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EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

DIRECTORATE D – Nuclear energy, safety and ITER
D.3 – Radiation protection and nuclear safety

Verification under the terms of Article 35 of the Euratom Treaty

Technical Report

FRANCE

Malvési nuclear site

Monitoring of radioactive discharges
Environmental radioactivity monitoring arrangements

14-16 December 2021

Reference: FR 21-02

VERIFICATION UNDER THE TERMS OF ARTICLE 35
OF THE EURATOM TREATY

FACILITIES	Environmental radioactivity monitoring arrangements at the Malvési site Discharge radioactivity monitoring arrangements at the Malvési site
LOCATION	Malvési uranium conversion facility, Narbonne, France
DATES	14-16 December 2021
REFERENCE	FR 21-02
TEAM MEMBERS	Mr V. Tanner (team leader) Ms E.L. Diaconu Ms K. Peedo Mr I. Zannas
REPORT DATE	5 August 2022
SIGNATURES	

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TABLE OF CONTENTS

ANNEXES

ABBREVIATIONS

ARS	Regional Health Agency
ASN	Nuclear Safety Authority
CTE	Euratom Technical Committee (France)
DGAL	Directorate-General for Food at the Ministry of Agriculture, Food, Fisheries, Agri-Food and Forestry
DGCCRF	Directorate-General for Competition, Consumer Affairs and Fraud Prevention at the Ministry of the Economy, Industry and the Digital Sector
DGPR	Directorate-General for Risk Prevention at the Ministry of Ecological and Solidarity Transition
DGS	Directorate-General for Health at the Ministry of Solidarity and Health
DREAL	Regional Directorate for the Environment, Planning and Housing
EC	European Commission
EU	European Union
EURDEP	EUropean Radiological Data Exchange Platform
IAEA	International Atomic Energy Agency
ICP-MS	Inductively Coupled Mass Spectrometer
INB	Basic Nuclear Installation
IRSN	Institute for Radiation Protection and Nuclear Safety
LIMS	Laboratory Information Management System
LT2E	Remote Detection and Environmental Laboratory at the IRSN
RNM	National Network for Environmental Radioactivity Measurements
SIRSE	Radiological Response and Environmental Monitoring Service at the IRSN
TLD	Thermoluminiscent dosimeter

TECHNICAL REPORT

1 INTRODUCTION

Under Article 35 of the Euratom Treaty, all Member States must establish the facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the basic safety standards[1]. Article 35 gives the European Commission (EC) the right of access to such facilities to verify their operation and efficiency. The radiation protection and nuclear safety unit of the European Commission's Directorate-General for Energy is responsible for undertaking these verifications. The Joint Research Centre Directorate-General provides technical support during the verification visits and in drawing up the reports.

The main purpose of the verifications under Article 35 of the Euratom Treaty is to provide an independent assessment of the adequacy of monitoring facilities for:

- liquid and airborne discharges of radioactivity from a site into the environment;
- levels of environmental radioactivity at the site perimeter and in the marine, terrestrial and aquatic environment around the site, for all relevant exposure pathways;
- levels of environmental radioactivity on the territory of the Member State.

Taking into account previous bilateral protocols, a Commission Communication[2] describing practical arrangements for Article 35 verification visits in Member States was published in the *Official Journal of the European Union* on 4 July 2006.

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The Commission notified France of its decision to conduct an Article 35 verification in a letter addressed to the France Permanent Representation to the European Union (EU). The French Government subsequently designated the Comité Technique Euratom (CTE) to lead the preparations for this visit.

2.2 DOCUMENTS

To assist the verification team in its work, the national authorities supplied a documentation package in advance[3]. Additional documentation was provided during and after the visit. The information thus provided was used extensively in drawing up the descriptive sections of the report.

The Malvési site has not been subject to an Article 35 verification earlier. This verification addressed both environment and discharge monitoring issues.

2.3 PROGRAMME OF THE VISIT

The Commission and the CTE discussed and agreed on a programme of verification activities in line with the Commission Communication of 4 July 2006.

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1 Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation; repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom with effect from 6 February 2018 (OJ L 13 of 17.1.2014).

2 Commission Communication *Verification of environmental radioactivity monitoring facilities under the terms of Article 35 of the Euratom Treaty — Practical arrangements for the conduct of verification visits in Member States* (OJ C 155, 4.7.2006, pp. 2-5).

3 Replies to the preliminary information questionnaire addressed to the national competent authority, received on 29 November 2021.

In the opening meeting, the following topics were presented and supporting documentation was provided to the verification team:

- National environmental radioactivity monitoring network (RNM) – Nathalie Reynal (ASN)
- Approval of laboratories – Nathalie Reynal (ASN)
- Presentation of Orano and Malvési site – Daniel Bect (Orano)
- Regulatory framework for surveillance of gaseous and liquid radioactive discharges and the environment at the Malvési site – Laurent Denis (DREAL), Lisa Barriere (DREAL), Nicolas Baglan (ASN), Julien Vieublé (ASN)
- Orano Malvési discharge and environment surveillance – Loïc Cardin (Orano)
- IRSN environmental surveillance – Maxime Morin (IRSN)

The verification team pointed to the quality and comprehensiveness of all the presentations and documentation.

The team carried out the verifications in accordance with the programme in Appendix 1. The representatives of the national authorities and other parties presented in the table below were involved in the verifications.

CTE
Eugénie VIAL, Deputy Head of the Secretary
Guillaume MILOT, European Policy Officer

ASN
Nathalie REYNAL, adjointe au directeur de l'environnement et des situations d'urgence, chef du bureau de l'environnement et de la prévention des nuisances
Nicolas BAGLAN, chargé d'affaires au sein du bureau de l'environnement et de la prévention des nuisances de la direction de l'environnement et des situations d'urgence
Julien VIEUBLE, inspecteur, division de Marseille de l'ASN

DREAL Occitanie
Laurent DENIS, chef de l'unité interdépartementale Aude-Pyrénées orientales
Lisa BARRIERE, inspectrice ICPE en charge du suivi de site

IRSN
Maxime MORIN, chef du laboratoire de surveillance de l'environnement par échantillonnage
Céline QUENNEVILLE, chargée d'études en sciences de l'environnement au Laboratoire de Surveillance de l'Environnement par échantillonnage

ORANO CE Malvési
Daniel BECT, Directeur Établissement de Malvési
Patrick DEVIN, Direction Sûreté Environnement, Recycling Business Unit
Catherine MERCAT, spécialiste Passifs Environnementaux
Jean-Michel FULCONIS, responsable du département Qualité Sécurité Environnement
Stéphanie WILLEMIN, responsable environnement

3 COMPETENT BODIES IN THE FIELD OF ENVIRONMENTAL RADIOACTIVITY MONITORING

3.1 INTRODUCTION

The environmental radioactivity measurements carried out by the various organisations in France have three main complementary objectives:

- to verify whether nuclear activities are being carried out in compliance with the regulations/legal framework applicable to them, in particular as regards discharges from installations, and the monitoring of the installations' impact resulting from the declared discharges;
- to ensure that the territory and all constituent parts remain in satisfactory radiological condition so that persons or ecosystems do not receive excessive exposure;
- to detect quickly and characterise any increase in radioactivity that may be the result of an incident or accident involving radioactive substances.

Monitoring at the Malvési site and in its vicinity includes these objectives and puts them into practice at local level. It involves the participation of many organisations, as outlined in the chapters below.

3.2 MINISTRIES AND STATE SERVICES

On national level, the following ministries are involved in radioactivity monitoring:

- Ministry of the Ecological and Solidarity Transition, whose Directorate-General for Risk Prevention (DGPR) includes a technological risks department (responsible, among other things, for radiological risks), and a department for preventing environmental harm and safeguarding environmental quality;
- Ministry of Solidarity and Health, whose Directorate-General for Health (DGS) is in charge of policy for preventing and managing risks linked to lifestyles and diet. The DGS is responsible for protecting the public as regards the various uses of water (drinking water, recreational waters, domestic hot water, bottled water, wastewater, etc.). It coordinates, inter alia, the local water quality monitoring networks managed by the Regional Health Agencies (ARS);
- Ministry of Agriculture and Food, whose Directorate-General for Food (DGAL) is responsible for supervising the quality and safety of foodstuffs intended for human and animal consumption. The DGAL's remit focuses on the safety and quality of the agri-food chain;
- Ministry of the Economy and Finance, whose Directorate-General for Competition, Consumer Affairs and Fraud Prevention (DGCCRF) is in charge of overall market surveillance.

State services are responsible for monitoring the national territory or specific sectors (i.e. the Ministry of Agriculture monitors foodstuffs, the Directorate-General for Health monitors drinking water). This includes twelve Regional Directorates for the Environment, Planning and Housing (DREAL) across the country, which are under the authority of the prefect of the region concerned and are responsible, among other things, for developing and implementing State policies on the environment and sustainable planning and development.

The Comité Technique Euratom (CTE), under the Prime Minister's responsibility, coordinates the activities in France for implementing the Euratom Treaty.

3.3 NUCLEAR SAFETY AUTHORITY

The Nuclear Safety Authority (ASN) is an independent administrative authority, which participates in monitoring nuclear safety, radiation protection and nuclear activities, as well as in providing public information and ensuring transparency in the areas within its remit. ASN has no laboratory, but it co-operates closely with the IRSN and regional surveillance laboratories. Pursuant to the Environmental Code (L. 592-1) the ASN has the following specific environmental responsibilities:

- organise permanent monitoring in the area of radiation protection, including environmental radioactivity monitoring across the entire country;
- regulate and monitor discharges of gaseous and liquid effluents and waste from basic nuclear installations (INB);
- propose, coordinate and implement the regulatory and control policy for environmental monitoring of nuclear sites;
- approve laboratories to perform environmental and food radioactivity monitoring.

ASN employs some 500 staff members on 12 locations; the headquarters are at Montrouge.

3.4 INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY

The Institute for Radiation Protection and Nuclear Safety (IRSN) is a public State body that provides expertise and carries out research in the field of nuclear security[4]. It participates in permanent radiation protection monitoring, takes part in environmental radiation monitoring and manages and uses dosimetry data of workers exposed to ionising radiation. In addition, it organises interlaboratory comparison exercises between the environmental surveillance laboratories approved by the ASN.

IRSN employs some 1800 staff members on 9 locations; the main laboratories are in Fontenay-aux-Roses, Cadarache and Le Vésinet.

3.5 OTHER ORGANISATIONS

Other involved organisations include air quality monitoring associations (local authorities), environmental protection associations and local information committees (bodies responsible for scrutiny, information provision and dialogue in relation to nuclear installations).

Operators of nuclear installations carry out monitoring near their sites pursuant to legislation or regulations. With specific regard to Malvési, Orano Cycle is the operator in charge of monitoring on the site and in its environment, in line with the conditions laid down in the administrative authorisations linked to the site and its installations.

[4] Under Article L. 591-1 of the Environmental Code, nuclear security includes nuclear safety, radiation protection, preventing and combatting malicious acts and civil protection activities in the event of accidents.

4 MALVESI NUCLEAR SITE

4.1 SITE DESCRIPTION

The Malvési plant is a uranium storage, refinery and conversion facility located in the Malvezy industrial area in the city of Narbonne in the south of France (Fig. 1). The site is located about 3 km north of the city centre. The plant handles the first phase of uranium conversion, which consists of purifying the concentrate of uranium oxide supplied by the mines, and thereby producing uranium tetrafluoride (UF_4).

Uranium is received from mines all over the world in drums containing uranium oxide ('Yellow cake'). This form of uranium is a concentrated powder, which is obtained after removing the impurities from raw uranium ore.

