Country Profile Template

Contracting Party: France

Section 1: Summary document detailing

- **Relevant national authorities and responsibilities**

The control of nuclear safety and radiation protection involves all of the State's structures:

- Parliament, to define the major long-term options;
- The Government, especially the ministers responsible for nuclear safety and radiation protection, who have been assigned the power for overall regulation and for matters concerning the desirability of creating a basic nuclear installation;
- The prefects, responsible for protecting the population;
- Advisory authorities, which provide an outside view on significant decisions regarding nuclear safety and radiation protection;
- The Nuclear Safety Authority (ASN), which is the control and regulation authority;

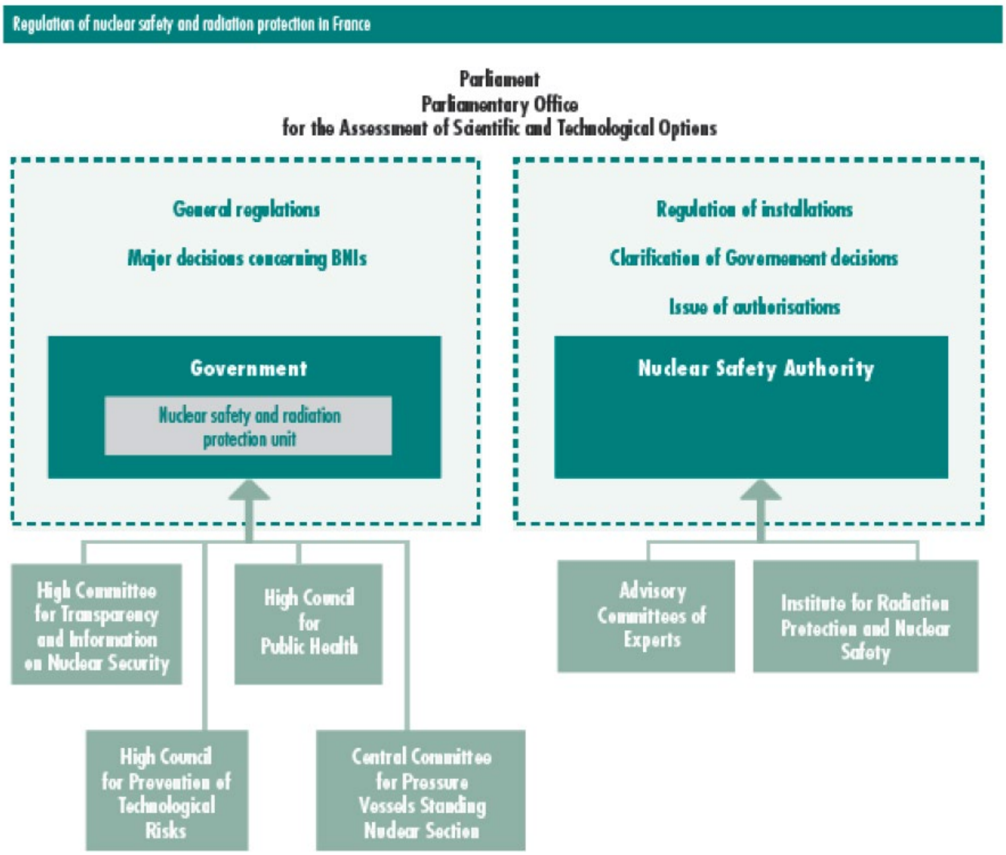


Figure 1 : The organization of nuclear safety and radiation protection control in France

- **Parliament**

Parliament's principal role in the field of nuclear safety and radiation protection is to make laws. Two major Acts were passed in 2006: the above-mentioned TSN Act of 13th June 2006, on transparency and security in the nuclear field; and the Programme Act of 28th June 2006, on the sustainable management of radioactive materials and waste. In 2015, the Energy Transition for Green Growth Act was published (LTECV Act of the 17th of August 2015). The Act takes additional steps in terms of providing transparency and public information regarding nuclear safety. The purpose of this Act, that was also supplemented with the ordonnance n°2016-128 of the 10th of February 2016 concerning several nuclear proposals, was also to strengthen the Nuclear Safety Authority's regulatory resources and powers. Parliament's decisions are clarified by the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST), whose mission is to inform Parliament about the consequences of choices of a scientific and technologic nature - which include nuclear safety and radiation protection matters. For this purpose it gathers information, implements research programs, and conducts evaluations. Its work is available on the OPECST's website (http://www.senat.fr/opecst/).

- **The Government**

The Government exercises regulatory powers. It is therefore in charge of laying down the general regulations concerning nuclear safety and radiation protection. The TSN Act also tasks it with making major decisions concerning BNIs, for which it relies on proposals or opinions from ASN. The Government can also call on advisory bodies such as the High Committee for Transparency and Information on Nuclear Safety (HCTISN).

The Government is responsible for civil protection in the event of an emergency.

- **Minister responsible for nuclear safety and radiation protection**

On the advice of ASN and, as applicable, on the basis of an ASN proposal, the Minister responsible for nuclear safety defines the general regulations applicable to BNIs and take the major individual decisions concerning:

- the design, construction, operation, final shutdown and decommissioning of BNIs;
- the final shutdown, maintenance and surveillance of radioactive waste disposal facilities;
- the manufacturing and the operation of pressure equipment (PE) specifically designed for these installations.

The above-mentioned minister can suspend the operation of an installation on the advice of ASN if it presents serious risks.

Furthermore, the Minister(s) responsible for radiation protection also define(s) - on the basis of ASN proposals if necessary – the general regulations applicable to radiation protection.

The regulation of worker radiation protection is the responsibility of the Minister for labour.

Finally, the Ministers responsible for nuclear safety and for radiation protection approve the ASN internal regulations by means of a Government order. Each of them also approves ASN technical regulatory resolutions and certain individual resolutions (setting BNI discharge limits, delicensing a BNI, etc.) affecting their own particular field.

The MSNR (Nuclear Safety and Radiation Protection Mission), within the General Directorate for Risk Prevention at the Ministry for an ecological and solidary transition is tasked - in collaboration with ASN - with proposing Government policy on nuclear safety and radiation protection, except for defence-related activities and installations and the radiation protection of workers against ionising radiations.

- **High Committee for Transparency and Information on Nuclear Safety**

The TSN Act created a High Committee for Transparency and Information on Nuclear Safety (HCTISN), an information, discussion and debating body dealing with the risks inherent in nuclear activities and the impact of these activities on human health, the environment and nuclear safety.

The High Committee can issue an opinion on any question in these fields, as well as on controls and the relevant information. It can also deal with any issue concerning the accessibility of nuclear safety information and propose any measures such as to guarantee or improve nuclear transparency. It can be called on by the Government, Parliament, the local information committees or the licensees of nuclear facilities, with regard to all questions relating to the transparency of information about nuclear safety and its regulation and monitoring.
All of this work is available on its website: http://www.hctisn.fr.

- **Prefects**

The Prefects are the State's representatives in the *départements*[1]. They are the guarantors of public order and play a particularly important role in the event of an emergency, in that they are responsible for measures to protect the general public. He issues his opinion on authorization request and, on the advide of ASN, calls on the Departmental Council for the Environment and Health and Technological Risks, to obtain its opinion on water intake, effluent discharges and other detrimental effects of BNIs.

- **Nuclear Safety Authority (ASN)**

The TSN Act created an independent administrative nuclear safety authority (ASN) to monitor and regulate nuclear safety and radiation protection. ASN's missions comprises regulation, authorization and monitoring as well as providing support to the public authorities for management of emergencies and contributing to informing the general public.
ASN is made up of a commission and of various departments.
From a technical point of view, ASN relies on the expertise with which it is provided, notably by the Institute for Radiation protection and Nuclear safety (IRSN) and by Advisory Committees of Experts (GPEs).
ASN is consulted on draft decrees and ministerial orders of a regulatory nature and dealing with nuclear safety. It can take regulatory resolutions of a technical nature to complete the implementing procedures for decrees and orders adopted in the nuclear safety or radiation protection field, except for those relating to occupational medicine. These resolutions are subject to approval by the Ministers responsible for nuclear safety and for radiation protection.
ASN reviews BNI authorization or decommissioning applications, issues opinions and makes proposals to the Government concerning the decrees to be issued in these fields. It defines the requirements applicable to these installations with regard to the prevention of risks, pollution and detrimental effects. It authorizes commissioning of these installations and pronounces delicensing following completion of decommissioning.
Some of these ASN resolutions require approval by the Minister responsible for nuclear safety.
ASN also issues the licenses provided for in the Public Health Code (CSP) concerning small-scale nuclear activities (including medical applications of ionizing radiations) and issues authorizations or approvals for radioactive substance transport operations.
ASN's resolutions and opinions are published in its Official Bulletin on its website (www.asn.fr).
ASN checks compliance with the general rules and specific requirements concerning nuclear safety and radiation protection applicable to nuclear activities.
ASN organizes permanent radiation protection monitoring throughout the national territory.
From among its own staff, it appoints nuclear safety inspectors, radiation protection inspectors and officers in charge of verifying compliance with pressure equipment requirements. It issues the required approvals to the organizations participating in the verifications and nuclear safety or radiation protection monitoring.

[1] Administrative region headed by a Prefect

ASN takes part in managing radiological emergency situations. It provides technical assistance to the competent authorities for the drafting of emergency response plans, taking account of the risks resulting from nuclear activities.
When such an emergency event occurs, ASN verifies the steps taken by the licensee to make the facility safe. It assists the Government with all matters within its field of competence and submits its recommendations on the medical or health measures or civil protection steps to be taken. It informs the general public of the situation, of any releases into the environment and their consequences. It acts as the competent authority within the framework of international conventions, by notifying international organizations and foreign countries of the accident.
ASN participates in informing the public in its areas of competence.

- **<u>Technical support organizations</u>**

Created by Act 2001-398 of 9th May 2001 and by decree 2002-254 of 22nd February 2002, Institute for Radiation Protection and Nuclear Safety (IRSN) was set up as an independent public industrial and commercial establishment, as part of the national reorganization of nuclear safety and radiation protection regulation, in order to bring together public expertise and research resources in these fields. Since the Energy Transition for Green Growth Act was published (LTECV Act of the 17th of August 2015), the decree n°2016-283 of the 10th of March 2016 on the Institute for Radiation Protection and Nuclear Safety has strengthened the governance of the Institute.

IRSN reports to the ministers for the environment, health, research, industry and defence.
IRSN conducts and implements research programs in order to build its public expertise capacity on the very latest national and international scientific knowledge in the fields of nuclear and radiological risks. It is tasked with providing technical support for the public authorities with competence for safety, radiation protection and security, in both the civil and defence sectors.
IRSN also has certain public service responsibilities, in particular monitoring of the environment and of populations exposed to ionising radiation.
IRSN manages national databases (national nuclear material accounting, national inventory of radioactive sources, file for monitoring workers exposure to ionising radiation, etc.), and contributes to informing the public about the risks associated with ionising radiation.
ASN relies on the technical expertise provided by the IRSN and Advisory Committees of Experts (GPEs).

- **<u>Advisory Committees of Experts (GPEs)</u>**

In preparing its decisions, ASN calls on the opinions and recommendations of eight Advisory Committees of Experts (GPE), with expert knowledge in the areas of waste, nuclear pressure equipments, medical exposure, non-medical radiation protection, reactors, transport, laboratories and nuclear plants and decommissioning.
ASN consults the GPEs in preparing its main decisions. In particular, they review the preliminary, provisional and final safety analysis reports for each BNI. They can also be consulted about changes in regulations or doctrine.
For each of the subjects covered, the GPEs examine the reports produced by IRSN, by a special working group or by one of the ASN departments. They issue an opinion backed up by recommendations.
The GPEs comprise experts nominated for their individual competence. They come from various backgrounds; universities, associations, appraisal and research organizations.

