modifications planned to enhance safety were integrated satisfactorily. ASN considers that EDF satisfactorily carried out the planned activities for the four reactor outages and complied with the corresponding safety requirements. Vulnerabilities were nevertheless observed in the control of the fire risk associated in particular with the maintenance of fire-fighting means and two reported significant events are related to this risk. ASN nevertheless noted the occurrence of several significant events during the last quarter of 2022 linked to the planning and preparation of the maintenance activities, and will remain attentive to this in 2023.

ASN considers that the radiation protection performance of the NPP is slightly down compared with 2021. Several significant events were effectively reported and deficiencies in the control of radiological cleanliness were noted. Likewise, several cases of worker contamination detection at the site exit were reported in 2022. ASN nevertheless noted improvements in worker dosimetry during the reactor 1 outage at the end of 2022.

With regard to environmental protection, ASN wants to see improvements in the site's practices. Although waste management remains satisfactory on the whole, the analysis of significant environmental events – including the groundwater pollution by effluents containing tritium in December 2021 and the exceeding of the maximum regulatory concentration of hydrocarbons at the outlet of an oil remover in October 2022 – has shown that the control of effluent storage areas and liquid containment, and the maintenance of the associated monitoring devices, need to be improved.

As far as occupational safety is concerned, ASN considers that the site's results are satisfactory and stable with respect to the preceding year. The accident rate, particularly during the reactor outages, was kept down. ASN nevertheless notes that a serious accident occurred this year during work on a ventilation system motor.

THE “NUCLEAR FUEL CYCLE” FACILITIES

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

The site comprises:

- the TU5 facility (BNI 155) for converting uranyl nitrate $UO_2(NO_3)_2$ resulting from the reprocessing of spent fuels into triuranium octoxide (U_3O_8);
- the W plant (ICPE within the perimeter of BNI 155) for converting depleted 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 (BNI 178, 179 and 180) for storing uranium in the form of oxides or UF_6 ;
- the maintenance, liquid effluent treatment and waste packaging facilities (IARU – BNI 138);
- the Atlas process samples analysis and environmental monitoring laboratory (BNI 176);
- a Defence Basic Nuclear Installation (DBNI), which more specifically accommodates former facilities undergoing decommissioning, radioactive substance storage areas and a liquid effluent treatment unit.

Following the inspections it conducted in 2022, ASN considers that the level of safety of the Orano facilities on the Tricastin site is satisfactory. In 2022, Orano improved its organisation for analysing the conformity of the facilities with the regulations and further improved its follow-up of the commitments made to ASN.

Trident, the new waste processing facility in BNI 138, continued its gradual start-up. Construction of the new Uranium Reprocessing Storage Facility called “FLEUR” (BNI 180) was completed and its commissioning has been authorised by ASN resolution 2023-DC-0750 of 3 January 2023. Lastly, ASN continued examination of the Creation Authorisation Application (DAC) for the future containers maintenance unit (AMC2). This DAC was the subject of a public inquiry from 10 December 2021 to 12 January 2022. The AMC2 unit will take over from the existing unit (AMC) which should stop operating in 2024. Orano did not start the construction work at the end of the public inquiry because of contractual problems, which will delay commissioning of the AMC2 unit.

In 2022, ASN conducted a campaign of simultaneous unannounced inspections on BNIs 93, 105, 138, 155, 168, 178 and 179, focusing on the management of the facilities in normal operating situations with the aim of checking Orano's organisation in this area. During these inspections the inspectors observed changes of shift, operators at work in the control room and during patrols and lockout/tagout operations. The overall result of these inspections is satisfactory.

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. Some operations planned with Russia have been suspended and alternatives must be found.

Lastly, in 2022, to increase its enrichment capacities, Orano initiated the project to extend the Georges Besse II North enrichment plant, which will undergo public consultations as of 2023.

In 2023, ASN will also ensure that Orano has and engages all the necessary resources in the new construction projects, whether to increase its production capacity or to improve certain support functions such as the AMC2 project or treating the backlog of radioactive substances stored on the site.

Orano uranium chemistry plants TU5 and W

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

ASN considers that the facilities situated within the perimeter of BNI 155 are operated with a satisfactory level of safety. Although 2022 was marked by a significant drop in the number of significant or notable events, ASN was attentive to the lessons learned from the two contamination events in the drumming enclosure of the TU5 plant. In 2023, ASN will be attentive to the maintaining of due operating rigour and will examine the impacts that the project to increase the capacity of the Georges Besse II North plant has on the W plant.

Orano uranium fluorination plants

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

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

Despite relative stability of operation in 2021, the Philippe Coste plant, whose facilities are classified Seveso high threshold and replace those of BNI 105 (formerly Comurhex), encountered various technical problems in 2022. ASN considers nevertheless that the safety of operation of this plant is satisfactory.

For the shutdown facilities, although the decommissioning operations have effectively started, ASN expects greater mobilisation on the part of the licensee to ensure the repackaging of the packages containing hazardous radioactive substances stored on storage areas 61 and 79 within the allocated time frames.

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 stopping production at this plant in May 2012, the licensee carried out, from 2013 to 2016, the Eurodif "Prisme" process of "intensive rinsing followed by venting", which consisted in performing repeated rinsing of the gaseous diffusion circuits with chlorine trifluoride (ClF₃), a toxic and dangerous substance. These operations, which are now completed, allowed the extraction of virtually all the residual uranium deposited in the diffusion barriers.

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

The decommissioning issues particularly concern the large volume of very low-level waste (VLLW) produced, including 160,000 tonnes of metal waste which is undergoing specific studies. In 2022, ASN inspected various decommissioning preparation operations such as the movement of heavy equipment, grouping of the waste storage areas and cutting tests on obsolete materials with a view to qualifying the tool options planned for cutting up the diffusers. The main residual risk of BNI 93 is now associated with the UF₆ containers in the storage yards, which are still attached to the perimeter of the facility. These yards should in the short term be attached to the Tricastin uranium storage areas (BNI 178).

Georges Besse II enrichment plant

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

The standard of safety of the plant's facilities in 2022 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.

Due to the deterioration of the handling gantry rolling tracks at Georges Besse II North, the gantries have been unavailable since October 2020. The buffer yard of the North plant has been completely emptied in order to secure this zone. In 2022, ASN continued monitoring the steps taken by the licensee to reduce cooling fluid discharges into the atmosphere and considers that the licensee has kept up its efforts to control this type of discharge.

Lastly, in 2022 Orano began the project to extend the Georges Besse II North enrichment plant with a view to increasing its production capacities by adding centrifuge modules. This project will be opened for public consultation as of 2023.

Maintenance, effluent treatment and waste packaging facilities

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

ASN considers that the efforts made by the licensee in 2022 to improve the level of operational safety and the rigour of operation must be continued. In 2022, ASN checked the numerous commitments made to it in 2021 on the subject of fire and waste treatment, and underlines the good progress made in meeting them. This being said, continued vigilance is required regarding the fire-fighting equipment. ASN conducted an inspection dedicated to the surface treatment activities which confirmed that the licensee had duly met the commitments made following an inspection in 2021.

Decree 2019-113 of 19 February 2019 authorised the substantial modification of the BNI to create in particular a site waste processing facility called "Trident", which continued its start-up in 2022.

The technical examination of the update of the discharge resolutions for BNI 138 was carried out in 2021, with a public consultation from 15 November to 6 December 2021. These resolutions entered into effect in July 2022.

ASN will be attentive in 2023 to the continuation of the measures taken by the licensee to reinforce operating rigour. ASN will also examine the integration of the conclusions of the periodic safety review, including prevention of the fire risk and upgrading of certain storage sites which will necessitate the construction of a new building baptised "57L".

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 yards and the new emergency management premises of the Tricastin platform. Following on from this delicensing process, facility “P35” (BNI 179) was created. It comprises ten uranium storage buildings. A complementary storage facility called “FLEUR”, for which the DAC underwent a public inquiry from 2 November 2020 to 3 December 2020, was authorised by Decree on 18 March 2022. Commissioning of this new BNI 180 was authorised by ASN resolution 2023-DC-0750 of 3 January 2023.

The overall level of safety of BNIs 178 and 179 was satisfactory in 2022. ASN notes that the licensee’s action plan for the periodic safety review of the storage yards is being followed very closely. In 2022, ASN inspected the end of the construction of the first two additional storage buildings associated with the FLEUR project. ASN approved the baseline safety requirements for the emergency management building and its equipment.

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.

The last operating activity consisted in finishing cutting up the used fuel cluster guide tubes from the PWRs operated by EDF. The decommissioning authorisation application is currently being examined. The public inquiry ran from 15 February to 17 March 2022. ASN considers that the level of safety of the BCOT is on the whole satisfactory. In 2023, ASN will be attentive to compliance with the applicable baseline for conducting the ongoing decommissioning preparation operations until 2024, pending issuing of the decommissioning decree.

ROMANS-SUR ISÈRE SITE

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

Framatome nuclear fuel fabrication plants

The fabrication of fuel for electricity generating reactors involves the transformation of UF_6 into uranium oxide powder. The pellets fabricated from this powder in Framatome’s Romans-sur-Isère plant, called “FBFC”, are placed in zirconium metal clads to constitute the fuel rods, then brought together to form the assemblies for use in the NPP reactors. In the case of experimental reactors, the fuels are more varied, 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 includes building F2, which houses the “uranium zone” in which compacted powder cores placed in aluminium frames and plates are produced. The licensee has undertaken to replace this uranium zone by a new uranium zone called “NZU”, in order to improve more specifically the containment of the premises, the process and the prevention of risks in the event of an extreme earthquake. The NZU construction work began in late 2017. These new buildings shall accommodate the current activities of the uranium zone of building F2. Construction of the NZU continued in 2022, notably with the manufacture and installation of new equipment and performance of the first operating tests. The update of the safety analysis report and the new RGEs associated

with the NZU were submitted to ASN in the first half of 2021, leading to complementary information requests on its part. With regard to the progress of the NZU project, due to technical problems and the impact of the Covid-19 pandemic, Framatome requested partial commissioning of the NZU (for the material storage premises only), to allow transfers of materials between the MA2, F2 and NZU buildings, for which ASN issued an authorisation in October 2022.

A request for a modification of the Order of 22 June 2000 regulating water intakes, discharges and environmental monitoring of the Romans-sur-Isère nuclear site was also submitted to ASN in July 2020. This request follows on from several changes, including the increase in the production capacity of the FBFC, the stopping of certain activities, the changes made to the liquid effluent treatment facilities, and the changeover from continuous discharging of liquid effluents to discharging via tanks. This case led to two ASN resolutions which came into effect in December 2022: the first setting the environmental discharge limits, the second setting requirements relative to the conditions of effluent discharge, water intakes and consumption and environmental monitoring. In substance, these new resolutions reinforce the regulation of discharges by improving environmental monitoring, the regulation of chemical gaseous discharges and a lowering of the preceding maximum discharge values except for fluorine and hexavalent chrome, for which the absence of significant environmental impacts has been demonstrated.

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

There was a decrease in the number of significant events relating to control of the criticality risk reported by Framatome and rated level 1 on the INES scale in 2022. However, a fire outbreak on 21 September 2022 in the SE9 unit of the “uranium zone” led to activation of the PUI: this impacted all Cerca’s production; extensive cleaning and verification work had to be carried out in the facilities before restarting the equipment. The management of the event enabled all the lines of defence to be maintained and there was no impact on the population or the environment. This event was rated level 0 on the INES scale.

The results of the inspections carried out on the Romans-sur-Isère site in 2022 are satisfactory on the whole. In 2023, ASN will be attentive to the continuation of the qualification tests for final commissioning of the NZU, and the deployment of the new environmental monitoring plan required by the resolutions concerning water intakes and consumption, effluent discharges and the environmental monitoring of BNI 63-U.

THE INDUSTRIAL AND RESEARCH FACILITIES

The Laue-Langevin Institute high flux reactor

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

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

On the basis of its oversight activities in 2022, ASN considers that the safety management of the RHF is satisfactory. The year 2022 was devoted to extensive works to renew and reinforce the safety of the installation.

In 2022, 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. ASN resolution 2022-DC-0738 validating the conclusions of this review and governing the continued operation of the RHF was signed on 28 July 2022.

The main works of the major outage, which should have lasted fourteen months, focused on the replacement of technological equipment constituting the reactor vessel, reinforcement of the outside air intake of the reactor building and the installation of anchor points on the containment dome in preparation for the future renovation operations on the main polar crane.

An unforeseeable event occurred on this latter work site when drilling holes in the containment dome. The ILL conducted investigations on the concrete of the containment before installing the anchor points. ASN is examining the supporting documents provided by the ILL.

At the start of the year, more than half of the radioactive inventory of the former detritiation facility was transferred to the reactor building pending its final processing, for which the ILL filed an application for authorisation to modify the functioning of the facility.

In July 2022 the ILL also submitted a “public information notice” file aiming to establish new technical requirements for discharges and environmental monitoring.

ASN will be particularly attentive in 2023 to the restarting conditions following a 16-month outage and the containment dome event. ASN will be attentive to the preparation of the next high-stake issues for ILL, and notably the pre-cleanout operations on the former detritiation facility and the renovation of the polar crane. Lastly, the revision of the requirements regulating discharges will be continued in 2023.

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.

The level of safety of the facility was found to be satisfactory in 2022.

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

An authorisation for recovery of the sludge from pool D1 (operated until November 1996) was issued by ASN in 2021. This operation was carried out in July 2022 and led to an inspection addressing contractor monitoring, which gave satisfactory conclusions.

CERN accelerators and research centre

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

requirements applied by CERN. The joint actions concern transport, waste and radiation protection.

Two joint visits by the Swiss and French authorities took place in 2022 on the subject of management of the on-site waste processing centre and the monitoring of outside contractors. These visits found the practices to be satisfactory.

SITES UNDERGOING DECOMMISSIONING

Superphénix reactor and fuel storage facility

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

EDF has submitted the periodic safety review concluding reports for BNI 141 and BNI 91. ASN made public its conclusions concerning the Superphénix periodic safety review on 28 July 2021 and has approved continuation of the decommissioning operations.

In the light of the APEC periodic safety review conclusions, ASN has regulated its continued operation through a resolution of 17 March 2022 setting requirements concerning the control of the seismic-related risks, beyond design-basis accident situations, removal of the fuel and waste stored in the pool, the handling operations and the management of soda blocks.

ASN considers that the safety of Superphénix decommissioning operations and of APEC operation is on the whole satisfactory. In 2018, ASN authorised commencement of the second Superphénix decommissioning phase, which consists in opening the reactor pressure vessel to dismantle its internal components, in dedicated facilities constructed in the reactor building, by direct or remote manipulation.

In 2022, the large rotating plug was cut into three pieces placed on specific accommodation platforms located on the slab and the vessel was covered by a containment structure to keep it sealed pending its decommissioning.

In 2019, EDF discovered legacy hydrocarbon pollution of the soils in a perimeter near a former buffer pond. ASN is currently examining a soil management plan.

ASN considers that the organisation and the measures implemented by the licensee on 2022 ensure good upkeep of the facilities and good tracking of the various commitments made to ASN.

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

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

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

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

With regard to radiological and chemical remediation of the STED soils, all the operations technically achievable at a reasonably acceptable cost have been carried out. In view of the presence of residual chemical and radiological contamination, the licensee submitted a new delicensing file in June 2021 which is currently being examined by ASN, which refused its first file in 2019. This delicensing is subject to the implementation of active institutional controls. An order instituting the institutional controls was issued by the Prefect of Isère *département* in December 2022.



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 58 inspections in small-scale nuclear activities in the Bourgogne-Franche-Comté region in 2022, comprising 20 inspections in the medical sector, 22 in the industrial, research and veterinary sectors, 8 concerning radon exposure, 1 to monitor approved organisations and laboratories, and 7 specific to the transport of radioactive substances.

One significant event in 2022 was rated level 2 on the INES scale following the accidental irradiation of an industrial radiography worker.

ASN also devoted particular attention to the Framatome manufacturing plants situated in the Bourgogne-Franche-Comté region. The actions conducted by ASN in this context are described in chapter 10. In Bourgogne-Franche-Comté in 2022 ASN carried out 3 inspections of Nuclear Pressure Equipment (NPE) manufacturers in their plants and 3 inspections of organisations accredited for the inspection of NPE.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ small-scale nuclear activities in the medical field:



- 8 external-beam radiotherapy departments,
- 4 brachytherapy departments,
- 14 nuclear medicine departments, of which 3 practise internal targeted radiotherapy,
- 35 centres performing fluoroscopy-guided interventional procedures,
- 56 computed tomography scanners for diagnostic purposes,
- about 800 medical radiology devices,
- about 2,000 dental radiology devices;

■ small-scale nuclear activities in the industrial, veterinary and research sectors:



- about 250 veterinary practices, of which 5 have a computed tomography scanner,
- about 400 industrial and research centres, including 30 companies with an industrial radiography activity,
- 1 industrial irradiator per radioactive source,
- 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;



■ ASN-approved laboratories and organisations:

- 2 organisations 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 NPP, currently undergoing decommissioning.

ASN carried out 29 inspections in 2022, comprising 3 at the Brennilis NPP undergoing decommissioning, 2 for the monitoring of accredited organisations and 24 in small-scale

nuclear activities (13 in the medical sector, 11 in the industrial, veterinary and research sectors).

One significant event was rated level 1 on the INES scale in 2022.

The Brennilis nuclear power plant

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

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

In 2022, ASN continued its examination of the complete Decommissioning Decree for the Brennilis NPP and started revising the resolutions regulating intakes and discharges.

During the year, EDF more specifically continued its preparatory work for complete decommissioning:

- inside the reactor containment, continuation of the asbestos removal operations in the accessible places and start of the civil engineering developments to enlarge the existing access points or to demolish bunkers;
- outside the reactor containment, completion of the site road and rail repair operations (removal of rails and railway sleepers, road repairs).

EDF has also signed contracts to initiate execution studies for certain complete decommissioning operations (such as that of the peripheral circuits) and to draw up specifications for upgrading the support functions that are absolutely necessary for complete decommissioning (handling cranes, ventilation in the reactor containment, etc.).

More generally, ASN notes that the schedule milestones for the first part of 2022 were met.

The July and August fires in the Monts d'Arrée had no impact on the work site. Nevertheless, the decommissioning operations in the reactor containment were interrupted on 19 July because the smoke was directed towards the NPP, and resumed on 20 July. The fire of 6 August did not stop any operations.

