RÉPUBLIQUE
FRANÇAISE
Liberté
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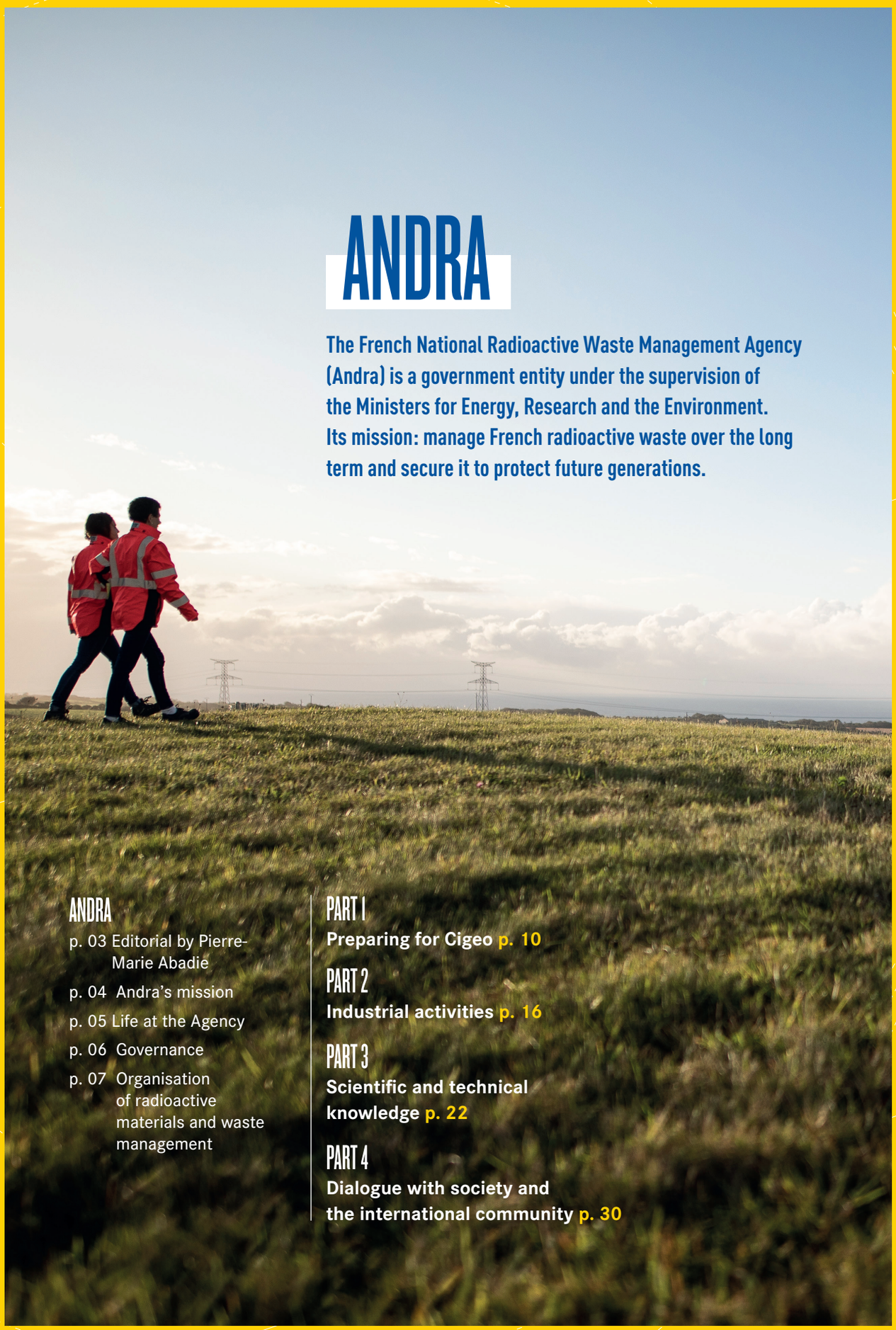
ANDRA
Agence nationale pour la gestion des déchets radioactifs

LONG-TERM RADIOACTIVE WASTE MANAGEMENT

Activity report 2022

ANDRA

The French National Radioactive Waste Management Agency (Andra) is a government entity under the supervision of the Ministers for Energy, Research and the Environment. Its mission: manage French radioactive waste over the long term and secure it to protect future generations.



EDITORIAL

2022: Pivotal decisions for radioactive waste management

The year 2022 was singular, marked by significant crises (the war in Ukraine and the energy crisis). These events remind us that, faced with the uncertainties in our society, it is imperative to start making decisions now to enable safe radioactive waste management. This is our ethical obligation regarding future generations.