They can also be licensees of nuclear facilities or come from other sectors (industrial, medical, etc.).
Participation by foreign experts can help diversify the approach to problems and take advantage of experience acquired internationally.

Since 2009, as part of its commitment to transparency in nuclear safety and radiation protection, ASN has published the GPE letters of referral, the opinions of the GPEs and ASN's position statements based on these opinions. IRSN for its part publishes the syntheses of the technical investigation reports it presents to the GPEs.

- **National legislation and basis for regulation**

The legal system applicable to basic nuclear installations (BNIs)

The legal system applicable to the BNIs was revised in depth by Act 2006-686 of 13th June 2006 on transparency and security in the nuclear field, called the "TSN" Act, and its application decrees, in particular amended decree 2007-1557 of 2nd November 2007, codified in 2019 in books V of the Regulatory Environment Code concerning BNIs and regulation of the nuclear safety of the transport of radioactive substances. It defines the framework in which the BNI procedures are carried out and covers the entire lifecycle of a BNI, from its authorization decree to commissioning, to final shutdown and decommissioning. In BNIs regulation, the BAT are to be understood in the sense of the Directive on industrial emissions 2010/75/EU (IED) thereby fully encompassing the definition given in the OSPAR Convention.

Since 6th January 2012, the provisions of the three main acts that specifically concern the BNIs, namely the "TSN" Act 2006-686 of 13th June 2006 on transparency and security in the nuclear field, the Programme Act 2006-739 of 28th June 2006 relative to the sustainable management of radioactive materials and waste (called the "Waste" Act), and Act 68-943 of 30th October 1968 relative to civil responsibility in the field of nuclear energy (called the "RCN" Act) – are now codified in the Environment Code. The legal system was also modified in 2016 by the Ordonnance n° 2016-128 of the 10th of February 2016 concerning several nuclear proposals. The Energy Transition for Green Growth Act 2015-992 of 17th August 2015 takes additional steps in terms of providing transparency and public information regarding nuclear safety. It establishes the conditions for decommissioning facilities and storing waste in compliance with stringent safety and environmental protection requirements. The Act sets a ceiling on nuclear electricity generation capacity at 63.2 GW, which is the current level.

The Ordonnance n°2016-128 of the10th of February 2016 introduces a number of other advances in the areas of nuclear safety and transparency. In particular in the OSPAR convention context, it:

- transposes the European directive on radioactive wastes, reaffirming the ban on storing foreign radioactive wastes in France, and requiring the storage of waste of French origin on the national territory ;
- extends the transparency obligations of nuclear operators and reinforces their primary responsibility.

The regulatory provisions in effect (particularly those of the abovementioned "BNI procedures" decree of 2nd November 2007) will also be soon codified into the Environment Code.

Environment Code

The provisions of chapters III and V of part IX of book V of the Environment Code underpin the BNI licensing and regulation system.

The legal system applicable to BNIs is said to be "integrated" because it aims to cover the prevention or control of all the risks and detrimental effects, whether radioactive or not, that a BNI could create for man and the environment.

About fifteen decrees, codified in 2019 in books V of the Regulatory Environment Code, implement the legislative provisions of book V of the Environment Code, in particular decree 2007-830 of 11th May 2007 concerning the list of BNIs and decree 2007-1557 of 2nd November 2007, concerning BNIs and the regulation of the nuclear safety of the transport of radioactive substances, known as the "BNI Procedures" decree (see below).

The provisions of chapter II of part IV of book V of the Environment Code (drawn in particular from the codification of the "Waste" Act of 28th June 2006) introduce a coherent and exhaustive legislative framework for the management of all radioactive wastes.

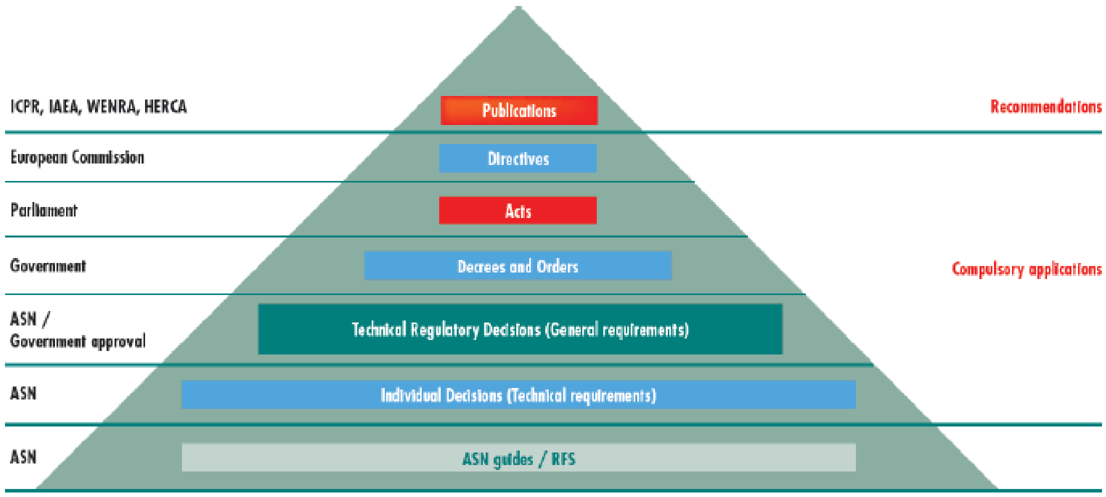


Figure 2 : Various levels of regulation in the field nuclear activities in France (orientations, recommendations): legally binding or non-binding nature

The amended decree 2007-1557 of 2nd November 2007 concerning BNIs and regulation of the nuclear safety of the transport of radioactive substances, known as the "BNI Procedures" decree, codified in 2019 in books V of the Regulatory Environment Code (articles R. 593-1 to R. 595-3) implements the article L. 593-38 of the Environment Code. It defines the framework in which the BNI procedures are carried out and covers the entire lifecycle of a BNI, from its authorization decree to commissioning, to final shutdown and decommissioning. Finally, it explains the relations between the minister responsible for nuclear safety and ASN in the field of BNI safety.

The Regulatory Environment Code clarifies the applicable procedures for adoption of the general regulations and for taking individual decisions concerning BNIs. It defines how the Act is implemented with regard to inspections and administrative or criminal sanctions.

Finally, it defines the particular conditions for implementation of certain regimes within the perimeter of the BNIs.

<u>Order of 7th February 2012 and ASN resolution 2013-DC-360 of 16th of July 2013</u>

The order of 7th February 2012 setting the general rules relative to basic nuclear installations, called the "BNI" order, significantly reinforces the regulatory framework applicable to BNIs, as it details a large number of requirements and provides a legal basis for several of the requirements expressed by ASN further to the analysis of the stress tests demanded of the licensees following the Fukushima accident.

The majority of the provisions of the "BNI" order, which was published in the Official Journal of 8th February 2012, came into force on 1st July 2013, on which date the following orders taken under the former regulation was repealed:

- the order of 10th August 1984 concerning the quality of design, construction and operation of BNIs, called the "Quality" order;
- the order of 26th November 1999 stipulating the general technical requirements concerning the limits and procedures applicable to BNI water intake and discharges requiring licensing;
- the order of 31st December 1999 stipulating the general technical regulations designed to prevent and mitigate the harmful effects and external hazards resulting from operation of BNIs.

The "BNI" order of 7th February 2012 addresses the following main subjects: organization and responsibility of BNIs, demonstration of nuclear safety, control of detrimental effects and of the impact on health and the environment, waste management, emergency situation preparedness and management.

The control of detrimental effects and of the impact on health and the environment part (4th part of the order) takes up and supplements the provisions of the orders of 26th November 1999 and 31st December 1999. This part was complemented by the ASN resolution 2013-DC-360 of 16th July 2013 relating to the control of detrimental effects and of the impact on health and the environment of BNIs. This resolution was approved by the Government by the order of the 9th August 2013 which was published in the Official Journal of 21st August 2013. It has been revised recently, by resolution 2016-DC-0569 of the 29th of the September 2016, amongst others to clarify some points of the monitoring program of the environment to be implemented by nuclear operators around their facilities.

The "BNI" order of 7th February 2012 and the amended ASN resolution 2013-DC-360 of 16th July 2013 govern water intakes and effluent discharges, monitoring of the said intakes and discharges and of the environment, the prevention of pollution and detrimental effects, and the conditions of informing public and the authorities. The main new provisions are:

- use of the best available techniques within the meaning of the installation classified on environmental protection ground (ICPE (classified facilities) regulation);
- setting up of monitoring of emissions and the environment;
- limiting of discharges and noise emissions to the thresholds;
- the application, in general, of a number of ICPE ministerial orders to the equipment necessary for BNI operation;
- the production of an annual discharge forecast and an annual impact report by the licensee.

Additionally, ASN has adopted resolution 2017-DC-0588 of 6th April 2017 relative to the conditions for water intake and consumption, discharge of effluents and monitoring of the environment around PWR reactors, which was approved by ministerial order of 14th June 2017. This resolution contains the "generic" requirements concerning water intake, effluent discharges and their monitoring for NPPs, as well as those concerning information of the public and the authorities, which were previously contained in licensing decisions.

Application of BAT/BEP in domestic legislation

France has fully incorporated the best available techniques (BAT) into its legislative and regulatory texts and has the tools to control their application in the various phases of the lives of its facilities.

The best available techniques constitute one of the pillars that underpin the requirements regarding protection of the environment and sustainable development. In this regard, the best available techniques are introduced at the highest level of French legal texts, which provide, through the Environmental Code, that actions for the protection, development, restoration, rehabilitation, and management of the environmental heritage must comply **with the principle of preventive and**

corrective action, preferably at the source, against damages to the environment, by using the best available techniques.

This requirement is imposed along with the following three other major principles:

- **The precautionary principle**, according to which a lack of certainty, in light of current scientific and technical knowledge, should not delay the taking of measured and effective steps aimed at preventing a risk of serious and irreversible damage to the environment, at an economically acceptable cost;
- **The polluter-payer principle**, under which the costs resulting from measures to prevent or reduce pollution and to combat it should be borne by the polluter;
- **The participatory principle**, according to which everyone has access to information about the environment, including information about hazardous substances and activities, and the public is involved in the process of developing projects having a significant effect on the environment or on land-use planning.

These principles are included in The Environmental Charter which is a constitutional text, built in the 2004 block of constitutionality of French law, recognizing the fundamental rights and duties related to environmental protection.

The TSN Law provides that the best available techniques, along with the other major principles in the area of environmental protection, apply to nuclear activities. It also reaffirms the major principles in the area of radiation protection. It sets out the fundamental principle of the primary responsibility of the operator as regards the safety of its facility, written into international law, to be applied every day, and essential in order that each person, both operator and controlling authority, have a clear understanding of their responsibilities.

Accordingly, the best available techniques appear in the front rank of the principles that control nuclear activities in France.

The best available techniques are imposed in order of 7th February 2012 and ASN resolution 2013-DC-360 of 16th of July 2013 amended establishing the general technical requirements concerning the limits and methods of withdrawals and discharges subject to permitting that are carried out by basic nuclear installations. In particular, this order requires that the limits for discharges must be established on the basis of the best available techniques (article 4.1.2).