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 field:

- 10 external-beam radiotherapy departments,
- 5 brachytherapy departments,
- 9 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:

- 1 cyclotron,
- 23 industrial radiography companies, including 4 performing gamma radiography,
- 25 research units,
- about 400 users of industrial equipment;



■ activities associated with the transport of radioactive substances;



■ ASN-approved laboratories and organisations:

- 10 organisations approved for measuring radon,
- 3 head-offices of laboratories approved for taking environmental radioactivity measurements.

ASN considers that the organisation for preparing the complete decommissioning of the NPP and for ensuring radiation protection is satisfactory. EDF must nevertheless be attentive to the rigour in writing the observations or comments in the periodic inspection procedures and finalise the updating of the document baseline for radiation protection and skills management. As of 2023, ASN will be particularly attentive to EDF's final treatment of the water infiltrations in the facilities.



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 2022, ASN conducted 152 inspections in the Centre-Val de Loire region, of which 118 were in the nuclear installations of the EDF sites of Belleville-sur-Loire, Chinon, Dampierre-en-Burly and Saint-Laurent-des-Eaux, 26 in small-scale nuclear activities, 6 in the transport of radioactive substance and 2 concerning approved organisations or laboratories.

ASN also carried out 51 days of labour inspections in the four NPPs. In the context of their oversight duties, the ASN inspectors issued two violation reports.

In 2022, 21 significant events rated level 1 on the INES scale were reported to ASN.

Belleville-sur-Loire nuclear power plant

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

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

From the nuclear safety aspect, in the area of management of the installations, ASN considers that the operating rigour in the control room, although slightly down compared with 2021, remains satisfactory. One significant event rated level 1 on the INES scale was however reported following non-compliance with the RGEs during fuel handling operations, and improvements are expected in the configuration management of circuits and components (alignments, lockouts/tagouts, administrative lockouts). An inspection will be carried out on this theme in 2023. Management of the fire risk is considered stable; corrective actions were taken in 2022 to address the anomalies detected by EDF in fire sectorisation management, and these are being continued.

With regard to maintenance of the facilities, the performance of the Belleville-sur-Loire NPP has improved. The year 2022 saw two reactor outages (one periodic inspection and one refuelling outage), for which the overall management is considered satisfactory.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ Basic Nuclear Installations:

- the Belleville-sur-Loire NPP (2 reactors of 1,300 MWe),
- the Dampierre-en-Burly NPP (4 reactors of 900 MWe),
- the Saint-Laurent-des-Eaux site: the NPP in operation (2 reactors of 900 MWe), and the 2 Gas-Cooled Reactors (GCRs) undergoing decommissioning and the irradiated graphite sleeve storage silos,
- the Chinon site: the NPP in operation (4 reactors of 900 MWe), the 3 GCRs undergoing decommissioning, the Irradiated Material Facility (AMI) and the Inter-Regional Fuel Warehouse (MIR);

■ small-scale nuclear activities in the medical field:



- 8 external-beam radiotherapy departments,
- 3 brachytherapy departments,
- 11 nuclear medicine departments,
- 32 departments performing fluoroscopy-guided 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:



- 10 industrial radiography companies,
- about 330 industrial, veterinary and research radiography devices;

■ activities associated with the transport of radioactive substances:



■ ASN-approved laboratories and organisations:

- 2 organisations approved for radiation protection controls,
- 4 laboratories approved for taking environmental radioactivity measurements.

In the area of radiation protection, ASN considers the performance of the Belleville-sur-Loire NPP to be stable. It underlines the radiological cleanliness of the premises and good overall control of the various issues.

In the area of environmental protection, ASN considers that effluent management and the monitoring of discharges in normal operating conditions are satisfactory. It notes that action is being taken to correct the deviations in waste management identified in early 2022. The year 2022 was marked by a large increase in cases of exceeding legionella colonisation thresholds (more than ten). The compensatory measures implemented by EDF were not enough to rapidly restore a normal and controlled situation, pending the commissioning of a monochloramine treatment station, planned for the end of 2024. The examination and consultations concerning the modification of the environmental resolutions regulating the site discharges continued in 2022.

As far as labour inspection was concerned, ASN focused its attention on monitoring the accidents and “near-accidents” in the Centre-Val de Loire region. With no serious accidents having occurred at the Belleville-sur-Loire NPP in 2022, cross-functional subjects were examined (right to strike, radiation protection skills centre). As in 2021, some of these inspections were conducted jointly by the labour inspectorate and safety inspection.

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 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 and radiation protection performance of the Dampierre-en-Burly NPP to be far below the national average. The environmental performance on the whole is in line with ASN’s general assessment of the EDF plants.

With regard to nuclear safety, normal operational management performance deteriorated markedly in 2022, with the number of significant events reported during the year being among the highest for the EDF NPPs (about ten of the events were

rated level 1 on the INES scale). The identified causes are organisational deficiencies relating to shortcomings in documents, insufficient communication between operational management teams, and inadequate command of the RGEs (particularly when material difficulties arise). Management of the periodic tests was also found to be far below average in 2022. In view of these factors, the unit director gave ASN a presentation of the plan of “operational management” rigour put in place as of May 2022, for which ASN will conduct various inspections in 2023 to verify its application and judge its effectiveness. The site’s management of the fire risk is also sub-standard and must remain a priority target for action in 2023.

As far as maintenance of the facilities is concerned, the site’s performance is considered below the national average, in an industrial context where the second reactor on the site is undergoing its fourth ten-yearly outage. The year 2022 was marked by several situations of out-of-service equipment necessitating reactor shutdowns and reflecting a problem of reliability of these equipment items. ASN also expects the improvements in the quality of the site’s operational documents used to conduct maintenance activities and in the methods of requalification following work interventions.

As far as radiation protection is concerned, the performance of the Dampierre-en-Burly NPP improved slightly in 2022 but remains insufficient. The radiological cleanliness of the facilities and the management of radiological work regimes must notably be improved to bring them in line with the general assessment of the EDF plants. ASN nevertheless underlines the effectiveness of the site’s action plan implemented further to numerous significant “transport” events that occurred in 2021 due to problems of surface contamination of trailers and wagons.

With regard to environmental protection, the performance of the Dampierre-en-Burly NPP improved in 2022, particularly in its management of the microbiological risk. Although no exceeding of the gaseous and liquid effluents discharge limits was observed in 2022, the management of hazardous substance containment must nevertheless be improved. Moreover, the environmental resolutions regulating the site’s discharges were modified in 2022 to allow the implementation of a new treatment against the proliferation of pathogenic organisms on reactors 2 and 4.

Lastly, with regard to labour inspection, following the actions taken in 2021 and 2022, management of the electrical risks shall remain a priority in 2023. Inspections were moreover carried out on diverse themes such as management of the radiation protection skills centres and the activities and work conducted during a reactor outage.

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 900 MWe reactors; the first two constituting BNI 107 were commissioned in 1982-1983, while the second two constituting BNI 132 were commissioned in 1986-1987. To the north, the three old graphite-moderated GCRs designated Chinon A1, A2 and A3, are currently being decommissioned. The site also accommodates the AMI, currently being decommissioned, whose former activities of expert assessment of activated or contaminated materials have been entirely transferred to a new laboratory called “the Lidec”, and to MIR.

Chinon nuclear power plant

Reactors B1, B2, B3 and B4 in operation

ASN considers that the performance of the Chinon NPP is in line with the general assessment of EDF in the areas of safety, radiation protection and the environment. Progress has been noted in 2022, particularly in the area of safety. The results in the area of radiation protection, however, must be consolidated.

With regard to safety, ASN observes that the performance in normal operational management is improving. Operational management in “incident” and “accident” situations is satisfactory, even if improvements are expected in the traceability of staff training and in the emergency situation documentation. Furthermore, particular attention is to be paid to the inspections of the main primary system and the implementation of the post-Fukushima measures.

As far as maintenance of the installations is concerned, the site's performance is stable and satisfactory. Improvements to enhance the reliability of the maintenance operation supporting documents are nevertheless expected. 2022 was marked by an outage associated with the problem of stress corrosion of reactor 3, on which the various inspections have revealed no major anomalies.

ASN considers that the radiation protection performance of the Chinon NPP remains relatively satisfactory. The radiological cleanliness of the inspected work sites did not raise any particular remarks. Progress is however expected in the cordoning off of radiography work areas, and in the effective application of the prevention measures chosen with regard to radiation protection and for the use of the radiographic work regimes.

The environmental performance of the Chinon NPP is improving. The maximum discharge values set for gaseous and liquid effluents are observed. However, the monitoring of contractors on short-term work sites must be improved in order to comply with the environmental protection requirements. In addition, the management of liquid containment can be further improved.

With regard to labour inspection, 2022 was marked by an accident which led to two inquiries, one of which necessitated numerous investigations conducted in collaboration with the gendarmerie of Chinon. In addition to this, on the Chinon site – as with all the Centre-Val de Loire region NPPs – ASN maintained its joint inspections between the labour inspectorate and safety inspection in order to benefit from the existing synergies. This was the case in particular with an inspection of the radiation protection skills centre, which evidenced a few minor deviations without calling into question the organisation adopted by the NPP.

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” GCR reactors. 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 is decommissioning “in air” and the Chinon A2 reactor pressure vessel would be decommissioned first (see chapter 13 of the full ASN Report). In this context, ASN has analysed the periodic safety review concluding reports submitted by EDF for the six GCR reactors, supplemented further to the requests from ASN. On completion of its analysis, ASN indicated in December 2021 that it has no objection to the continued operation of 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, that the decommissioning operations are carried out under suitable conditions of safety and radiation protection, within controlled time frames.

For the Chinon A2 reactor, EDF has continued the decommissioning preparation operations situated outside the reactor pressure vessel, particularly as concerns removal of the shells from the heat exchanger premises, and continued the investigations inside the pressure vessel. EDF also continued the decommissioning of the Chinon A3 heat exchangers. After completing the decommissioning work in the heat exchangers “South” building and transferring all the cylinders to the Industrial centre for grouping, storage and disposal (Cires), the decommissioning work on the “North” heat exchangers building has started, with the transfer of the first cylinders in June 2022.

ASN considers that the level of safety of the Chinon nuclear installations undergoing decommissioning (Chinon A1, A2 and A3) is satisfactory. The inspections conducted in 2022 revealed in particular the use of high-performance computing aids for the management of the work sites and the documents. In this respect, one must nevertheless note the reporting of two significant events associated with a lack of equipment and document modification tracking which occurred in 2017 and 1993. The procedures currently implemented contain provisions to avoid the recurrence of such deviations. Improvements are expected in the tracking of the periodic inspections of the NPP equipment items which are under the responsibility of the Chinon dismantling organisation.

NUCLEAR “FUEL CYCLE” FACILITIES

Inter-regional fresh fuel warehouse

Commissioned in 1978, the Chinon 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 2022, ASN observed a generally satisfactory level of safety, and more specifically good upkeep of the premises and the availability of the fuel assembly reception and shipping files.

RESEARCH FACILITIES UNDERGOING DECOMMISSIONING

Irradiated materials facility

The AMI, which was declared and commissioned in 1964, is situated on the Chinon nuclear site and operated by EDF. This facility (BNI 94) has stopped operating and is being decommissioned. It was primarily intended for performing examinations and expert assessments on activated or contaminated materials from the PWR 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 and necessitating inerting operations¹ to meet the disposal criteria of the French radioactive waste management agency (Andra) has been packaged and re-characterised in 2021. The characterisation results were not as expected, making it necessary to apply to Andra for a waiver to allow acceptance of the waste. The waste removal work was therefore stopped pending the outcome of this procedure. The work is expected to resume by the end of 2023. Lastly, in early February 2021, EDF filed a decommissioning authorisation application for the highly active liquid effluent circuits, which is currently being examined. Given that EDF reported technical and contractual difficulties as of April 2022, these operations – which were initially planned as of 2023 – will have to be rescheduled.

On the basis of the checks made during these inspections, ASN considers that the safety management applied at the AMI is satisfactory, particularly with regard to the application of the new RGEs approved further to the decommissioning transition. The outside contractor monitoring methods implemented are satisfactory on the whole, and vigilance is expected in the continuation of the operations initiated to deal with the legacy chemical products.

1. Inerting is a procedure that consists in replacing a reactive atmosphere (oxidising, inflammable, explosive) by an inert gas such as nitrogen, CO₂ or argon.

SAINT-LAURENT-DES-EAUX SITE

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

Saint-Laurent-des-Eaux nuclear power plant

Reactors B1 and B2 in operation

ASN considers that the environmental protection performance of the Saint Laurent-des-Eaux NPP stands out positively with respect to its general assessment of EDF plant performance, and that safety and radiation protection performance is in line with the general assessment on these themes.

ASN considers that the site's nuclear safety performance improved in 2022. The changes in the safety management plan have restored a satisfactory level of performance. The in-depth inspection conducted by ASN in June 2022 confirmed this improvement. These factors must nevertheless be considered alongside the fact that only one refuelling outage was carried out in 2022 instead of the usual two. There remains room for progress in supervision rigour (monitoring in the control room, operating range excursion), configuring of the systems and application of reliability-enhancement practices. This recovery will have to be confirmed in 2023 with the performance of two refuelling outages, including the fourth ten-yearly outage of reactor 2.

Maintenance at the Saint-Laurent-des-Eaux NPP improved in 2022 compared with 2021, and reached a level considered to be relatively satisfactory. Few significant events are caused by maintenance deficiencies. Here again these elements must be considered alongside the fact that there was only one refuelling outage in 2022. It is to be noted that a significant event was again reported in 2022 further to errors during inspections of the anti-chatter devices which limit the movements of the primary cooling system in the event of high stresses, such an earthquake situation, which shows that the subject is still not fully mastered.

Generally speaking, the management of radiation protection at the Saint-Laurent-des-Eaux NPP meets ASN expectations. The site's performance is considered stable with respect to 2021. The setting up of the radiation protection skills centre in 2022 is found to be satisfactory on the whole.

The site's organisation to meet the regulatory environmental requirements is considered highly effective, particularly in view of the quantities of effluents discharged. The use of retention areas to store equipment must be monitored and the control of the sheets framing the discharge conditions must be consolidated.

As far as labour inspection was concerned, ASN focused its attention on monitoring the accidents and "near-accidents" in the Centre-Val de Loire region. In this context, and with no serious accidents necessitating specific investigations on the Saint-Laurent-des-Eaux site, only cross-functional subjects underwent checks (post Fukushima, radiation protection skills centre, reactive inspection). As in 2021, these checks were conducted jointly by the labour inspectorate and safety inspection. In 2023, following on from the actions carried out in 2021 and 2022, the electrical risks shall remain a priority for the ASN labour inspectorate.

Reactors A1 and A2 undergoing decommissioning

The former Saint-Laurent-des-Eaux NPP constitutes a BNI comprising two "integrated" GCR reactors, 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 GCR reactors, 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 are carried out under suitable conditions of safety and radiation protection, within controlled time frames.

In 2022, EDF continued its decommissioning work sites, and more specifically the decommissioning work outside the reactor vessel (Saint-Laurent A2) and the decontamination of the pool (Saint-Laurent A1). ASN considers that the level of safety of the Saint-Laurent-des-Eaux A reactors is satisfactory. ASN's inspections found that the overall upkeep of the premises and worksites was good. In addition, the organisation put in place to meet the commitments made further to the inspections and significant events is satisfactory. The same goes for the monitoring of outside contractors and the setting up of the radiation protection skills centres. Even though the in-service monitoring of the pressure equipment is performed correctly, improvements are expected, notably to ensure that the particularities of certain equipment items are properly taken into account.

Saint-Laurent-des-Eaux silos

The facility, authorised by the Decree of 14 June 1971, consists of two silos for storing 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 2022, ASN carried out 2 inspections in Corsica, one in the medical field and

one of the management of the radon exposure risk.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ **small-scale nuclear activities in the medical field:**



- 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:**



- some 40 veterinary surgeons using diagnostic radiology devices,
- some 40 industrial and research centres, including 2 companies exercising an industrial radiography activity;

■ **activities associated with the transport of radioactive substances;**



■ **ASN-approved laboratories and organisations:**

- 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 2022, 24 inspections were carried out in the small-scale nuclear activities sector in the French Overseas *départements*, regions

and collectivities. Four on-site inspection campaigns were carried out by ASN.

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ small-scale nuclear activities in the medical field:



- 4 external-beam radiotherapy departments,
- 1 brachytherapy department,
- 3 nuclear medicine departments,
- 23 centres performing fluoroscopy-guided interventional procedures,
- about 30 centres holding at least 1 computed tomography scanner,
- about 100 medical radiology practices,
- about 1,000 dental radiology devices;

■ small-scale nuclear activities in the industrial, veterinary and research sectors:



- more than 70 users of veterinary radiology devices,
- 3 industrial radiography companies using gamma radiography devices,
- 1 cyclotron;

■ activities associated with the transport of radioactive substances.





Grand Est REGION

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

In 2022, ASN conducted 164 inspections in the Grand Est region, of which 75 were in the NPPs in service, 19 in radioactive waste disposal facilities and on the sites of the Fessenheim and Chooz A NPPs currently being decommissioned, 67 in small-scale nuclear activities, 2 in the transport of radioactive substances and 1 concerning approved organisations or approved laboratories.

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

During 2022, 7 significant events reported by nuclear installation licensees in the Grand Est region were rated level 1 on the INES scale.

In small-scale nuclear activities, 3 significant events were rated level 1 on the INES scale (1 in the industrial sector and 2 in the medical sector) and 1 significant event concerning a patient was rated level 1 on the ASN-SFRO scale.

Cattenom nuclear power plant

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

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

ASN considers that the performance of the Cattenom NPP with regard to nuclear safety and radiation protection is in line with its general assessment of the EDF plants. The environmental protection performance of the Cattenom NPP is considered to be below the average for the fleet. 2022 was a special year for the site due to the long outages of three of the four reactors as a result of the stress corrosion phenomenon affecting the safety injection systems.

With regard to the operation and operational management of the reactors, ASN considers that the performance levels confirm the improvement noted since 2020. The inspections have revealed proficiency of the operational management teams and progress with respect to the findings of the in-depth inspection of 2021. A number of issues nevertheless remain, particularly shortcomings in monitoring by the operational management teams observed in several significant events.