The characteristics of the powder are different depending on the production site, so the first stage of the process is to dissolve the yellow cake in nitric acid and to mix uranium from different suppliers to achieve the optimal chemical characteristics for the subsequent purification and conversion process.

The degree of purification achieved by the Orano process at Malvési is such that it can treat any type of uranium ore, whatever its origin. The final product of the facility is Uranium tetrafluoride (UF_4), which is loaded into approved containers for transport by rail or by road. The final transformation stage, which completes the conversion to uranium hexafluoride (UF_6), is carried out at the Orano Tricastin site.

The plant has an average capacity of about 15,000 tU as uranium tetrafluoride per year. At this level, the total amount of removed residues ending up in the evaporation ponds is about 300 tonnes per year.

The Malvési facility employs about 500 people. The site (about 100 ha) consists of process facilities, uranium (yellow cake) drum storage area and process/drainage water evaporation ponds. In addition, there are two former water ponds, which are now dry and covered with a bitumen layer. These ponds are classified as INBs (Basic Nuclear Installation), since they contain traces of long-lived radioactive residues from past treatment of reprocessed uranium at the Marcoule facility.

Figure 1. Orano Malvési nuclear site

5 MONITORING OF RADIOACTIVE DISCHARGES

5.1 GENERAL

The Malvési site includes both a "basic nuclear installation" (INB: "Installation nucléaire de base") and an ICPE ("Installation classée pour la protection de l'environnement") facilities, and therefore comes under two different and complementary regulatory frameworks.

Monitoring discharges from a basic nuclear installation (INB) is the responsibility of the operator according to the order of 7 February 2012[5], setting the general rules relative to basic nuclear installations. It is governed by two levels of authorisation:

- limits for discharges into the environment of liquid and gaseous effluents, which are set for each INB by a decision of the ASN ratified by the Ministry of Ecological and Solidarity Transition;
- procedures and conditions for the intake and consumption of water and discharge into the environment of liquid and gaseous effluents specified by decision of the ASN.

The Order of 7 February 2012 is complemented by the ASN decision n° 2013-DC-0360 of 16 July 2013, modified by the ASN decision n° 2016-DC-0569 of 29 September 2016, concerning the monitoring of the environmental effects of the basic nuclear installations.

For the ICPE part of Malvesi site, the discharge authorisation has been granted by the Order of the Prefect DREAL-UID11-2017-39. Orders DREAL-UD11-2018-022 of 22 May 2018 and DREAL-UD11-2018-037 of 26 July 2018 lay down further regulation for the CERS project ("casier d'entreposage réversible de surface") and the Uranium dioxide production facility.

The rules governing discharges specify the minimum checks that the operator must carry out. This monitoring is carried out on liquid and gaseous effluents (monitoring radioactivity of discharges, characterising certain effluents before discharge, etc.) and on the environment in the vicinity of the installation (checks during discharge, sampling of air, water, milk, grass, etc.). The findings of this monitoring are entered in a register and sent to the ASN and DREAL each month.

In addition, the INB operators regularly send a certain number of discharge samples to an independent laboratory for comparative analysis. The results of these crosschecks are sent to the ASN. This programme of crosschecks makes it possible to ensure that the measurements carried out by the operators' laboratories are correct.

DREAL or ASN carry out dedicated inspections to ensure that operators are properly complying with the regulatory provisions applicable to them concerning the management of discharges. Some of them (10 to 20 inspections per year on the whole national territory) include sampling operations for realising conformity analyses. These inspections are generally unannounced and carried out with the support of specialised independent laboratories commissioned by the ASN. Samples of effluents and samples from the environment are taken for the purpose of radiological and chemical analyses.

5.2 GASEOUS DISCHARGES

The Malvési site discharges airborne effluents into the atmosphere at several controlled discharge points. Sampling is carried out using ALGADE Environment Aerosols Samplers (6-100), where a bypass airflow is pumped though a paper filter to trap particulate material. The sampler includes a flowmeter and a total flow counter. The same device is used also for on-site environmental sampling. Altogether there are 17 such samplers at site gaseous discharge points and 5 in the environment (Fig. 2). The filters are analysed in the Orano laboratory for gross alpha and beta activity. Certified laboratory Algade Lyon analyses the U and Pu isotopes, Am-241 and Cs-137 on the filters.

[5] https://www.legifrance.gouv.fr/loda/id/JORFTEXT000025338573/

The plant control room has an indication of the functioning of the samplers (flow rate, total air volume and alarms on malfunction).

In addition to the sampling by Orano, there is also a regular control programme carried out by an external organisation. This programme includes quarterly or annual samples taken at the gaseous discharge points and analysed for uranium and total alpha/beta.

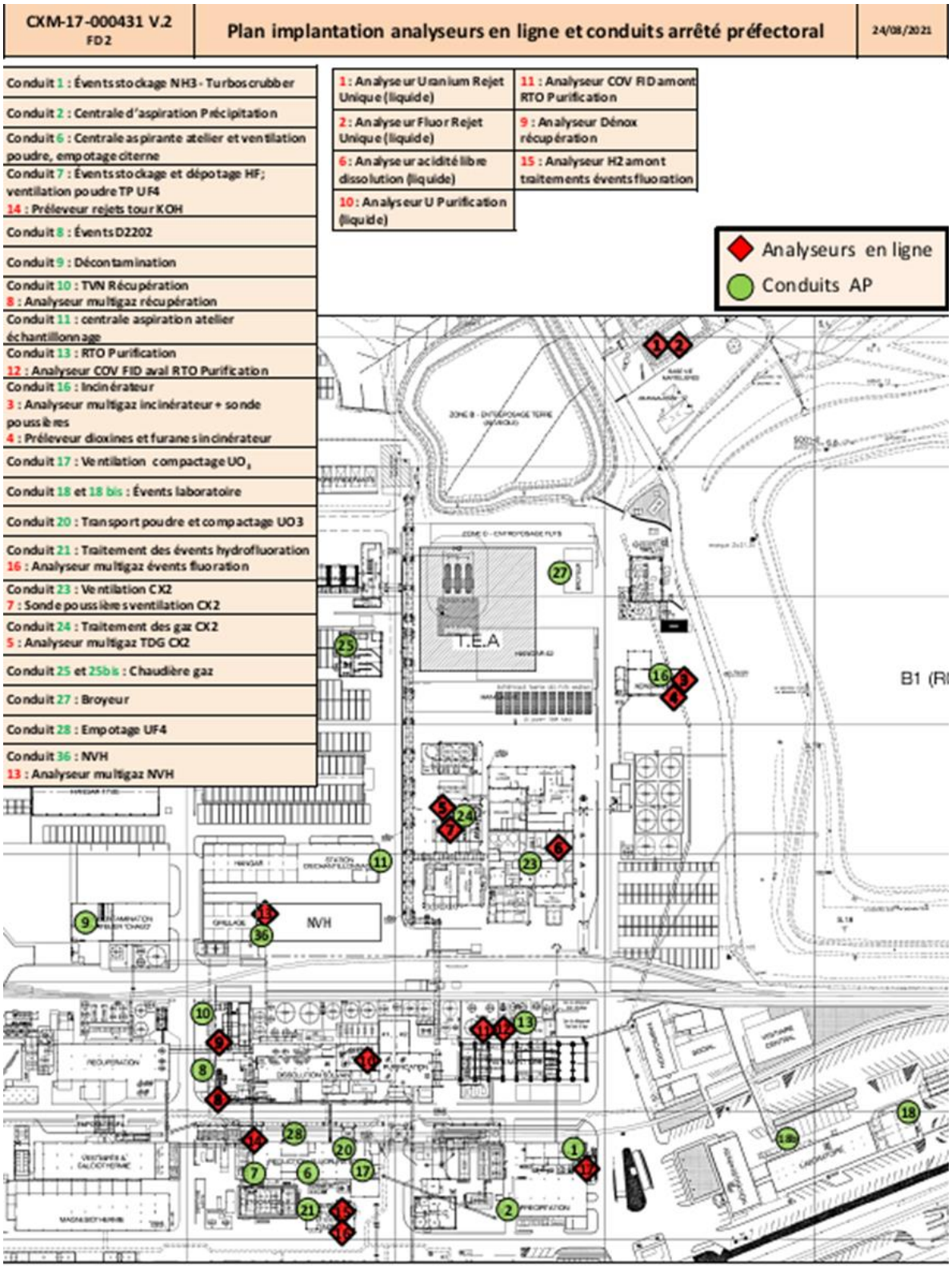


Figure 2. Locations of the discharge points (green) and air samplers (red)

5.3 LIQUID DISCHARGES

Liquid radioactive discharges from the Malvési site are very small. The liquid effluents produced in the uranium purification process are collected in on-site treatment ponds. The off-site discharges consist of small amounts of purified drainage waters from the site area. There is only one common discharge point, where the site liquid discharge is mixed and released to the canal de Tauran.

Authorised limits for liquid discharges are laid down by the Order of the Prefect DREAL-UID11-2017-39. Limits for uranium concentration and for alpha/beta radioactivity are presented in Table I below.

Table I. Liquid discharge limits

Parameter	Maximum concentration	Maximum flow	Maximum flow
	Average over 24 hours	24 hours consecutively	/
Flow rate	650 m^3/h 15 600 m^3/day		/
Uranium	0.8 mg/l	10 kg/day	0.131 t/year
Alpha and beta radioactive discharges	40 Bq/l	0,5 GBq/day	6.65 GBq/year

Orano carries out routine monitoring of this discharge, as presented in the Table II below. Samples are taken by an automatic sampler (Fig. 3 and 4); they are representative of a 24h release. Once a year, there is a control sample taken by an accredited external laboratory.

Table II. Liquid discharge point sampling and analysis programme

Analysis	Uranium content	Activity alpha+beta	^{99}Tc	^{230}Th	^{137}Cs
Discharge type	Continuous				
Frequency	Daily	Monthly	Every 3 months	Every 3 months	Every 6 months

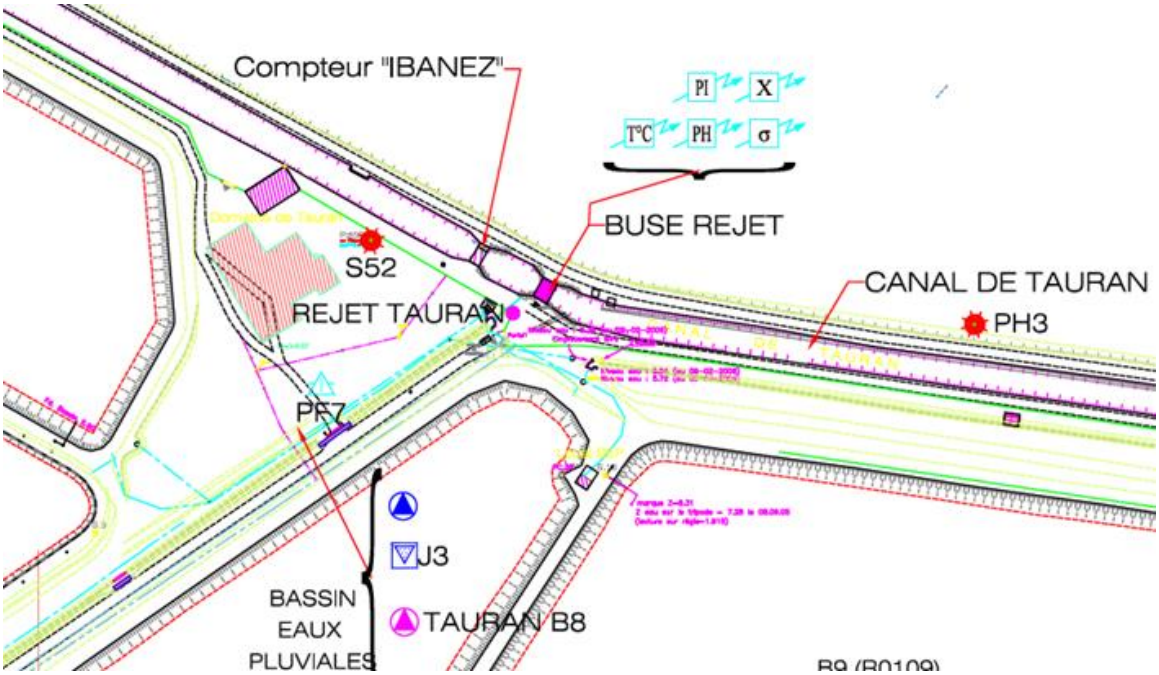


Figure 3. Sampling at the common liquid discharge point (RU) to canal de Tauran (Rejet Tauran – automatic water sampler)