In BNIs regulation, the best available techniques are to be understood in the sense of the Directive on industrial emissions 2010/75/EU (IED) thereby fully encompassing the definition given in the OSPAR Convention:

"best available techniques" means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole:

(a) "techniques" includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

(b) "available techniques" means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;

(c) "best" means most effective in achieving a high general level of protection of the environment as a whole;

Appendix III: Criteria for determining best available techniques

1. *the use of low-waste technology;*
2. *the use of less hazardous substances;*

3. *the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate;*
4. *comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;*
5. *technological advances and changes in scientific knowledge and understanding;*
6. *the nature, effects and volume of the emissions concerned;*
7. *the commissioning dates for new or existing installations;*
8. *the length of time needed to introduce the best available technique;*
9. *the consumption and nature of raw materials (including water) used in the process and energy efficiency;*
10. *the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it;*
11. *the need to prevent accidents and to minimize the consequences for the environment;*
12. *information published by public international organizations.*

Dose limit, constraints and discharge limit setting rationale;

In France there is very little radiological impact from radioactive discharges produced by the nuclear industry, medical activities, or other industrial and research activities.
Nevertheless, although effluent discharges have been broadly reduced, France believes it is necessary in light of the objectives set by the OSPAR strategy to continue to aim at reducing radioactive discharges in France when possible, in line with technical advances. It contributes to these goals by setting limits for discharges and by requiring operators to use the best available techniques, while providing a fully transparent control process.
The ASN checks that the operators fulfill their responsibilities, starting with the design of the facility and continuing throughout its operation. It is vigilant concerning the optimization of discharges and the reduction of their impact.

1.1 Permitting of discharges from BNIs

1.1.1 The new BNI system

The TSN Law creates an integrated system based on a strong conception of nuclear safety, covering both the prevention of accidents and the protection of human health and of the environment. It defines the conditions for the issuance of a permit to build or to decommission a BNI, imposing measures concerning prevention and limits the importance they deserve. In particular, it recognizes the fact that in this area as in all others risk cannot be completely eliminated, and that the measures adopted are aimed at preventing or limiting the risks, in light of current scientific knowledge and techniques.
The BNI permitting and control system is governed by Regulatory Environment Code concerning basic nuclear installations and the control, as regards nuclear safety, of the transport of radioactive substances (see point 2.1).

The system provides that permits for the construction, final shutdown, and decommissionning of basic nuclear installations, which are issued as decrees, incorporate all of the issues, whether they concern nuclear safety, radiation protection, or protection of the environment, using an integrated approach. These authorizing decrees will therefore include the authorization of discharges from the BNI.
These authorizing decrees are supplemented by individual stipulations based on ASN resolutions which set out in particular, where needed, the requirements regarding withdrawals of water by the BNI and the discharge of radioactive effluents produced by the BNI. The specific stipulations setting the limits for discharges from the BNI into the environment are subject to ratification by the ministers responsible for nuclear safety.

The integrated approach required by this new system also applies to changes in the facilities and to reassessments of the facilities' safety. For these reassessments, Article L.593-18 of Enviromnent code (from TSN Law) stipulates that "the operator of a nuclear installation must periodically undertake a reassessment of the safety of its installation, in light of the best international practices...every ten years". This is called the periodic review process. This review meets a dual purpose: to examine thoroughly the state of the installation, taking into account its aging to verify that it complies with the applicable safety standards, and also to improve its level of safety in order to integrate the feedback and technical progress made on the most recent facilities.

Implementation of the new BNI system enables problems related to effluent discharges to be considered during periodic review process.
For existing facilities, ASN resolution 2013-DC-360 of 16th of July 2013 modified requires that operators must periodically conduct a performance analysis of prevention and reduction of impacts caused by the nuclear facility in relation to the effectiveness of best available techniques including assessing performance differences. In case of discrepancy, operators perform a technico-economic study to improve the performance obtained by the implementation of these best techniques. When the best available techniques allow a significant reduction of the impacts and if it’s technically and economically feasible, ASN requires the operator to implement them by revising the individual stipulations related to discharges from the BNI.

1.1.2 <u>Setting limit values</u>

The first limits for discharges from French nuclear facilities had been set on the basis of an impact lower than the current thresholds for effects on health. It was then observed that the regulatory limits established in the past were not representative of actual discharges.
It was blatantly obvious that the optimization efforts required by the authorities and implemented by the operators had led to a substantial reduction in the discharges.
To establish regulatory limits that encourage operators to reduce their discharges, France requires that the limits be set as low as the best available techniques will allow, taking into account feedback from experience with the discharges produced by the facilities. Since the 2010’s, the ASN has undertaken an approach to revising the discharge limits such that they are close to actual discharge figures, thus encouraging the operators to keep up their efforts to reduce and control their discharges.
The lowering of discharge limit values is expressed in a reduction by the factor shown in the table below.

	Orano La Hague	Nuclear power stations	
		900 MWe	1300 MWe
Activation produts / fission products (excluding tritium)	12,7	2,2	2,6
Alpha emitters	12	No emission	No emission

Figure 3 : Reduction factors for the radioactive liquid discharge limits defined in discharge permits from1995 and 2018

Updating of the stipulations concerning discharges according to the principles described above for all the sites requires a sustained effort over several years (almost all French facilities are currently fully regulated by provisions made in application of the TSN Law, the rest of them are still regulated by provisions made in application of the former above-mentioned Decree No. 95-540). The improvements caused by the application of these provisions provide justification for continuing this approach.

The radiological impact of nuclear activities

In application of the optimization principle, the operator must reduce the radiological impact of its facility to values as low as reasonably possible, taking into account the economic and social factors.
The operator is required to evaluate annually the dosimetric impact caused by its activity, based on the real discharges. This obligation arises either from Article L.1333-8 of the Public Health Code or from the regulations concerning discharges from BNIs, depending on the case.
This evaluation covers discharges from identified outlets (stack, and discharge outfalls into the fluvial or marine environment). It also includes diffuse emissions and sources of radiological exposure to ionizing radiation present in the facility. The impact is estimated for identified reference groups. These are homogeneous groups of persons receiving the highest average dose among the entire population exposed at a given facility, under realistic scenarios.
This approach enables a comparison between the total dose and the acceptable annual dose limit for a member of the public (1 mSv/year) defined in Article R1333-11 of the Public Health Code.
Prior to authorization, the impact is evaluated on the basis of the required annual limit, considering the radionuclides likely to be discharged. This evaluation is reassessed each year, based on the activity of the radionuclides measured in the discharges, to which must be added the radiation exposure (due in particular to the storage of wastes). This evaluation is annually published in the ASN's annual report.

In France, liquid radioactive discharges produced by the nuclear industry have very little radiological impact.

As concerns medical uses of radioactivity, contaminated effluents from nuclear medicine departments are stored in decay tanks during at least 100 days before being discharged via the sewage system. This practical is considered to be the best available technique for managing liquid radioactive effluent from nuclear medicine, as it allows the radioactive discharges from the medical sector, amongst others in iodine-131, to be extremely low.

- **<u>Regulation, surveillance and monitoring</u>**

Monitoring of the discharges from a facility is primarily the operator's responsibility. The provisions regulating discharges provide for controls that the operator must implement. These controls particularly concern effluents (monitoring of the discharges' activity, characterization of certain effluents before discharge, etc.). They also include provisions concerning monitoring of the environment (checking in the discharge stream, sampling of air, milk, grass, etc.). Lastly, measurements of related parameters are required where necessary (especially meteorology). The results of regulatory measurements must be recorded in registers which, in the case of BNIs, are sent to the ASN each month for checking.
In addition, BNI operators must regularly send a certain number of samples collected from the discharges to an independent laboratory for analysis. The results of these controls, called "cross" analyses, are sent to the ASN. The cross-analysis program defined by the ASN is designed to provide grounds for verifying that the results obtained by the operators are accurate. Cross-analysis control programs were established for the majority of facilities. It is currently a requirement of Order of 7th February 2012 and ASN resolution 2013-DC-360 of 16th July 2013 for all BNIs.
Lastly, ASN carries out unscheduled inspections to ensure that operators comply with regulatory provisions. During these inspections, the inspectors, who can be assisted by technicians from a specialized independent laboratory, check that the regulatory requirements are being met, have

samples collected in the effluents and the environment, and have them analyzed by this laboratory. ASN carries out around 20 inspections with sampling per year.

Figure 4 : ASN inspections with sampling (Credit photo : ASN)

1.1.3 <u>Accounting for BNI discharges</u>

The reduction in the activity of radioactive effluents discharged by BNIs, the changes in the categories of radionuclides regulated under discharge permits, and the need to be able to calculate the dosimetric impact of discharges on the population led the ASN to make changes in 2002 to the accounting rules for radioactive discharges.

The principles underlying the accounting rules are the following:

- For each of the regulated categories of radionuclides, the activities discharged are based on the specific analysis of radionuclides and not on overall measurements;
- The detection limits to be complied with are defined for each type of measurement;
- For each BNI and each type of effluent, a so-called "reference" spectrum is defined, i.e., a list of radionuclides which are likely to be present in the effluent and whose activity must be systematically accounted for, whether or not it is greater than the decision threshold. These reference spectra, which are subject to change, are based on feedback from experience with previous analyses. When the activity is less than the decision threshold, the threshold figure is used in the accounting.
- Other radionuclides that may be locally present are included when their activity concentration is greater than the decision threshold.

As their discharge permits are renewed, these regulations have been progressively applied to almost all of the French nuclear facilities in the OSPAR area. These rules are currently a requirement of ASN resolution 2013-DC-360 of 16th July 2013 amended.

- **<u>Environmental monitoring programmes;</u>**

The monitoring of radioactivity in the environment is an international concern, operating within two agreements:

- The Euratom Treaty which, in its Article 35, requires Member States to establish permanent control structures for radioactivity in the atmosphere, waters, and the soil, in order to ensure checks on compliance with basic standards for the protection of the health of populations and workers against the dangers resulting from ionizing radiation.

- The OSPAR Convention, whose strategy for a Joint Assessment and Monitoring Programme (JAMP) provides for the establishment of a program of monitoring for radioactive substances in the marine environment.
- In France, many actors are involved in environmental monitoring:
  - the nuclear facility licensees, who monitor their nuclear sites and their surroundings;
  - IRSN, who perform a monitoring of radioactivity in the environment within the national territory;
  - ASN, the Ministries (DGPR – General Directorate for Risk Prevention, DGS – General Directorate for Health, DGAL – General Directorate for Food, DGCCRF – General Directorate for Competition Policy, Consumer Affaires and Fraud Control, etc.), the State services and other public players tasked with ensuring national monitoring of the territory and/or carrying out inspection or monitoring assignments in specific sectors (foodstuffs, for example, in the case of the Ministry of Agriculture);
  - the approved air quality monitoring associations (local authorities), associations and private laboratories that conduct monitoring campaigns independently of the public authorities (CLIs, environmental protection associations).

The French National Network for Environmental Radioactivity Monitoring (RNM) federates all these players. It primary aim is to bring together and make available to the public, on a dedicated website www.mesure-radioactivite.fr, all the environmental measurements made in a regulatory framework on the French territory. The quality of these measurements is guaranteed by subjecting the measuring laboratories to an approval procedure, those approvals being granted by ASN. Since the decree of 4th june 2018 regarding to basic safety standards, all these measurements are automatically integrated in the RNM.

Monitoring of environmental radioactivity by the operators

Licensee prime responsibility includes monitoring the environment around nuclear sites in accordance with ministerial Order of 7th February 2012, ASN resolution 2013-DC-360 of 16th July 2013 amended and individual requirements (creation authorization decree, discharge license or ASN resolution) defining the samplings to be taken and the measures to be carried out, as well as their frequency, regardless of any additional arrangements made by the licensees for their own monitoring.