Last year this position led to pivotal decisions on the organisation of radioactive waste management. We now have a strategic framework and a clear roadmap for the years to come with the fifth French National Radioactive Materials and Waste Management Plan (PNGMDR) as well as the Objectives and Performance Contract (COP) between the French government and Andra, which sets strategic and operational objectives for the long-term management of all radioactive waste.

Moving forward step by step with the support of our experience

After more than 30 years of existence as a government agency, independent from radioactive waste producers, Andra's maturity makes it a key player in the nuclear sector. This is seen in the significant milestones for Cigeo that we reached in 2022. The project's declaration of public utility, signed by the French government, reaffirms the recognition of its general interest. The finalisation and the submission of the construction license application for Cigeo enable the French Nuclear Safety Authority to begin examining the project.

We put our maturity to the test every day in our waste disposal facilities in Aube and Manche. The robustness, performance and high system safety level of our industrial activities is based on solid expertise developed over many decades, but is still fuelled by innovation and optimisation. In 2022, the safety reviews at the Aube and Manche disposal facilities went smoothly, which is a good example of this, as is the progress of the Acaci project*, for which we submitted the environmental authorisation application in 2023.

Finally, while progress is strong in France, the same is true internationally. In 2022, at various stages of progress, Finland, Sweden, Switzerland and Belgium reached significant milestones in their geological disposal project. This is also the case for Belgium and South Korea with surface disposal. These dynamic results show more than ever our collective responsibility for managing radioactive waste safely and over the long term.

*Increased capacity of Cires (Industrial Facility for Nuclear Waste Collection, Storage and Disposal) in Aube.

"From the decree declaring public utility to the finalisation of the construction licence application, important milestones were reached for Cigeo in 2022."

Pierre-Marie Abadie,
Chief Executive Officer of Andra

ANDRA'S MISSION

Monitor, in particular, the Manche disposal facility (CSM), the first French facility for surface disposal of low- and intermediate-level radioactive waste, currently in a closure phase.

Operate the two existing surface disposal facilities in Aube: the Aube disposal facility (CSA), dedicated to low- and intermediate-level waste, mainly short-lived (LILW-SL); and the Industrial Facility for Nuclear Waste Collection, Storage and Disposal (Cires), dedicated to very low-level waste (VLLW).

Study and design long-term disposal solutions for waste not yet covered: low-level long-lived waste (LLW-LL); high-level waste (HLW); and intermediate level long-lived waste (ILW-LL) through the Cigeo project.

Inform and encourage dialogue with all members of the public and inform public decisions (prepare every five years for the *National Inventory of Radioactive Materials and Waste* for substances present on French soil).

Fulfil a public service mission for collecting old radioactive objects held by private individuals and for cleanup of old sites with radioactive pollution.

Preserve the memory of disposal facilities

Share and utilise the Agency's know-how abroad

LIFE AT THE AGENCY

MANCHE DISPOSAL FACILITY

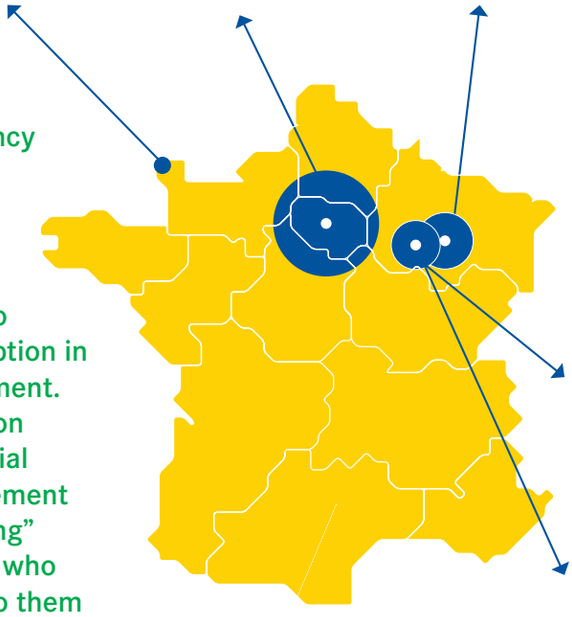
9 employees

ANDRA'S HEADQUARTERS IN CHÂTENAY-MALABRY

427 employees

ANDRA'S MEUSE/HAUTE-MARNE FACILITY (CMHM)

176 employees

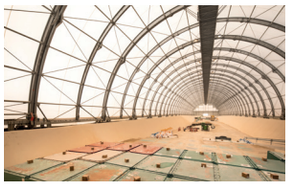


> In 2022, the Agency made a strong commitment to the ecoresponsible approach in government services. This mainly came down to reducing energy consumption in buildings and in IT equipment. We also took on prevention with regard to psychosocial risks and signed an agreement on recognising "care-giving" employees; that is, those who support someone close to them with health issues.