With regard to maintenance, the year 2022 was marked by prolonged reactor outages – two refuelling and maintenance outages and one specific unscheduled outage – due to the investigations into the problem of stress corrosion cracking on the safety injection systems observed on some of the EDF NPPs. Due to the long duration of the outages without operating the reactors, the quality of the maintenance activities could not be assessed in detail. ASN nevertheless notes positively the monitoring of the new operations linked to the stress corrosion cracking issue (ultrasonic inspections, welds).

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 Soullaines-Dhuys in the Aube *département*;

■ the Cigéo geological disposal project for long-lived high- and intermediate-level radioactive waste;

■ small-scale nuclear activities in the medical field:

- 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:

- 277 industrial and veterinary activities coming under the licensing system,
- 24 companies exercising an industrial radiography activity,
- 47 research laboratories situated primarily in the universities of the region;



■ activities associated with the transport of radioactive substances.



As in the preceding years, ASN notes that the significant events management process is well mastered on the whole and effectively mobilises the site players up to senior management level.

With regard to fire risk prevention, ASN observes that the site has improved in several areas, such as the management of fire loads and sectorisation. Moreover, weekly patrol rounds have been put in place and are proving effective. Nevertheless, occasional findings reveal that these improvements must be consolidated and further efforts must be made in this area.

The site's emergency response organisation was deployed during a national exercise, as well as in two real situations (discharges causing iridescent sheens on the Moselle River and detection of a discharge of ammonia in the atmosphere). The organisation and resource deployment associated with these events ran smoothly. Nevertheless, the licensee's lack of knowledge of the monochloramine production facility created difficulties in the management of the event involving the ammonia discharge detection.

With regard to environmental protection, the site remains marked by weaknesses, as some events reveal room for improvement in the control of specific facilities and activities relating to discharges and monitoring of the environment. Controlling the risk of proliferation of microorganisms in the cooling towers still necessitates reinforced biocide treatments which have consequences on the aqueous discharges.

Lastly, the site saw an improvement in several radiation protection themes in 2022: management of sources, access to red (prohibited) controlled areas, control of industrial radiography work, number of significant events. The radiation protection skills centres have been put in place and correctly equipped, even if work on facilitation and uptake of the initiative still has to be developed. Deficiencies nevertheless persist, particularly in the control of accesses to and marking out of the limited stay (orange) areas and the dispersion of contamination. Lastly, with regard to occupational safety, the conformity of the electrical installations needs to be improved.

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 (BNI 139 and 144), commissioned in 2001.

Reactors B1 and B2 in operation

With regard to nuclear safety, given that the reactors did not function in 2022 due to the repair work on the pipes with stress corrosion cracks, ASN considers that the performance of the Chooz B NPP cannot be compared with that of the other NPPs.

ASN considers moreover that the radiation protection and environmental performance of the Chooz B NPP is in line with ASN's general assessment of the EDF plants.

As far as nuclear safety is concerned, even if the reduced level of activity resulting from the reactor outages does not enable a trend to be established with respect to the 2021 assessment, ASN considers that standard of safety has remained satisfactory. It nevertheless notes that the operational documentation and the organisation of the department responsible for operational management of the reactors can be further improved to limit sources of error. Particular attention must also be focused on the equipment lockout/tagout process, which has been the cause of several significant events.

With regard to maintenance, ASN underlines the satisfactory management of the exceptional volume of activity created by the build-up of inspections performed on account of the maintenance outages on the two reactors and the activities induced by the stress corrosion problem.

In the field of radiation protection, the annual result concerning compliance with the collective dosimetry targets is satisfactory. Shortcomings in the control of radiological cleanliness on certain work sites, however, caused numerous contaminations, particularly of garments, at the beginning of the scheduled maintenance operations on reactor 2. ASN noted that the licensee took corrective action immediately, and urges it to remain particularly vigilant on this subject. The licensee must also encourage rigour in workers' individual behaviours and be attentive to the management of industrial radiography work, which showed some weaknesses.

ASN considers that the site's environmental protection organisation is on the whole satisfactory, as it was in the preceding year.

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

Reactor A undergoing decommissioning

In 2022, the works to treat the waste resulting from the decommissioning of equipment inside the pressure vessel were started. The emptying of the reactor building pool in order to decommission the reactor vessel could not be undertaken due to the delay in installing an evaporator intended to treat the pool water prior to discharge. Commissioning of this evaporator is planned for early 2023.

The decommissioning work on all the equipment still present in the bunkers of the "auxiliary" vault continued. This work is carried out mainly by remote operation using a robotic arm.

The decommissioning work on the effluent treatment station equipment items that are not necessary for treating the water from the rock or floor drains also continued.

With regard to radiation protection, the prevention of worker contamination with alpha particles is the main challenge during the facility dismantling phases. ASN considers that the licensee has made progress in this area, with the setting up of a medical monitoring system tailored to ensure faster detection of cases of contamination, which remained at a low level.

The labour inspections on the themes of “worksite coordination” and “lockout/tagout and verification of electrical systems” revealed no major findings. Progress was observed in worksite coordination. The results of these inspections are satisfactory and the interchanges with the site are constructive.

More generally, ASN considers that the licensee is progressing in the various areas inspected and notes a strengthening of the teams which promotes a dynamic of progress.

Fessenheim nuclear power plant

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

ASN considers that the site has maintained a robust level of conscientiousness and vigour in the monitoring of operation of the facilities, despite a significantly different level of operating and maintenance activities. Nevertheless, a better adaptation of the site's past practices to the changing context would give a better quality in both operation and performance of the activities.

The year 2022 was essentially taken up by the continuation of the decommissioning preparation activities, such as the preparation, installation and execution of the decontamination work on reactor 1, the installation of new resin storage capacities, the removal of large quantities of waste and continuation of boron

treatment and removal. The decontamination of the primary system turned out to be much more complicated than EDF had expected, resulting in delays in execution.

Major milestones have been reached, such as the finalisation of fuel removal. Several major work sites will be continuing in 2023, notably with the decontamination of the primary system of the second reactor and the creation, in the turbine hall, of the facility for managing the waste resulting from the decommissioning.

With regard to radiation protection, 2022 saw a drop in the number of reported events compared with the preceding years and confirmation of the improvement in the prevention of contamination of the site roads. Nevertheless, some shortcomings persist in the radiation protection culture of certain workers (excess dose alarms, radiation protection marking out) and the management of sources and the associated removal actions were not considered satisfactory.

Nogent-sur-Seine nuclear power plant

Operated by EDF and situated in the municipality of Nogent-sur-Seine in the Aube *département*, 70 km northwest 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 in the areas of safety, radiation protection and the environment are in line with ASN's general assessment of the EDF NPPs.

In the field of nuclear safety, ASN considers the results to be satisfactory on the whole, except as concerns system configuring and equipment lockout/tagouts, which were the cause of a large portion of the significant events involving operational management of the reactors. Progress is expected in this area. The licensee must also continue its efforts to maintain adequate staffing of the independent safety organisation.

The maintenance operations during the reactor 1 outage went satisfactorily on the whole.

As far as occupational radiation protection is concerned, ASN observes better management of worksite radiological cleanliness and a reduction in the number of internal exposures of workers. 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 management of industrial radiography work, which has shown some weaknesses.

With regard to protection of the environment, ASN considers that the licensee's organisation is satisfactory. Nevertheless, the condition of some installations, particularly regarding the injection of sulphuric acid into the secondary system, requires priority action on the part of the licensee.

The labour inspections revealed nonconformities in the work equipment, particularly with respect to prevention of the risk of falling or of electrocution.

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, benefiting from the experience gained with the latter. This facility, located in Soulaines-Dhuys, has a disposal capacity of one million cubic metres (m³) 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 m³ volume, or by compacting 200-litre drums.

At the end of 2022, the volume of waste in the facility had reached about 350,000 m³, or 37% of the authorised capacity.

According to the estimates made by Andra in 2016 in the concluding report on the CSA periodic safety review, the CSA could be completely filled by 2062 rather than 2042 as initially forecast. This 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 2022 showed an appropriate organisation for radiation protection and emergency management, and compliance with the deadlines for the commitments made during the second periodic safety review of the facility.

Deep geological disposal centre project

ASN considers that the scientific experiments and work conducted by Andra in the underground laboratory at Bure continued in 2022 with a good standard of quality, comparable with that of the preceding years.

Furthermore, on the basis of the work carried out since ASN examined the *Cigéo* project safety options dossier in 2017, Andra filed the Creation Authorisation Application (DAC) for this deep geological disposal centre (see chapter 14 of the full ASN Report) with the Minister responsible for nuclear safety on 16 January 2023.



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 2022, ASN's carried out 124 inspections in the Hauts-de-France region, of which 33 were in the Gravelines NPP, 82 in small-scale nuclear activities and 9 in the transport of radioactive substances.

ASN also carried out 14 days of labour inspection in the Gravelines NPP.

In the course of 2022, 12 significant events rated level 1 on the INES scale were reported by the Gravelines NPP, including 3 concerning radiation protection.

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

Gravelines nuclear power plant

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

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

Nuclear safety performance did not improve in 2022, particularly with regard to the rigour of work interventions. The plan of rigour put in place by the licensee has started to bear fruit, particularly in the operational management of the facilities, but some inappropriate practices or behaviours subsist in other activities. The site must therefore continue its efforts to federate all the protagonists. At the end of the first half of 2022, ASN carried out an interim assessment of the measures put in place by the licensee through a tightened inspection on the theme of safety management, supervised by the ASN Chief Inspector, which did not call into question the relevance of the plan of rigour.

The year 2022 was marked by a larger number of significant events reported to ASN than in the preceding years and higher than the average for the EDF reactors, even if the number of events rated level 1 remained stable. The application of new safety baseline requirements linked to the fourth ten-yearly outages and the large volume of modifications deployed (nearly 500) explains some of them. This upward trend does not necessarily indicate a deterioration in the operating conditions as it may also reflect better performance in the detection of deviations or greater receptiveness on the part of the site's internal independent safety organisation.

As far as maintenance is concerned, 2022 was again marked by significant prolongations in the maintenance and refuelling outage durations, despite an alleviation of the maintenance programme applied in late 2022 to limit the downtime of the

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ the Basic Nuclear Installation:

- the Gravelines NPP (6 reactors of 900 MWe) operated by EDF;

■ small-scale nuclear activities in the medical field:



- 19 external-beam radiotherapy departments,
- 3 brachytherapy departments,
- 30 nuclear medicine departments,
- 92 centres performing fluoroscopy-guided interventional procedures,
- 129 computed tomography scanners,
- some 4,600 medical and dental radiology devices;

■ small-scale nuclear activities in the industrial, veterinary and research sectors:



- about 600 industrial and research establishments, including 29 companies exercising an industrial radiography activity, 6 particle accelerators, including 1 for inspecting freight trains and 2 cyclotrons, 38 laboratories situated mainly in the universities of the region and 11 companies using gamma ray densitometers,
- 340 veterinary surgeries or clinics practising diagnostic radiology;

■ activities associated with the transport of radioactive substances;



■ ASN-approved laboratories and organisations:

- 3 agencies approved for radiation protection controls.

last reactor. Three reactors were in outage at the same time, from early July to mid-September, 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 with, in particular, the fourth ten-yearly outage of reactor 3, the end of the replacement of the reactor 6 steam generators and of the work on the peripheral protection against external flooding, implemented further to the lessons learned from the Fukushima Daiichi NPP accident in Japan.

Concerning environmental protection, ASN considers that the Gravelines NPP has improved its maintenance response to the challenges presented by the equipment using the insulating greenhouse gas (SF₆) and that it must continue its efforts on the facilities for treating the radioactive effluents produced by reactor operation. A tightened inspection will be carried out in 2023.

In terms of radiation protection, on the basis of a tightened inspection conducted in 2022 and year-round monitoring, ASN considers that the situation remains sub-standard and that the site is still unable to restore it to a satisfactory level, despite the preventive measures put in place in 2021. The efforts must be increased in order to rapidly and sustainably restore satisfactory performance in occupational radiation protection in 2023.

The labour inspection actions conducted in 2022 were split between the inspections on the maintenance work sites, particularly during reactor outages, and specific inspections focusing on subjects such as lifting, electrical risks and work times. Regular meetings were organised with senior management, members of the health, safety and working conditions committee, and personnel representatives. The number of workplace accidents remains high in 2022 despite the measures taken by the licensee. Non-compliance with certain vital rules, induced by individual behaviours or work organisations, and shortcomings in the control of equipment lockout/tagouts were observed on several occasions. The labour inspectorate will be particularly attentive to these aspects in its next inspections.



On 5 July 2022, the ASN Chairman visited the Gravelines NPP to meet employees and contractors and get their feedback on the effects of the site's "plan of rigour" put in place to improve safety performance. He had met the members of the Gravelines Local Information Committee (CLI) the day before.



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 313 inspections in the Île-de-France region in 2022, of which 107 were in the field of nuclear safety, 149 in small-scale nuclear activities, 27 in the transport of radioactive substances and 30 concerned approved organisations or laboratories.

Ten significant events were rated 1 on the INES scale in the small-scale nuclear activities, 3 in the BNIs and 6 in the transport of radioactive substances.

CEA SACLAY SITE

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

The CEA Paris-Saclay centre, of which the main site covers an area of 125 hectares, is situated about 20 km south-west of Paris, in the Essonne *département*. About 6,000 people work there. Since 2005, this centre has been primarily devoted to physical sciences, fundamental research and applied research. The applications concern physics, metallurgy, electronics, biology, climatology, simulation, chemistry and the environment. The main aim of applied nuclear research is to optimise the operation and enhance the safety of the French NPPs. 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 has an authorised power of 70 Megawatts thermal (MWth). It was primarily intended for technological irradiation of structural materials and fuels for various power reactor technologies. Another of its functions was to produce radionuclides for medical purposes.

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

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ Basic Nuclear Installations regulated by the Orléans division:

- the CEA Saclay site of the CEA Paris-Saclay centre,
- the Artificial Radionuclide Production Plant (UPRA) operated by CIS bio international in Saclay,
- the CEA Fontenay-aux-Roses site of the CEA Paris-Saclay centre;

■ small-scale nuclear activities in the medical sector regulated by the Paris division:



- 26 external-beam radiotherapy departments,
- 12 brachytherapy departments,
- 41 *in-vivo* nuclear medicine departments and 13 *in-vitro* nuclear medicine departments (medical biology),
- 149 centres performing fluoroscopy-guided interventional procedures,
- more than 200 centres possessing at least 1 computed tomography scanner,
- about 850 medical radiology practices,
- about 8,000 dental radiology devices;

■ small-scale nuclear activities in the industrial, veterinary and research sectors under the oversight of the Paris division:



- some 650 users of veterinary radiology devices,
- 8 industrial radiography companies using gamma radiography devices,
- some 100 licenses concerning research activities involving unsealed radioactive sources;

■ activities associated with the transport of radioactive substances;



■ ASN-approved laboratories and organisations:

- 4 organisations approved for radiation protection controls.

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

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

The inspections revealed a robust organisation for conducting the safety review and supervising the associated action plan. Improvements are nevertheless expected in the examination of compliance with regulations and the technical baseline requirements of the facility. The subject of static and dynamic containment is properly understood. The state of conservation of a ventilation duct however, requires particular vigilance.

With regard to the prevention of pollution and detrimental effects, the updating of the hazardous substances inventory must be improved and further information on the facility's water consumption is awaited. The tracking of commitments made to ASN and of deviations is satisfactory.

Two significant events reported in 2022 are linked to problems of equipment aging, an important issue for the facility given the forecast time frames of the decommissioning operations.

The licensee's control of the decommissioning preparation operations, the management of waste and the monitoring of aging of the facilities shall be among the themes to which ASN will be attentive in 2023.

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 are currently being discussed following the CEA's re-prioritising of the decommissioning operations and its consequences on the updating of the decommissioning strategy of BNI 101.

Based on the facility inspections and monitoring carried out in 2022, ASN considers that the level of safety of the Orphée reactor is on the whole satisfactory. However, a number of points requiring special attention, such as identification of the safety important activities and their technical monitoring, and the formalising and tracking of the qualification files of safety important components, are necessary. The significant events show that vigilance is required in the monitoring of the periodic inspections and tests and of the effectiveness of the high efficiency particulate air filters. Improvements are expected regarding compliance with the storage rules for certain potentially activated materials or VLL packages.

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

Spent fuel testing laboratory

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

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

Further to the last periodic safety review, ASN issued the resolution of 30 November 2016 (amended on 26 June 2017) regulating the continued operation of the facility through technical prescriptions relating in particular to the improvement plan that CEA had undertaken to implement. Some of the CEA's commitments have not been fulfilled within the deadlines. In particular, the 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. ASN is therefore still waiting for the CEA to submit a robust action plan.

As of the end of 2022, BNI 72 will no longer accept 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 LECL”, in order to process, package and remove the irradiating waste (existing and future) without saturating the storage capacities of LECL.

Two significant events rated level 1 on the INES scale were reported in 2022. They concerned the presence of legacy fuel samples not authorised by the baseline requirements, and the absence or incorrect positioning of emergency brakes on a travelling crane and two lifting units. These reports come from the discovery of nonconformities dating back several years, and the facility has started corrective actions to find compatible outlets for the non-compliant samples and upgrading of the handling equipment according to the conclusions of the conformity check of the equipment in order to restore an acceptable situation. ASN will be particularly attentive to the monitoring and implementation of these actions.

The inspections conducted on the LECL in 2022 concluded that the facility’s safety management is satisfactory but improvements are expected in the management of VLL waste and monitoring of the technical controls of activities important for the protection of protected interests (Protection Important Activities – PIA). Moreover, ASN observes an increase in the times taken to reply to follow-up letters and to send in significant event reports.

Poséidon irradiator

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

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

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

ASN considers that the facility is operated satisfactorily and with the aim of continuously improving its safety. ASN has effectively observed that the licensee provides adequate responses within the set deadlines to its commitments resulting from the preceding periodic safety review (commitments made by licensee, technical requirements or requests from ASN). The periodic inspections and tests are correctly tracked despite an accelerator failure in 2022 which delayed the periodic inspection but had no consequences on the safety of the

facility. With regard to radioactive source management, the licensee has given ASN its undertaking to look into ways of improving the control of sources aged more than ten years for which a service life extension has been requested. Lastly, the work conducted by the licensee to determine the cause of the increase in tritium activity observed in the Poséidon pool water in 2021 enabled it to identify the cause of the phenomenon and to take appropriate corrective action.

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 (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 13 of the full ASN Report).