This environmental monitoring:

- gives a picture of the condition of the radiological and radio-ecological state of the facility's environment through measurement of regulated parameters and substances, whether or not radioactive, in the various compartments of the environment (air, water, soil) as well as in the various biotopes and the food chain (milk, vegetables, etc.): a zero reference point is identified before the creation of the facility and environmental monitoring enables any changes to be tracked throughout the lifetime of the facility;
- enables to verify that the impact of the facility on health and the environment is in conformity with the impact assessment;
- detects any abnormal increase in radioactivity as early as possible;
- ensures there are no facility malfunctions, amongst others by analyzing the ground water and checking licensees' compliance with the regulations;
- contributes to transparency and informing the public by transmitting monitoring data to the RNM.

All French nuclear facilities in the OSPAR area are subject to systematic environmental monitoring. The nature of this monitoring is adjusted to the risks and disadvantages that the facility might present for the environment, as described in the permitting documents and especially in the impact study.

Regulatory monitoring of the environment around BNIs is adapted to each type of installation, according to whether it is a nuclear power reactor, a plant, or a laboratory (figure 6).

SAMPLE	**CONDITIONS ON**	**MONITORED PARAMETER**	**FREQUENCY**	**ANALYSIS** (for all nuclear facilities)	**ANALYSIS** (for facilities emitting α

	RADIOACTIVE DISCHARGES				emitters radionuclides)
Air at ground level	In case of atmospheric discharges	Volumic activity in air	Weekly to monthly	According to the discharges	
		Airborne dusts	Daily	Determination of gross β activity γ spectrometry if the gross β activity exceeds 2 mBq/m^3	Determination of gross α activity γ spectrometry if the gross α activity exceeds 2 mBq/m^3
			Monthly	γ spectrometry compiling all daily filters from the same sampling station	α spectrometry compiling all daily filters from the same sampling station
Ambient radioactivity		Ambient radioactivity in a 10 km radius around the facility	Continuous recording	Ambient γ dose rate	
Rainfall	In case of atmospheric discharges	Continuous collecting of rainwater	Every 2 weeks	Determination of gross β activity Tritium (HTO) Potassium concentration (for seaside sites)	Determination of gross α activity
Surface water	In case of liquid discharges	Activity in surface water	Hourly to monthly	Determination of gross β activity Tritium (HTO) Potassium concentration	Determination of gross α activity
Groundwater		Activity in groundwater	Monthly to annually	Determination of gross β activity Tritium (HTO) Potassium concentration	Determination of gross α activity
Terrestrial plants	In case of atmospheric discharges	Activity in plants sampled downwind from the facility, close to the facility (about 1 km)	Monthly to annually	γ spectrometry Tritium (HTO & OBT) Carbon 14	α spectrometry

Milk	In case of atmospheric discharges	Activity in milk produced in the vicinity of the plant (0-10 km)	Monthly to annually	γ spectrometry Tritium Carbon 14 Strontium 90	
Soil	In case of atmospheric discharges	Activity in superficial layers of soil	Annually	γ spectrometry	
Aquatic flora	In case of liquid discharges	Activity in aquatic flora sampled near the discharge point	Annually	γ spectrometry	
Aquatic fauna	In case of liquid discharges	Activity in aquatic fauna sampled near the discharge point	Annually	Freshwater :γ spectrometry, OBT & ^{14}C on fishes Seawater:γ spectrometry and OBT on crustaceans, molluscs and fishes, ^{14}C on fishes or molluscs	
Sediments	In case of liquid discharges		Annually	γ spectrometry	α spectrometry
Agricultural productions	In case of atmospheric discharges	Activity in main agricultural productions, especially downwind	Annually	Tritium (HTO & OBT) γ spectrometry	

Figure 5 : Parameters, samples and analyses required by ASN resolution 2013-DC-360 of 16th July 2013 amended for radiological monitoring of the environment around BNIs

Monitoring of environmental radioactivity on the national territory

One of the missions of IRSN is to ensure a monitoring of environmental radioactivity on the national territory.

It is ensured through measurement and sampling networks dedicated to:

- air monitoring (aerosols, rainwater, ambient gamma activity);
- monitoring of surface water (watercourses) and groundwater (aquifers);
- monitoring of the human food chain (milk, cereals, food intake);
- terrestrial continental monitoring (reference stations located far from all industrial facilities).

It uses two approaches for this:

- continuous on-site monitoring using independent systems (remote-monitoring networks) providing real-time transmission of results. This includes:
    - the Téléray network (ambient gamma radioactivity of the air); the density of detectors in the network is going to be increased around the nuclear sites in the zone of 10 to 30

    - km around the BNIs to reach around 400 detectors (there were 163 measurement detectors in 2012);
    - the atmospheric aerosols radioactivity measurement network;
    - the Hydrotéléray network (monitoring of the main water courses downstream of all nuclear facilities and before they cross national boundaries);
- processing and measurement in a laboratory of samples taken from the various compartments of the environment, whether or not close to facilities liable to discharge radionuclides.

Monitoring of the Atlantic, Manche, and North Sea coasts involves OSPAR regions 1, 2, and 3, as defined by the RSC.
The radioactivity levels measured in France are stable and situated at very low levels, generally at the detection sensitivity threshold of the measuring instruments. The artificial radioactivity detected in the environment results essentially from fallout from the atmospheric tests of nuclear weapons carried out in the 1960's, and from the Tchernobyl accident.

Traces of artificial radioactivity associated with discharges can be sometimes detected near installations. This can be added very local contaminations resulting from past industrial incidents or activities, and which do not represent a health risk.

The selection of environmental sampling stations and measurements is based on the following objectives:
- To contribute to an assessment of the environmental impact of various sources of radioactivity (evaluate the levels of radioactivity, monitor its development in space and time, and identify and characterize the sources of the radionuclides);
- To contribute to an evaluation of human radiologic exposure (in particular, to quantify radioactivity levels in foodstuffs);
- To contribute to the detection and monitoring of a possible radiologic event and to informing the public authorities;
- To contribute to compliance with the regulations (checking the conformance of practices with respect to the regulatory framework, and cross-checking the operator's own monitoring)
- In light of these objectives, the seacoast monitoring plan comprises:
    - Reference stations enabling characterization of the background noise and pollution sources other than the discharges from major nuclear facilities, and monitoring the contributions of major rivers;
    - Stations within the area of influence of nuclear facilities located on the coast, enabling a monitoring of the spatial distribution and development over time of the radiologic state of the marine environment.

Optimization of the monitoring program relies on knowledge acquired from radioecologic studies, feedback from experience with the monitoring networks, and use of dispersion models developed by the IRSN.

The radiologic monitoring program for the marine environment implemented by France on its seacoast provides a comprehensive response to the objectives set forth by the RSC under the OSPAR Convention. In particular it leads to the acquisition of extended time series of measurements, which are made available to the RSC for the preparation of periodic assessment reports. France thus annually provides the RSC with the following environmental measurements:

OSPAR Region	Station	Environmental and radionuclide categories				
		Seawater (surface)			Mollusks	Algae
		3H	137Cs	239,240Pu	239,240Pu	137Cs

1	Roscoff	A	A			S
	Brest	Q	A*			
	Concarneau	A	A			S
	Pornichet	S	A			
	Oléron	A	A			S
	Arcachon	A	A			
2	Carteret	Q			S	Q
	Goury	Q	Q	A	Q	Q
	Cherbourg	Q				
	Barfleur	Q			S	Q
3	Honfleur	S				S
	Mers les bains	S				S
	Wimereux	A	A			S
A: Annually, Q: Quaterly, S: Semi-annually						
*137Cs annually measured in Brest with a lower Limit of Detection						

Figure 6 : Sampling and measurements from monitoring of the French seacoast, representing the concentration data sent to RSC OSPAR

The sampling stations are shown on the following map:

Figure 7 : Sampling stations on the French seacoast sending measurements to RSC OSPAR

Twelve stations are distributed along the French seacoast, with a higher density in Manche where the majority of the coastal nuclear facilities are located.

This effort to optimize the collection of concentration data for OSPAR is accompanied by an effort to develop methods to make use of them as part of the RSC's work. In fact, France has played a key role in leading the Inter-sessional Correspondence Group (ICG-Stats) in recommending the statistical methods to be employed by RSC in compiling its periodic assessment reports on the implementation of the OSPAR strategy for radioactive substances. In particular, it has suggested rigorous methods for conducting statistical tests while taking into account the presence in the data series of values lower than the detection limits (Fiévet and Della Vedova, *Journal of Environmental Radioactivity*, 101:1-7, 2010). France has also played a key role in the application of these data for estimating the impact on the biota. These methods have been employed by the RSC since its third periodic assessment report.

- **Radiation dose assessment methods;**

The national network for environmental radioactivity measurement (RNM)

As part of the implementation of the Euratom 96/29 and 2013/59 directives laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation and the 2003/4/CE directive on public access to environmental information, France has established a national network for measuring radioactivity in the environment (RNM), designed to provide the public with the results of the monitoring of environmental radioactivity and with information concerning the nuclear industry's impact on health throughout the national territory. This database is intended to contribute towards informing the public through the development of an Internet portal enabling access to radioactivity measurements and their interpretation in terms of radiologic impact. The development and validation of the portal's contents were completed in 2009, and it was opened to the public in 2010 (www.mesure-radioactivite.fr/). The website allows everyone to have a grasp of the radioactivity monitoring carried out around his place of life. It has been entirely redesigned in 2016, so as to better meet visitors' expectations, either aimed at the general public, by offering a "guided" mode of consultation, or an "advanced" mode for a more informed public.

The public availability of the results from monitoring of environmental radioactivity, and information concerning the nuclear industry's impact on health throughout France, is ensured by the regulatory obligation imposed on institutional actors and on nuclear operators to publish the results of mandatory environmental monitoring on the national network's website. The regulations require that the mandatory monitoring measurements of radioactivity in the environment are carried out in approved laboratories. Non-mandatory measurements carried out in approved laboratories (including the laboratories of associations) may also be published on the national network's website.

There are currently a total more than 2,5 million data on the website presenting results of measures in the various compartments (air, water, soil, fauna and flora) and in foodstuff. Around 300 000 new measurements are carried out each year in France.

In order to guarantee the quality of the measurements, only those taken by an approved laboratory or by IRSN may be communicated to the RNM (see § 4.4).

The website is organized showing the France's map on the homepage and can be used to obtain information about radioactivity (what is RNM? Why and how is radioactivity measured? how to use the site?), about the RNM (operation, actors of the network, regulatory framework, laboratory approval procedure, publications), plus access to a database containing all the radioactivity measurements taken nationwide (more than 2,500,000 measurements). The RNM management report is also available on it.