Fabrice Puyade,
Director of Human Resources

ANDRA'S INDUSTRIAL FACILITIES IN AUBE

Aube disposal facility (CSA)



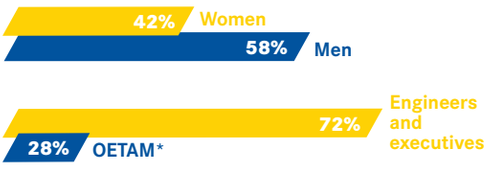
Industrial Facility for Nuclear Waste Collection, Storage and Disposal (Cires)

94 employees

Staff as of 31 December

706 employees

along with 16 doctoral students and 18 interns

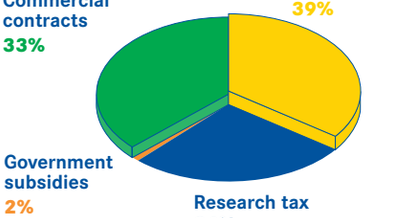


*Workers, employees, technicians and supervisors.

Finances

Budget of €223 million

Funding activities



Local purchases

€19.6 million

in orders underway, complying with the principles of government orders in dealings with local companies in the Meuse, Haute-Marne, Aube and Manche departments where the Agency's facilities are located.

GOVERNANCE

as of 31 May 2023

New organisation for the ownership of the Cigeo project

This new organisation put in place on 1 May 2022 aims to effectively carry out the examination phase of the construction licence application (DAC) for Cigeo, and to prepare for the production of the disposal facility. It is structured around the essential functions of ownership and technical leadership for producing an industrial facility on this scale. To this end, three divisions have been created within Andra:

- **Cigeo programme division.**
This division ensures the strategic direction of the programme as a whole, notably concerning structural choices, and directs the examination of the DAC dossier on behalf of the Agency.

- **Operational division of the Cigeo project.**
This division is in charge of administrative procedures relating to prior development works and their completion. It also prepares for the initial construction of the disposal facility and the development of the associated engineering tools.

- **Scientific and technical division.**
This division provides scientific and technical support for Andra's activities for the various life phases of the disposal facilities. For Cigeo, it continues to build knowledge and perform technological tests.

These three new divisions are closely linked to the safety, environment and waste management strategy division. The mission of this division is to study, specify and document the safety and environmental management strategy. It thus mobilises its expertise to support the Agency's facilities and projects.

Adolphe COLRAT
Chairman of the Board of Directors

Pierre-Marie ABADIE
Chief Executive Officer

Sébastien CROMBEZ
Director of Safety, Environment and Waste Management Strategy

Sébastien FARIN
Director of Dialogue and Foresight

Thierry LASSABATERE
Operational Director of the Cigeo Project

Frédéric PLAS
Director of the Cigeo Programme

Fabrice PUYADE
Director of Human Resources

Gaëlle SAQUET
Secretary General

Stéphan SCHUMACHER
Scientific and Technical Director

Patrice TORRES
Industrial and Grand East Operations Director

ORGANISATION OF RADIOACTIVE MATERIALS AND WASTE MANAGEMENT

Publication of the fifth edition of the French National Radioactive Materials and Waste Management Plan

At the end of 2022, the French government published the decree and order establishing the specifications of the new French National Radioactive Materials and Waste Management Plan (PNGMDR) for the 2022-2026 period. Andra has a clear roadmap for the next five years.

For the first time since its creation, the PNGMDR was developed following a public debate organised by the French National Public Debate Commission (CNDP). It also gave rise to a consultation after the public debate directed by the French Ministry of Ecological Transition, under the control of the CNDP guarantors. In addition, the ministry formed a committee of stakeholders to support it in the application of the orientations defined during these consultations.

In compliance with the law, this fifth PNGMDR was then the subject of an opinion of the French Environmental Authority and a final consultation of the public. It was definitively adopted and its implementation authorised by the Decree of 09 December 2022. This gives the PNGMDR a specifying role for radioactive waste producers, but also for Andra.

Preparing for the future

Like previous editions, this new PNGMDR aims to set up safe and long-lasting management solutions for all radioactive waste.
It is also exploring other possibilities. A larger role was thus accorded to cross-cutting challenges (public health, environmental, economic, ethical, etc.) and to consultation, notably by implementing multi-actor, multi-criteria analyses to better integrate these various challenges in the studies to carry out in the coming years.