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

In 2017, in view of the delays in the removal from storage operations, the CEA requested that the deadlines prescribed in ASN resolution 2010-DC-0194 of 22 July 2010 for removal of the irradiated fuel from storage and removal of the waste stored in the “40 wells” area be pushed back by several years. In 2020, the CEA asked for a further postponement to 31 December 2030 of the deadline for removal of the waste stored in the 40 wells area, which was approved by ASN Chairman’s resolution CODEP-CLG-2022-005822 of 2 February 2022.

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

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.

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*. It will enter into application on the date ASN approves the General Operating Rules (RGEs) or, at the latest, one year after the publishing of this Decree.

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 favourably the removal of several fuel cans present in the pool of a building, which contributes to the gradual reduction of its dispersible inventory.

In 2022, ASN examined the progress of the operations concerning removal of fuel from the pool and a fuel rod transport package. Delays are observed due to technical contingencies and problems with the supply of fuel rod transport packages. However, the BNI is implementing corrective actions to overcome the difficulties the organisation has encountered and the actions implemented by the CEA to remove the irradiated fuels from block 108 and from the pool. Despite the observed delays, ASN underlines the CEA's ability to adapt to the various contingencies encountered. Nevertheless, the action plans to ensure compliance with the stated schedules must be more rigorous. ASN underlines that projects that contribute to reducing the dispersible inventory within facilities constitute priorities for safety.

Alongside this, ASN's inspections find the facility to be in good overall condition. ASN nevertheless expects improvements in the rescheduling of corrective actions initiated as a result of surveillance measures.

Liquid effluents management zone

The liquid effluents management zone constitutes BNI 35. Declared by the CEA by letter of 27 May 1964, this facility is dedicated to the treatment of radioactive liquid effluents. 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 Andra's above-ground waste disposal centres.

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

The 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 made this decision 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. Despite the work remaining to be done, the CEA plans resuming encapsulation in cement in the coming months.

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.

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 2022 revealed a satisfactory organisational set-up and tools to keep track of the commitments made to ASN. When unannounced inspections were carried out, the inspectors found the facility and the premises to be in good overall condition and the teams to be duly responsive. The theme of static and dynamic containment is suitably monitored by the licensee. Lastly, the operations to characterise the "legacy" organic effluents stored in the facility have started and must now continue.

On the other hand, improvements are expected in waste management, particularly with regard to the presence of legacy waste that is unidentified or to be repackaged, in the management of interim storage durations, and compliance with the storage area operating requirements. More rigorous tracking of chemical products is also necessary. 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 performed on the Saclay site concern two finally shut down BNIs (BNIs 18 and 49) and three BNIs in operation (BNIs 35, 40 and 72), parts of which have ceased activity and in which operations in preparation for decommissioning are being carried out. They also concern two Installations Classified for Protection of the Environment – ICPEs (EL2 and EL3), previously classified as BNIs but which have not been completely decommissioned due to the lack of a disposal route for the low-level long-lived waste (LLW-LL). Their downgrading from BNI to ICPE status in the 1980's, in compliance with the regulations of that time, could not be done today.

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

Ulysse reactor

Ulysse was the first French university reactor. The facility, which constituted BNI 18, was definitively shut down in February 2007. The BNI Decommissioning Decree was published on 21 August 2014 and provided for a decommissioning duration of five years.

On 8 August 2019, the CEA announced the end of the decommissioning operations provided for in the decommissioning decree, with the completion of final post-operational clean-out.

The CEA sent a delicensing application file to ASN in February 2021. After examining the file, ASN delicensed the Ulysse reactor in June 2022 and BNI 18 has thus been deleted from the list of BNIs (see chapter 13 of the full ASN Report).

High-activity laboratory

The High-activity laboratory (LHA) comprises several laboratories which were intended for research or production work on various radionuclides. It constitutes BNI 49. On completion of the decommissioning and clean-out work authorised by Decree of 18 September 2008, only 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 2022 was marked primarily by the operations prior to the resuming of decommissioning. Several contracts were moreover signed in order to restart, as of 2023, the clean-out and decommissioning operations which have been stopped since late 2018.

ASN considers that the level of safety of BNI 49 undergoing decommissioning is on the whole satisfactory. The inspections revealed meeting of the commitments made by the facility licensee to ASN, and the good condition of the premises and of the ventilation equipment. The performance of unannounced inspections also evidenced good responsiveness on the part of the licensee. On the other hand, the inspections revealed weaknesses in waste management, with the need to repack a large volume of noncompliant waste packages. The management of the VLL waste from the packaging and storage facility for the retrieval of sources surplus to requirements must also be improved in order to rapidly reduce the volume of waste stored in the premises. The surveillance of contractors on worksites must be stepped up to ascertain compliance with the provisions of the facility's baseline requirements.

One significant event rated level 1 on the INES scale was reported by the facility during 2022, caused by a safety culture deficiency on the part of workers responsible for replacing the fire detection system. This event followed on from late reporting of faults on the fire detection control system of part of the facility.

ASN remains vigilant with regard to the management of the VLL 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 turns out to be of major importance for the planned schedule of decommissioning operations.

ASN will conduct an inspection to check the conditions of resumption of the decommissioning work on the TOTEM shielded line, expected during 2023, following the discovery in late 2022 that the initial state of the shielded line was not as expected.

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 the continuation in 2022 of the operations to reduce the radiological inventory stored in the BNIs, particularly following several removal operations in BNI 72.

As in 2021, the decommissioning and Waste Retrieval and Packaging (WRP) operations continued to fall behind schedule in 2022. ASN considers that the progress of the decommissioning projects is one of the major safety challenges for the shutdown installations and that the management of the waste from the decommissioning operations is crucial for the smooth running of the decommissioning programmes. The majority of the CEA Saclay site BNIs are concerned, either directly or indirectly, by decommissioning or decommissioning preparation operations. It should nevertheless be noted that the Ulysse reactor (former BNI 18) was delicensed during 2022. ASN therefore expects the CEA to continue its efforts to make its implementation schedules for these operations more robust. Several files are currently being drafted or examined to define the decommissioning schedules of the facilities for the coming decades. ASN will remain particularly attentive to the progress of the decommissioning and WRP projects, with the aim of checking control of the schedules.

In 2021, an abnormally high tritium content was discovered in the Fontainebleau Sands aquifer, at a new piezometer installed on the site. The studies conducted by the CEA during 2022 furthered knowledge of the origin of this pollution and

its development over time, based on models. The installation of new piezometers during 2023 will enable the posited hypotheses to be verified and better identify the extent of the pollution plume.

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. Acceptance of the new emergency premises is now planned for 2024.

With regard to the emergency organisation and resources, an update of the On-Site Emergency Plan submitted by the CEA in late 2021 was discussed during 2022 in order to clarify the chosen provisions. In 2023, ASN will examine emergency management and the holding of exercises with, in particular, active situational exercises involving the site's local safety organisation.

Following a reorganisation of VLL waste management on the CEA Saclay site in early 2021, which led to a few occasional difficulties within the BNIs, ASN conducted a specific inspection focusing on six BNIs on the site in order to review the situation.

The inspections revealed that the BNIs are now capable of managing directly the packaging and removal of this waste. Some of the BNIs are examining the implementation of new measures to meet their future needs. Particular vigilance is nevertheless required in the management of waste storage durations and the quality of the waste inventories in the BNIs. The hazardous substance inventories must also be kept more strictly up to date. Even though the CEA conducted a specific study of the strategy for managing the liquid radioactive effluents produced on the Saclay site at the request of ASN, more specifically to examine the possibility of treating them in BNI 35, the organisational set up for managing the radioactive effluents, which have been treated on the Marcoule site for several years, was found to be appropriate.

With regard to radioactive substance transport, ASN's inspection found the tracking of these operations to be satisfactory, with a transport organisation providing for appropriate management of the safety issues.

Lastly, ASN conducted an inspection on the CEA Saclay site as part of its examination of the file concerning the setting up of radiation protection skills centres within the CEA Paris-Saclay centre. It served to review the substantial work achieved by the CEA teams and examine the methods of integrating the regulatory requirements, and thereby supplement or clarify certain aspects of the file. An inspection on this theme was also carried out on the CEA Fontenay-aux-Roses site. The setting up of radiation protection skills centres constitutes a positive point.

Artificial Radionuclide Production Plant of CIS bio international

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

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

The licensee CIS bio international mobilised its resources in 2022 for its ongoing periodic safety review, as well as carrying out operations that significantly improved safety. Thus, more high-activity disused sealed sources have been removed from the facility where they were stored, further reducing the dispersible inventory. The works conducted to improve liquid effluent management further to the deviations observed over the last few years, continued and underwent checks during ASN inspections.

Despite the stability of the internal organisation and better skills management, factors that contributed to the improvement in safety observed in the previous three years, ASN observed in 2022 that CIS bio international was having difficulties in carrying out certain activities within reasonable time frames and under conditions that complied with the safety baseline requirements. This finding applies equally well to ongoing projects, to everyday operation of the facilities, to addressing the responses to inspection follow-up letters and to the in-depth examination of significant events having occurred on the facility.

ASN's inspections in 2022, as in 2021, found that the management of the periodic inspections of Nuclear Pressure Equipment (NPE) must be improved rapidly. This subject has formed the subject of priority corrective action requests from ASN.

The tracking of emergency organisation training courses also needs to be improved. ASN has also observed deviations in occupational radiation protection, such as the signalling of the radiological risk and the management of liquid effluents, particularly fire-extinguishing fluids. CIS bio international's organisation for managing transport movements – which involve large quantities of packages with diverse contents – remains efficient, even if improvements are expected in the associated quality assurance and documentation management.

The number of significant events increased in 2022. Even though the events fall under varied themes, there is a predominance of organisational or human deficiencies. Consequently, compliance with the management and operating rules, alarm management, maintenance operations and the integration of lessons learned remain tenuous. Events reports are submitted beyond deadlines in the majority of cases, but the quality of document drafting and of the events analyses must be underlined. In this respect moreover ASN notes an improvement in the detection of significant events.

In 2022, ASN thus observed that there is still room for progress in several areas, particularly as concerns meeting the deadlines for the licensee's commitments.

To conclude, ASN observes in 2022 that despite CIS bio international's efforts, the action to improve the safety of the facility engaged in the preceding years is no longer progressing. This finding does not, at this stage, call into question the continuation of CIS bio international's activities. However, CIS bio international must focus its efforts in particular on the cross-cutting functioning of the organisation, compliance with the facility's baseline requirements and keeping to schedules. The shortcomings in operating rigour and safety culture observed in 2022 must be addressed by specific actions, taking particular care to meet the completion deadlines.

THE CEA FONTENAY-AUX-ROSES SITE

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

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

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

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

Procédé and Support facilities

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

ASN deemed that the first versions of these decommissioning decree modification application files were not admissible. In accordance with the commitments made in 2017, the CEA submitted the revised versions of these files in 2018. These files were supplemented over the 2019-2022 period, particularly with respect to the planned decommissioning operations and their schedule. The CEA forecasts end of decommissioning of the BNIs beyond 2040, perhaps even 2050 in the case of BNI 165. The two draft decommissioning decree modifications are under examination. The new decrees will set the decommissioning characteristics, notably their completion time frame.

Assessment of the CEA Fontenay-aux-Roses site

The licensee must maintain its efforts to ensure the operational safety of its facilities. Safety is considered acceptable, even if areas for improvement have been identified in a number of technical subjects.

In the light of the inspections carried out in 2022, the noteworthy modifications management process is found to be correctly implemented, even if some areas for improvement have been identified. The management of radioactive substance transport and the setting up of radiation protection skills centres are positive points to be emphasised.

Most of the points requiring particular attention identified in 2022 had already been identified in 2021. They concern in particular control of the lightning risk on the site and control of the fire risk in BNI 165. Vigilance is also required in waste management, particularly in one building of BNI 166. Specific actions by ASN are in progress on these subjects (priority action requests, examination of file or inspection scheduled on the theme in 2023).

Concerning management of the fire risk, particularly in BNI 165, the scheduled or ongoing compliance work must be a priority. The compliance work still to be done on the fire doors, the prolonged unavailability of the fire extinguishing system of the shielded lines, and the reporting of a significant event linked to the malfunction of fire dampers demonstrate that appropriate corrective measures must be implemented rapidly to restore the required level of safety in BNI 165. ASN keeps regular track of the licensee's commitments on these issues.

Further to the significant events reported in 2022, corrective actions are required in the management of the periodic inspections and tests, and especially compliance with the frequencies indicated in the RGEs. The licensee must also be attentive to the conditions of worker access to delimited areas.

In 2023, ASN will examine emergency management and the holding of exercises with, in particular, active

situational exercises involving the site's local safety organisation.

Broadly speaking, ASN concedes that the CEA is encountering real technical difficulties in retrieving the legacy waste currently stored in its facilities, but it again underlines the delays in performing the studies and in the scheduling of these projects. In 2022, as in the preceding year, the CEA presented ASN its forecasts concerning the coordination of the studies and work planned on the site to reduce the dispersible inventory within the facilities. The new organisation deployed since September 2020 for the periodic safety reviews and work on the facility decommissioning files is found to be robust but must continue to prove its effectiveness. ASN expects the CEA to continue to implement proactive measures to control and render reliable the time frames associated with these projects, particularly the deadlines announced for the submission of the decommissioning worksite preparatory studies.



Normandie REGION

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

In 2022, ASN carried out 208 inspections in Normandie, comprising 67 in the NPPs of Flamanville, Paluel and Penly, 15 on the Flamanville 3 EPR reactor construction site, 65 on “fuel cycle” facilities, research facilities and facilities undergoing decommissioning, 53 in small-scale nuclear activities and 8 in the transport of radioactive substances.

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

In 2022, 16 significant events rated level 1 on the INES scale were reported to ASN.

Flamanville nuclear power plant

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

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

In the area of nuclear safety, ASN observed that the action plan implemented in the context of tightened surveillance has been effective, particularly with regard to the upgrading of the facilities and integration of the fundamental safety principles by the employees and outside contractors. The difficulties the licensee encountered in the management of the local emergency response centre at the beginning of the year led it to implement an action plan of which ASN will monitor the results in 2023. Improvements are also expected in the completeness and quality of the files submitted to ASN.

With regard to reactor management and operation, ASN considers that the site’s performance is improving. The action plan of the operational management service brought a change in the teams’ practices which notably allowed controlled restarting of reactor 2 following its maintenance and refuelling outage which lasted from February to November 2022. These changes must now be maintained and sustained, particularly for the restarting of reactor 1 in early 2023.

With regard to the maintenance operations, the licensee took advantage of the outage of the two reactors to perform compliance work on various safety important components. On reactor 1 this resulted in the replacement of the four steam generators. As part of the inspections concerning the detection of stress corrosion cracks on the Penly 1 and Civaux 1 reactors in late 2021, the licensee took samples of pipes from reactor 2 in order to perform expert assessments, and also replaced them. As a general rule, ASN considers that the licensee carried out these maintenance operations competently. ASN will nevertheless remain attentive in 2023 to the traceability of the actions carried out for the management of contingencies and

THE INSTALLATIONS AND ACTIVITIES TO REGULATE COMPRISE:

■ Basic Nuclear Installations:

- the NPPs operated by EDF, namely Flamanville (2 reactors of 1,300 MWe), Paluel (4 reactors of 1,300 MWe) and Penly (2 reactors of 1,300 MWe),
- the Flamanville 3 EPR reactor construction worksite,
- the Orano spent nuclear fuel reprocessing plant at La Hague,
- the Manche repository (CSM) operated by Andra,
- the National large heavy ion accelerator (Ganil) in Caen;

■ small-scale nuclear activities in the medical field:



- 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:



- 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 associated with the transport of radioactive substances;



■ ASN-approved laboratories and organisations:

- 9 head-offices of laboratories approved for taking environmental radioactivity measurements,
- 1 organisation approved for radiation protection controls.

Tightened surveillance at Flamanville

In September 2019, ASN decided to place the Flamanville NPP under tightened surveillance further to the difficulties EDF encountered during the two ten-yearly outages which began in 2018. This tightened surveillance was materialised by a larger number of ASN inspections, some thirty per year, and regular interchanges with the licensee on the progress and effectiveness of its practices improvement plan. At the end of 2021, after completing the deployment of its action plan, the licensee asked ASN to lift the tightened surveillance status.

In 2022, ASN conducted two tightened inspections which revealed correct application of nuclear safety principles and rules by the personnel of EDF and the outside contractors, the good overall condition of the facilities, and the improvement in the control of radiation protection on the high-risk worksites. In view of the improvement in the state of the facilities and the safety practices, ASN decided to lift the tightened surveillance of the Flamanville NPP in July 2022. ASN has asked the licensee to continue to maintain a high level of stringency to consolidate the observed improvements.

the licensee's surveillance of worksites. Improvements are also expected in the robustness of the process for managing the periodic inspections of pressure equipment, which has shown vulnerabilities on several occasions.

The site's radiation protection performance improved in 2022. ASN observes progress in the organisation of radiation protection and notes that the process for identifying and reporting significant radiation protection events is effective. Improvements are however still expected in the preparation, by the workers – including those of outside contractors, of activities involving major radiation protection implications, including outside contractors, and in the control of the radiological cleanliness of the facilities.

ASN observes progress in environmental protection, the site having more specifically improved its organisation. ASN underlines the actions undertaken through the action plan to remove the legacy waste hulls and observes the good upkeep of the facilities and competent management of hazardous chemical products. Progress is nevertheless expected in the stormwater network, and particularly in the control of discharges and the monitoring of renovation work. These subjects will receive particular attention in 2023.

With regard to labour inspection, ASN considers that the licensee must make improvements in several areas. Deviations have been observed in particular in the verification of the electrical installations or the protection of certain areas with respect to the risk of falling from height.

Paluel nuclear power plant

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

The site accommodates one of the regional bases of the Nuclear Rapid Intervention Force (FARN) created by EDF in 2011 further to the Fukushima 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 that the performance of the Paluel NPP with regard to nuclear safety and environmental protection is broadly in line with the general assessment of the EDF plants. ASN considers that the radiation protection performance stands out positively with respect to its general assessment of the EDF plants.

The nuclear safety performance of the Paluel NPP was satisfactory, despite some weaknesses. In the area of reactor operational management, an action plan deployed to control activities involving a reactor trip risk gave satisfactory results. Nevertheless, there is room for progress in mastering the control of sensitive transients, particularly during the shutdown and restarting phases. Moreover, several significant safety events reported were caused by a deficiency in the preparation of the activity or shortcomings in the operational documentation. ASN considers that action must be taken to improve the quality of the operational documentation and the activity preparation and performance documents.