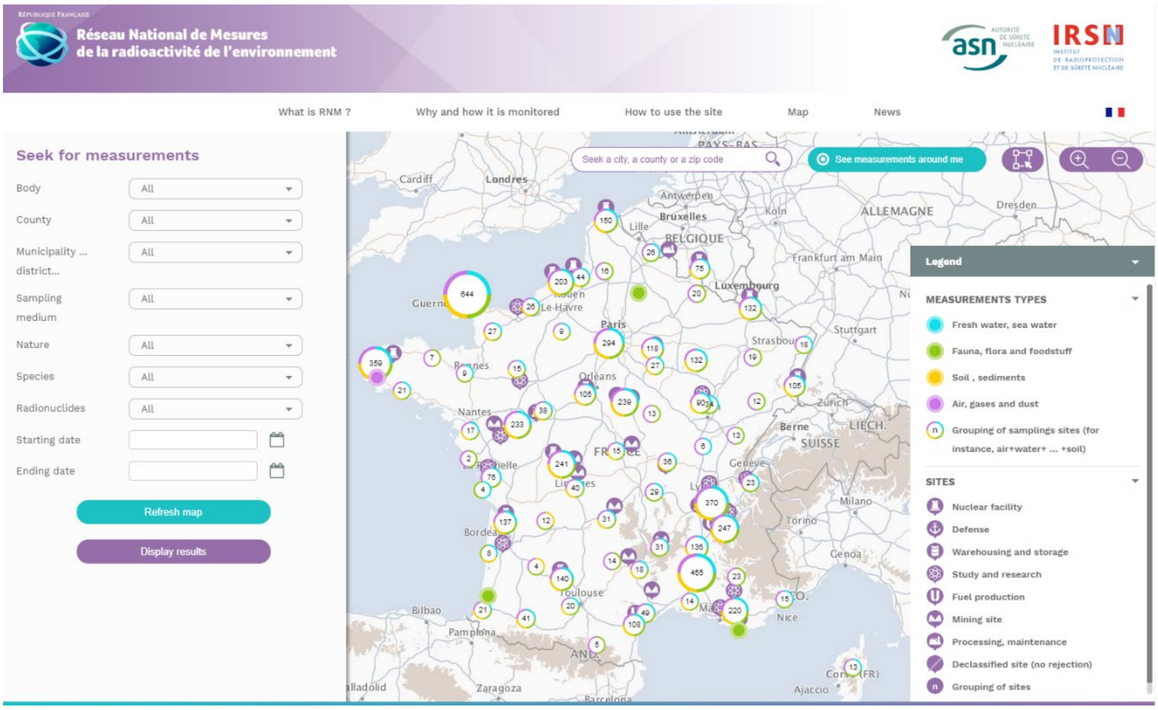


Figure 8 : National network for environmental radioactivity measurement website

Radiological monitoring of the environment in France helps to ensure the highest possible level of protection to the environment and the population. In this aim, the IRSN has published an annual Report

on the Radiological State of the Environment in France since 2004. This report published at the end of 2012 was drawn for the first time using data from the RNM[2] (for 2010 and the first half of 2011).
At the end of 2015 it published a new report on the radiological state of the French environment for the years 2011 to 2014[3], as well as an update specifically addressing the marine environment of the Channel Sea[4]. A new version of the report containing all the data from the RNM has been issued in December 2018. With more than 300,000 measurements considered, the report provides the most comprehensive view possible of all the environmental radioactivity measurements taken by the various stakeholders. It is moreover supplemented by estimates of the radiological impacts of the main nuclear activities.
For most of the radionuclides observed close to the nuclear facilities (E.g. tritium, C-14, Cs-137, Sr-90 and isotopes of Pu), the concentrations include contributions from routine discharges and from the background (mainly from the former nuclear weapon tests in the atmosphere and the Chernobyl accident). For most of the radionuclides, the contribution of the routine discharges is measured usually at extremely low levels a few kilometres around the facilities and can be detected only with the best measurement techniques.
Doses received by the population around the facilities from all pathways are estimated very low; less than 1 µSv/y for the population close to NPPs and of the order of 8 µSv/y close to the La Hague reprocessing plant.

- **<u>Environmental norms and standards & Quality assurance.</u>**

Articles R.1333-25 and R.1333-26 of the Public Health Code make provision for the creation of a National Network for Environmental Radioactivity Monitoring (RNM) and a procedure for having the radioactivity measurement laboratories approved by ASN. The RNM procedures were defined by an ASN resolution (approved ASN resolution 2008-DC-0099 of 29th April 2008, that has been amended by ASN resolution 2015-DC-0500 of 26th February 2015).
This network is being deployed for two main reasons:
- to ensure the transparency of information on environmental radioactivity by making the results of this environmental monitoring and information about the radiological impact of nuclear activities in France available to the public;
- to promote a quality assurance policy for environmental radioactivity measurements.

In order to pursue a policy aimed at guaranteeing the quality of measurements of environmental radioactivity, a system for approving laboratories was introduced. These approvals are granted to the laboratories by ASN resolution, pursuant to Article L. 592-21 of the Environment Code.

The approvals cover all of the environmental matrices: water, soils and sediments, biologic matrices (fauna, flora, and milk), aerosols, and atmospheric gases. The measurements include the principal artificial and natural radionuclides, alpha, beta, and gamma emitters, and ambient gamma dosimetry.

In total, some fifty types of measurement can be covered by an approval. There are a corresponding number of inter-laboratory comparison trials. These trials are organized by IRSN over a five-year cycle, corresponding to the maximum duration of an approval's validity.

---

[2] http://www.irsn.fr/FR/expertise/rapports_expertise/Documents/environnement/IRSN_surveillance_France_2010-2011.pdf

[3] http://www.irsn.fr/FR/expertise/rapports_expertise/surveillance-environnement/Documents/BR-2011-2014/index.htm

[4]https://www.irsn.fr/FR/expertise/rapports_expertise/Documents/environnement/IRSN_201501_Constat-Nord-Normandie-Aquatique-Methodo.pdf

Besides making information about environmental radioactivity available to the public, France believes that the issue of the quality of the information is a primary concern, particularly in a context as sensitive as that of radioactivity in the environment. The importance of this matter becomes apparent when a comparison is made of the results obtained by the various actors supplying data to the national environmental radioactivity network. It is therefore essential to begin by ensuring the technical and organizational abilities of the laboratories.

This approach is very much in line with the quality objectives set by the strategy for a Joint Assessment and Monitoring Programme (JAMP).

Procedure for approving laboratories

The abovementioned ASN resolution 2008-DC-0099 of 29th April 2008, as amended in 2015, specifies the organization of the national network and sets the approval arrangements for the environmental radioactivity measurement laboratories.

The approval procedure includes:

- presentation of an application file by the laboratory concerned, after participation in an inter-laboratory test (ILT);
- review of it by ASN;
- review of the application files – which are made anonymous – by a pluralistic approval commission which delivers an opinion on them.

The laboratories are approved by ASN resolution, published in its Official Bulletin (www.asn.fr).
This resolution obliges BNI licensees to use approved laboratories to carry out the environmental radioactivity monitoring measurements required by regulations.
The approval commission is the body which, for the RNM, is tasked with ensuring that the measurement laboratories have the organizational and technical competence to provide the network with quality measurement results. The commission is responsible for giving ASN its proposed approval, refusal, revocation or suspension of approval. It decides on the basis of an application file submitted by the candidate laboratory and its results in the ILTs organized by IRSN.
The commission presided over by ASN comprises qualified persons and representatives of the State services, laboratories, standardizing authorities and IRSN. ASN resolution CODEP-DEU-2013-061297 of 12th November 2013, for appointing candidates to the environmental radioactivity measurement laboratory approval commission, renewed the mandates of the commission's members for a further five years.

Approval conditions

Laboratories applying for approval must set up an organization meeting the requirements of standard NF EN ISO/IEC 17025 concerning the general requirements for the competence of calibration and test laboratories.
In order to demonstrate their technical competence, they must take part in ILTs organized by IRSN. The ILT program, which now operates on a five-yearly basis, is updated annually.
It is reviewed by the approval commission and published on the national network's website (www.mesure-radioactivite.fr).

The ILTs organized by IRSN can cover up to 70 laboratories in each test, including a few foreign laboratories.

To ensure that the laboratory approval conditions are fully transparent, precise assessment criteria are used by the approval commission. These criteria are published on the national network's website.
IRSN organized 70 ILTs since 2003 covering 58 types of approvals. Most of the approved laboratories specialized in water monitoring, with 57 laboratories holding up to 13 different approvals for monitoring of this medium. 31 laboratories are approved for measurement of biological matrices (food chain), atmospheric dust, air, or ambient gamma dosimetry. 31 laboratories deal with soils. Although most of the laboratories are competent to measure gamma emitters in all environmental matrices, only about ten of them are approved to measure carbon-14, transuranium elements or radionuclides of the natural chains of uranium and thorium in water, soil and biological matrices. In 2017, ASN issued 123 approvals or approval renewals. On 1st of January 2018, the total number of approved laboratories stood at 65, which represents 880 approvals of all types currently valid.
The detailed list of approved laboratories and their scope of technical competence is available on www.asn.fr.

In conclusion, France has set up a system for monitoring environmental radioactivity that meets the objectives of the OSPAR strategy both in terms of coverage of the French part of the OSPAR area, and of the quality of the monitoring data provided under the agreement concerning the program for monitoring radioactive substances in the marine environment.

Section 2: Nuclear Power Plants

- Name of nuclear facility
- Location of nuclear power plant(s)
- Year for commissioning/licensing/decommissioning
- Receiving waters and catchment area
- Other voluntary relevant information that does not tend to change.

Fifteen EDF NPPs are concerned by an OSPAR area (Cf. Table 1). They are part of the EDF French nuclear fleet distributed on 19 sites for 58 PWRs in operation (Cf. Figure 1):
There are 3 standardized plant series in operation in France, all are pressurized water reactors (PWR):

- 900 MW (3 loops) – 34 units ;
- 1300 MW (4 loops) – 20 units ;
- 1450 MW (N4, 4 loops) – 4 units.

Table 1 - EDF NPPs concerned by an OSPAR area

Map reference	NPP	Destination of discharges	Number and type of units	Installed capacity (MWe)	Date of first divergence
F1	Belleville-sur-Loire	Loire	2 PWR	2600	1987
F2	Le Blayais	Gironde Estuary	4 PWR	3600	1981
F3	Cattenom	Moselle	4 PWR	5200	1986
F4	Chinon	Loire	4 PWR	3600	1982
F5	Chooz	Meuse	2 PWR	2900	1996
F6	Dampierre-en-Burly	Loire	4 PWR	3600	1980
F7	Fessenheim	Rhin	2 PWR	1800	1977
F8	Flamanville	English Channel	2 PWR	2600	1985
F9	Golfech	Garonne	2 PWR	2600	1990
F10	Gravelines	North Sea	6 PWR	5400	1980
F11	Nogent-sur-Seine	Seine	2 PWR	2600	1987
F12	Paluel	English Channel	4 PWR	5200	1984
F13	Penly	English Channel	2 PWR	2600	1990
F14	Saint Laurent des Eaux	Loire	2 PWR	1800	1981
F15	Civaux	Vienne	2 PWR	2900	1997

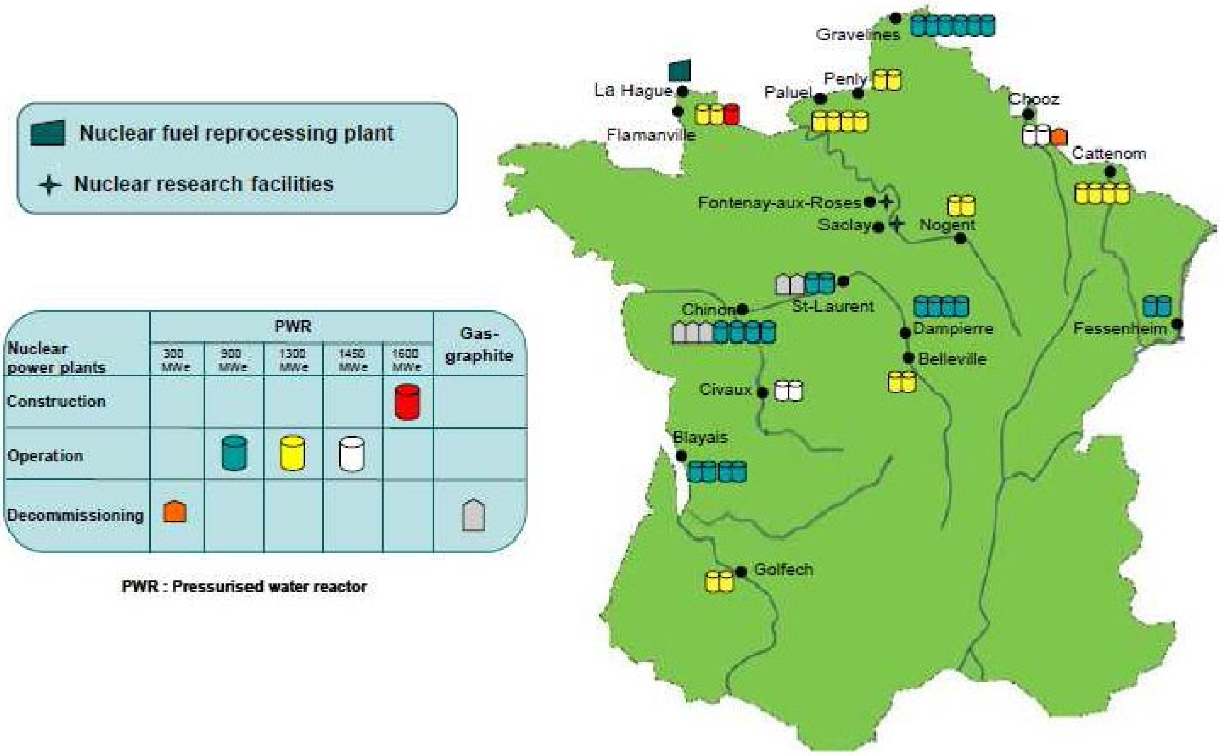


Figure 1 - EDF NPPs and other French facilities concerned by an OSPAR area.