Figure 4. Automatic water sampler

6 MONITORING OF ENVIRONMENTAL RADIOACTIVITY

6.1 GENERAL

The Malvési site processes uranium, which is naturally radioactive. The conversion process does not concentrate or increase radioactivity, hence low-radioactive uranium is the only radioactive material of environmental concern. Small amounts of uranium are released as dust particles in ventilation air or dissolved in site drainage water discharges. These discharges are monitored by the Orano laboratory. Surveillance of environmental radioactivity in the site vicinity is carried out by Orano and IRSN. Annex 2 presents an overview of the Orano programme and Annex 3 the IRSN programme.

The internal Orano procedure CXM-11-002462 lays down the environmental monitoring programme, complemented with other procedures (CXM-16-002878/CXM-11-009125) that specify the schedule and frequency of analytical measurements for different type of environmental samples.

There is no possibility of a large radioactive release from the Malvési site in the event of an accident, therefore the emergency environmental monitoring concentrates on chemical hazards.

6.2 AMBIENT RADIATION DOSE RATE

6.2.1 IRSN automatic dose rate monitoring

At national level, monitoring of the ambient dose equivalent rate is carried out on the whole territory of France at the IRSN remote sensing laboratory of the Radiological Response and Environmental Monitoring Service (SIRSE). The automated detectors (Teleray system[6]) are proportional counters manufactured by BITT Technology (Austria) (Fig. 5).

Figure 5. BITT Technology detectors used by the IRSN in the Teleray system

The main technical features of the detectors are the following:

- measuring range: a few nSv/h to 15 mSv/h;
- calibration with a ^{137}Cs calibration source (certificate supplied on delivery);
- energy range: 40 keV to 3 MeV;
- ambient temperature range allowing proper operation: -30 °C to 70 °C;
- acceptable relative atmospheric humidity: up to 95 % (IP67);
- average relative uncertainty: 10 %.

6 https://teleray.irsn.fr

Detector characteristics in terms of energy and the direction of incidence of the radiation are depicted in Fig. 6.

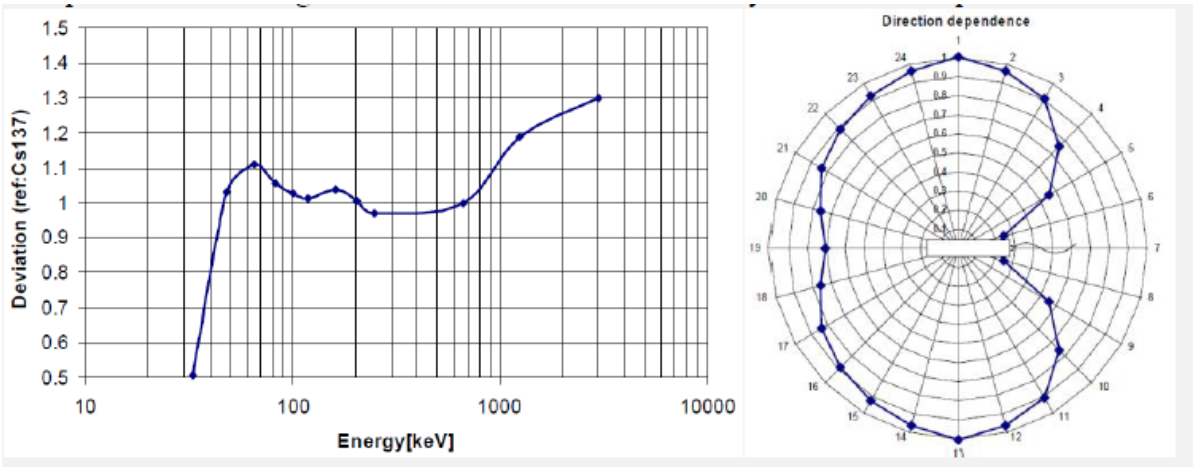


Figure 6. BITT detector characteristics

The measurements of the monitors are transmitted every 10 minutes via a multiprotocol label switching virtual private network (MPLS VPN), either under a direct contract between the IRSN and a telecommunications operator or under the agreement between the IRSN and the Gendarmerie Nationale (which also has a contract with a large telecommunications operator). The data is made available also at the EURDEP system.

The monitoring system ensures retrieval of the measurement data in a Microsoft SQL Server database. Each measurement result is automatically compared to a sliding reference average of one week's data. The measurement is automatically validated if it is within the acceptable variation range (±40 nSv/h) of the average reading; in other cases the measurement has to be manually validated by the Téléray remote sensing system team member on call. First alarm is raised at background level +40 nSv/h; the second at background level +114 nSv/h.

The system functions in real time. It incorporates redundancy, has a recovery plan and an agreed service commitment from the network operator.

One station of the Téléray network is located close to the Malvési site in Narbonne. This station is installed at a police station roof, about 10 km from the site (Fig. 7). The next closest stations are in Carcassonne and Perpignan.

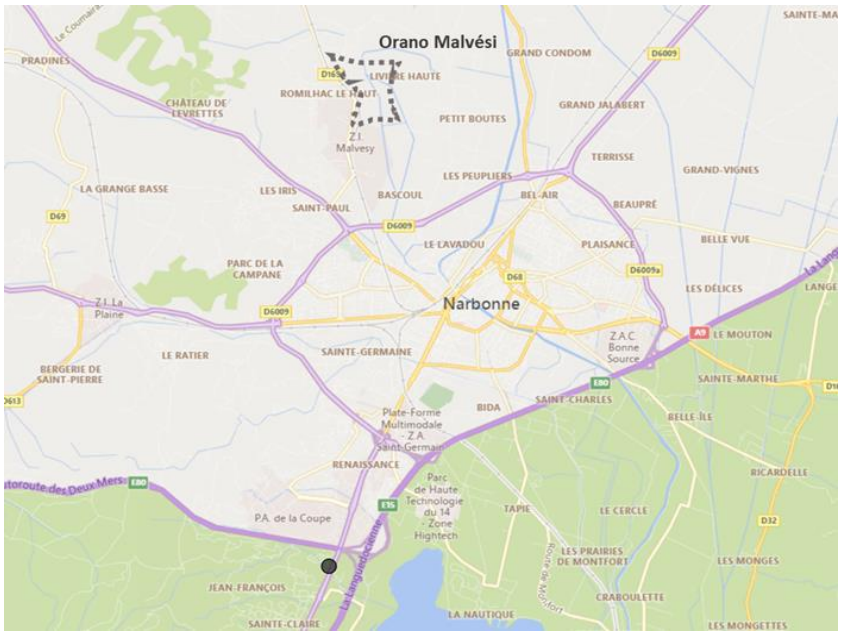


Figure 7. Location of the closest IRSN automatic radiation dose rate monitor

6.3 PUBLIC RADIATION DOSE

6.3.1 Orano on-site TLD system

Monitoring of the public radiation dose by passive dosimetry is carried out using 16 TLD dosimeters (Fig. 9) distributed on the site surroundings (red triangles on Fig. 8). The dosimeters are replaced every three months and analysed by the Marcoule site laboratory.

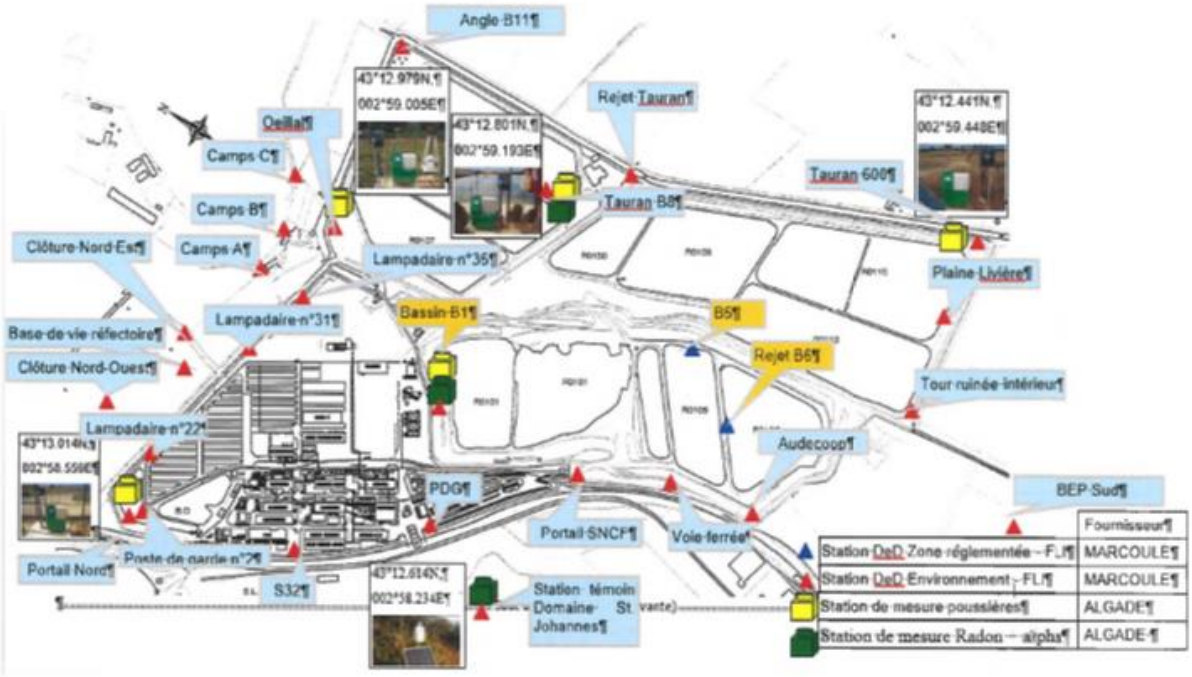


Figure 8. Orano monitoring system at the Malvési site

(red triangle – TLD dosimeter, yellow box – air sampler, green box – water sampler, blue triangle – ground water sampling point)

Figure 9. TLD dosimeter on the site fence

6.4 AIRBORNE RADIOACTIVITY

6.4.1 Orano on-site air samplers

Orano has 5 low-volume air samplers on the Malvési site (yellow boxes on Fig. 10). These are type ALGADE Environment Aerosols Sampler 6-100k (Fig. 11), which has a 51 mm particle filter. The sampler is equipped with a compensated total flow counter.

The filters are changed weekly and analysed by the Malvési site laboratory for gross alpha/beta radioactivity. Two times a year measurements of radionuclides (Th-230, Am-241, Pu-239-240, Tc-99) are done in an outside laboratory.