MAIN AREAS OF THE 2022-2026 PNGMDR

Renovated governance: strengthen the association of civil society.

Storage of spent fuel: meet the needs of new capacities.

Management of high-level waste (HLW) and intermediate-level long-lived waste (ILW-LL): continue the development of deep geological disposal without pre-empting future management choices.

Strengthened interactions between energy policy and radioactive materials and waste management.

Management of very low-level waste (VLLW): improve management solutions to deal with future volumes.

Management of special waste categories: continue the implementation of suitable management solutions.

Radioactive materials: apply and anticipate waste requalification.

Management of low-level long-lived waste (LLW-LL): stabilise a strategy of overall management.

For better integration of the environmental, public health, economic, ethical, and regional challenges.

Consult the 2022-2026 French National Radioactive Materials and the Waste Management Plan.

https://vu.fr/YBJO

AN OBJECTIVES AND PERFORMANCE CONTRACT FOR FIVE YEARS

Signed in January 2022 between the French government and Andra, the new 2022-2026 Objectives and Performance Contract (COP) is based on seven strategic areas defined to meet its future challenges. It also integrates the orientations of the fifth French National Radioactive Materials and Waste Management Plan (PNGMDR) which covers the same period.

7 STRATEGIC AREAS

COLLECTIVE SUCCESS OF CIGEO,

as part of its missions as owner and aligned with the previous contract, following the declaration of public utility in July 2022.

ANTICIPATE FUTURE NEEDS

for radioactive waste management and structure the corresponding solutions as part of its missions as a public agency.

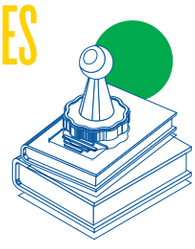
MAINTAIN INDUSTRIAL EXCELLENCE

in the operation of disposal facilities, in waste collection and storage, and in site cleanup, as part of its essential missions as an industrial operator.

ADAPT AND CONDUCT RESEARCH

and the necessary studies for the development and improvement of waste solutions, as part of its missions as a research institute.

CHALLENGES



Provide

public authorities with the means to make decisions regarding management solutions for all waste, in application of the French National Radioactive Materials and Waste Management Plan for the 2022-2026 period.

Organise

Andra to move from design ownership to ownership of the production of Cigeo and perform preliminary work.

Consult the 2022-2026 Objectives and Performance Contract

https://vu.fr/XKsL

5

STRENGTHEN INTEGRATION

of the environment, health, and security as key to Andra's projects and activities.

6

CONTINUE DIALOGUE WITH SOCIETY

and guarantee intergenerational and regional equity.

7

STRENGTHEN THE AGENCY'S PERFORMANCE

and drive its transformation.

Maintain

a high level of performance of the Agency in the areas of safety and environment, health and security, social responsibility, dialogue and consultation, satisfaction of Andra's customers and waste producers, and cost control.