As shown in figure 2, seven of the nine EDF reactors under decommissioning are potentially concerned by an OSPAR area:

- The Heavy Water Reactor (HWR) based in Brennilis along the Ellez River ;
- The three Natural Uranium “Graphite-Gaz” (UNGG) based in Chinon along the Loire River ;
- The two Natural Uranium “Graphite-Gaz” (UNGG) based in Saint-Laurent des Eaux along the
- Loire River ;
- The Pressurized Water Reactor (PWR) based in Chooz along the Meuse River.

Figure 2 – Nuclear reactors under decommissioning.

But only the PWR in Chooz (called hereafter Chooz A or CHO A) and the three UNGGs reactors in Chinon (called hereafter Chinon A or CHI A) have permits for liquid discharges into the environment.

- CHO A have been in operation between 1967 and 1991 ;
- CHI A have been in operation between 1963 and 1990.

It has to be noted that the HWR based in Brennilis and the UNGGs based in Saint-Laurent des Eaux have no permits for liquid discharges into the environment.

1.2. Schedule for renewals of discharges permits for EDF NPPs

Table 2 - Schedule for renewals of discharges permits for EDF NPPs.

Administrative status	NPP	Date of renewal of discharge permits
Renewed	St-Laurent des Eaux	02/19/2015
Renewed	Flamanville with EPR	07/19/2018
In progress	Paluel	5/11/2000
In progress	Belleville	01/16/2014
Renewed	Chinon B	10/20/2015
In progress	Gravelines	11/07/2003
Renewed	Le Blayais	09/18/2003
Renewed	Cattenom	01/16/2014
Renewed	Nogent	12/29/2004
Renewed	Golfech	09/18/2006
Renewed	Penly	02/15/2008
In progress	Civaux	07/05/2011
Renewed	Chooz B[1]	11/17/2009
Renewed	Fessenheim	07/17/2018
In progress	Dampierre	05/06/2011

1 This renewal includes discharges due to the decommissioning of the CHOOZ A NPP.

1.3. Radioactive liquid discharges limits for EDF NPPs in operation

Table 3 - Annual limits (GBq/y) on radioactive liquid discharges for two 900-MWe units Example of Saint Laurent-des-Eaux NPP.

PARAMÈTRES	LIMITES ANNUELLES (EN GBQ/AN)
Tritium	45 000
Carbone 14	130
Iodes	0,2
Autres produits de fission ou d'activation émetteurs bêta ou gamma	20

Arrêté du 19 mars 2015 portant homologation de la décision n° 2015-DC-0498 de l'Autorité de sûreté nucléaire du 19 février 2015 fixant les limites de rejets dans l'environnement des effluents liquides et gazeux des installations nucléaires de base n° 46, n° 74 et n° 100 exploitées par Electricité de France - Société Anonyme (EDF-SA) dans la commune de Saint-Laurent-Nouan (département de Loir-et-Cher).

Table 4 - Annual limits (GBq/y) on radioactive liquid discharges for two 1300-MWe units Example of Belleville NPP.

PARAMÈTRES	LIMITE ANNUELLE (en GBq/an)
Tritium	60 000
Carbone 14	190
Iodes	0,1
Autres produits de fission ou d'activation émetteurs bêta ou gamma	10

Arrêté du 4 mars 2014 portant homologation de la décision n° 2014-DC-0414 de l'Autorité de sûreté nucléaire du 16 janvier 2014 fixant les limites de rejets dans l'environnement des effluents liquides et gazeux des installations nucléaires de base n° 127 et n° 128 exploitées par Electricité de France-Société Anonyme (EDF-SA) dans les communes de Belleville-sur-Loire et Sury-près-Léré (département du Cher).

Table 5 - Annual limits (GBq/y) on radioactive liquid discharges for two 1450-MWe units Example of Civaux NPP.

Paramètres	Limites annuelles (GBq/an)
Tritium	Valeur maximale par an (1) (2) : 40 000*N1+ 45 000*N2 avec N1 : nombre de réacteurs avec une gestion du combustible autre que à haut taux de combustion. En particulier nombre de réacteurs avec une gestion standard N4 (combustible enrichi à 3,4 %) N2 : nombre de réacteurs avec une gestion du combustible à haut taux de combustion (du type ALCADE) N1 + N2 = 2
Carbone 14	190
Iodes	0,1
Autres produits de fission ou d'activation émetteurs bêta ou gamma	5

N1 & N2 correspond to two different possibilities of fuel management mode.
Arrêté du 2 août 2011 portant homologation de la décision n° 2011-DC-0233 du 5 juillet 2011 de l'Autorité de sûreté nucléaire fixant les limites de rejets dans l'environnement des effluents liquides et gazeux des installations nucléaires de base n° 158 et n° 159 exploitées par Electricité de France (EDF-SA) sur la commune de Civaux (département de la Vienne).

1.4. Schedule of discharge permits for EDF NPPs under decommissioning

The current permits for radioactive liquid discharges of the three UNGGs of Chinon A have been promulgated in 2015. Previous permits where promulgated in 2005, with no specific limits for NPPs under decommissioning. The current permits cover the preliminary decommissioning operations. New permits are expected after 2020 to cover the reactors core decommissioning operations (one of the three UNGG) and safe enclosure configuration (other UNGGs).
The current permits for radioactive liquid discharges of the Chooz A PWR have been promulgated in 2009. The permits cover all steps of the decommissioning operations, including reactor core and spent

fuel pool decommissioning.

1.5. Limits for radioactive liquid discharges for EDF NPPs under decommissioning

Limits for radioactive liquid discharges of Chinon A (e.g. Chinon A3D reactor) are given in table 6. They take into account atmospheric and industrial water gathered from the nuclear buildings during preliminary decommissioning operations.

Table 6 – Limits for radioactive liquid discharges of Chinon A.

Radionuclides	**Limit** (GBq/y)
Tritium (^{3}H)	0,93
Carbon-14 (^{14}C)	0,031
Others β and γ emitting radionuclides	0,86
α emitting radionuclides	none

Arrêté du 27 novembre 2015 portant homologation de la décision n° 2015-DC-0527 de l'Autorité de sûreté nucléaire du 20 octobre 2015 fixant les limites de rejet dans l'environnement des effluents des installations nucléaires de base n° 94, n° 99, n° 107, n° 132, n° 133, n° 153 et n° 161 exploitées par Electricité de France-Société anonyme (EDF-SA) dans la commune d'Avoine (département d'Indre-et-Loire).

Limits for radioactive liquid discharges of Chooz A are given in table 7. They take into account atmospheric and industrial water gathered from the "nuclear buildings" during all the decommissioning operations.
Specific limits are defined for underwater decommissioning of the reactor core, and other for the monitoring of the effluents after the decommissioning operations of the core.

Table 7 - Limits for radioactive liquid discharges of Chooz A.

Radionuclides	**Limit** (GBq/y)	**Limit during core decommissioning** (GBq/y)	**Limit after core decommissioning** (GBq/y)
Tritium (^{3}H)	100	100	3
Carbon 14 (^{14}C)	10	80	none
Others β/γ emitting radionuclides	2	5	0,75
α emitting radionuclides	none	None	None

Arrêté du 30 novembre 2009 portant homologation de la décision n° 2009-DC-0165 de l'Autorité de sûreté nucléaire du 17 novembre 2009 fixant les limites de rejets dans l'environnement des effluents liquides et gazeux des installations nucléaires de base n° 139, n° 144 et n° 163 exploitées par Electricité de France (EDF-SA) sur la commune de Chooz (département des Ardennes).

Section 3: Reprocessing facilities

- Name of reprocessing facility
- Location of reprocessing facility
- Year for commissioning/licensing/decommissioning
- Receiving waters and catchment area
- Other voluntary relevant information that does not tend to change.

1.1. Name of site

Établissement ORANO CYCLE de La Hague, formerly Établissement AREVA NC de La Hague.

The plants of the ORANO CYCLE de La Hague site

1.2. Type of facility

Spent nuclear fuel uranium and plutonium recycling facility and associated functions: interim storage pools, liquid effluent treatment unit, plutonium recovery unit in wastes, waste conditioning units, fission products vitrification units, interim storage for wastes before return to foreign customers or disposal in France, process control laboratory, discharge control laboratory, environmental control laboratory and associated internal logistics. Redundant facilities are being decommissioned and legacy waste recovered and conditioned.

1.3. Year of commissioning/licensing/decommissioning

The first reprocessing plant on the La Hague site, UP2, designed for the French natural uranium gas graphite reactor fuels with a capacity of more than 600 tU/y, came into operation in 1966 with the corresponding effluent treatment plant STE2 very soon after.

Because of the development of reactors using enriched uranium oxide and ordinary water (known as "light water reactors"), France proceeded to adapt its reprocessing plants to deal with the fuels used in the reactors of these series. It was in response to this requirement that a new "High Activity Oxide" head-end of UP2 (HAO) was brought into service in 1976 to carry out the preliminary operations of shearing and dissolution of "light water" fuels, with a corresponding reference capacity of 400 tU/y.

The later development in France and in the world of these light water reactors led COGEMA (became AREVA NC then ORANO CYCLE) to increase the reprocessing capacity. First, extensive modifications were planned to increase UP2-HAO plant reference capacity from 400 to 800 tU/y for light water reactor fuel. The implementation of these modifications, under the designation of UP2-800, was completed in 1994. Secondly, a completely new plant, with the same reference capacity (around 800 tU/y of light water reactor fuel), was designed and built on the same site, intended to be used only for the reprocessing of foreign reactor fuels during the first ten years of its operation. This plant came into operation in 1990.

These new plants were accompanied by a new effluent treatment plant, named STE3, which came into operation in 1987. For the first time, STE3 allowed the direct conditioning of waste resulting from the treatment of the effluents of the reprocessing operations.

The oldest units of UP2 being nearly 30 years old when UP2-800 started in 1994, some of them have been subject to refurbishment and a completely new plutonium tail end (purification, conversion and conditioning) using a new process equipment, named R4, was built and came into operation in 2002.

In addition, a new facility called ACC (hulls compaction facility), was set up and started in 2002 in order to decrease the volume of conditioned solid waste of both UP2-800 and UP3-A. This facility allows reducing the volume of technological and structural waste (hulls and end-pieces) by a factor of five.