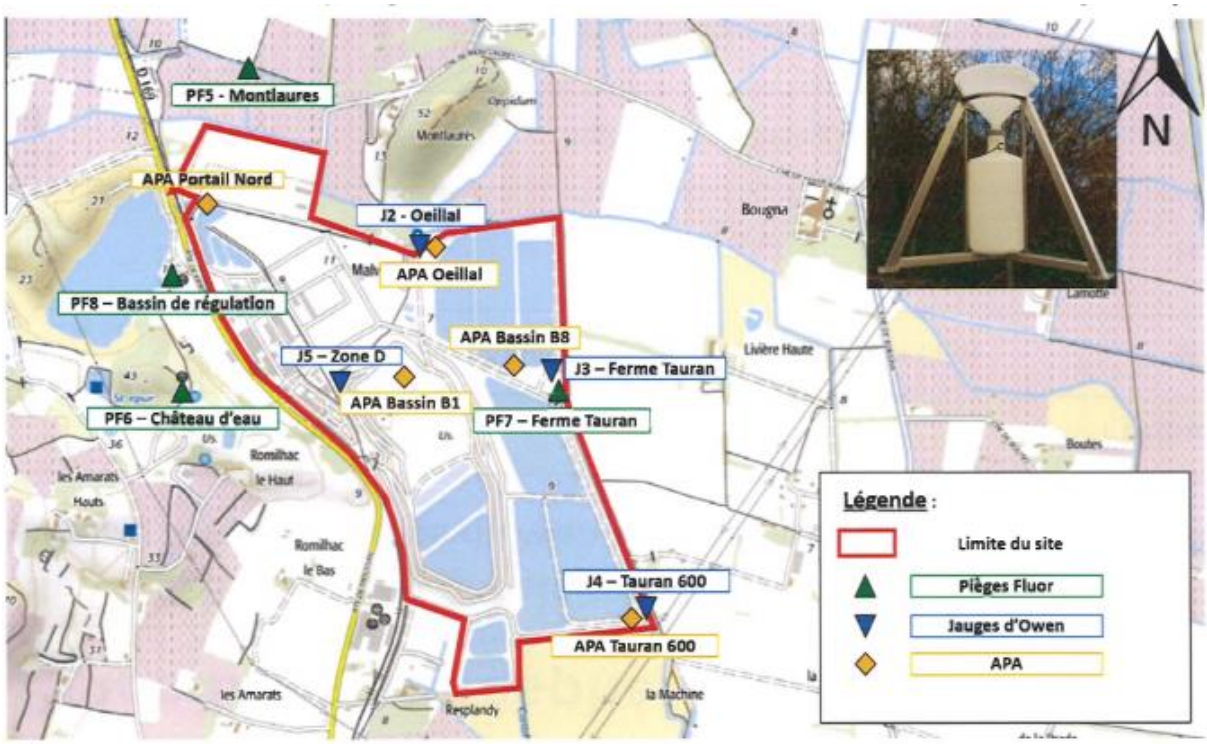


Figure 10. Air monitoring locations at the Malvési site (air sampler - yellow rectangular, fluoride trap - green triangle, dry/wet deposition sampler - blue triangle)

Figure 11. Orano on-site air sampler

6.4.2 IRSN air sampler

IRSN operates a network of 40 medium-volume and 10 high-volume air samplers in France (OPERA-AIR). One of the medium-volume stations is located in the vicinity of the Malvési site (Fig. 12 and 13). The filter is changed weekly by Orano, and then sent to the IRSN laboratory in Vésinet. The analysis includes gamma spectroscopy and isotopic Uranium using ICP-MS.

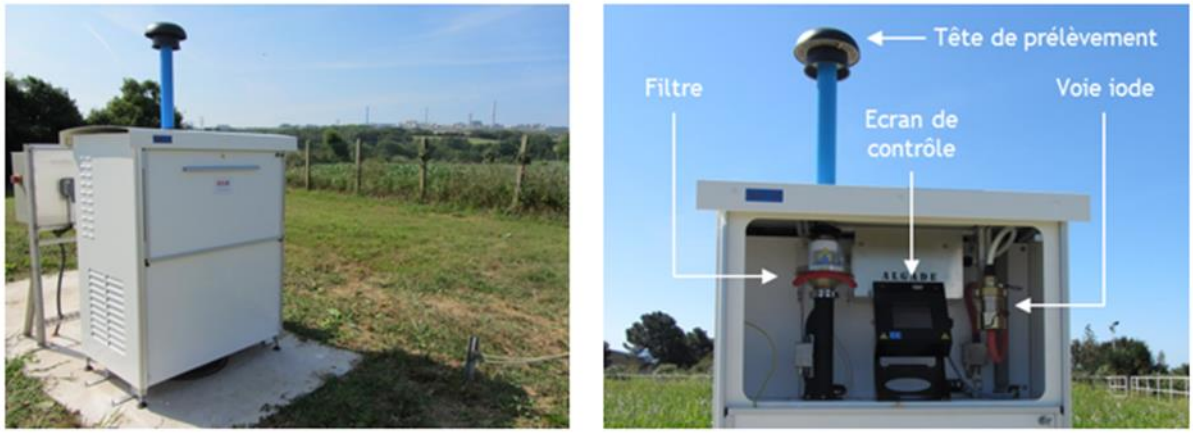


Figure 12. IRSN air sampler

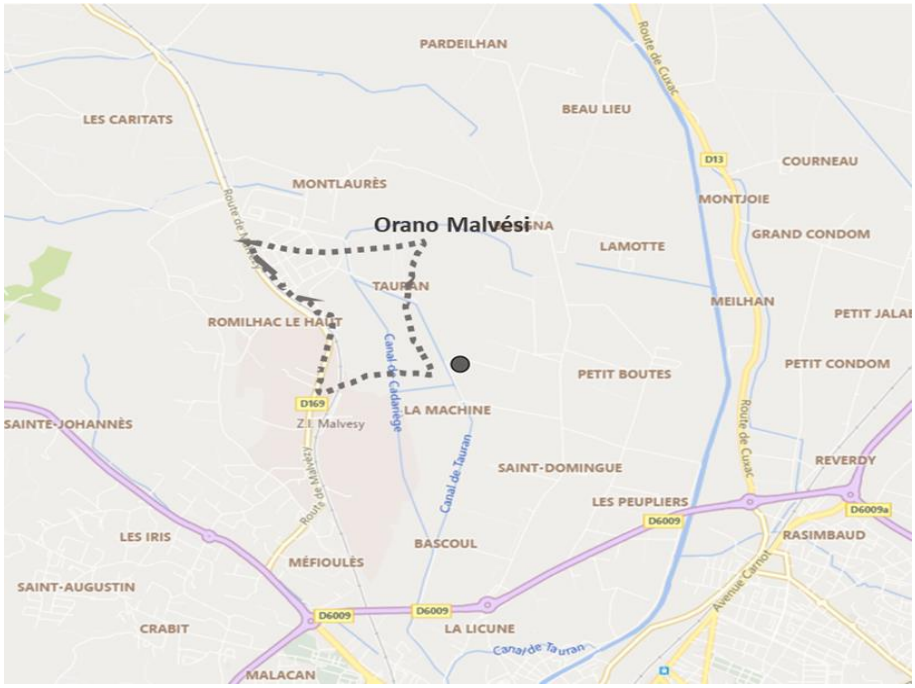


Figure 13. IRSN air sampler and deposition collector location

6.5 ATMOSPHERIC DEPOSITION

6.5.1 Orano on-site deposition collectors

Orano has four dry/wet deposition sample collection points at the Malvési site (Fig. 14, blue triangles on Fig. 10). Samples are collected monthly and analysed at the site laboratory for uranium and total alpha/beta, and at the certified laboratory of CIME (SEPA, Orano) in Bessines for Tc-99 and Th-230 (twice a year).

Table III. Orano precipitation and ground deposition sampling

Sample type	Number of sampling points	Frequency of sampling	Radionuclide
Precipitation and ground deposition	4	4*12 (monthly)	Uranium
	1	1*12 (monthly)	Gross α / β
	1	1*2 (biannually)	^{99}Tc
	1	1*2 (biannually)	^{230}Th
	1	1*12 (monthly)	^{40}K

Picture 14. Orano dry/wet deposition collector

6.5.2 IRSN deposition collector

IRSN operates a dry/wet deposition collector at the same location with the air sampler (Fig. 15). The sample is collected weekly by Orano, and then sent to the IRSN laboratory in Vésinet. The analysis includes gamma spectroscopy of the filtered sample.

Figure 15. IRSN dry/wet deposition collector

6.6 WATER

6.6.1 Orano sampling

Surface water

Orano has a surface water sampling programme, which consists of the following:

- Continuous automatic sampling (Sampler "Tauran 600" manufactured by Endress-Hauser) from the Canal Tauran
- Manual sampling from points Amont RU, Rocade, PV0, PV1, PV2 and PV3

The sampling point locations are shown on the map in Figure 16. Table IV below presents the sampling frequency and radionuclides that are analysed. Samples are analysed at the site laboratory for uranium and total alpha/beta. Tc-99 and Th-230 are analysed by the laboratory CIME (Sepa) in Bessines. Cs-137 is analysed by the laboratory CIME (SEPA) in Bessines.

Table IV. Orano surface water sampling

Point de surveillance	Analyses	Fréquence
Point de rejet Unique: RU	Uranium	J
	Alpha global, Béta global	M
	Tc99, Th230	T
	Cs137	S
Amont RU	Uranium, Alpha global, Béta global	T
Tauran 600	Uranium	H
	Alpha global, Béta global	M
Rocade	Uranium	H
PV0, PV1, PV2 PV3	Uranium	T
Bages 9, 10, 11	Uranium	A
Ecluses Mandirac et Ste Lucie	Uranium	A

Mesures comparatives avec organisme COFRAC ou agréé une fois/an pour le rejet unique

T Trimestriel
J Journalier
A Annuel
H Hebdomadaire
M Mensuel

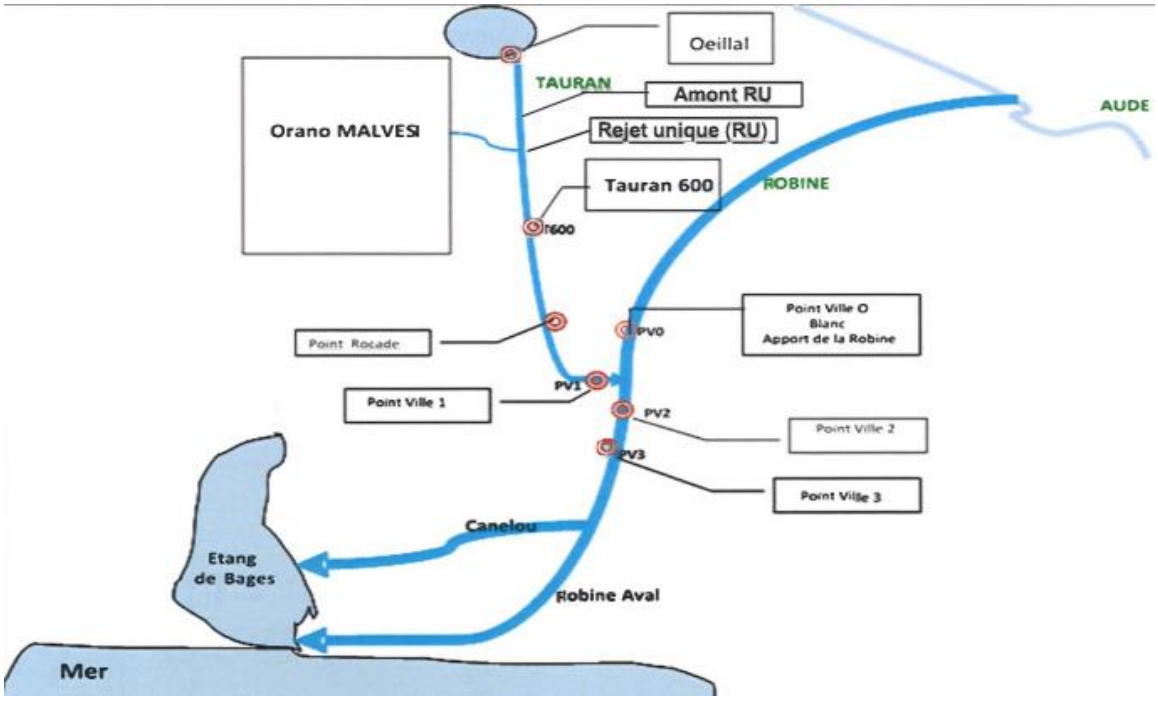


Figure 16. Surface water sampling locations

Ground water

Ground water is sampled from several locations at the Malvési site (Fig 17). Table V below presents the analytical programme (« *32*4* » means 32 sampling points 4 times each year). Ground water is sampled through ''piezometers'' distributed along the site perimeter, as can be seen in the figure 18 (red points).