PART 1

PREPARE FOR CIGEO

CIGEO DISPOSAL FACILITY

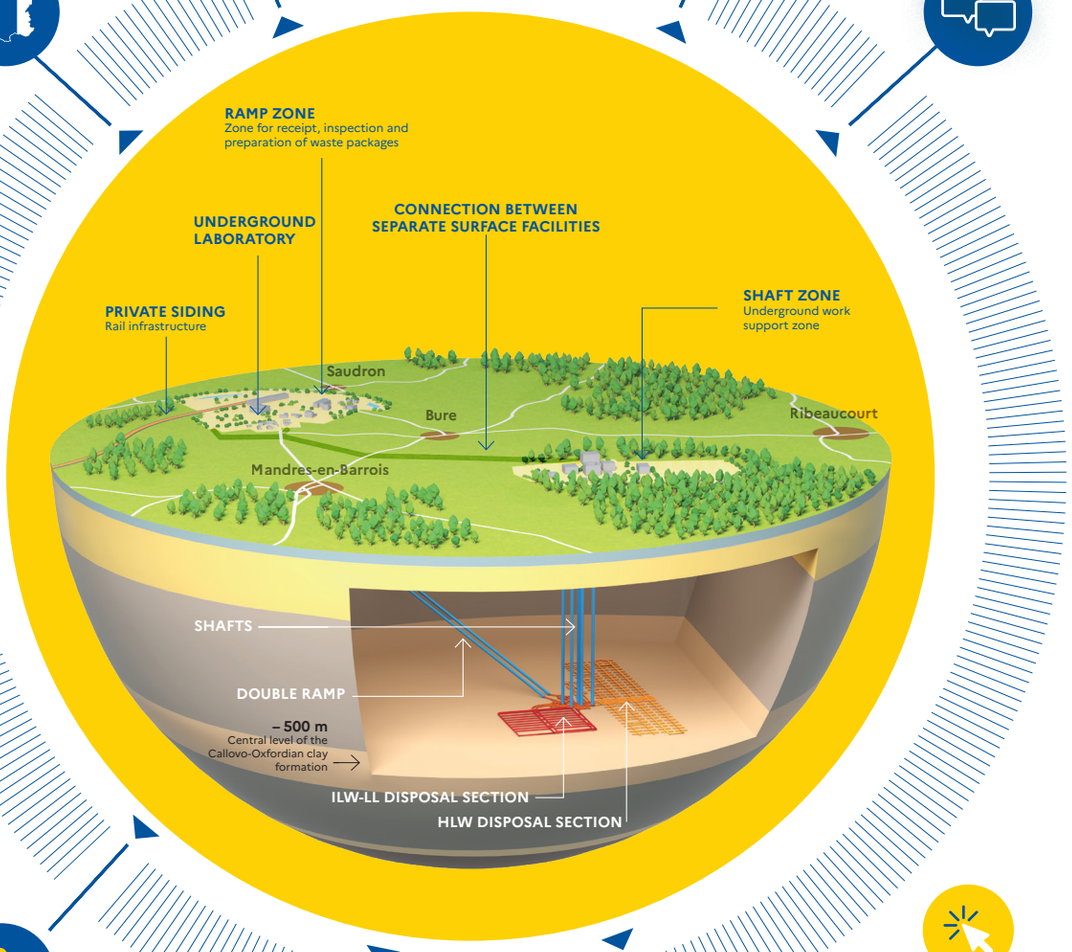
A general interest project

Assurance for future generations in a world of uncertain changes

A reversible disposal facility for at least 100 years

Support for local development in the region selected for Cigeo

Continuing dialogue and consultation with society



3

Number of acts passed (1991, 2006 and 2016) and number of public debates organised (2005, 2013 and 2019), about or linked to Cigeo

30

Number of years of research on Cigeo, evaluated at regular intervals

83,000 m³

This is Cigeo's reference inventory which corresponds to the total volume of high-level radioactive waste (HLW) and intermediate-level long-lived waste (ILW-LL) to be disposed of

Watch the video on disposal steps

https://vu.fr/hpEg

DECLARATION OF PUBLIC UTILITY

The Cigeo project is declared to have public utility

The decree declaring the public utility (DUP) of Cigeo was published in July 2022. This marked an important step for many reasons impacting the project and its continuation.

Submitted by Andra in August 2020 to the French Ministry of Ecological Transition, the DUP application dossier included the characteristics of the disposal facility, legal and administrative documents, and those concerning consultation, the economy, urban planning and regional issues. The project's impact study was the key component.

Following an examination by French government services and an opinion of the French Environmental Authority and of the 24 regional authorities concerned by the project, the DUP application underwent public inquiry in autumn 2021. It collected 4,150 contributions and obtained, during December 2021, an favourable opinion with no reservations of the inquiry board, with five recommendations. After the French State Council examined the dossier, the French government signed the decree declaring public utility, published in the French *Official Journal* in 2022.

A key milestone

The declaration of public utility for Cigeo indicates the recognition of the project's general interest. It enables guaranteeing the control of the land where the disposal facility will be located as well as the compatibility of urban planning documents (MECDU) concerned by the project, namely the regional consistency scheme of Pays Barrois, the local intracommunal urban development plan of Haute-Saulx and the local urban development plan of Gondrecourt-le-Château. These documents can thus be adapted and modified so that the project can be completed.

Next steps

The DUP is also a milestone prior to the submission of a series of authorisation applications necessary for the project's completion. However, it does not authorise the creation of Cigeo, which underwent a specific procedure (*see sidebar*).

Starting with the DUP decree, some prior operations could be initiated in the region where the project will be located, provided that the regulatory authorisations are obtained. For example, this concerns the preventive archaeology campaign and the geotechnical surveys to prepare for Cigeo's future worksite, if it is authorised. In addition, other development works prior to the construction of the disposal facility are necessary (securing the sites, preparing for and organising the surface zones to install the first operations of construction, earthworks, etc.). Some of these operations, those of connection (water, electricity, roads, railways), are carried out by other owners than Andra.