On January 10th 2003, new authorisation decrees have been published for STE3, UP2-800, and UP3-A. The purpose was essentially to give some operational flexibility to the plants. The authorized capacity limit of the storage pools has been increased, the allowed production limit of each plant (UP2-800 and UP-3A) has been brought up to the usable capacity of 1,000 tU/y, the total production limit of the site being set at 1,700 tU/y. The industrial reprocessing of MOX fuels and new fuels (such as higher burn-up fuels as well as MTR fuels) is authorised as well as the treatment of products coming from the outside the site, provided that they are compatible with the facility process.

Though none of the changes induced significant modifications of the facilities, or any increase of the discharges, in order to take into account the progress of the techniques, apply the BAT principles and encourage the continuous improvement performed by the operator, the authorisation limits of the associated discharge application order (also published on January 10^{th} 2003) were lowered for most of the nuclides, and applied to a finer cutting out of the types of discharges and radionuclides.

In compliance with the discharge order of January 10^{th} 2003, which states that the discharge authorisation limits were to be reviewed after four years, a complementary ministerial order was set in force on January 8^{th} 2007. It brought another set of significant reductions of the authorisation limits (presented in § 2.5).

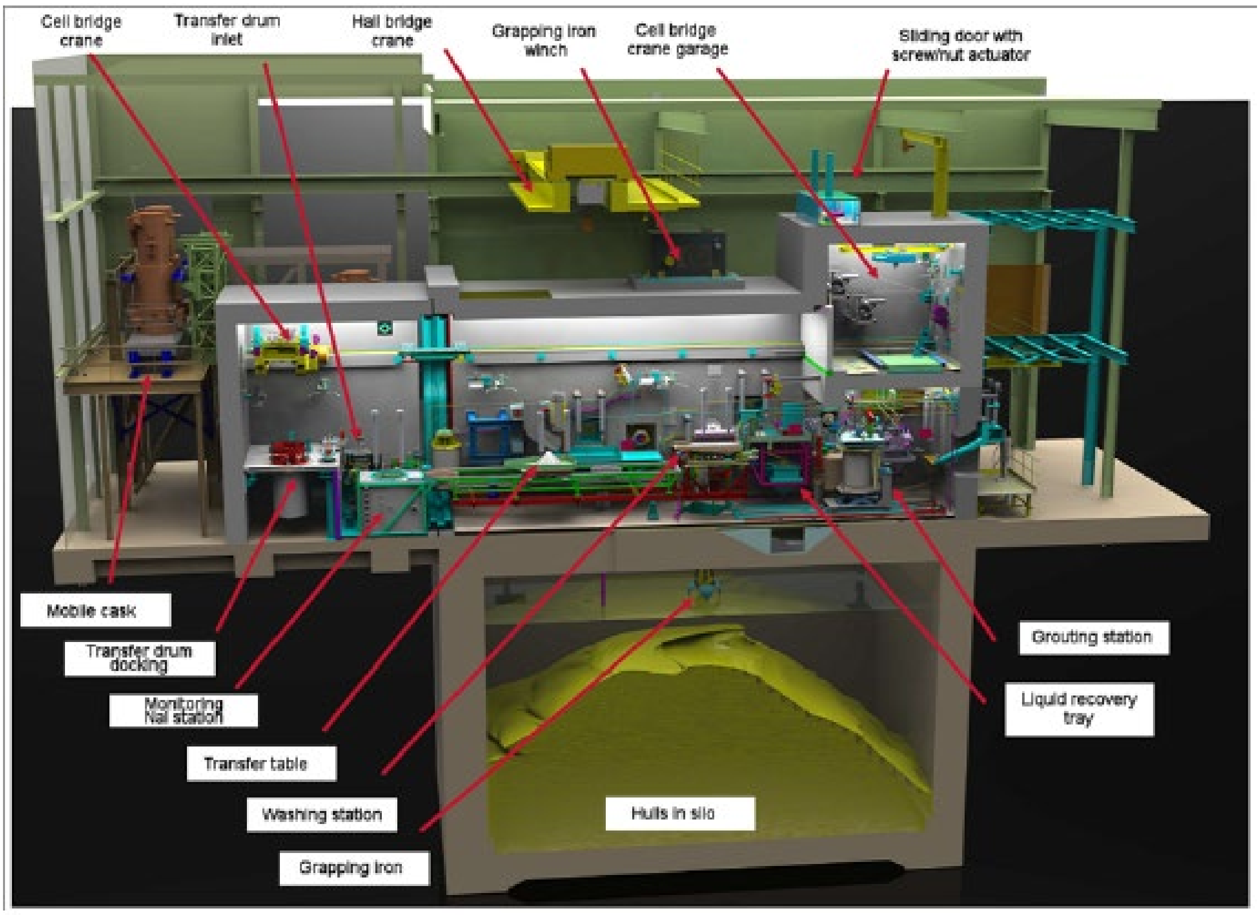
By the end of 2015, the discharge order of 2003 was replaced by two ASN Resolutions. The first one, the ASN Resolution 2015-DC-0535 defines the conditions of water and discharges sampling; the second one defines the limits. The main change deals with the extension of the authorization of discharges for effluents of decommissioning, which were formerly limited to 2015. Besides, the discharges limits of two radionuclides were lowered: the limit of cesium 137 and the one of “other beta-gamma emitters” (for decommissioning discharges).

******

Concerning decommissioning, it has been undertaken on two pilot plants belonging to the French CEA, a small industrial isotope production plant, and one for the reprocessing of fast neutron reactor fuels, 1 kg/day capacity (decommissioning completed). The operation of this latter plant has ceased in 1979, the equipment has been rinsed from 1979 to 1981, then the equipment has been removed from 1989 to 1995 and the premises cleaned up from 1996 to 2001. The premises are now free from radiological control. One can enter them with civilian clothes, without the requirement of any monitoring. In several other buildings, the premises have been cleaned up and reused to install the equipment used in more elaborated processes.

The plants that came into operation in 1966 and 1976 have been submitted since 2003 to CDE standing for “Cessation Définitive d’Exploitation”, that is to say the final stop of the operation. It consists, using the normal process and maintenance equipment as well as the usual operating team, in removing as much as possible radioactive substances and contaminated equipments and sending them to their normally used destination, either in the process for reusable substances or to the waste for the others. Since this phase uses only the means intended for the normal operation, it does not require a specific ministerial decree, but an ASN Resolution. ASN checks that the operation is consistent with the original safety file.

The next stages, the MAD, standing for “Mise à l’Arrêt Définitif”, that is to say the final cessation of operation, and the DEM, standing for Démantèlement (decommissioning) are different in nature, requiring specific means for example for the decontamination of the structure of the buildings and other competences than those of the usual operating team. It thus requires a specific safety file and a new ministerial decree. For this purpose, AREVA NC (that succeeded to COGEMA) – and which has become ORANO CYCLE in 2018 - has submitted in February 2008 a file requiring such an order for the MAD/DEM of the HAO workshop, comprising a transportation cask unloading facility, a fuel storage pond and its filtering unit, a fuel shearing and dissolution unit, a clarification unit and two storage units for the structural debris of fuel. The setting of such a decree requires a public enquiry that has taken place in November 2008. The ministerial decree authorising the MAD/DEM on the Nuclear Facility N°80 (HAO workshop) has been signed by the Prime Minister on July 31st 2009 and the corresponding operations have immediately begun. Some of them generate exceptional discharges, authorised and reported as such.



Retrieval and conditioning of legacy waste: LWR hulls stored in the HAO silo

The framework of these operations of “MAD DEM” is defined by the ASN Resolution 2014-DC-0471.

Apart from the decommissioning activities, the other exceptional type of operation is RCD, standing for “Reprise et Conditionnement des Déchets” meaning retrieval and conditioning of legacy waste. Up to the 1990’s, some by-products, that had no agreed disposal channel, have been either stored in silos or conditioned in provisional form. This is for instance the case of the hulls from LWR fuels that were stored in bulk in the HAO silo. For safety and consistency reasons, it is important that these by-products are retrieved and conditioned in forms that allow them to be directed to agreed disposal channels. The framework of these operations of “RCD” is defined by the ASN Resolution 2014-DC-0472.

1.4. Location

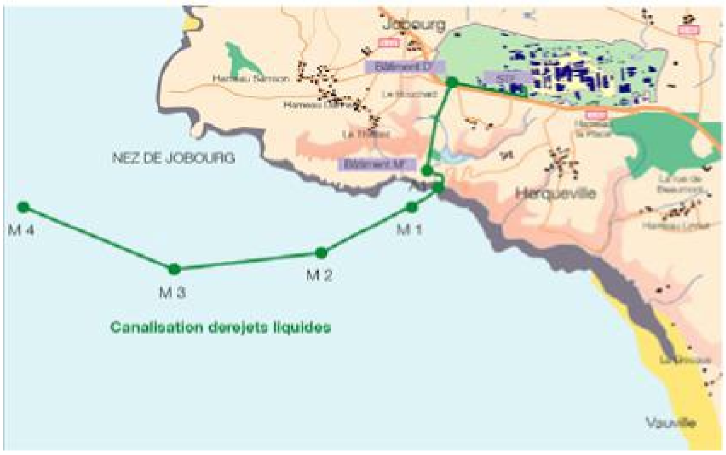
The plants are located on the northwest tip of the Cotentin peninsula, 6 km from the Cap de la Hague, 270 km west from Paris and 20 km west of the Cherbourg conurbation (nearly 90,000 inhabitants). The plants are located in the central part of the Jobourg plateau, at the highest point reaching 180 m above sea level. It covers an unbroken area of 2.3 square km.

1.5. Receiving waters and catchment area

Receiving water is the Channel, 1.5 km west from the Cap de la Hague at a place where the tidal streams have the highest velocity (up to 10 kt, that is to say around 5 m/s). Discharge of radioactive liquid effluent is carried out during a relatively short time, beginning at a precise moment before the high tide, to ensure the best dilution. The dilution rate is around 500,000 at a distance of 1 km from the end of the discharge pipe, and 1,000,000 in the vicinity of Goury, the nearest fishing harbour. The diluted activity is then transported to the North Sea by residual tidal currents.

ASN, relying on the regulations, sets the technical specifications applicable to the limits of the discharges submitted to authorisations. These require that the operator monitors radioactive discharges before and during the emission. Before the discharge the monitoring is aimed at:

- Verifying that the limits set for the discharge of the effluents are complied with, and, if these limits are not complied with, that the effluents are sent to appropriate treatment equipment;
- Determining the parameters of the discharges (agenda and flow), taking into account the regulations set in order to insure the optimal dispersion of the discharges, and particularly the limits set by the discharge authorisations.



The discharge point location

Thus, each emission is performed after the analysis of representative samples by the operator. The volume and radioactivity discharged are transcribed on a monthly register communicated inter alia to ASN.

A large number of streams having their source on the plateau flows from the northeast and southwest slopes to the sea. An important part of the southwest basin is collected in the Moulinets valley, in an impoundment built by the coast to hold 400,000 m^3 of fresh water used for supplying the plant process. The three major streams are submitted to the Discharges ASN Resolutions of 2015, defining radioactive and physicochemical concentration limits of the ORANO CYCLE La Hague site, and are carefully monitored. No radioactive effluent is discharged by the ORANO CYCLE plant in these streams.

Section 6: Research reactors

- Name of research reactor
- Location of research reactor
- Year for commissioning/licensing/decommissioning
- Receiving waters and catchment area
- Other voluntary relevant information that does not tend to change.