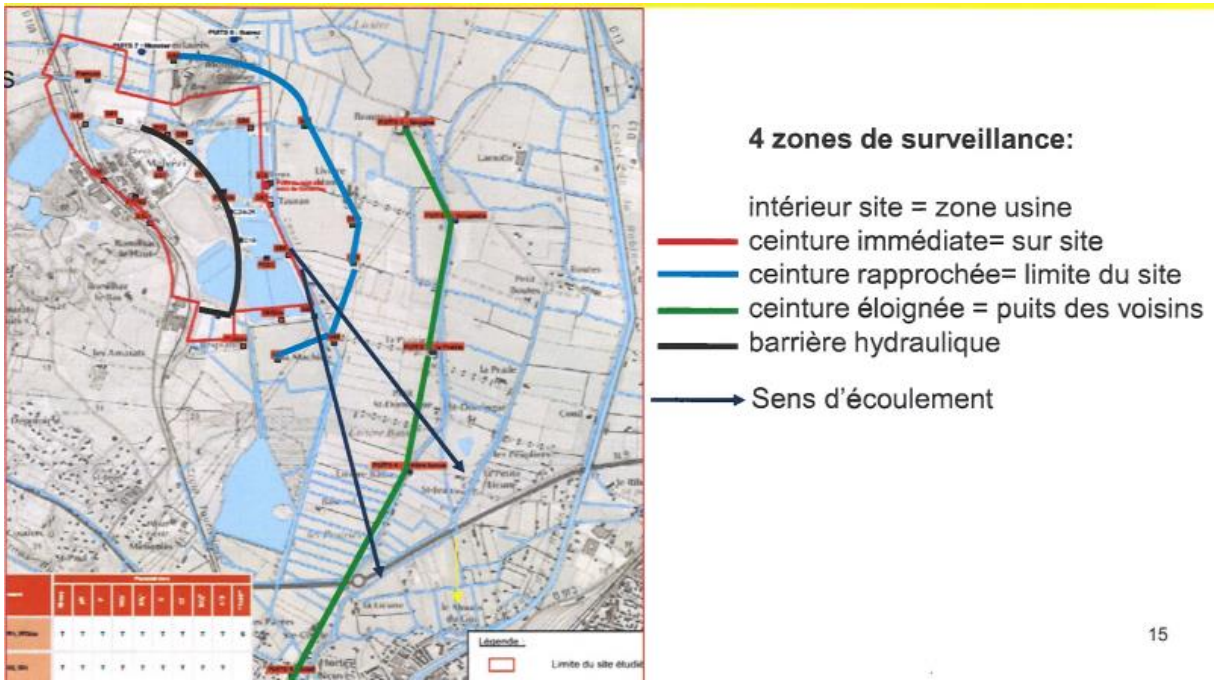


Figure 17. Ground water sampling locations

Table V. Ground water analysis programme

Uranium	Activity α /β	^{40}K	^{99}Tc	^{230}Th	^{137}Cs	Other radionuclides[7]
32*4 3*1	32*4 3*2	23*1	5*2 21*1	26*1	7*1	7*1 (1)

6.6.2 IRSN sampling

Surface water

IRSN samples the water in the water source de l'Oeillal upstream of the Malvési plant and at the canal de Tauran downstream (Fig. 18). 2 litre samples are taken twice a year on both locations and analysed in the Vesinet laboratory for uranium and ^{226}Ra.

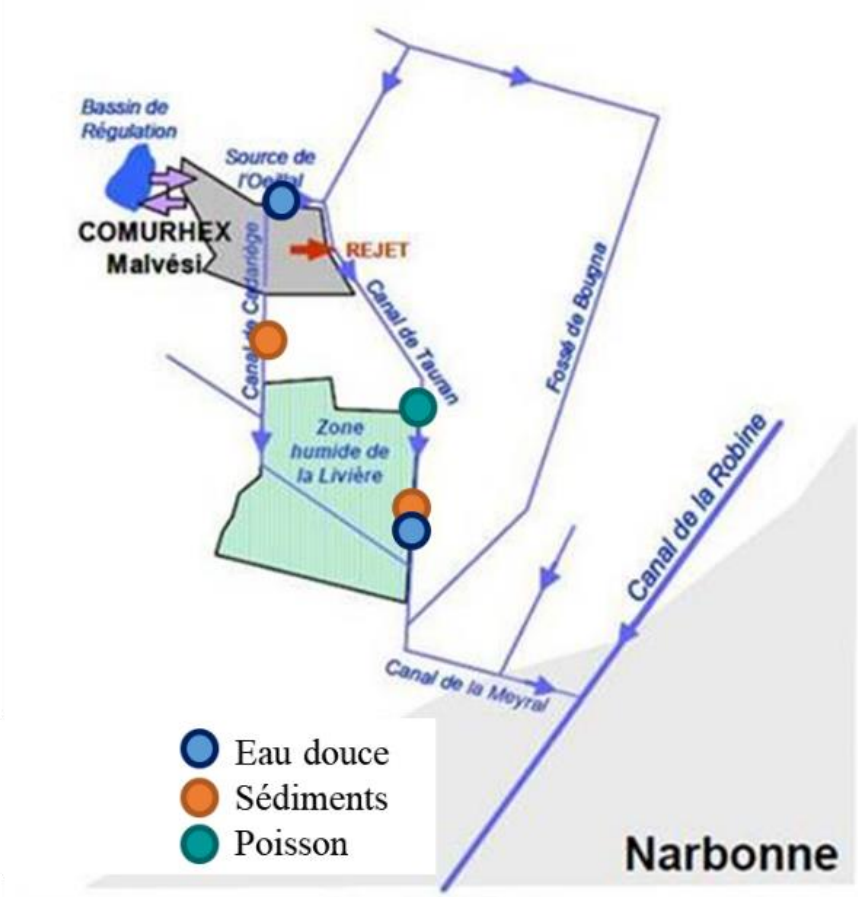


Figure 18. IRSN aquatic environment sampling (water, sediment and fish)

Marine water

IRSN samples seawater from the Mediterranean sea twice a year at the Narbonne beach (Fig. 23) for analysis at the Vésinet laboratory. The analysis includes gamma emitters and tritium.

6.7 SOIL, SEDIMENTS AND BIOTA

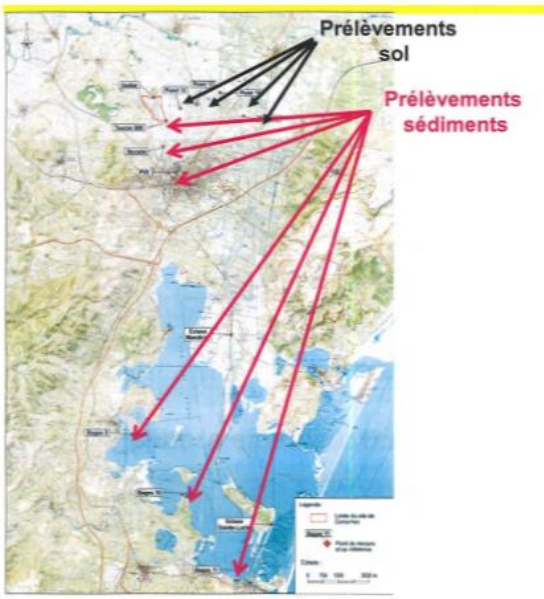
6.7.1 Orano sampling

The ARCADIS organisation has a contract with Orano to carry out sampling of surface soil, sediments and biota for uranium analysis. In 2020, this programme included 4 soil samples (1 kg) and 9 sediment

[7] ^{90}Sr, $^{239+240}Pu$, ^{232}Th, $^{226+228}Ra$, ^{241}Am, ^{210}Pb, ^{210}Po, ^{40}K, ^{234}U, ^{235}U, ^{238}U

samples (200 g). Biota is sampled annually by collection and analysis of plaintain-leaf sedge, horsetails and wild lettuce. The programme includes also water plants.

The soil and sediment sampling locations are shown in Fig. 19 below. Soil is analysed from four locations annually for uranium and for gross alpha beta radioactivity. Sediments are measured annually at the Oeillal for uranium; in other 8 locations in addition to uranium also gross alpha/beta analyses are carried out annually.

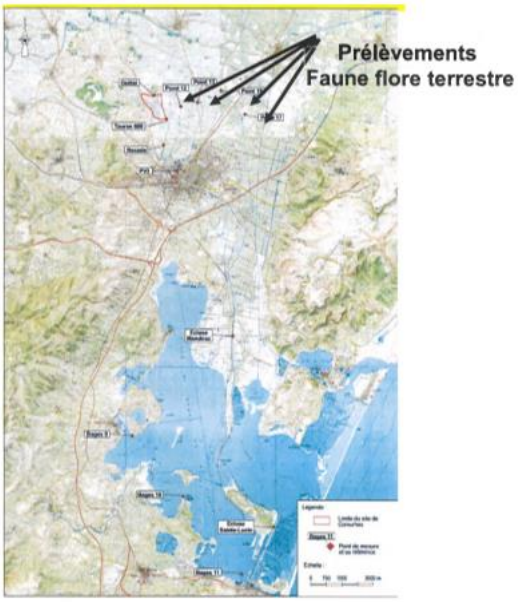


Installations	U	^{40}K	Radioactivité alpha et beta
Sols			
Point 12	A		A
Point 13	A		A
Point 16	A		A
Point 17	A		A
Sédiments			
Oeillal	A		
Tauran 600	A	A	A
Rocade	A	A	A
PV3	A	A	A
Bages n°9	A	A	A
Bages n°10	A	A	A
Bages n°11	A	A	A
Ecluse Mandirac	A	A	A
Ecluse Sainte Cécile	A	A	A

A Annuel

Figure 19. Orano sampling locations for soil and sediments

Analyses of terrestrial fauna and agricultural products are carried out once a year. The samples are taken from four locations, as shown in the Figure 20.