With regard to maintenance, ASN considers that the site's performance in 2022 still remains below average. Several inspections during the maintenance outages highlighted deviations in the monitoring of activities and of certain worksites. This was the case for example during the refuelling and maintenance outage of reactor 4, when a video inspection revealed a crack on a control rod drive shaft, a crack which had not been identified during the previous outages. In addition, the analysis of several safety-related significant events revealed a lack of preparation and shortcomings in the risk analyses before carrying out the activities. Improvements are therefore required, firstly through more rigorous preparation of the work interventions, and secondly by good uptake of the activities by the operators before carrying them out.

With regard to radiation protection, ASN notes that the site's performance is stable with respect to 2021. The dosimetry of all the maintenance outages during 2022 was below their initial forecast. The inspections confirmed the good upkeep of the work sites and, more generally, satisfactory management of the contamination risk. Improvements are nevertheless expected regarding compliance with the procedures for managing contaminated persons and in the contamination follow-up actions determined by the preparation committee for activities with high radiological risks. ASN notes that in 2022 a worker received a skin dose exceeding one quarter of the regulatory limit; this incident led to the reporting of a significant radiation protection event rated level 1. ASN will be attentive to the deployment of the action plan decided upon further to the analysis of the root causes of this event.

As regards environmental protection, ASN notes stable performance and considers that the organisational set-up for protection of the environment is satisfactory, and that the equipment necessary for monitoring environmental discharges is correctly maintained. Concerning atmospheric discharges of greenhouse gases, ASN observes a reduction in discharges of SF₆ but a significant increase in discharges of cooling fluids. ASN expects to see improvements in this latter point.

With regard to labour inspection, ASN observes that the workers know and comply with the safety requirements, but that the observed improvements must be continued. The ASN inspections have also found deviations in the verifications of handling cranes and the management of the fire evacuation plans in some parts of the facility. ASN will be attentive to the remedial actions taken to prevent the recurrence of such situations.

Penly nuclear power plant

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

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

With regard to nuclear safety, ASN considers that operating rigour is improving, despite a few persistent weaknesses. ASN considers that particular attention must be paid to the quality of work preparation, particularly when performing the periodic tests. Some significant events for safety still reveal shortcomings in personnel training, and in the monitoring of the installations during the management of transient operating phases. ASN will be particularly attentive to these points in 2023, particularly during the restarting of the two reactors.

As far as maintenance is concerned, at the end of 2021 during the ten-yearly outage of reactor 1 the licensee detected stress corrosion cracks on systems connected to the main pipes of the primary cooling system. This led to a programme of inspections, expert assessments, and large-scale repairs throughout the year 2022. With regard to the maintenance and refuelling outage of reactor 2, the maintenance operations were well managed on the whole and will continue in 2023, also further to the discovery of cracks. During the work on the two reactors, ASN observed repeated shortcomings in contractor monitoring, both in the documentation part and in the checking of the workers' practices. Greater rigour is expected on this subject. Alongside this, although ASN notes a reduction in the number of significant events linked to the detection of maintenance nonqualities, it considers that the safety impacts of the detected deviations must be analysed in greater depth.

In the area of radiation protection, ASN considers that shortcomings persist in the control of the contamination risk and in the radiation protection culture during reactor outage periods, particularly in the deployment and maintaining of measures to limit occupational exposure on the worksites. Organisational improvements are also expected, particularly for the setting up of the radiation protection skills centre.

As for environmental protection, ASN considers that the Penly NPP has obtained satisfactory results in waste monitoring and management and notes an improvement in the measures taken to control discharges of ozone-depleting gases. Improvements are nevertheless expected in the management of non-radiological risks. Although ASN has observed, in an exercise held during an inspection, that the NPP teams' organisation for managing non-radiological emergency situations is responsive and appropriate, the operational documentation available to the teams must be supplemented in order to integrate certain risks which are not taken into account at present.

With regard to labour inspection, ASN observes that the workers generally know and comply with the safety requirements. However, the inspections have occasionally found deviations in the prevention of vital risks (such as the prevention of the risk of anoxia or electrocution) and risks relating to lifting operations. ASN will therefore be attentive to the steps taken to reinforce the measures to prevent these risks.

In-depth inspection at Penly

In November 2022, ASN conducted a week-long in-depth inspection at the Penly NPP addressing themes such as safety management, operational control, maintenance, dealing with deviations and the modification of the facilities. This inspection, which mobilised some ten ASN inspectors, found the site organisation and operation to be efficient on the whole.

Flamanville 3 EPR reactor construction worksite

Following issuing of the Creation Authorisation Decree 2007-534 of 10 April 2007 and the building permit, the Flamanville 3 EPR reactor has been under construction since September 2007.

Overall, ASN notes that a substantial amount of work remains to be done in 2023 in preparation for reactor commissioning. In effect, apart from the actions relating to the examination of the commissioning file, which are continuing, EDF will have to check completion of the installation in order to demonstrate its conformity and the adequacy of preparation for reactor operation.

In 2022, EDF continued with work to complete the installation, to make modifications to certain equipment and to draw up the various documents needed for operation. EDF also continued the analysis and correction of deviations, particularly those affecting the welds of the Main Secondary Systems (MSS), three branch pipes of the Main Primary System (MPS), and the shrinkage of adhesive causing clogging of the filters of the safety injection system in the rooms concerned. ASN considers, on the basis of its inspections, that EDF is addressing these deviations appropriately. For the MSS welds in particular, ASN considers that the various parties involved have set up an organisation and a system for monitoring the activities conducive to achieving, with confidence, a high standard of quality in the production of these welds, thereby making it possible to meet the break preclusion baseline requirements. In 2023, ASN will continue its oversight of these activities and of the due preparation and performance of the hydrostatic tests of these systems.

Numerous systems, structures and components have been shut down for the work on the MSS's. After reviewing the preservation doctrine defined by EDF, ASN conducted several inspections in 2021 and 2022 to check its implementation, which turns out to be satisfactory on the whole. EDF must remain attentive to the preservation exit phase and to the implementation of appropriate means for the period between preservation exit and reactor commissioning.

Apart from the main deviations mentioned above and currently being corrected, ASN observed in 2022 that a lot of work remained to be done to finalise the fitting out of the installations (such as addressing the other deviations, performing certain start-up tests, making several equipment modifications and the finishing work). In this respect, ASN has asked EDF to submit periodic progress reports on installation completion and has initiated a verification campaign. ASN has noted that EDF has set up a dedicated organisation and taken appropriate corrective action in response to its demands. ASN nevertheless drew EDF's attention to the fact that a large amount of work remained to be carried out prior to reactor commissioning in order to demonstrate conformity of the installation with the commissioning file. Alongside this, ASN continued the verification of the equipment quality review which was requested in 2018 due to the serious shortcomings observed in EDF's monitoring of its outside contractors. ASN ascertained in 2022 that a programme of complementary verifications was established and implemented, and will examine the results of these actions and the main conclusions EDF draws from them.

Alongside the completion of the facility, 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. ASN's oversight has confirmed the defining and implementation of the organisational set-ups on the various themes, but it has also highlighted the substantial amount of work still to be carried out prior to reactor commissioning. ASN will continue its oversight in this respect in 2023 through dedicated inspections, including an in-depth inspection.

ASN also ensures the labour inspection duties on the Flamanville EPR reactor construction site. In 2022, in addition to checking that the contractors working on the site complied with the provisions concerning labour law, ASN checked 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), commissioned in 1969, was the first radioactive waste disposal centre operated in France. 527,225 m³ of waste packages are emplaced in it. The last waste packages to enter this facility were accepted in July 1994. From the regulatory aspect, the CSM is in the decommissioning phase (operations prior to its closure) until the installation of the long-term cover is completed. An ASN resolution shall specify the date of closure of the repository (entry into monitoring and surveillance phase) and the minimum duration of the monitoring and surveillance phase.

Examination of the periodic safety review guidance file had resulted in ASN formulating specific demands at the end of 2017, concerning the justification of the technical principles of deployment of the long-term cover, the CSM memory system and the updating of the impact study.

In this context, ASN is currently examining the CSM periodic safety review report submitted by Andra in 2019. The periodic safety review inspection 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 for Waste (GPD) pertaining to the CMS 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.

In 2022, ASN considers that the organisation defined and implemented for operation of the CSM facilities with regard to radiation protection and environmental monitoring is satisfactory. The licensee has notably taken measures to improve the monitoring of outside contractors. It must nevertheless

continue to embrace the requirements associated with the creation of the radiation protection skills centres and consolidate the operational control of the actions planned for the management of situations that could take the facility outside its operating range.

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 of the 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. For the purpose of the technical examination conducted jointly with IRSN, ASN underlines the speed with which Ganil provided the complementary information requested. In the light of the file and the complementary information provided, ASN informed the Nuclear Safety and Radiation Protection Mission (MSNR) in November 2022 that the file submitted by the Ganil was sufficiently robust for the examination to continue, and in particular for the consultations provided for by the regulations to be launched.

As far as the existing facilities are concerned, ASN considers that the licensee’s organisation for nuclear safety in 2022 was satisfactory. This being said, improvements are expected in the time frames and the exhaustiveness in the transcription of the new regulatory requirements into the documents, in order to avoid delays such as were observed with the formalising and implementation of the new radiation protection regulations.

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, in terms of the quantities of uranium and plutonium contained in the fuel assemblies before burn-up

(in the reactor), and limit the total capacity of the two plants to 1,700 tonnes per year. The limits and conditions for discharges and water intake by the site are defined by ASN resolutions 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 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 ATI facility, prototype facility currently being decommissioned;

BNI 47 ELAN IIB facility, research installation currently being decommissioned.

INSTALLATIONS IN OPERATION

BNI 116 UP3-A plant:

- T0: Facility for dry unloading of spent fuel elements,
- Pools D and E: Storage pools for spent fuel elements,
- T1: Facility for shearing fuel elements, dissolving and clarification of the resulting solutions,
- T2: Facility for separating uranium, plutonium and fission products and concentrating/storing fission product solutions,
- T3/T5: Facilities for purification and storage of uranyl nitrate,
- T4: Facility for purification, conversion to oxide and packaging of plutonium,

- T7: Fission products vitrification facility,
- BSI: Plutonium oxide storage facility,
- BC: Plant control room, reagent distribution facility and process control laboratories,
- ACC: Hull and end-piece compaction facility,
- AD2: Technological waste packaging facility,
- ADT: Waste transit area,
- EDS: Solid waste storage area,
- E/D EDS: Solid waste storage/removal from storage facility,
- ECC: Facilities for storage and retrieval of technological waste and packaged structures,
- E/EV South-East: Vitrified residues storage facility,
- E/EV/LH and E/EV/LH 2: Vitrified residues storage facility extensions;

BNI 117 UP2-800 plant:

- NPH: Facility for “under water” unloading and storage of spent fuel elements in pool,
- Pool C: Spent fuel element storage pool,
- R1: Facility for shearing and dissolving fuel elements and clarification of the resulting solutions (including the URP: plutonium redissolution facility),
- R2: Facility for separating uranium, plutonium and fission products and concentrating of fission product solutions (including the UCD: centralised alpha waste conditioning unit),
- SPF (4, 5, 6): Fission product storage facilities,
- R4: Facility for purification, conversion to oxide and initial packaging of plutonium oxide,
- BST1: Facility for secondary packaging and storage of plutonium oxide,
- R7: Fission products vitrification facility,
- AML AMEC: 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.

The nitric acid solution comprising the dissolved radioactive substances is then processed in order to extract the uranium and plutonium and leave the fission products and other transuranic elements.

After purification, the uranium is concentrated and stored in the form of uranyl nitrate ($\text{UO}_2(\text{NO}_3)_2$). It will then be converted into a solid compound (U_3O_8) called “reprocessed uranium” in the TU5 facility on the Tricastin site.

After purification and concentration, the plutonium is precipitated by oxalic acid, dried, calcined into plutonium oxide, packaged in sealed containers and stored. The plutonium is then 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 et CSD-C packages).

Marking events of the year 2022

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 particularly complex project has necessitated several authorisations. It was the subject of 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.

With regard to the NCPF T2 project, the T2 facility has been shut down since September 2022 in order to connect the new evaporators to the existing facilities and to continue the tests prior to commissioning, which is planned for April 2023. ASN has performed two inspections concerning the tests conducted by the licensee in 2022 and will continue its specific oversight operations in 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 are planned as of autumn 2023, with commissioning scheduled for the first half of 2024.

Storage of plutonium-bearing materials

Since the end of 2021, the Orano La Hague site has been faced with a problem of saturation of the storage capacities for these materials, linked to the operating difficulties encountered by the Melox plant. This problem gave rise to a hearing of Orano by the ASN Commission on 28 September 2021 and was also examined during the joint hearing of Orano and EDF relative to the balance of the "nuclear fuel cycle" on 10 February 2022.

To cope with this storage capacity problem, Orano has submitted several noteworthy modification authorisation applications with the aim of increasing its plutonium-bearing material storage capacities:

- a first application was filed in September 2021 to increase the storage capacities for plutonium-bearing materials in the BSTI facility. This led to an ASN authorisation in April 2022;
- a second application was filed in September 2022 to increase the storage capacities for plutonium-bearing materials in the R4 facility. This file is currently being examined by ASN with the technical assistance of IRSN.

Orano plans filing further applications of the same nature if the storage capacity problems persist.

Revision of the resolutions regulating the site's discharges

On 16 June 2022, ASN adopted two resolutions regulating the conditions of water intake, consumption, discharge into the environment, and the effluent discharge limits for the La Hague site. As of 1 January 2023, these resolutions update the resolutions of 2015

which were applicable until now. In accordance with the regulations, the resolution modifying the limits applicable to effluent discharges from the installation was approved by Ministerial Order published in the *Official Journal* of 7 December 2022.

The resolutions adopted by ASN take into account some of the licensee's requests concerning more specifically the modification of the maximum monthly activity concentration of rare gases, including krypton-85, measured at the regulatory environmental monitoring stations, and regulation of the limits and conditions of monitoring discharges into the sea of eleven chemical substances detected by the licensee in small quantities in the discharges during a regulatory compliance evaluation procedure. Other requests from the licensee, representing lower risks, have also been accepted if justified in view of the environmental risks and compatible with the applicable regulatory provisions, for example concerning the management of drainage waters from certain facilities, the conditions of effluent analyses and the frequency of submitting the regulatory studies determining the possibilities of reducing radiological and chemical discharges. Lastly, some requests asking for a relaxation of the requirements concerning water intakes, monitoring of the marine environment or the effluent discharge conditions, were rejected.

These resolutions ratify the principle of a significant reduction in the discharges into the sea authorised for certain radiological or chemical substances, in view of experience feedback and the improvement in effluent management practices and techniques. They also impose complementary provisions for environmental monitoring, evaluation of the radiological impact on the populations and effluent monitoring.

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 incurred in WRP. Consequently, ASN will continue to monitor the management of these projects in 2023.

LEGACY WASTE RETRIEVAL AND PACKAGING OPERATIONS

Unlike the direct on-line packaging of waste, as is done with the waste produced in the new UP2-800 and UP3-A plants at La Hague, the majority of the waste produced by the first UP2-400 plant was stored in bulk without final packaging. The operations to retrieve this waste are complex and necessitate the deployment of substantial means. They present major safety and radiation exposure risks, which ASN monitors with particular attention.

The retrieval of the waste contained in the old storage facilities of the La Hague site is also a prerequisite for the decommissioning and clean-out of these storage facilities.

Retrieval and packaging of the STE2 sludges

The STE2 station of UP2-400 was used to collect the effluents from the UP2-400 plant, treat them and store the precipitation sludge resulting from the treatment. The STE2 sludges are precipitates that fix the radiological activity contained in the effluents and they are stored in seven silos. A portion of the sludges has been encapsulated in bitumen and packaged in stainless steel drums in the STE3 facility. Following ASN's banning of bituminisation in 2008, Orano studied other packaging methods for the non-packaged or stored sludges.

The scenario for the retrieval and packaging of the STE2 sludges presented in 2010 was broken down into three steps:

- retrieval of the sludges stored in silos in STE2 (BNI 38);
- transfer and treatment, initially envisaged by drying and compaction, in STE3 (BNI 118);
- packaging of the resulting pellets into "C5" packages for deep geological disposal.

ASN authorised the first phase of the work to retrieve the sludges from STE2 in 2015. The Creation Authorisation Decree for 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 Cycle 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 packaging 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.

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”. Today, 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 scenario for retrieving and packaging this waste comprises four stages:

- retrieval and packaging of the solid GCR waste;
- retrieval of the liquid effluents;
- retrieval and packaging of the residual GCR waste and the sludges from the bottom of the silo;
- retrieval and packaging of the soils and rubble.

Orano has built a retrieval unit above the pit containing the waste and a new building dedicated to the sorting and packaging operations.

The various works conducted on silo 130 in 2022 enabled the licensee to validate industrial commissioning of the waste retrieval process. Quantitatively, 36 drums of waste were retrieved in 2022, bringing the total number of drums retrieved since the facility started operation in 2021 to about sixty. The licensee is nevertheless encountering numerous difficulties in terms of rates of waste retrieval and equipment reliability, which have a significant impact on the waste retrieval time frame. Waste retrieval has thus been stopped since the end of August 2022 following the rupture of the retrieval rake cable. ASN considers that the licensee must take measures to restore an operating capacity as close as possible to what was planned for at the design stage and must take into account the lessons learned for the other WRP projects.

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 2022, 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. The efforts focused in particular on upgrading the cement encapsulation carriage for fines and resins. Resolution CODEP-DRC-2022-02887 of 15 July 2022 authorised the partial commissioning of the unit for retrieval and packaging of the waste from the HAO silo and the SOC pools in “ECE” drums. The time frames are consistent with the “integrated schedule” of the project transmitted in February 2022 to meet the requirements to keep to the schedule in accordance with resolution 2014-DC-0472 of 9 December 2014, amended.

Assessment of the La Hague site

ASN considers that the performance of the Orano Recyclage La Hague site in 2022 is satisfactory in the areas of nuclear safety, radiation protection and environmental protection.

With regard to nuclear safety however, ASN considers that Orano must be more attentive to compliance with the deadlines for regulatory requirements and commitments.