> Submitting the DUP dossier and obtaining the decree was a long-term adventure lasting more than three years. But the Cigeo project is necessarily planned over a much longer period with milestones along the way for the many decisions to come. Moving forward with Cigeo ensures the project for future generations in an uncertain climate and societal context.

Pierre-Marie Abadie,
Chief Executive Officer

ZOOM

Finalisation and submission of the construction licence application for Cigeo

Finalised by Andra in 2022, the construction licence application (DAC) for Cigeo was submitted in January 2023 to the French Ministry of Ecological Transition. It aims to obtain authorisation to start building the disposal facility with the initial construction phase. It is a voluminous dossier of around 10,000 pages that must now be examined. This supporting dossier for the construction licence application includes the description and the project development plan for the disposal facility; the safety demonstration for the facility, during operation and after closure over the long term; and the risk control study.

Consult all of Cigeo's reference documents

https://vu.fr/bkJQ

TECHNOLOGICAL TESTS

Full-scale testing of the safety of Cigeo's funicular

A full-scale demonstrator of Cigeo's future funicular was tested over several months by Andra. Objective: check that the design is robust and that the braking systems operate properly.

Cigeo's funicular will travel at a speed of 10 km/h on a ramp approximately 4 km long, inclined at 12%; its task is to carry radioactive waste disposal packages to the underground facility. Weighing nearly 210 tonnes, load included, this component is a major piece of equipment for Cigeo, the safety of which must withstand any circumstances. It was thus built with an unprecedented assembly of independent, redundant braking systems, designed to counteract any failure of the normal operating braking systems: the emergency stop brakes, the ultimate emergency brakes and the end-of-track bumpers. These components were tested in real conditions throughout 2022 in a hall of Forges de Froncles (52), specifically rearranged for this purpose.

An unprecedented braking system assembly

No conventional funicular has these safety systems, which were custom designed based on proven principles. The emergency stop brake consists of the a trolley connected to the vehicle and equipped with six clamps that tighten around the rails if an overspeed of more than 13% is detected. The ultimate emergency brake, which is triggered beyond 20% of the nominal speed, makes it possible to lower the vehicle's frame on the rails. Finally, the end-of-track bumpers slide and slow the vehicle in case of overspeed upon arrival in the station.

A unique test bench

Specially developed for the test's requirements, the demonstrator reproduced the design and operation of the full-size funicular; that is, a weight of 80 tonnes and a load of 100 to 130 tonnes of ballasts (equivalent in weight of a disposal package and its transport cask). Various scenarios were tested on an 80-metre circuit of sloped rails, making it possible to confirm braking system reliability. The results of the tests served as a basis for the construction licence application (DAC) submitted by Andra in January 2023.

> Each braking system benefits from technology and a specific information system to guarantee its independence and maximise the assembly's safety.

Cyril Briancourt,
Mechanical engineer in charge of qualification tests on the funicular

Watch a video of the demonstrator
https://vu.fr/gMKwd

ZOOM + Stacking test of ILW-LL disposal containers in concrete

The experimentation conducted since 2016 at Andra's Meuse/Haute-Marne facility produced the first results in summer 2022. Its objective was to assess over the long term the mechanical behaviour of some containers of radioactive waste packages with intermediate-level long-lived waste (ILW-LL) once stacked, which will be the case in Cigeo's ILW-LL disposal cells.

Each full container weighs more than 12 tonnes! First results: the measurements performed using fibre optics made it possible to precisely measure deformations in the containers before they become stable. They are extremely low, around 140 micrometres, or the thickness of one or two hairs for a container measuring 2.25 metres in height with 1.54-metre sides.

REGION

Agricultural compensation: A call for projects to support the sector

As part of the collective agricultural compensation related to the Cigeo project, Andra and 21 stakeholders prepared a call for projects in 2022 to support the completion of innovative agricultural projects.

If it is authorised, the Cigeo disposal facility will be installed on a surface area more than half of which is currently used for agricultural activities. Despite the reduction and avoidance measures in place, it will impact the agricultural sector in the region. As the project's owner, Andra assessed this impact in detail as part of a prior agricultural study in 2021. On this basis, compensation was planned in the form of support for innovative agricultural projects, aimed at supporting the economic potential of local agriculture.

A dedicated budget

In 2022, an initial step consisted of creating a fund of 4.4 million euros dedicated to agricultural compensation and a steering committee composed of 21 partners (institutional stakeholders and representatives of the agricultural sector and environmental associations) and Andra. Its mission: ensure that this fund functions properly and conduct a call for projects. A call for projects was then launched at the start of 2023.
It aims to mobilise agricultural, industrial and regional actors so that collective agricultural projects emerge, making it possible to compensate the region's agricultural economy impacted by Cigeo.