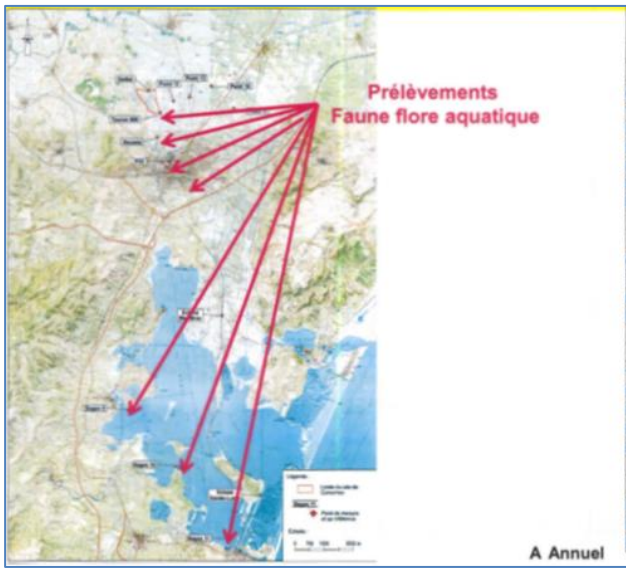


Installations	U	Radioactivité alpha et beta
Faune et flore terrestre : Végétaux terrestres		
Point 12	A	A
Point 13	A	A
Point 16	A	A
Point 17	A	A
Faune et flore terrestre : Produits agricoles		
Point 12	A	A
Point 13	A	A
Point 16	A	A
Point 17	A	A

A Annuel

Figure 20. Orano sampling locations for terrestrial fauna and flora

Aquatic fauna and flora (fish, macrophytes, arenicoles, seashell) are monitored at seven locations, as presented on the map in Fig. 21.



Installations	U	Radioactivité alpha et beta
Faune et flore aquatique : Poissons		
Oeillal		
Tauran 600	Tous les 3 ans	Tous les 3 ans
Rocade		
PV3	Tous les 3 ans	
Bages n°9	Tous les 3 ans	
Bages n°10	Tous les 3 ans	
Bages n°11	Tous les 3 ans	
Faune et flore aquatique : Macrophytes		
Oeillal	A	A
Tauran 600	A	A
Rocade	A	A
PV3	A	A
Faune et flore aquatique: Arénicoles		
Taurant 600	Tous les 3 ans	Tous les 3 ans
PV3	Tous les 3 ans	
Bages n°9	Tous les 3 ans	
Bages n°10	Tous les 3 ans	
Bages n°11	Tous les 3 ans	
Faune et flore aquatique: Coquillage		
Bages n°9	Tous les 3 ans	
Bages n°10	Tous les 3 ans	
Bages n°11	Tous les 3 ans	

Figure 21. Orano sampling locations for aquatic fauna and flora

6.7.2 IRSN sampling

The IRSN biota sampling programme in Malvési includes conifer needles and grass from three sampling sites. The analysis includes uranium and gamma emitters. In addition, the IRSN takes sediment samples from two canals downstream of the Malvési site (Fig. 19) for analysis at the Vésinet laboratory. The analysis includes Uranium, ^{238}Pu, $^{239+240}$Pu, ^{241}Am and gamma emitters.

6.8 FOOD

6.8.1 Orano sampling

Orano samples annually vegetables, potatoes, onions, etc. (depending on availability) for uranium analysis. Milk is not sampled, since there is no local production in the Malvési vicinity.

6.8.2 IRSN sampling

IRSN samples goat milk twice a year and fruit, vegetables and grain once a year (Fig. 22).

Fish and molluscs are sampled from the canal de Tauran and the Mediterranean Sea (Fig. 23). The analysis includes uranium, tritium, $^{238, 239+240}$Pu, ^{241}Am and gamma emitters.

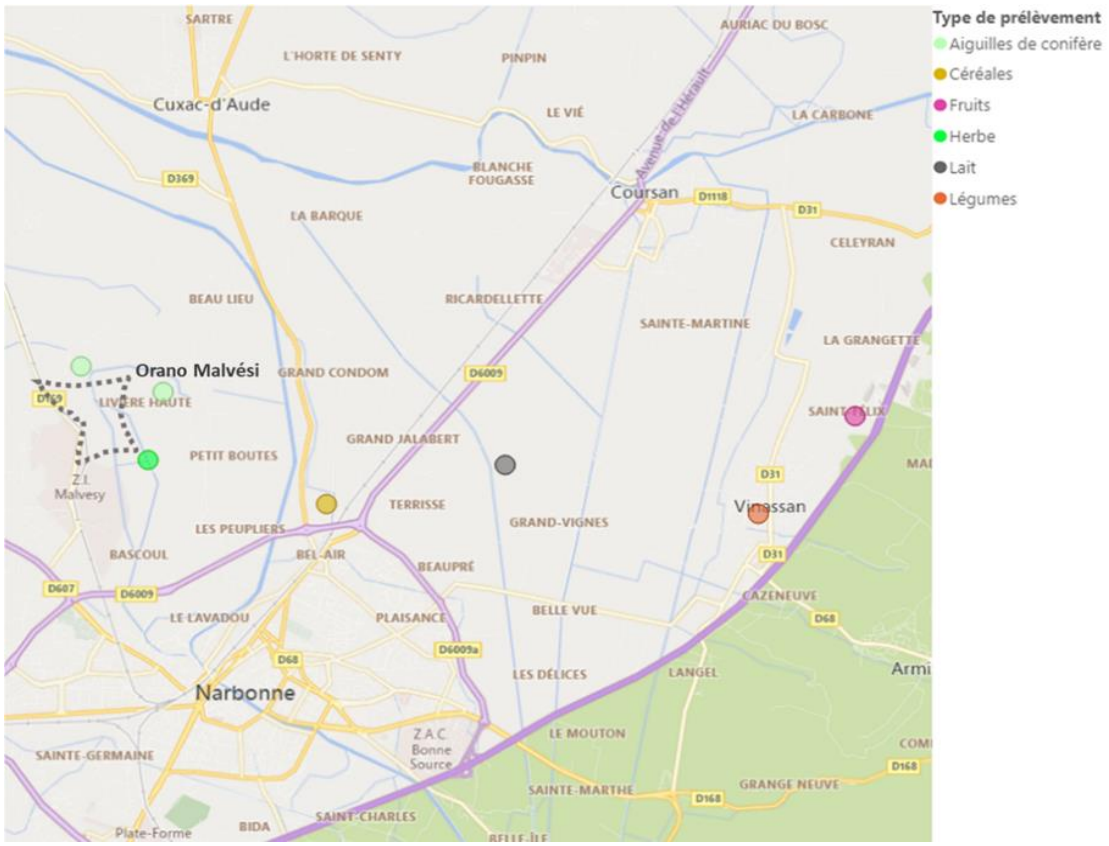


Figure 22. IRSN foodstuffs sampling sites in the vicinity of the Malvési site

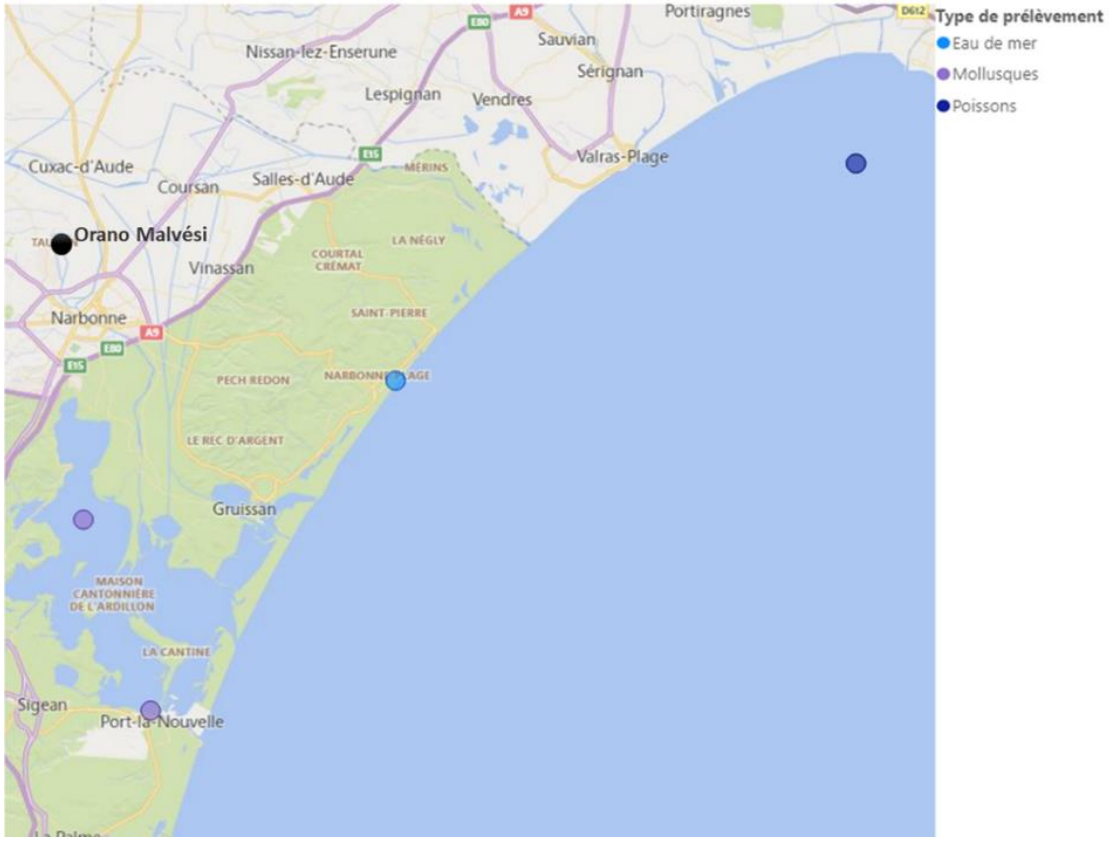


Figure 23. IRSN marine sampling in the vicinity of the Malvési site

7 PARTICIPATING LABORATORIES

7.1 NATIONAL ANALYTICAL CAPABILITIES

7.1.1 Approved laboratories to measure environmental radioactivity

In France, there are many laboratories approved to monitor radioactivity in the environment. The approval to measure environmental radioactivity is issued by a decision of the ASN pursuant to decision No 2008-DC-0099 of 29 April 2008, as amended by ASN decision No 2015-DC-0500 on the organisation of the National Network of Environmental Radioactivity Measurements. These decisions lays down the approval procedures and the qualification requirements which must be met by the laboratories in order to be certified.

The list of laboratories approved to carry out the environmental radioactivity measurements referred to in Articles R. 1333-11 (R. 1333-25 from 1 July 2018) and R. 1333-11-1 (R. 1333-26 from 1 July 2018) of the Public Health Code is available on the ASN website[8]. Approval is granted for a maximum of five years.

7.1.2 Approved laboratories to measure foodstuffs radioactivity

The laboratories approved by the DGAL to monitor foodstuffs as of 17 march 2022 are listed in the table VI below.