From the operational aspect, Orano has continued the improvements initiated in the formalising of operator authorisations and deployment of the operational management teams. ASN also views positively the weighted and cautious approach of the operational management teams observed during the inspection of the STE3 facility. Particular attention must however be paid to the formalising of operating instructions for managing downtimes of the various operational control systems, and correct application of the provisional controller modification authorisations and the equipment lockout/tagout procedures. Greater rigour is also expected in the filling out and traceability of certain checks and registers, as this information is necessary to track parameters that are important for the safety of the facilities.

Further to the in-depth inspection conducted in early February 2022 on the themes of periodic inspections and tests and maintenance, ASN considers that Orano must significantly reinforce the requirements associated with the PIA relative to the periodic inspections and the management of deviations.

ASN underlines the generally good organisation of outside contractor monitoring. The monitoring reports are available but in some cases do not give the references providing proof of the monitoring actions, therefore greater rigour is required in filling them out.

As regards management of worksites, ASN observes their good general upkeep, with the exception of the worksite for the extension of the plutonium oxide discards storage areas in the BST1 facility, conducted with very tight deadlines, in which ASN noted significant deviations, such as worksite tracking folders not up to date, absence of proof of monitoring and non-validated

documents. ASN notes that these shortcomings make it impossible to ensure satisfactory traceability of the verifications and ultimately to guarantee compliance with the safety requirements defined by the licensee. Orano must therefore take care to maintain the quality of outside contractor monitoring, irrespective of the various constraints on the worksites.

ASN considers that the work programmes to reinforce fire detection and protection are on the whole proceeding satisfactorily. With regard to the situational exercises, improvements are required in the adoption of the actions to be taken by the local response groups and greater rigour is necessary in the management of hot work permits, fire loads and the fire-fighting means specific to worksites.

With regard to the storage of plutonium-bearing materials, Orano commissioned a first storage area extension within a room of the BST1 facility in May 2022. This project was examined and deployed under very tight timelines. Orano filed another application in May 2022 for a storage extension within the R4 facility which also requires examination and deployment in very short time frames. ASN thus again considers that Orano must reinforce its forward-looking initiatives for managing the capacities of certain storage areas, such as those for plutonium-bearing materials or spent fuels, in order to define and deploy storage arrangements and solutions with more reasonable time frames.

With regard to radiation protection, the year 2022 was marked by the creation of the radiation protection skills centre. The organisation in place broadly meets the regulatory requirements and the licensee has made commitments regarding the last points to address.

The year 2022 was however also marked by an increase in significant radiation protection events concerning noncompliance with the conditions of access to delimited areas. ASN considers that the licensee must continue and intensify its action plan to prevent this type of event from happening again. Alongside this, ASN notes that the management of radioactive sources within the site

can be improved. Numerous expired sources are still in service or have not been removed. It is important that the licensee steps up its ongoing action plan in this respect so as to be able to remove the expired sources as quickly as possible. These various aspects were examined in depth during the ASN's tightened inspection on radiation protection carried out in October 2022.

Concerning environmental protection in 2022, ASN takes positive note of the licensee's actions in response to the findings of a tightened inspection conducted the preceding year. The improvement actions undertaken to ensure the regulatory compliance of the facilities presenting risks and drawbacks for environmental protection must be continued, and stepped up as regards the control of fluorinated greenhouse gases.

Concerning the treatment of effluents, ASN also observes the operational control teams' proficiency in the process and the ability of the licensee to mobilise the appropriate resources for the contingencies. This being said, measures are awaited to improve the availability of certain items of equipment and control of the defined requirements applicable to the environmental discharges. In this context, ASN also points out the need to continue the actions to reduce environmental discharges, an objective that was taken into account in ASN's revision of the resolutions regulating the site's discharges completed in 2022.

With regard to the management of the decommissioning and WRP projects, significant progress was made in 2022, particularly in the MAU, MAPu and HADE facilities. Orano has also continued to implement the fundamental improvements in the organisation of the decommissioning and WRP projects, which began in 2021, aiming to achieve greater robustness.

ASN nevertheless still observes that several decommissioning and WRP 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. As for the WRP projects, difficulties encountered in 2022 on the projects associated with silo 130, silo 115 and sludge treatment are significantly delaying the lowering of the dispersible inventory of the facilities concerned. Regarding silo 130, which is the most advanced project and is in the industrial operation phase, the licensee is faced

with numerous problems of equipment reliability, which have a significant impact on the waste retrieval times. ASN considers that the licensee must take measures to restore an operating capacity as close as possible to what was planned for at the design stage and must take into account the lessons learned for the other projects.

Lastly, ASN considers that Orano must take care to maintain the facilities undergoing decommissioning in good condition in order to control the infiltrations in certain buildings, guarantee the radiological characterisation of the residual materials in cells, and ensure that the required controls are properly performed.



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 2022, ASN carried out 140 inspections in the Nouvelle-Aquitaine region, comprising 52 in the Blayais and Civaux NPPs, 77 in small-scale nuclear facilities, 6 in the area of radioactive substance transport and 5 concerning ASN-approved organisations and laboratories.

ASN also carried out 13 days of labour inspection at the Blayais NPP and 9.5 days at the Civaux NPP.

During 2022, 6 significant events rated level 1 on the INES scale were reported by the NPP licensees in Nouvelle-Aquitaine. In small-scale nuclear activities, 1 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.

ASN temporarily modified the requirements regulating thermal discharges from the Blayais NPP during the heat waves of summer 2022 (see “Notable events” in the introduction to this report).

Blayais nuclear power plant

The Blayais NPP situated in the Gironde *département*, 50 km north of Bordeaux, is operated by EDF. This NPP comprises four 900 MWe PWRs, commissioned in 1981 and 1982. Reactors 1 and 2 constitute BNIs 86 and 110 respectively.

ASN considers that the performance of the Blayais NPP with regard to nuclear safety, radiation protection and environmental protection is in line with ASN's general assessment of the EDF plants. ASN considers that further improvement measures must be taken to raise the standard of nuclear safety performance. It considers that the radiation protection and environmental protection performance is progressing, but that the improvement efforts already undertaken need to be continued.

With regard to nuclear safety, the performance of the Blayais NPP dropped during 2022. ASN considers that the licensee's performance in the operational control of the reactors was below the expected standard, particularly during operational operations conducted at the end of the reactor 3 refuelling and maintenance outage, during which inappropriate actions on the electrical power supplies caused several significant events for safety. Furthermore, some inspections revealed the presence of malfunctions in the control of the fire loads, shortcomings in the integration of a number of “post-Fukushima” requirements, and the need to improve primary system monitoring for prevention of the stress corrosion risk. On the other hand, in the area of maintenance, ASN notes a good command of the activities carried out during the reactor outages and appropriate addressing of the anomalies encountered.

With regard to occupational radiation protection, ASN considers that performance has improved with respect to 2021, with the continued deployment of the action plan in this area. ASN more specifically notes an improvement in dosimetry

monitoring and control of the “red area” process. Nevertheless, ASN still observes dysfunctions in the field regarding the wearing of dosimeters, the marking out of controlled areas and the provision of contamination meters expected in zone transition areas. These deficiencies are indicative of a lack of monitoring, training, and informing of workers: the radiation protection culture must therefore be improved.

With regard to environmental protection, ASN notes the licensee's constant efforts to remedy the degraded situations which have existed for several years, such as remediating the legacy presence of pollutants in the soils and in the site's confined groundwater tables. Alongside this, ASN underlines the proactive measures implemented to control the discharges of SF₆, a greenhouse gas used for electrical insulation. It nevertheless considers that control of the discharges of other greenhouse gases can be substantially improved and that improvements are expected regarding the consistency of the performance of the discharges from the site's wastewater treatment plant. Lastly, ASN finds persistent weaknesses in that the containment of accidental spillages of non-radioactive liquids on the site cannot be guaranteed under all circumstances.

Concerning labour inspection, ASN considers that the results regarding worker safety are still not of the expected standard. ASN has observed risk situations for personnel working at height, and the occurrence of events affecting safety linked to hand-held power tools. ASN considers that the relevance of the risk analyses must be improved. It also underlines poorly managed situations that have led to the accidental exposure of several employees to asbestos fibres. A strong response is expected of the licensee on this subject. ASN nevertheless notes positively the setting up of worksite protection reviews.

Civaux nuclear power plant

The Civaux NPP is operated by EDF in the Vienne *département*, 30 km south of Poitiers in the Nouvelle-Aquitaine region. It comprises two 1,450 MWe PWRs, 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 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.

The Civaux NPP had a highly singular year in 2022 with its two reactors shut down. This situation is linked to the management of the stress corrosion phenomenon detected in 2021 on reactor 1 which affects certain pipes connected to the primary system, and the proceedings of the ten-yearly outages on the two reactors. Consequently, with regard to safety, ASN is unable to compare the performance of the Civaux NPP with that of the other NPPs. It considers that the radiation protection performance of the Civaux NPP stands out positively with respect to its general assessment of the EDF plants, and that its environmental protection performance is in line with this general assessment.

In the area of nuclear safety, ASN commends the attitude of EDF which gave priority to the safety of its facilities by voluntarily maintaining the outage of its two reactors in order to successfully replace pipes potentially affected by stress corrosion cracks. During this period where the operational control teams were less occupied with controlling the facilities, ASN notes that EDF took appropriate measures to maintain and develop its employees' skills by reactively adapting the training programme for the purpose of integrating numerous modifications associated with the second ten-yearly outage. With regard to maintenance, ASN considers that the situation of the site is satisfactory on the whole. It nevertheless considers that the associated documentation needs to be improved, as does the monitoring of contractors. The year 2022 was marked in particular by a maintenance non-quality which caused a sudden loss of sealing of the main primary system during the increase in its pressure for its hydrostatic test. The event had no major consequences. ASN observed the licensee's competent management of this event. Lastly, management of equipment lockouts/tagouts prior to interventions is considered sub-standard and must be improved.

Worker radiation protection was an important issue in 2022 due to the large number of activities associated with the two ten-yearly outages. As in 2021, ASN considers that radiological cleanliness is one of the site's strong points. The collective dosimetry associated with the pipe replacement work to prevent the stress corrosion phenomenon was lower than expected, thereby limiting the ionising radiation exposure of the workers. ASN nevertheless still observes inappropriate behaviours of workers in controlled areas with respect to the applicable radiation protection rules. It notes missing radiation meters and noncompliant worksite air locks.

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:



- 19 external-beam radiotherapy departments,
- 6 brachytherapy departments,
- 26 nuclear medicine departments,
- 89 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:



- about 700 industrial and research centres, including 59 companies with an industrial radiography activity,
- 1 cyclotron particle accelerator,
- 49 laboratories situated mainly in the universities of the region,
- some 500 veterinary surgeries or clinics practising diagnostic radiology;

■ activities associated with the transport of radioactive substances;



■ ASN-approved laboratories and organisations:

- 2 organisations approved for radiation protection controls,
- 15 organisations approved for measuring radon,
- 8 laboratories approved for taking environmental radioactivity measurements.

With regard to environmental protection, ASN considers that in 2022 the Civaux NPP managed waste and radioactive effluents satisfactorily. Significant progress has been observed in the projects for containing fire extinguishing liquids and for the management of backfill soils, but this must be consolidated.

With regard to labour inspection, ASN considers that the organisational set up for detecting and addressing hazardous situations and the adopting of the key points of the lockout/tagout procedures must be rendered more robust. It notes in particular several risk situations for workers in confined environments. ASN has also observed recurrent deficiencies in the control of the asbestos-related risk, which have resulted in several cases of accidental exposure. ASN considers that the licensee must step up its efforts in this area. Nevertheless, ASN takes positive note of the setting up of weekly workshops intended for the managers to promote the safety culture within their teams, and the site's undertaking to accompany contractors during field visits.



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 2022, ASN carried out 125 inspections in the Occitanie region, comprising 55 inspections in BNIs, 56 in small-scale nuclear activities, 11 in the transport of radioactive substances and 3 concerning ASN-approved organisations and laboratories.

ASN also carried out 15 days of labour inspection at the Golfech NPP.

During 2022, four significant events rated level 1 on the INES scale were reported by the licensees of the nuclear installations in Occitanie. In small-scale nuclear activities, 3 significant radiation protection events rated level 1 on the INES scale were reported to ASN (2 in the industrial sector and 1 in the

medical sector). One significant event in the medical field rated level 2 on the ASN-SFRO scale was reported to ASN.

In the context of their oversight duties, the ASN inspectors issued one violation report. One medical centre was moreover summoned in order to raise senior management's awareness of the issues of occupational and patient radiation protection.

ASN temporarily modified the requirements regulating thermal discharges from the Golfech NPP during the heat waves of summer 2022 (see "Notable events" in the introduction to this report).

Golfech nuclear power plant

The Golfech NPP operated by EDF is located in the Tarn-et-Garonne *département*, 40 km west of Montauban. This NPP comprises two 1,300 MWe PWRs, 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 and environmental protection is below ASN's general assessment of the EDF plants. The radiation protection performance is in line with the general assessment.

With regard to nuclear safety, ASN considers that deployment of the Safety rigour plan since 2019 demonstrates senior management's commitment to improving the site's nuclear safety performance. Nevertheless, the actions and efforts undertaken in this context have not yet produced sufficiently visible results on the performance levels observed during inspections or on the Golfech NPP indicators. The shortcomings in the area of operational control already identified in previous years persist in 2022 despite some progress: deficiencies in skills, in communication between departments, in compliance with procedures and recording of activities. ASN considers that in 2023 the licensee must improve operating rigour by enhancing operator skills and compliance with procedures.

With regard to maintenance, the marking event of 2022 was the ten-yearly outage of reactor 1. The work undertaken by the site to improve the quality of maintenance has resulted in visible progress in this area. ASN notes more particularly improvements in the identification and addressing of deviations, in the consolidation of technical controls and in the

consideration 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 is stable with respect to 2021. ASN notes the strong involvement of the members of the workers' radiation protection skills centre in the training course and the increase in the monitoring of radiation protection contractors. Improvements are nevertheless expected in the control of the procedures for accessing limited stay (orange) areas and in industrial radiography activities.

In the area of environmental protection, ASN considers that the performance of the Golfech NPP deteriorated in 2022. The year was marked by a relatively large number of events. Improvements in the management of the containment of non-radioactive liquid substances are expected in 2023.

Concerning labour inspection, ASN considers that there is a deterioration in worker safety results. Compliance with the requirements of the Labour Code must be improved, particular regarding work at height and handling and lifting operations. The ASN labour inspectorate considers that coordination of the risks associated with the interface between different activities must be improved, as must the quality of activity preparation and risk analyses. It also notes the existence of design faults in certain electrical installations, witnessed by an inspection organisation.

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 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 Laboratory for research and fabrication of advanced nuclear fuels (Lefca), were transferred here from the CEA Cadarache centre in 2017.

On completion of the analysis of the facility’s periodic safety review report submitted in December 2016, ASN published resolution 2022-DC-0720 of 19 April 2022 which sets the CEA requirements applicable to Atalante, intended to regulate the continued operation of the BNI. More specifically, the frequency of treatment of Radioactive Organic Liquids (LOR) by the “DELOS” process, for which the final date has been prescribed, shall form the subject of specific ASN oversight in the coming years. The licensee must moreover improve the organisation adopted to ensure the monitoring and traceability of the actions defined at the end of this periodic safety review.

In 2022, ASN authorised the implementation of new software for managing material and monitoring criticality, which broadly improves the integration of measurement uncertainties when evaluating fissile material masses. The commissioning of a liquefied nitrogen reservoir on the new gas platform of Atalante has also been authorised.

Deficient periodic inspections and tests, essentially due to human errors, led to significant discharges of greenhouse gases and failure to perform periodic tightness inspections of glove boxes and of fire-extinguishing gas cylinders. These deviations were reported to ASN as significant events. The licensee informed the outside contractors concerned and shared a feedback analysis on the identified risks with them in order to prevent the recurrence of this type of event.

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 ioniser,
- the Écrin waste storage facility on the Malvési site;

■ small-scale nuclear activities in the medical field:



- 14 external-beam radiotherapy departments,
- 6 brachytherapy departments,
- 21 nuclear medicine departments,
- 100 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:



- about 800 industrial and research centres, including 4 cyclotron particle accelerators, 28 companies exercising an industrial radiography activity and 58 laboratories situated mainly in the universities of the region,
- some 630 veterinary surgeries or clinics practising diagnostic radiology;

■ activities associated with the transport of radioactive substances;



■ ASN-approved laboratories and organisations:

- 7 laboratories approved for taking environmental radioactivity measurements,
- 7 organisations approved for measuring radon,
- 4 organisations approved for radiation protection controls.

ASN considers that the level of safety of Atalante is satisfactory on the whole, particularly regarding the management of the waste zoning plan and the monitoring of outside contractor activities. The measures taken in 2022 have improved the static and dynamic containment of the BNI. A working group has been set up on the subject of piercing of gloves, with an action plan that will be applied within Atalante.

Assessment of the CEA Marcoule centre

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

The organisation of outside contractor monitoring must be improved, particularly to clarify the distribution of monitoring actions between the Marcoule centre and the BNIs and improve the sharing of Operating Experience Feedback (OEF) between the CEA centres.

The organisation of on-site transport operations and the application of the on-site transport rules are robust. ASN has observed an improvement but will remain attentive to the measures taken for transport package maintenance.

ASN has authorised the setting up of the CEA Marcoule radiation protection skills centres under Articles R. 593-112 of the Environment Code and R. 4451-113 of the Labour Code, along with the General Operating Rules (RGEs) of the CEA Marcoule. The organisational provisions regarding radiation protection observed in inspections are satisfactory on the whole; ASN will be attentive to the emergency situation organisation of the radiation protection, particularly where duties necessitating service continuity are involved.

In 2020, the CEA submitted its study on the sanitary and environmental evaluation of the liquid and gaseous chemical discharges from the Marcoule platform, for which ASN has requested complementary information. An ASN resolution concerning the requirement for a third-party expert assessment of this study shall be formalised.

Phénix reactor – CEA centre

The Phénix NPP (BNI 71) is a demonstration fast breeder reactor cooled with liquid sodium. This reactor, with an electrical power rating of 250 MWe, was definitively shut down in 2009 and is currently being decommissioned.

The major decommissioning phases are regulated by Decree 2016-739 of 2 June 2016. ASN resolution 2016-DC-0564 of 7 July 2016 sets the CEA various milestones and decommissioning operations.

Removal of the spent fuel and equipment continued in 2022 in accordance with the ASN requirements and the licensee's commitments made during the facility's periodic safety review, which was completed in 2012, and the transition to the decommissioning phase.