First projects at the end of 2023

Eligible projects must be within a geographical scope covering the former cantons of Gondrecourt-le-Château, Montiers-sur–Saulx and Ligny-en-Barrois in Meuse and Poissons in Haute-Marne and must be a source of employment and economic benefits for the region, while not competing with other existing activities. This can involve maintaining and developing existing sectors, diversifying production, developing technical and technological innovations, managing natural hazards, and adapting to climate change. The support is scheduled to start at the end of 2023 for the selected projects.

> This 4.4 million euro fund was deposited at the French deposit office (Caisse des dépôts) *via* the bank of regions (Banque des territoires), Andra's partner. This sum will not take the place of existing subventions, but will serve to support the projects in the concerned region.

Emmanuel Hance,
Engineer in charge of land operations

ZOOM

Meeting of the High-Level Committee

A meeting of the High-Level Committee (CHN) took place in December 2022 at Andra's Meuse/Haute-Marne facility. Presided over by the Minister of Ecological Transition, Agnès Pannier-Runacher, it brought together prefects and elected officials of the Meuse and Haute-Marne departments as well as representatives of the administration, nuclear waste producers and Andra. On the agenda: taking stock of the work conducted by the Agency to prepare for Cigeo, mobilising operators in the nuclear sector to participate in local economic development, and finally, reviewing progress made by regional projects and the challenges around local taxation associated with the Cigeo project.

Learn more about the call for projects **https://vu.fr/QshL**

CONSULTATION

Assessment of the consultations on the industrial pilot phase and Cigeo's governance

In September 2022, Andra published the results of the two organised consultations on the industrial pilot phase and the governance of Cigeo's disposal facility.

Conducted in 2021 and 2022, these consultations drew on several approaches to public participation to enable as many people as possible to contribute and express their opinions: public meetings and an online participation space, organising a citizen's panel, and meetings with the stakeholders. They brought together a diversity of observations and recommendations on the deployment and development of the industrial pilot phase, and on the main orientations concerning the implementation of Cigeo's governance.

Proposals to debate

The Agency had developed proposals on the duration of the industrial pilot phase (15 to 25 years) and its breakdown into two phases: construction of the facility and tests on the packages not containing radioactivity, then commissioning tests with the radioactive waste packages and start of disposal operations. It also proposed the first fundamental components of knowledge (disposal safety/security, reversibility, environmental monitoring, etc.) to be confirmed during the industrial pilot phase. From the viewpoint of governance, the industrial pilot phase will constitute, for the participation of the public and stakeholders, an implementation and break-in phase, like the tests in the facility for technical aspects.

Three major requirements

Around 40 requirements proposed by the public, citizens and stakeholders were compiled. Three major requirements were also highlighted: guarantee the public's trust throughout the project, specify the process and expectations for the industrial pilot phase, and continue and strengthen the information provided to the public.

> Providing information and encouraging the public and stakeholders to participate will be ongoing during the examination of the construction licence application for Cigeo and during the industrial pilot phase.

Camille Peiffer,
In charge of consultation

ZOOM

Progress of local consultations

From end-January to mid-March 2022, the project to bypass the departmental road 60/960 connecting Saudron to Mandres-en-Barrois (bypass necessary due to the construction of Cigeo, if it is authorised) was subject to a prior consultation conducted by the Haute-Marne departmental council. Three routes were presented during the consultation.
As for SNCF Réseau, it continued its consultation approach to the modernisation of the freight line between Nançois-Tronville and Gondrecourt-le-Château (Meuse) with the organisation of two public meetings in December 2022.
This modernisation work aims to enable the carriage of construction materials then the radioactive waste packages to Cigeo.

ZOOM

New guarantors of the consultation

In July 2022, the French National Public Debate Commission (CNDP) named two new guarantors of the consultation on the Cigeo project: Claire Morand and Jean-Luc Campagne. Their mission is to guarantee the quality of information and the participation of the public. In this way, they oversee the quality, sincerity and intelligibility of the information shared, the smooth running of the consultations and the possibility for the public to raise questions and give their opinion.

Read the summary of the consultations
https://vu.fr/YpTU

Video of results
https://vu.fr/eKcg

PART 2

INDUSTRIAL ACTIVITIES

MANCHE DISPOSAL FACILITY

Safety review of CSM continues

Started in 2019, the safety review of the Manche disposal facility (CSM) reached two major milestones in 2022.