Table VI. Approved foodstuffs monitoring laboratories

LDA 13	Bouches du Rhône	Laboratoire départemental d'analyses Technopôle de Château-Gombert 29 rue Frédéric Joliot-Curie 13013 MARSEILLE
LDA 19	Corrèze	QUALYSE site de Tulle Le Treuil - BP 202 19012 TULLE Cedex
LDA 31	Haute-Garonne	Laboratoire départemental Eau - Vétérinaire - Air 76, chemin Boudou CS 50013 31140 LAUNAGUET
LDA 44	Loire Atlantique	INOVALYS Nantes La Chantrerie Route de Gâchet - BP 52703 44327 NANTES cedex 3
LDA 50	Manche	LABEO Manche 1352 avenue de Paris CS 33608 50008 SAINT LÔ Cedex
LDA 53	Mayenne	Laboratoire vétérinaire départemental 224, rue du Bas des Bois BP 1427 53014 LAVAL Cedex
LDA 68	Haut Rhin	Laboratoire Alsacien d'Analyses (L2A) site de Colmar 4, allée de Herrlisheim - BP 20351 68006 COLMAR Cedex
LDA 82	Tarn et Garonne	Public Labos - site du Tarn-et-Garonne 60, av Marcel Unal 82000 MONTAUBAN

[8] https://www.asn.fr/l-asn-reglemente/bulletin-officiel-de-l-asn/laboratoires-organismes-agrees-et-mesures-de-la-radioactivite

7.1.3 Approved laboratories to measure drinking water radioactivity

The laboratories approved by the Ministry of Health to carry out sampling and radiological analyses of drinking water as part of the quality monitoring of water are the following:

- Eichrom (Bruz, department 35)
- Subatech (Nantes, department 44)
- Labéo Manche (Saint Lô, department 50)
- Laboratoire Eurofins Expertises Environnementales - Maxéville site (Maxéville, department 54)
- Laboratoire des Pyrénées et des Landes (Tarbes, department 65)
- CARSO - Laboratoire Santé Environnement Hygiène (Vénissieux, department 69)
- Lyon Nuclear Physics Institute (Villeurbanne, department 69)
- SGS Multilab - Rouen site (Saint Etienne du Rouvray, department 76)
- IRSN/PRP-ENV/STEME Institute for Radiation Protection and Nuclear Safety (Le Vésinet, department 78)
- Tarn-et-Garonne Departmental Veterinary Laboratory (Montauban, department 82)
- Pearl (Limoges, department 87)
- Eurofins Hydrologie France - Les Ulis site (Les Ulis, department 91)

The list of laboratories approved to take samples and carry out analyses as part of the quality monitoring of water is available on the website of the Ministry of Health[9].

7.2 ON-SITE ANALYTICAL CAPABILITIES - ORANO MALVÉSI LABORATORY

7.2.1 General

At the Malvési site Orano operates two separate laboratories: one for quality control analyses of the end-product (uranium tetrafluoride) and the second for analyses of discharge and environmental samples. It is not allowed to transfer samples or equipment from one laboratory to another.

The laboratories have a staff of 10; 6 of them working on environmental analysis.

7.2.2 Analytical process

Sample receipt

Samples of liquid discharges arrive to the laboratory building by a special elevator and are received by the laboratory staff. Gaseous discharge samples (filters) are brought to the laboratory by dedicated staff, who have removed the filters from the samplers. The samples are then registered in the laboratory information management system (LIMS). The process includes verification of the sample integrity and recording of anomalies.

Sample preparation

Prior to the analyses each water sample is filtrated in order to remove solid particles. After filtration the sample can be directly measured for uranium. For alpha/beta counting the water sample is evaporated to a thin layer of solid residue in a stainless-steel planchet. The air filters from gaseous discharge sampling do not need any sample preparation.

Sample analysis

The laboratory carries out

- Uranium concentration analyses on the liquid samples following the standards NF M60-805-4 and NF EN ISO 5667-3
- Low-level gross alpha/beta analysis on the liquid samples following the standards NF ISO 10704 and NF ISO 11929

[9] http://social-sante.gouv.fr/sante-et-environnement/eaux/article/laboratoires-agrees-pour-le-controle-sanitaire-des-eaux

- Low level gross alpha/beta analysis on the air filter samples following the standards NF ISO 10704 and NF ISO 11929

The laboratory has the following counting systems:

- Inductively coupled mass-spectrometer (ICP-MS) for measuring uranium concentration in liquid discharges (Perkin Elmer)
- gas proportional counter LB4200 for low-level gross alpha/beta measurement in liquid discharges (Mirion)
- gas proportional counter Pégase for low-level gross alpha/beta measurement of air filters (Eurisys, taken over by Mirion)

Measurement results

All the analytical results are kept in the laboratory LIMS-system (STARLIMS), which provides full traceability of the analytical process (operator, date, modifications, materials, etc.). From the laboratory database the results are transferred to the Orano environmental database (RSE - Réseau de Surveillance Environnementale). The following rules are applied on the results below the detection limit:

- On radioactivity alpha/beta measurements, the data is recorded as 'below detection limit', when the result is below the detection limit.
- On uranium measurements, the data is recorded as 'below quantification limit' when the result is below the quantification limit.

7.2.3 Reporting of results

Analytical results are reported to the national environmental results database (RNM - Réseau national de mesure de la radioactivité dans l'environnement). In addition, there is monthly reporting to stakeholder organisations (DREAL, ASN, RNM, Orano, Agence de l'eau, etc.)

7.2.4 Sample storage

Samples are kept until the corresponding analytical results have been approved by the Orano environment unit and reported to the authorities, typically at least for one month (uranium and alpha/beta samples). Acidified water samples are kept in a refrigerator.

7.2.5 Laboratory accreditations

Orano Malvési laboratory is not accredited, however as an approved laboratory of ASN, it follows closely the requirements of standard ISO17025. The approved measurement methods by ASN are listed in Table VII.

Table VII. Orano Malvési laboratory approved measurement methods.

	Measurement method				
	Gross alpha activity on air filters (gaseous discharges)	**Gross alpha in water (liquid discharges)**	**Gross beta in water (liquid discharges)**	**Uranium concentration in water (liquid discharges)**	**Gross beta activity on air filters (gaseous discharges)**
Reference of approved method	4_03	1_03	1_04	1_17	4_04
Period of validity	01/01/2019-31/12/2023	01/07/2019-29/06/2024	01/07/2019-29/06/2024	01/01/2020-30/12/2024	01/01/2021-31/12/2025
Reference of the ASN decision	CXM-18-001986	CXM-19-000540		CXM-19-000750	CXM-20-001425

7.2.6 Outsourced analysis

Some of the analyses related to the discharge or environment monitoring programmes have been outsourced by Orano. Table VIII below lists the outsourced analytical tasks.

In addition, in the past Orano has outsourced the following control programmes:

- Monitoring of gaseous discharges in 2021 - Orano CE contracted the company APAVE (accredited by COFRAC).
- Monitoring of liquid discharges in 2021 - Orano contracted the company IRH for sampling and analysis (comparison measurements).
- In 2020 the company ARCADIS carried out analysis of soil, sediments, fauna and flora (terrestrial and aquatic).

Table VII. Orano outsourced analysis

Tableau de suivi des agréments site Orano Malvési

Labo agréé	Analyse	Code agrément	Type d'agrément	Date limite de validité de l'agrément
SEPA BESSINES	Technétium 99	1_08	Matrice eaux souterraines (Type 1)	31/12/2022
ORANO MALVESI	Alpha global	4_03	Matrice aérosols sur filtre (APA env) (Type 4)	31/12/2023
ALGADE LYON	Pu^{238}, $Pu^{239-240}$	4_13	Matrice aérosols sur filtre (APA env) (Type 4)	31/12/2023
ALGADE LYON	Am^{241}	4_13	Matrice aérosols sur filtre (APA env) (Type 4)	31/12/2023
ORANO MALVESI	Alpha et beta	1_03 et 1_04	Matrice des eaux de surface et eaux souterraine (Type 1) ***(+ jauge T600 incluse)***	30/06/2024
AREVA NC PIERRELATTE LBSE (ORANO)	Alpha et beta	1_03 et 1_04	Matrice des eaux de surface et eaux souterraine (Type 1)	30/06/2024
AREVA NC MARCOULE (ORANO)	Gamma	6_16	Milieu ambiant (Type 6)	30/06/2024
ORANO MALVESI	Uranium (ICPMS)	1_17	Matrice eaux souterraines et eaux de surface (Type 1)	31/12/2024
ALGADE LYON	Uranium	1_17	Matrice eaux de surface (Type 1)	31/12/2024
ALGADE LYON	U^{234}, U^{235}, U^{238}	4_09	Matrice aérosols sur filtre (APA env) (Type 4)	31/12/2024
ALGADE LYON	Uranium	2_17	Matrice sols (Type 2)	30/06/2025
ORANO MALVESI	Beta global	4_04	Matrice aérosols sur filtre (APA env) (Type 4)	31/12/2025
ALGADE LYON	Césium 137	4_01	Matrice aérosols sur filtre (APA env) (Type 4)	31/12/2025
SEPA BESSINES (sous-traité à ce labo actuellement)	*Thorium 230*	*1_10*	*Matrice eaux souterraines (Type 1)*	*Pas de labo agréé pour le moment*
ALGADE (à confirmer nouvelle commande)	^{222}Rn	*5_11*	Gaz air (type 5)	*Pas de labo agréé pour le moment*
ALGADE (à confirmer nouvelle commande)	^{220}Rn	*5_12*	Gaz air (type 5)	*Pas de labo agréé pour le moment*

8 VERIFICATIONS

8.1 INTRODUCTION

Verifications were carried out in accordance with the agreed programme (Annex 1). This chapter summarises the verifications carried out the by the verification team. The team has assessed the monitoring arrangements based on their own expertise and comparison with similar arrangements in other Member States.

The outcome of the verification is expressed as follows:

- A '*Recommendation*' is made when there is a clear need for improvement in implementing Art. 35. These are included in the main conclusions of the verification. The Commission requests a report on the implementation of the recommendations – lacking implementation of a recommendation can lead to a reverification.
- A '*Suggestion*' is made when the verification team identifies an action, which would further improve the quality of the monitoring.

In addition, the team may '*commend'* particularly good arrangements, which could serve as a best practice indicator for the other EU Member States.

8.2 MONITORING OF RADIOACTIVE DISCHARGES

8.2.1 Gaseous discharges

Building CX2 (ventilation)

The verification team verified the ventilation discharge air sampler in the building CX2 (ventilation). This device is identical to all other air samplers at the site. The discharge airflow passes through a HEPA filter before sampling. The sampler has a 51 mm particle filter and a total flow counter. The airflow through the filter (about 7 m^3/h) is a bypass from the total outgoing airflow. The filter is changed and analysed every two weeks. A filter change demonstration was provided to the verification team.

Yellow cake barrel sampling station

The verification team verified the operation of the ventilation discharge air sampler G2005 at the beginning of the process (Sampling station building). This sampler identical to other site samplers. Airflow was 5.9 m^3/h.

UF_4 container filling station

The verification team verified the operation of the ventilation discharge air sampler G34301 at the UF_4 filling station. This sampler is identical to other site air samplers. Airflow was 5.9 m^3/h.

No remarks.

8.2.2 Liquid discharges

The water used in the uranium process is not discharged to the environment; it is deposited in the site water evaporation ponds.

The verification team verified the unique liquid discharge point to the canal Tauran, where an automatic water collector is installed before discharge in the canal (Fig. 24). Only rain and ground water is discharged in this point. 60 ml of water are collected continuously from every 6 m^3 of discharge water. Samples are analysed daily for uranium and chemicals.

The verification team verified the water collection tank, which collects discharge water (Fig. 25). All water is treated by osmosis and analysed before discharge. The following equipment is installed at this point:

- flowmeter with a remote connection (flow 41.7 m^3/h),
- PH measurement,

- Uranium analyser installed before the water tank (not yet in use);
- Conductivity and temperature.

No remarks.