Uncertainties as to the future and the processing of the spent fuel from Phénix nevertheless remain (see chapter 11 – “Fuel cycle” of the full ASN Report).

ASN considers that the level of nuclear safety and radiation protection of the Phénix NPP is satisfactory on the whole, particularly with regard to waste management, deviation management, organisation for tracking ongoing worksites and meeting commitments. Improvements are however expected in the management of accident-situation instructions, particularly for their periodic review and their integration in the modification process.

A significant event concerning the falling of a shock-absorbing device in a cell further to a safety culture deficiency was rated level 1 on the INES scale.

Construction of the NOAH facility, which will treat some of the sodium from Phénix and other CEA facilities, progressed in 2022 with the continuation of the pre-commissioning operating tests.

The reference decommissioning scenario 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. The licensee moreover submitted the conclusions of its periodic safety review on 26 October 2022.

Diadem facility – CEA centre

The Diadem facility, currently under construction, shall be dedicated to the storage of containers of radioactive waste from decommissioning emitting beta and gamma radiation, or waste rich in alpha emitters, pending construction of facilities for the disposal of long-lived waste (LLW) or LL/ILW-SL whose characteristics – especially the dose rate – mean they cannot be accepted in their present state by the CSA.

In 2022, the CEA continued the procedures initiated further to ASN's findings in 2021 to improve the exercising of its responsibilities as nuclear licensee, its project management and the handling of deviations.

ASN considers that the organisation in place for the powered-on qualification tests of the facility's electrical equipment is on the whole satisfactory.

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. The operations necessary for its effective commissioning, which corresponds to reception of its first radioactive waste package, must be a priority for the CEA.

Melox plant

Created in 1990 and operated by Orano Recyclage, the Melox plant (BNI 151) produces MOX fuel which consists of a mix of uranium and plutonium oxides.

ASN considers that the level of nuclear safety and radiation protection is satisfactory in the field of fire risk management and broadly satisfactory in the fields of operational control and waste management. ASN also observes an improvement in the extent to which the regulatory baseline requirements for pressure equipment are assimilated.

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.

In addition, for several years now the licensee has had difficulties in producing the planned quantities of fuel in accordance with the safety specifications of the nuclear reactors. This situation results in the production of a large quantity of fabrication rejects which are sent to La Hague for interim storage, leading in the short term to the site's plutonium storage areas being filled to maximum capacity. These difficulties could have major consequences for the "fuel cycle" as a whole and for French nuclear power production.

This situation induces significant maintenance needs at Melox, which have consequences in terms of radiation protection,

with a growing reliance on outside contractors and a very high collective dosimetry.

An ASN inspection conducted on these themes revealed that the increase in the maintenance operations had led to a significant increase in waste production, leading in turn to a risk of saturating the local storage capacities.

In 2022 the licensee qualified a new uranium oxide powder which should normally bring a reduction in the quantity of rejects. The industrial production of this new type of powder requires the creation of a new facility on Orano's Malvési site (see chapter 11 – "Fuel cycle" of the full ASN Report).

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, baptised "PPRM" project, continued in 2022. An inspection on these themes was carried out in 2022 and found that the resources and areas of work engaged by Orano Recyclage should resolve the facility's production and maintenance difficulties.

The construction of the emergency centre should be completed shortly, allowing the building to be commissioned in 2023, as prescribed by ASN.

Centraco plant

The Centraco plant (BNI 160), was created in 1996 and is operated by Cyclife France, a 100% subsidiary of EDF. The purpose of the Centraco plant is to sort, decontaminate, reuse, treat and package – particularly by reducing their volume – waste and effluents with low and very low levels of radioactivity. The waste resulting from the plant's processes is then routed to Andra's CSA repository. The facility comprises:

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

ASN considers the level of safety of the facility to be broadly satisfactory, particularly as regards the management of transport and of aging. Waste management, for its part, must undergo radical changes in order to meet the storage deadlines defined in the baseline safety requirements. ASN also conducted an inspection concerning the BNI's periodic safety review.

Furthermore, Cyclife France sent ASN modification requests for its facility in 2020 to allow the treatment of particular types of waste in Centraco with specific sorting put in place for this waste. ASN considers that the technical and organisational

provisions presented by the licensee for this prior sorting operation in dedicated units are satisfactory in principle, but double-checking of the conformity of the waste introduced into the incineration or melting furnaces must be maintained. ASN thus modified the requirements of its resolution 2008-DC-0126 of 16 December 2008 through resolution CODEP-CLG-2022-003400 of 19 January 2022.

In March 2022, Cyclife submitted a noteworthy modification application file with the aim of creating a VLL asbestos waste processing facility in order to be able to treat waste from the decommissioning of Chinon A. This file, which is currently being examined by ASN, provides for the creation of a new facility baptised "asbestos facility" allowing the sorting of bags of asbestos waste before repackaging.

The investigations conducted following the discovery of a waste item having exceeded its storage deadline, which formed the subject of a significant event report to ASN in July 2022, revealed numerous other waste items whose storage duration exceeds the time stipulated in the facility's Creation Authorisation Decree. This led the licensee to deploy an action plan to conduct an in-depth review of its technical and organisational arrangements for managing its waste in the facility. The implementation of this action plan and the meeting of the commitments made shall be checked by ASN.

Gammatec ioniser

The Gammatec ioniser (BNI 170) is an industrial irradiator operated by the company Stéris since 2013. Gammatec treats products by ionisation (emission of gamma radiation) with the aim of sterilising them or improving the performance of the materials. The installation consists of an industrial bunker and an experimental bunker. Both bunkers contain sealed sources of cobalt-60 which provide the radiation necessary for the facility's activity.

The level of safety and the control of source security are broadly satisfactory in 2022. Improvements must be made in formalising the documentation.

Écrin facility

The Écrin facility, BNI 175, is situated in the municipality of Narbonne in the Aude *département*, within the Malvési site operated by Orano, which represents the first step of the "fuel cycle" (excluding extraction of the ores). The transformation process produces liquid effluents containing nitrated sludge loaded with natural uranium. The entire plant is subject to the system governing Seveso high-threshold Installations Classified for Protection of the Environment (ICPEs).

The Écrin BNI consist of two storage basins (B1 and B2) containing the legacy sludge from the plant. These two basins have BNI classification due to the presence of traces of artificial radioisotopes. This BNI was authorised by Decree of 20 July 2015 for the storage of radioactive waste for a period of 30 years.

The works defined in the Decree of 20 July 2015, which began in 2019, continued in 2022 with the transfer of materials to the vault baptised "PERLE", a French acronym standing for "Project for Reversible Lagoon Storage in the Écrin BNI"), excavated to the south of basin B2.

An unannounced inspection held in July 2022 confirmed that the monitoring of the facility and the state of the worksite remain satisfactory. 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 2022, ASN carried out 62 inspections, comprising 2 inspections in the facilities of the company Ionisos (Pouzauges and Sablé-sur-Sarthe), 3 inspections of approved organisations, 4 in the transport of radioactive substances and 53 in small-scale nuclear activities (31 in the medical sector and 22 in the industrial, research and veterinary sectors).

Three significant events in the industrial sector and one in the transport sector were rated level 1 on the INES scale in 2022.

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

Ionisos irradiator

The company Ionisos operates two industrial ionisation installations on the sites of Pouzauges (*Vendée département*) and Sablé-sur-Sarthe (*Sarthe département*). These installations constitute BNI 146 and 154 respectively

The gamma radiation emitted is used to sterilise, destroy pathogenic germs or reinforce (by cross-linking) the technical properties of certain polymers, by exposing the products to be ionised (single-use medical equipment, packaging, raw materials and finished 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 operation of the Pouzauges and Sablé-sur-Sarthe irradiators is generally satisfactory in terms of nuclear safety and radiation protection, with improvements in the management of waste and emergency situations. Improvements must nevertheless be made in equipment monitoring and maintenance. Two modifications to the Pouzauges facility and one modification to the Sablé-sur-Sarthe facility were authorised in 2022, concerning the extension of the use of certain radioactive sources aged more than 10 years.

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 field:

- 7 external-beam radiotherapy departments,
- 2 brachytherapy units,
- 12 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:

- 1 cyclotron,
- 36 industrial radiography companies, including 10 performing gamma radiography,
- 18 research units,
- about 400 users of industrial equipment;



■ activities associated with the transport of radioactive substances;



■ 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 2022, ASN carried out 131 inspections in the Provence-Alpes-Côte d'Azur region, comprising 63 inspections in BNIs, 63 in small-scale nuclear activities, 2 in the transport of radioactive substances and 3 concerning organisations and laboratories approved by ASN.

During 2022, 3 significant events rated level 1 on the INES scale were reported by the nuclear installation licensees, 1 of which related to on-site transport.

In small-scale nuclear activities, 5 significant events rated level 1 on the INES scale were reported to ASN, 3 in the industrial sector and 2 in the medical sector.

CADARACHE SITE

CEA's centre in Cadarache

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 CEA's strategy for decommissioning and management of radioactive materials and waste.

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 research reactor (BNI 42);
- the enriched Uranium Processing Facilities (ATUe – BNI 52);
- the Central Fissile Material Warehouse (MCMF – BNI 53);
- the Chemical Purification Laboratory (LPC – BNI 54);
- the High-Activity Laboratory LECA-STAR (BNI 55);
- the solid radioactive waste storage area (BNI 56);
- the Phébus research reactor (BNI 92);
- the Minerve research reactor (BNI 95);
- the Laboratory for research and experimental fabrication of advanced nuclear fuels (Lefca – BNI 123);
- the Chicade laboratory (BNI 156);
- the Cedra storage facility (BNI 164);
- the Magenta storage warehouse (BNI 169);
- the Effluent advanced management and processing facility (Agate – BNI 171);
- the Jules Horowitz Reactor (JHR – BNI 172), under construction.

At the Cadarache centre, 10 installations are in final shutdown status, 10 are in operation and one is under construction. The CEA Cadarache centre operates numerous installations which vary in their nature and their safety implications. ASN has moreover started or is continuing the examination of the periodic safety review guidance files or the concluding reports for 14 of the 21 installations: Pégase-Cascad, Cabri, STE, ATPu, Éole, MCMF, LPC, LECA-STAR, Phébus, Lefca, Minerve, Cedra, Magenta and Agate, and has issued its conclusions on the periodic safety review of Chicade and 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.

As part of the decommissioning preparation operations, the CEA submitted two authorisation application files to ASN in June 2021 concerning the setting up of the project for removal from storage of the araldite-encapsulated fuels of Pégase, for transfer to the Cascad facility, known by its French acronym "DECAP". The DECAP project was authorised in August 2022 by resolution CODEP-DRC-2022-033330 (see chapter 13 of the full ASN Report – "Decommissioning of Basic Nuclear Installations"). In July 2022, as part of this project, the CEA also sent ASN a request for the acceptance of fuel cans

stored within the bounds of the Cadarache DBNI and which originally came from the Pégase pool. This request led ASN to initiate a process to amend resolution CODEP-CLG-2017-006524 amended relative to the removal from storage operations on the Pégase facility. This amendment will be subject to public consultation in 2023.

ASN considers that the nuclear safety and radiation protection of the Pégase and Cascad facilities for 2022 is on the whole satisfactory. ASN found the worksite organisation to be satisfactory. The actions resulting from the periodic safety review are followed correctly. ASN will nevertheless remain attentive to the consistency between the baseline requirements applicable to the facilities and the progress of the decommissioning preparation operations, as well as to the management of fuel storage capacity saturation in the Cascad facility.

Cabri research reactor – CEA centre

The Cabri reactor (BNI 24), created on 27 May 1964, is intended for conducting experimental programmes aiming to achieve a better understanding of the behaviour of nuclear fuel in the event of a reactivity accident. The reactor has been equipped with a pressurised water loop since 2006 in order to study the behaviour of the fuel at high combustion rates in accident situations of increasing reactivity in a PWR. Since January 2018, the CEA has been conducting a programme of tests called “CIP” (Cabri International Program), which began in the early 2000's and necessitated substantial modification and safety upgrading work on the facility.

ASN examined the safety of the reactor taking into consideration the action plan and the compensatory measures proposed by the CEA to deal with the two leaks reported in September 2020 and February 2021. It authorised the resumption of the CIP programme tests by resolution CODEP-MRS-2022-022299 of 9 June 2022, after the repair of the fault found on the “core water” system. The licensee has undertaken to provide feedback before 31 October 2023 on the implementation of the compensatory measures which consist in reinforcing monitoring of the condition of the faults still present on the hodoscope.

Decree 2022-1108 of 2 August 2022 amending Creation Authorisation Decree 2006-320 of 20 March 2006 has also been signed by the Minister responsible for nuclear safety, further to ASN's approval. This Decree amendment extends the scope of activities of the facility to include the performance of irradiation tests on electronic components.

ASN considers that the level of nuclear safety and radiation protection of the facility is on the whole satisfactory. The licensee has duly taken into account and dealt with some of the faults detected on the various reactor equipment items. Authorisation requests are currently being examined to address the residual defects of the hodoscope and therefore restore a completely normal situation. In this context, the licensee has taken into account ASN's requests for additional information on reactor operational control in accident situations.

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 ioniser;

■ small-scale nuclear activities in the medical field:



- 13 external-beam radiotherapy departments,
- 3 brachytherapy departments,
- 16 nuclear medicine departments,
- 104 centres performing 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:



- 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;



■ ASN-approved laboratories and organisations:

- 3 laboratories approved for taking environmental radioactivity measurements,
- 4 organisations approved for measuring radon,
- 5 organisations approved for radiation protection controls.

Rapsodie research reactor – CEA centre

The Rapsodie reactor (BNI 25) is the first sodium-cooled fast-neutron reactor built in France. It operated from 1967 to 1978. A sealing defect in the reactor pressure vessel led to its final shutdown in 1983. Decommissioning operations were subsequently undertaken, but have been partially stopped further to a fatal accident in 1994 during the washing of a sodium tank.

At present the core has been unloaded, the fuel evacuated from the installation, a large part of the fluids and radioactive components have been removed and the reactor vessel is contained. The reactor pool has been emptied, partially cleaned out and decommissioned and the waste containing sodium has been removed.

The Decommissioning Decree was signed on 9 April 2021. This Decree sets a new perimeter for the facility and regulates, until 2030, the next phase of reactor life, consisting in treating the sodium from the reactor and introducing air into the tank 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 during 2022 consisted in characterising, repackaging and removing waste, and starting the preparatory work for renovation of the polar crane of the reactor building.

ASN considers that the level of nuclear safety and radiation protection of this facility in 2022 is broadly satisfactory, particularly with regard to fire protection, emergency management and the monitoring of outside contractors, an area in which the licensee has progressed by taking into account the lessons learned from the significant event reported in 2021 concerning an outside contractor employee.

Solid Waste Treatment Station – CEA centre

BNI 37 of CEA Cadarache historically comprised the active Effluents Treatment Station (STE) and the Waste Treatment Station (STD), grouped into a single installation. As the CEA wishes to ensure continued operation of the STD and proceed with the final shutdown of the STE, BNI 37 was divided into two BNIs: 37-A (STD) and 37-B (STE) by ASN resolutions CODEP-DRC-2015-027232 and CODEP-DRC-2015-027225 of 9 July 2015. These records were made further to the Orders of 9 June 2015 defining the perimeters of these two BNIs.

At present, the STD is the CEA's only civil BNI licensed for the packaging of intermediate-level long-lived (ILW-LL) radioactive waste before it is stored in the Cedra facility (BNI 164) pending transfer to a deep geological repository. This situation makes the STD an indispensable part of the CEA's decommissioning and waste management strategy.

The continued operation of the STD 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 preparatory work for this renovation started in late 2022.

The licensee submitted its periodic safety review report in March 2022, and an inspection was carried out on this subject in July 2022. Tracking and execution of the action plan stemming from the periodic safety review is satisfactory on the whole.

ASN considers the level of safety of the STD to be broadly satisfactory, particularly with regard to contractor monitoring and modification management, which has improved. Fire protection, however, must be monitored rigorously, and improvements are expected in the defining of the specified requirements for the Protection Important Components (PIC) necessary for the constitution of the waste packages. In addition, radiation protection management is unsatisfactory. In effect, measures such as displaying temporary modifications in radiation protection zoning, in temporary waste zoning or the application of instructions established inside these zones are either not carried out or they lack stringency.

Active Effluents Treatment Station

– CEA centre

The STE (BNI 37-B) has been shut down since 1 January 2014. The CEA submitted the decommissioning file for this facility in December 2021.

During decommissioning preparation, the licensee characterised the soils and equipment to determine the initial radiological status of the facility. This characterisation work revealed the presence of artificial radionuclides outside the identified contaminated areas and in the stormwater network. These contaminations have again formed the subject of significant event reports to ASN in 2021 and 2022, despite the implementation of an action plan to improve stormwater management, whose effectiveness is monitored by the CEA. In view of the first results and the new significant event reports, this action plan will be continued and will be supplemented in 2023.

ASN conducted an in-depth inspection concerning the facility decommissioning project in 2022. It observed a positive dynamic in the management of the decommissioning. However, the schedule must be put to the test to determine possibilities of reducing the time frames proposed in the decommissioning file.

ASN considers that the standard of nuclear safety of BNI 37-B remains broadly satisfactory in 2022 but the licensee must improve the management of the zones with legacy radiological contamination. ASN has observed improvements in the monitoring of outside contractors.

Plutonium Technology Facility and Chemical Purification Laboratory

– CEA centre

The ATPu (BNI 32) produced plutonium-based fuel elements intended for fast neutron or experimental reactors as from 1967, then, from 1987 until 1997, for PWRs using MOX fuel. The activities of the 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 operations associated with monitoring, upkeep and operation, management and monitoring of solid waste and liquid effluents (characterisation, grouping, removal) continued and enabled the dispersible inventory of the two facilities to be reduced.

With regard to the ATPu, in accordance with the last schedule proposed by the CEA in November 2020, all the campaigns for processing the drums containing alpha emitting radionuclides from BNI 56 are now finished.

With regard to the LPC, several glove boxes have been decommissioned. The HV/LV substation has been moved, in connection with the modification of the utilities needed during the BNI decommissioning phases. The cryogenic treatment process removal work also continued.

The inspections conducted in 2022 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 2022, 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 (SPR) of the CEA Cadarache centre, for 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 accesses to controlled areas at the CEA shall be examined.