Fontenay-Aux-Roses Site

1.1.1 Type of facility

The Fontenay-aux-Roses site is the first historical site of CEA, established since 1946. It hosted a wide range of research and development activities in the nuclear field, whether for safety, security, radioprotection, robotics and finally biomedical research. Today, its activities are mainly devoted to life sciences around themes placed at the heart of societal concerns such as radiobiology, toxicology, neurovirology and neurodegenerative diseases. With nearly 300 researchers, the scientific production of the three institutes devoted to biomedical research gives the site a scientific influence of international scale. The Fontenay-aux-Roses site is currently heavily involved with two major projects for the fight against infectious diseases and neuroscience.

1.1.2 Start of operations and decommissioning

Since 1946, several generations of nuclear facility have been constructed in the site of Fontenay-aux-Roses. They were in operation until their gradual decommissioning occurred between 1982 and 1995. Up until 2006, there were 4 Basic Nuclear Installations (BNI) on the site. Since then, only 2 BNI remain:

- BNI 165 known as "BNI procédé" (Process-BNI),
- BNI 166 known as "BNI support" (Support-BNI).

Figure 1 : Dismantling of building (BNI 165) © CEA

1.1.3 Location

The CEA Fontenay-aux-Roses site is located several kilometers south from Paris and about 150 kilometers from the Manche (English Channel), with average coordinates of latitude 48°78' North and longitude 2°28' East. The site is located in the district of Fontenay-aux-Roses (Department 92).

1.1.4 Receiving waters and catchment area

All of the radioactive effluents are stored and then evacuated following processes which depend on the specific nuclear sector concerned.

Liquid effluents which are likely to contain traces of radioactivity are stored in the laboratory's tanks. These effluents are inspected before authorization for discharge.

Note that effluents from the Fontenay-aux-Roses site are not directly discharged into the environment, but are transferred to public sewage network and end at the waste water treatment is granted. For simplicity of reading, the term of discharge is used, even if it is a transfer.

These discharge are realized in accordance with the ministerial order of March 30, 1988 relating to the authorizations for the discharge of liquid radioactive effluents by the nuclear industry research site of Fontenay-aux-Roses. This authorization is being currently under review.

Monitoring programs for liquid effluent discharges, put in place for CEA Fontenay-aux-Roses site, also comply with the regulation on authorization of discharges of non-domestic wastewater from this site into the public sewage network of the Department of Hauts-de-Seine. This prefectoral order, dated March 1st, 2011, was established by the Hauts-de-Seine General Council.

The characteristics of the effluents are conform to the prescriptions defined in these ministerial orders. The discharge is made directly into the communal and departmental sewerage systems, following the methods defined in the effluent instructions of the site; these internal specifications define the procedures that must be followed in order that the prescriptions are adhered to. The waters are then transferred to the purification plant at Achères (30 km from the site), which then discharges the treated effluent into the Seine.

1.1.5 Production

The site is dedicated to research. There are no research reactors active on the site.

2 SACLAY SITE

3 SITE CHARACTERISTICS

The CEA Saclay site, with 5000 researchers, is the largest of the CEA sites. Located on an area of around 150 hectares, it houses research and innovation of the highest quality on the national and European scales. It is characterised by a wide diversity of activities, ranging from fundamental research to applied research in very varied areas and disciplines, such as astrophysics, nuclear physics, particle physics, metallurgy, electronics, biology, nuclear medicine, pharmacology, climatology, numerical simulation, chemistry and the environment.

Five primary research directions are pursued there: research in physical sciences, nuclear applications research, health research, technological research and studies of the environment. The CEA Saclay site also houses the National Institute for Nuclear Science and Technology (INSTN) whose mission is focused on higher education and training.

3.1.1 Type of facility

The CEA Saclay site has eight basic nuclear installations (BNI) and around 80 facilities, mostly classified for environmental protection (ICPE); these are the research laboratories. The eight BNI are the following :

- Two open pool-type research reactors of which one is now in the dismantling phase and one teaching reactor, the latter being permanently shut down,
- One reactor for training, being dismantled,

- Two high-level activity laboratories for the study of irradiated materials, of which one is now in the dismantling phase,
- Two reprocessing facilities for radioactive liquid effluent and solid radioactive waste,
- One irradiation facility with a mission to study radiosterilisation of products intended for medical use.

The company CURIUM/CIS Bio International is situated on the edge of the site. It manufactures and sells radiopharmaceutical products for medical use and contains an BNI.

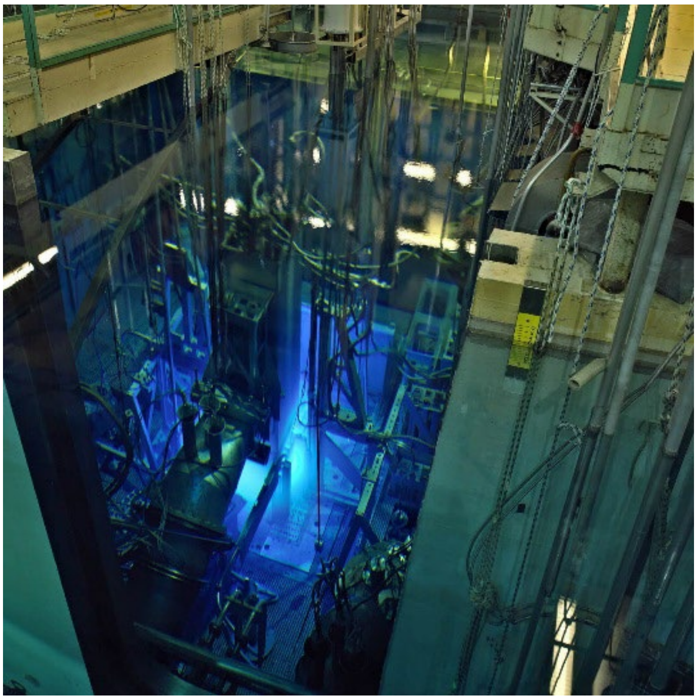


Figure 6: The CEA's OSIRIS and ORPHEE reactors © CEA

3.1.2 *Start of operations and decommissioning*

Research was first performed at CEA Saclay site at the start of the 1950s. The key dates for the 8 BNI at the site are the following:

BNI	Type of installation	Authorization of commissioning	Shut down	Decree of final shutdown and dismantling
40 - OSIRIS	Research reactor	8th June 1966	16th December 2015	-
101 – ORPHEE	Research reactor	21th March 1978	End of 2019	-
18 - ULYSSE	Teaching research reactor	23th July 1961*	9th February 2007	18th August 2014**
49 - LHA	High-level activity laboratory	1954*	February 1996	18th September 2008
50 - LECI	Irradiated fuel research laboratory	November 1959*	-	-

35 - STELLA	Radioactive liquid effluent reprocessing and management area	1958*	-	-
72 – Zone de gestion de déchets radioactifs solides (ZGDS)	Solid radioactive waste management area	14th June 1971	-	-
77 - POSEIDON	Irradiation facility	7th August 1972	-	-

* Date of achievment

** Implementation within 5 years

3.1.3 Location

The CEA Saclay site is located around 20 km south-west of Paris, with average coordinates of latitude °43’ North and longitude 2°09’ East.

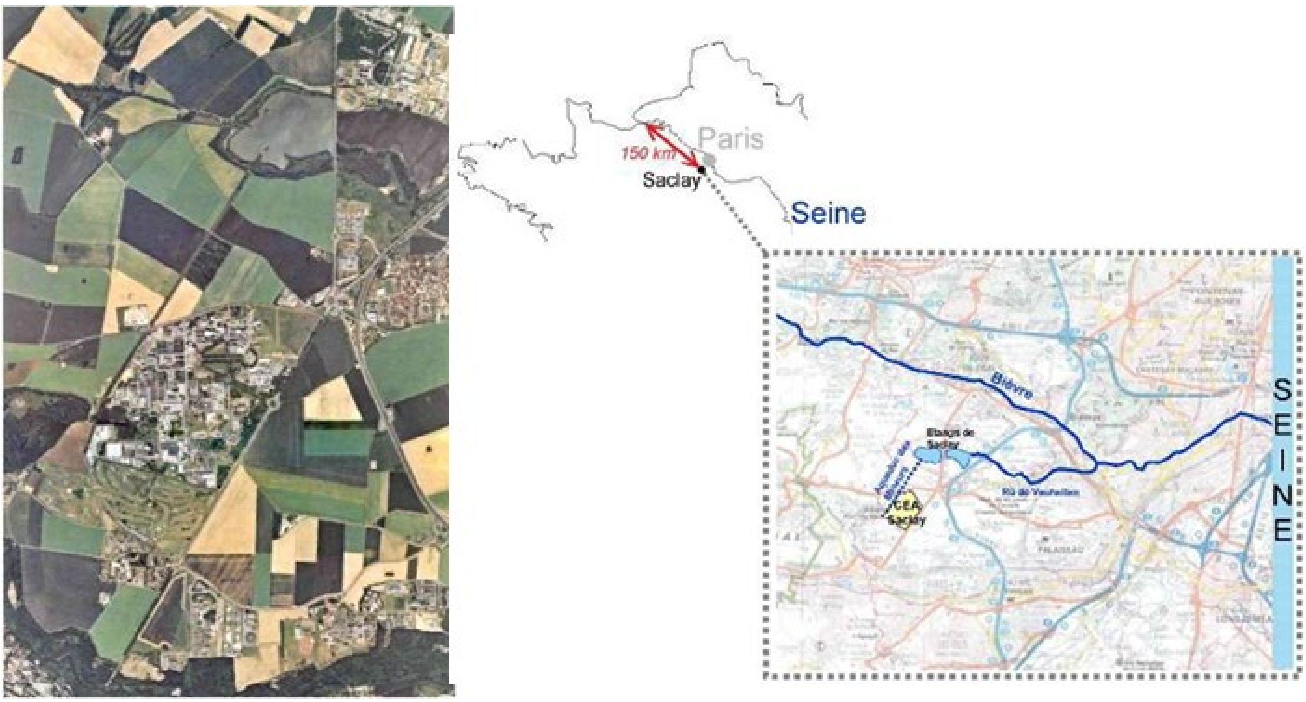


Figure 7: Aerial view and geolocation of Saclay site © CEA

3.1.4 Receiving waters and catchment area

The industrial waste water produced by the CEA Saclay site is sent, after treatment, into the Saclay ponds, from where the waters flow on into the ru de Vauhallan and then into the Bièvre and the Seine before finally reaching the English Channel. The dilution factor at the mouth of the Seine, when compared to the mean flow of industrial water produced, is around 50,000.

Figure 8: Aerial view of the Saclay site and the ponds © CEA

3.1.5 <u>Production</u>

The ORPHEE reactor has a power of 14 MW (th). No energy production (heat or electricity) is coming from this reactor.

3.1.6 <u>Other relevant information</u>

Radioactive liquid effluents, produced by the various facilities at CEA's Saclay site, are collected exclusively in dedicated tanks, or drums in the case of small producers. For this type of effluent, there is no network of channels on the site which could carry it to a direct or indirect discharge point. Rather, these effluents are transported in special road tankers to the radioactive liquid effluent treatment station, which is part of BNI 35 known as STELLA, and are treated there, most of the time. After a very major renovation program including, in particular, the commissioning of a new evaporator and a new cementation workshop, the facility has started in 2011 for radioactive effluent treatment. The volumes treated could range between 0 and 1000 m^3 per year.

Figure 9: View of the STELLA facility© CEA Figure 10: Evaporator at the STELLA facility © CEA

- This section is specifically related to all types of facilities at Sections 2 - 6
- Name of nuclear facility
- Location of nuclear/non-nuclear installation
- Year for commissioning/licensing/decommissioning
- Receiving waters and catchment area
- Other voluntary relevant information that does not tend to change.

See the sites CEA of Fontenay-aux-Roses and Saclay described at the section 6 ; the EDF reactors under decommissioning described at the section 2 and the ORANO facilities under decommissioning describes at the section 3