Figure 24. Automatic water sampler at the unique discharge point

Figure 25. Discharge water collection tank

8.3 MONITORING OF RADIOACTIVITY IN THE ENVIRONMENT

8.3.1 Air

The verification team verified the operation of the IRSN medium-volume air sampler (Fig. 13), which is located in a fenced area (Orano property) about 1 km east of the site, and the Orano small-volume air sampler (ALGADE, flow 6.9 m^3/h) at the site fence (Fig. 26). In addition, the team verified two Orano small volume air samplers at the point TAURAN 600. The filters are changed once a week and analysed for uranium. Th-230, Am-241, Pu-239/240, Tc-99 are analysed two times a year in an outside laboratory.

All samplers have flowmeters and total flow counters. They are located in a fenced areas protected from intrusion.

The IRSN sampler, which is part of the OPERA-AIR-network has a back-up battery for communications, but no electrical back-up for operating the pump during a power cut. Operational history can be downloaded using a hand-held code scanner and a tablet PC.

No remarks.

Fig. 26. Orano small-volume air sampler next to the site fence

8.3.2 Surface water

The verification team verified the automatic surface water collector in the point Tauran 600, which collects every 10 min a sample of 50 ml from the canal Tauran (Fig. 4). In 24h a 7 litre of sample is collected. The sample is kept in a refrigerator and then sent to the laboratory for uranium analyses once a week. The samples are kept for 3 months.

No remarks.

8.3.3 Ground water

For protection of ground water there are four underground physical barriers. Samples of groundwater are taken using piezometers. There are in total 33 piezometers on Malvesi site, part of the sampling and planning of measurements. During the visit, the verification team saw several piezometers, some very old, not used anymore for sampling, some new.

There are two types of piezometers, some of which are part of the pond stability monitoring programme (barrier monitoring) and some part of the environmental monitoring.

The verification team participated in taking sample from the piezometer PZ73 (Fig. 27). Before taking the water sample, water is taken out with a pump (four times the quantity needed, approximately 30 min). A 1 litre sample is collected and sent to the laboratory for alpha and beta global measurements, and chemical composition measurements.

No remarks.

Figure 27. Ground water sampling

8.3.4 **Other**

The team verified the Orano environment monitoring vehicle (Fig. 28). There are two similar vehicles equipped with a fridge for storage and transfer of samples to the laboratory and equipment for taking samples. Samples are brought into the laboratory through an outside elevator for avoiding cross-contamination.

No remarks.

Figure 28. Orano environment monitoring vehicle

8.4 ORANO MALVÉSI LABORATORY

8.4.1 General

The verification team visited the Orano environmental laboratory, which analyses the air filters and water samples received from the facility and the surrounding environment. The laboratory is not accredited, but it is approved by the ASN for carrying out the following analyses:

- Water: alpha total, beta total, uranium concentration
- Air filters: alpha total, beta total

The laboratory is well staffed (10 people) and has suitable working facilities. A LIMS system is available. Demonstrations of water sample filtration (uranium analysis) and air filter preparation were presented to the verification team.

No remarks.

8.4.2 Inductively coupled plasma mass spectrometry

The Orano site laboratory has an ICP-MS device (PerkinElmer NexION 300) for uranium-analysis in environmental water samples (Fig. 29). The counters are calibrated using commercial reference materials. Quality control and reporting principles were explained by the responsible technician. A quality control measurement is carried out after 10 sample analysis.

No remarks.

Figure 29. Inductively coupled plasma mass spectrometer (ICP-MS) at the Orano site laboratory

8.4.3 Gross alpha/beta counting of water samples

The Orano site laboratory has an LB 4200 gross alpha/beta counter for analysing water samples (Fig. 30). This counter is installed in the area of the laboratory that is separated with a glass wall. The counter has 8 sample positions; typical counting time is 3*16 hours. Samples are discarded after counting.

No remarks.

Figure 30. Alpha/beta counter for water samples at the Orano site laboratory

8.4.4 Gross alpha/beta counting of air filters

The Orano site laboratory uses a PEGASE alpha/beta counter for measuring the alpha/beta activity in air filters (Fig. 31). The system is quite old (from 1992), but functional. The system is equipped with an automatic sample changer. Typical counting time is 3*3 hours. Regular quality control is in place. A control chart of alpha counting was presented to the verification team. If the result indicates a high alpha activity, the sample is sent to an external laboratory (ALGADE) for alpha-spectroscopy.

> *The verification team suggests that Orano prepares for renewal of this equipment in the near future.*[10]

Figure 31. Alpha/beta counter for air filters at the Orano site laboratory

[10] After the verification visit the verification team was informed, that this new detector has been commissioned in June 2022.

8.5 OTHER VERIFICATIONS

8.5.1 Monitoring of ambient radiation dose

The verification team verified the TLD-dosimeter (number 10/21) on the site fence (Fig. 32). The TLD (identical to the one used for personnel dosimetry) is placed about 1 m above ground in an open location protected from intrusion. The TLD is analysed every three months by the Orano Marcoule laboratory.

No remarks.

Fig. 32. TLD-dosimeter on the site fence

8.5.2 IRSN environmental sample database

The IRSN presented to the verification team the database used for compiling environmental radioactivity monitoring data in France. The database receives data from the nuclear site operators, regional monitoring authorities and national organisations. This is very valuable, taking into account the large number of involved organisations in France. The system includes a website[11] (in French and English) for making data available to the public.

Verification team commends the sophisticated IRSN system for compiling and presenting environmental radioactivity monitoring data to the public.

[11] http://www.mesure-radioactivite.fr

9 CONCLUSIONS

All planned verification activities were completed successfully. The documentation supplied in advance of the visit, as well as the additional information received during and after the verification activities, met a high quality standard and proved to be very useful.

The information provided and the verification findings gave rise to the following observations:

(1) The verification activities found that the facilities to carry out continuous monitoring of levels of radioactivity in the environment, drinking water and food in the vicinity of the Malvési site are adequate. The Commission could verify the operation and efficiency of a representative part of these facilities.

(2) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the gaseous and liquid discharges at the Malvési site are adequate. The Commission could verify the operation and efficiency of a representative part of these facilities.

(3) One technical suggestion is formulated. Notwithstanding this remark, the verified parts of the monitoring system for environmental radioactivity and radioactive discharges in place are in conformity with the provisions laid down under the Article 35 of the Euratom Treaty.

(4) The verification summary is set out in the 'Main Conclusions' document addressed to the French competent authority through the France Permanent Representative to the European Union.

(5) The Commission services kindly request that the French authorities submit a report on any significant changes in the set-up of the monitoring systems.

(6) The verification team acknowledges the excellent cooperation it received from all persons involved in the activities undertaken during its visit.

ANNEX 1

VERIFICATION PROGRAMME

14 December 2021 - Orano site of Malvési

9h15	Welcome *Daniel BECT – Orano ; Eugénie VIAL, Guillaume MILOT - CTE* Introduction to the verification visit *Vesa TANNER - Commission européenne* Tour de table
9h45	General presentation of the monitoring of the environmental radioactivity in France, the national network for the measurement of environmental radioactivity and the national laboratory accreditation system *Nathalie REYNAL – ASN*
10h15	General presentation of the Orano group and of the site of Malvési *Daniel BECT – Orano*
10h45	Regulatory framework for liquid and gaseous discharges from the site of Malvési and environmental monitoring by the two control authorities *Laurent DENIS, Lisa BARRIERE – DREAL ; Nathalie REYNAL – ASN*
11h30	Organisation and monitoring program of the operator *Stéphanie WILLEMIN – Orano*
12h00	General presentation of the Institute, its national monitoring policy and the monitoring plan around Malvési Maxime MORIN – *IRSN*
12h45	Le RNM sur le site de Malvési *Nathalie REYNAL – ASN*
14h15 – 15h00	Verification visit planning
15h00 – 18h30	Visit of the site - storage park - part of a facility or factory - lagoons - factory E3

15 December 2021 - Orano site of Malvési

9h10	Team 1 – Environment monitoring *Aurélie ALLAUX - Orano* Follow-up of an environmental sample – Phase 1 in the environment : - visit of a sampling vehicle; - visit of selected measuring stations (air, water, soil); - IRSN/Orano aerosol sampling; - TLD locations; - sampling from a hydro collector; - ground water monitoring;	Team 2 – Discharge monitoring *Julie FUMAT - Orano* Follow-up of a liquid or gaseous discharge sample – Phase 1 at discharge sources: - on-line aerial discharge monitoring systems; - off-line aerial discharge monitoring systems; - liquid discharge monitoring systems;
Après-midi (17h30)	Follow-up of an environmental sample – Phase 2 on site : operator's laboratory for environmental samples (identification, measurement devices, methodology, …) *Coralie COTTENCIN – Orano*	

16 December 2021 - Orano site of Malvési

9h30	Additional visits in the site surroundings - IRSN aerosol sampling - IRSN precipitation sampling - Other locations TBD
11h00	Presentation of the IRSN environmental sample database *Maxime MORIN - IRSN*
11h30	Presentation of the Article 35 database and review of FR data *European Commission*
12h00	Time for in-depth discussions and Questions / Answers
14h30	Feedback from the verification visit *European Commission*

ANNEX 2

ORANO ENVIROMENTAL SURVEILLANCE PROGRAMME AT THE MALVESI SITE

		Uranium	Activity α / β	^{99}Tc	^{230}Th	^{137}Cs	Other nuclides	TLD	Radon+ α
Discharge water	Common discharge point (RU)	1*365	1*12	1*4	1*4	1*2			
Surface water		5*4 2*52 5*1	1*4 1*12						
Ground water		32*4 3*1	32*4 3*2	5*2 21* 1	26*1	7*1	7*1 **(1)** 23*1 (^{40}K)		
Precipitation and ground deposition		4*12	1*12	1*2	1*2		1*12 (^{40}K)		
Aerosol filters			5*52 2*24						2*12
Air ambient								22*4	
Soil and sediments	Soil	4*1	4*1						
	sediments	9*1	8*1				8*1 (^{40}K)		
Terrestrial fauna and flora	Terrestrial flora	4*1	4*1						
	Agricultural products	4*1	4*1						
Aquatic fauna and flora	Fish	5*1 **(2)**	1*1 **(2)**						
	Macro-phytes	4*1	4*1						
	arénicoles	5*1 **(2)**	1*1 **(2)**						
	seashells	3*1 **(2)**							

(1) Other radionuclides: ^{90}Sr, $^{239+240}$Pu, ^{232}Th, $^{226+228}$Ra, ^{241}Am, ^{210}Pb, ^{210}Po, ^{234}U, ^{235}U, ^{238}U.

(2) Analysis once every 3 years since 2015.

ANNEX 3

IRSN ENVIROMENTAL SURVEILLANE PROGRAMME AT THE MALVESI SITE

Matrix	Number of samples per year	Radionuclides analysed
Aerosols	52	Gamma, uranium isotopic (1/month)
Conifer needles	1	Gamma, uranium isotopic
Grain	1	Gamma, uranium isotopic
Precipitation	12	Gamma
Surface water	2	Uranium isotopic, ^{226}Ra
Sea water	2	Gamma, ^{3}H
Fruits	1	Gamma, uranium isotopic
Herbs	1	Gamma, uranium isotopic
Milk	2	Gamma, uranium isotopic
Vegetables	1	Gamma, uranium isotopic
Molluscs	1	Gamma, ^{14}C, TOL, uranium isotopic, ^{238}Pu, $^{239+240}$Pu, ^{241}Am
Fish	1	Gamma, ^{14}C, TOL, uranium isotopic, ^{238}Pu, $^{239+240}$Pu, ^{241}Am
Sediment	2	Gamma, uranium isotopic, ^{238}Pu, $^{239+240}$Pu, ^{241}Am

Uranium isotopic: ^{234}U, ^{235}U, ^{236}U and ^{238}U