Masurca research reactor – CEA centre

The Masurca reactor (BNI 39), whose construction was authorised by a Decree of 14 December 1966, was intended for neutron studies, chiefly on the cores of fast neutron reactors, and the development of neutron measurement techniques. The reactor has been shut down since 2007.

Final shutdown of the facility was declared by the CEA on 31 December 2018. The licensee submitted the facility decommissioning file in December 2020 and in the interim has carried out decommissioning preparation work, such as removal of asbestos from the premises, rehabilitation of buildings and removal of conventional equipment. At the end of 2021, all the fertile materials had been transferred to the centre's materials storage facility and the ventilation network had been simplified. A provisional building, whose construction was completed in 2022, was built to accommodate the VLL waste from the operations prior to decommissioning.

The licensee has made progress in the management of deviations, which are subject to rigorous tracking. ASN considers that the standard of nuclear safety in 2022, particularly concerning fire protection and decommissioning work, and of radiation protection, is satisfactory on the whole.

Éole and Minerve research reactors

– CEA centre

The experimental reactors Éole and Minerve are very-low-power (less than 1 kW) critical mock-ups that were used for neutron studies, in particular to evaluate the absorption of gamma rays or neutrons by materials.

The Éole reactor (BNI 42), whose construction was authorised by a Decree of 23 June 1965, was intended primarily for neutron studies of moderated arrays, in particular those of PWRs and Boiling Water Reactors (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.

The decommissioning files for BNIs 42 and 95, submitted by the CEA in 2018, underwent a public inquiry during October 2022 with a view to preparing the decommissioning decrees.

ASN considers that the standard of safety of BNIs 42 and 95 is broadly satisfactory, but the monitoring of outside contractors must be improved.

The inspection conducted in 2022 showed that the organisational provisions for monitoring the action plan stemming from the periodic safety review are robust, with good coordination between these actions, the ongoing decommissioning preparation operations and the BNI functioning operations. This being said, the feedback from the actions implemented further to the periodic safety review must be better formalised.

The Enriched Uranium Processing Facilities – CEA centre

From 1963 to 1995, the ATUe (BNI 52) converted uranium hexafluoride (UF₆) from the enrichment plants into sinterable oxide, and ensured the chemical reprocessing of waste from the manufacture of fuel elements. Decommissioning of this facility was authorised by decree in February 2006.

The licensee had fallen substantially behind the initial schedule in the decommissioning operations. It requested a modification of its decree in 2010 and 2014, to take account of the true radiological status of the facility. The new Decommissioning Decree was published on 16 April 2021. ASN has regulated the performance of certain decommissioning operations by two resolutions of 14 October 2021. In 2022, the licensee was authorised to update its baseline requirements further to the publishing of the BNI Decommissioning Decree. The activities in the facility today are essentially maintenance and periodic and regulatory inspection operations. The decommissioning operations will thus be able to begin.

Most of the actions stemming from the periodic safety review of 2017 have been completed, with the exception of the roof sealing work, which is planned for 2023.

Central Fissile Material Warehouse

– CEA centre

Created in 1968, the MCMF (BNI 53) was a warehouse for storing enriched uranium and plutonium until its final shutdown and removal of all its nuclear materials on 31 December 2017. The licensee submitted its decommissioning file in November 2018, and ASN is currently examining it.

The public inquiry concerning the MCMF decommissioning application file was held from 26 September 2022 to 28 October 2022.

The decommissioning preparation operations initiated in 2018, notably the chemical and radiological characterisations of the facility, continued in 2022. ASN considers that the licensee's organisational measures for monitoring these preparation operations are on the whole satisfactory.

High-Level Activity Laboratory LECA-STAR – CEA centre

BNI 55 accommodates the LECA laboratory and its extension STAR, which constitute the CEA's expert assessment facilities for the analysis of irradiated fuels. Commissioned in 1964, the LECA laboratory enables the CEA to carry out destructive and non-destructive examinations of spent

fuel from the nuclear power, research and naval propulsion sectors. As the facility is old, it was partially reinforced in the early 2010's to improve its earthquake resistance.

The guidance file for the next periodic safety review (DOR) of LECA was submitted by the CEA in January 2022.

In March 2022, the licensee reported a significant event rated level 1 on the INES scale following the discovery of a fuel storage can that was not in conformity with the criticality risk management rules, in a storage well of cell C5 of the LECA laboratory. An assessment of the cans stored in cell C5 was carried out before resuming the activities, which was authorised by the head of the BNI. Documentary searches for all the dimensional characteristics of the cans in multi-sector wells and inspection operations with opening of wells shall be carried out.

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

The CEA sent ASN the STAR periodic safety review report in February 2018 and its commitment letter in February 2021, on both of which ASN shall issue position statements. The CEA added the STAR impact study to its file in December 2021, pursuant to ASN resolution 2017-DC-0597 of 11 July 2017. In 2022, ASN asked the licensee for additional information on the assessment of the sum of the impacts of the operation of LECA-STAR with the Cadarache platform and the other facilities existing or approved under Article R. 122-5 of the Environment Code.

ASN considers that in 2022 the level of nuclear safety of the LECA-STAR facility is broadly satisfactory, particularly with regard to waste management within the facility and monitoring of outside contractors.

The monitoring of atmospheric discharges from BNI 55 must be improved. ASN expects the Cadarache site to comply with the site's discharges resolution in order to ensure redundancy of the continuous samplings taken at the gas outlets.

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.

The CEA continued its WRP operations in the BNI in accordance with the schedule presented at the start of the year. The fitting out and the active tests with radioactive materials have enabled the video inspections of pit 1 to begin, and the clean-up work on the extraction cell of trench T2 has been carried out.

ASN considers that in 2022 the management of static and dynamic containment and the conditions of the systems are satisfactory on the whole. ASN has more specifically observed improvements in the tracking and traceability of the modification work. ASN will nevertheless be 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 stormwaters.

Phébus research reactor – CEA centre

The Phébus reactor (BNI 92) is an experimental pool-type reactor with a power rating of 38 MWth which functioned from 1978 to 2007. Phébus was designed for the study of serious accidents affecting light water reactors and for defining operating procedures to prevent core melt-down or to mitigate its consequences.

The licensee submitted its decommissioning file to the Minister on 14 February 2018 and its periodic safety review report to ASN in October 2017. This file is being examined concomitantly with the decommissioning application. The public inquiry concerning the decommissioning application for the facility was held in October 2022 after the Environmental Authority had issued its opinion in July 2021.

Since December 2021, all the fuel has been removed in accordance with the priority objectives of the decommissioning preparation operations.

ASN considers that the standard of nuclear safety of the facility in 2022 is satisfactory, particularly concerning the monitoring of outside contractors.

Laboratory for research and experimental fabrication of advanced nuclear fuels

– CEA centre

Commissioned in 1983, Lefca (BNI 123) was a laboratory tasked with conducting studies on plutonium, uranium, actinides and their compounds with the aim of understanding the behaviour of these materials in the reactor and in the various stages of the "fuel cycle". In 2018, Lefca finalised the transfer of part of its research and development equipment to the Atalante laboratories (BNI 148) at Marcoule.

The CEA submitted the final shutdown declaration for the facility in April 2019. In December 2021, the CEA informed ASN of its decision to keep the Lefca facility in operation and conduct new activities in it. An action plan with a consolidated schedule was sent to ASN in January 2022. The forthcoming periodic safety review must integrate this change of strategy. On this account, the CEA submitted the facility's guidance file in March 2022, with this continued operation in mind.

ASN considers that the standard of nuclear safety of the facility in 2022 is satisfactory on the whole, particularly concerning the monitoring of outside contractors. The licensee must nevertheless improve its fire protection measures. ASN has also noted areas for progress in the installation and signalling of fire-fighting equipment. The deviations observed in 2021 in the conformity and integrity of the facility's piezometers for monitoring the groundwater tables were either corrected in 2022 or are currently undergoing remedial action.

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.

ASN considers that the level of safety and radiation protection is satisfactory on the whole, particularly with regard to waste management and meeting commitments. Improvements in the management of radioactive waste are currently being implemented, particularly as regards the collection, storage and removal of the radioactive samples produced by the facility.

Further to the examination of the periodic safety review concluding report, ASN has set technical requirements aiming to regulate the continued operation of the facility in resolution CODEP-MRS-2022-004859 of 29 August 2022.

Resolution CODEP-DRC-2022-001529 of 19 September 2022 authorises the licensee to package the disused sealed sources in "870L Bulk Source" packages. This resolution will enable the CEA to carry out a characterisation programme on packages of controlled composition and thereby improve and qualify certain characterisation techniques, and enhance the understanding of the corrosion and radiolysis phenomena within radioactive waste packages.

Cedra storage facility – CEA centre

Since 2006, the Cedra facility (BNI 164) is used to store ILW-LL pending the creation of appropriate disposal routes. The CEA forecasts that this facility will be filled to capacity by 2027. The studies concerning a project to double the storage capacity began in 2020.

ASN considers that the licensee's verifications regarding the monitoring of outside contractors and the meeting of its commitments are satisfactory on the whole. Improvements are expected in management of the fire risk and maintaining the appropriate technical skills and qualifications necessary for operation of the facility.

Due to the CEA's desire to stagger the filing of the conclusions of the periodic safety reviews of its facilities over time, it submitted the concluding report for the periodic safety review of Cedra in November 2022, ahead of schedule.

Magenta storage warehouse – CEA centre

The Magenta facility (BNI 169), which replaces the MCMF currently being decommissioned, has been dedicated since 2011 to the storage of non-irradiated fissile material and the non-destructive characterisation of the nuclear materials received.

The licensee submitted its safety review conclusion report in February 2021. In 2022, the licensee supplemented this file at the request of ASN and a dedicated inspection was carried out. Shortcomings were found in the conformity check and areas for improvement in action plan monitoring were identified.

An authorisation application file for the densification of storage of certain types of package in the facility was submitted to ASN in January 2022. This file is currently being examined by ASN.

The CEA confirmed the need to commission the Magenta glove boxes, planned for at the design stage but not yet authorised, by 2028/2030.

ASN considers that the level of nuclear safety and radiation protection of the facility in 2022 is on the whole satisfactory, primarily concerning protection of the environment.

Effluent advanced management and processing facility – CEA centre

The Agate facility (BNI 171), commissioned in 2014 to replace BNI 37-B which is now shut down, uses an evaporation process to concentrate radioactive liquid effluents containing mainly beta- and gamma-emitting radionuclides.

ASN considers that the licensee has competently managed the repair work on the superheated non-radioactive water pipe, on which a leak was detected in December 2020. This repair enabled the facility's evaporator to be returned to service in the first quarter of 2022.

ASN sent the CEA its opinion on the periodic safety review guidance file on 25 April 2022. The consequences of the planned changes to the facility must thus be taken into consideration in the concluding report of the facility's first periodic safety review, to be submitted by 29 April 2024 at the latest.

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 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 activities on the construction site and on the suppliers' sites continued in 2022. The work has more specifically concerned lining of the pools and channels of the nuclear auxiliaries building, installation of the door or gate equipment and the hot cells. Numerous in-plant manufacturing operations are in progress.

The CEA continued the studies and analyses concerning the problems detected in 2020 during the qualification tests of certain internal equipment items of the reactor pile block. The expert assessment of the RER pool, displaying signs of corrosion on a weld, was completed and appropriate corrective actions have been defined.

Assessment of the CEA Cadarache centre

ASN considers that the level of nuclear safety of the CEA Cadarache centre in 2022 is on the whole satisfactory.

ASN considers that the BNIs are operated satisfactorily on the whole, especially modifications management and the meeting of commitments. Improvements are nevertheless expected in the performance and traceability of the technical verifications of maintenance operations and monitoring of the condition of Protection-Important Components, and in the indication of their specified requirements. The monitoring of outside contractors has improved compared with the previous situation, and this progress must be consolidated.

The majority of the outside contractors are subject to monitoring which is framed and formalised by a specific plan. These monitoring plans are broadly followed and applied by the licensee, which is good. A periodic assessment of monitoring appropriateness and effectiveness is now carried out on some but not all of the facilities.

With regard to the containment of radioactive substances, the situation is satisfactory on the whole, but improvements are still to be made in defining the monitoring of certain barriers.

ASN observes that deviation management remains contrasted. In effect, improvements are required in certain services concerning in the analysis of the causes or trends relating to recurrent deviations of similar types.

ASN considers that the organisation in place for the re-assessment and the conformity check of the periodic safety reviews of the facilities is satisfactory. The tracking of action plan implementation is satisfactory on the whole.

With regard to emergency situation management, the licensee has asked for a further extension to the commissioning deadline for the emergency centre that can withstand extreme hazards, further to the difficulties in completing this project. ASN underlines the importance of this centre in the licensee's emergency organisation, and emphasises the need to keep the compensatory measure proposed by the CEA operational pending the availability of an emergency centre capable of withstanding extreme hazards.

The licensee must verify and periodically assess the relevance of the instructions for accident, incident and degraded operating modes. This is because inconsistencies between these instructions and the reality of the facility were discovered in the

instructions tested by sampling in inspections in the course of the year.

With regard to radiation protection, ASN authorised setting up of the CEA Cadarache radiation protection skills centres under Articles R. 593-112 of the Environment Code and R. 4451-113 of the Labour Code.

In the area of waste management, the management of deviations and the traceability of waste monitoring are satisfactory on the whole, but can be improved in certain cases, notably for the legacy waste for which there is no immediate disposal route. The licensee must define action plans to treat and remove the legacy waste which cannot be removed immediately.

ASN observes that the level of environmental protection is relatively satisfactory. A polluted sites and soils management procedure must be applied to the historically contaminated areas of the Cadarache site. This procedure must define and prioritise the management actions as appropriate for the current and future uses of the areas concerned. Improvements are also required in the upkeep and appropriateness of the hazardous substance retention structures and the maintaining of measurement redundancy on the discharges for which monitoring is required.

During its inspections in 2022, ASN noted the rigour applied by the project teams in the investigations into the signs of corrosion and the overall organisation of the worksite. The handling of the manufacturing irregularities in a plant in Portugal and of the modified material certificates was also deemed appropriate and satisfactory.

ASN considers that the organisation in place for construction of the JHR remains satisfactory and that the project is managed rigorously with a commitment to transparency.

ITER

The ITER installation (BNI 174), under construction on the Cadarache site since 2010 and adjacent to the CEA facilities, will be a fusion experimental reactor used for the scientific and technical demonstration of the control of thermonuclear fusion energy obtained by magnetic confinement of a deuterium-tritium plasma during long-duration experiments with a significant power level (500 MW developed for 400 seconds). This international project enjoys financial support from China, South Korea, the United States, India, Japan, Russia and the European Union, who make in-kind contributions by providing equipment for the project.

The large quantities of tritium that will be brought into play in this installation, the intense neutron flow and the resulting activation of materials have serious implications regarding radiation protection and will represent true challenges for the safe management of waste during the operation and decommissioning of the installation.

The works on the site and the manufacture of equipment are continuing with the targeted utilisation of the first hydrogen plasma pushed back with respect to the previously announced deadline of 2025. The revised schedule, integrating the assessment of the impact of the Covid-19 pandemic, has not yet been received. A further delay was announced by ITER Organization (IO) at the end of 2022 following the discovery of fabrication defects in sectors of the vacuum vessel and stress corrosion defects on the thermal shields.

These defects will necessitate repairs on the first sector, which was lowered into the tokamak pit in May 2022, and on the two other sectors delivered to the site and currently undergoing preparation (installation of the thermal shields and the toroidal coils) in the assembly hall. The civil engineering works this year concerned several areas of the worksite, and more particularly the "Tritium building" of the "Tokamak complex". Fabrication of the cryostat elements is also completed.

In February 2022, IO sent ASN an authorisation application for water intakes and discharges of non-radioactive effluents for the facility construction phase. Complementary information will have to be provided before examination of this file can begin.

The inspections conducted on the site in 2022 showed mixed results, having revealed a lack of safety culture in the handling of certain manufacturing deviations (as is the case for example with the dimensional defects in the vacuum vessel sectors), and shortcomings in the facility's safety case (e.g. for the qualification of the electronic systems necessary for safety), and the strategy for addressing these manufacturing deviations has not yet been established.

Integrating the project developments and addressing the technical difficulties encountered will necessitate in-depth discussions between IO, ASN and IRSN. ASN emphasises the importance of the licensee providing information transparently, promptly and fully on these various subjects.

Hold point concerning assembly of the tokamak

By Decree 2012-1248 of 9 November 2012, the International Organisation IO was authorised to create the Basic Nuclear Installation 174 called "ITER" on the municipality of Saint-Paul-lez-Durance (Bouches-du-Rhône *département*). ASN resolution 2013-DC-0379 of 12 November 2013 sets the technical requirements that govern more specifically the design and construction of this installation. Certain key stages in the construction are subject to "hold points" requiring the submission of justifications so that ASN can authorise the commencement of these stages.

On 1 February 2021, IO sent ASN a file requesting commencement of assembly of the tokamak equipment inside the cryostat^(*) as defined by the technical requirement (BNI 174-07) of the above-mentioned resolution. This stage corresponds to the third hold point since construction of the BNI began, and the regulatory time for examining these elements is set at one year, that is to say a deadline of 1 February 2022.

ASN considers that the elements provided by IO do not enable it to adopt a position on the lifting of the hold point in question. ASN has asked IO to submit a new specific file presenting the finalised design and all the demonstrations on the themes associated with the hold point for starting tokamak assembly.

The awaited justificatory and demonstration elements concern more specifically the addressing of the dimensional nonconformities found on the first vacuum vessel sectors delivered to the site, the behaviour of the civil engineering structures, or controlling the limitation of exposure of workers and the public to ionising radiation.

* The cryostat is the vacuum enclosure that will surround the vacuum chamber and the supraconductor magnets.

Gammaster ioniser

Since 2008, the company Steris has been operating an industrial irradiator called Gammaster, situated on the land of the municipality of Marseille. Gammaster treats products by ionisation (emission of gamma radiation) with the aim of sanitising, sterilising or improving the performance of materials. The facility is made up of an industrial bunker and houses sealed sources of cobalt-60 which provide the radiation necessary for its activity.

The organisational set-up for monitoring the facility's discharges must be improved. This is because although the environmental discharges are very limited, the implementation times for certain actions must be monitored to avoid time-lags.

The measures taken by the licensee to ensure the security of sources are broadly satisfactory. Improvements must nevertheless be made in formalising the documentation.

ASN considers that the level of safety and of radiation protection and the control of source security are broadly satisfactory in 2022.

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