Performed every 10 years, CSM's safety review is a regulatory examination for assessing the facility's compliance with the regulations in force and its current safety over the long term. It calls for Andra to submit a safety review dossier to the French Nuclear Safety Authority (ASN) for examination. In this framework, ASN draws on the French Institute for Radiological Protection and Nuclear Safety (IRSN) and the "standing waste group" (GP) made up of waste producers, university experts and representatives of associations.

Positive feedback from the GP

After two years of technical examination and nearly 450 questions raised, IRSN submitted its expert assessment report to the GP. This phase ended in February 2022 with an official meeting of the GP in the presence of ASN, IRSN and Andra. Pending the final decision of ASN, the Agency is working on the 29 commitments for improving the facility's safety: reinforcing the disposal facility's cap, monitoring the facility, preserving memory, updating regulatory documents, etc.

Favourable opinion of ASN

Following the submission of the safety review and its examination, in 2021 Andra submitted a request to modify CSM's safety analysis report to include the associated changes. This reference document presents the facility's safety analysis and justifies the suitability of the selected provisions to meet the safety objective. After examining the request, in 2022 ASN sent Andra a favourable opinion on this update of the safety analysis report.

> There were no particular points of contention between our proposals and IRSN's recommendations. The feedback from the GP experts was positive overall.

Catherine Dressayre,
Safety engineer at Andra

Environmental monitoring

In 2022, the Manche disposal facility maintained a very low impact on its environment.

Assessment of the radiological impact for 2022:

2,087
samples collected at and around the CSM

12,024
radiological and physico-chemical analyses

0,000,000,013
milliserverts for discharges in the sea

0,000,11
milliserverts for discharges in the Sainte-Hélène River

ZOOM

For an ever more leaktight cap at CSM

Andra has been experimenting since the end of 2022 with a design for improving the leaktightness of some parts along the boundaries of the cap and thus for sustaining it over the long term. This involves adding large impermeable concrete tiles, very resistant over time. They could help prevent water from infiltrating the boundaries of the cap, increasing its "umbrella" effect. If this option is selected and authorised, it could be installed during the work to make the cap sustainable, which is planned over the next 15 years.

New water sampling campaigns

Throughout 2022, Andra took samples of underground water *via* piezometers (bore holes) installed on and at the exterior of CSM and also in three rivers liable to be impacted by the facility's activities: Sainte-Hélène River, Grand-Bel River and Roteures River. Regular radiological controls were then conducted at Andra's analysis laboratory. Two other sampling campaigns were organised over the year, at low and high water levels to control the physico-chemical parameters. They were carried out by the laboratory ASPECT Services Environnement, one of Andra's service providers.

ANDRA'S INDUSTRIAL FACILITIES IN AUBE

A new industrial operator at the Aube disposal facility

Following a call for tenders, Andra selected Asteralis, a subsidiary of Veolia Nuclear Solutions, to ensure part of the industrial operations performed on the Aube disposal facility (CSA).

To support it in its mission of managing radioactive waste, Andra is calling on its service providers for some industrial operations (reception and inspection of packages upon their arrival at the site, environmental samples, etc.). Selected by calls for tenders, these service providers carry out their mission in compliance with the requirements stipulated in the specifications of Andra, which supports the teams, preforms daily monitoring and ensures that the required tasks are carried out properly.

Historic expertise

Since the contract with Orano NC expired in spring 2022, the Agency organised a new call for tenders to select its new service provider. At the end of the procedure and in compliance with the rules of government orders, Andra chose Asteralis, a subsidiary of Veolia Nuclear Solutions. Present on several other industrial sites in France, the company has provided services to Andra's Industrial Facility for Nuclear Waste Collection, Storage and Disposal (Cires) since 2008. Asteralis' new mission at CSA started in June 2022. The team, composed of around thirty people, includes former Orano employees who come with their knowledge of the site and participate in training new hires.

> The teams became operational very rapidly and its young recruits offer a dynamism that challenges our practices.

Elvina Blot,
Head of the operations department for Andra's industrial facilities in Aube

ZOOM

10-year safety review validated at CSA

Following the examination of the 10-year safety review dossier, in July 2022 CSA obtained the green light of the French Nuclear Safety Authority (ASN) for continued operation.
ASN highlighted the in-depth work carried out for the periodic review and noted the satisfactory deployment of a multiyear action plan aiming to improve the facility's safety level. ASN also noted that additional actions were to be continued, notably relative to the risk of disseminating radioactive substances, the site's hydrogeology and the long-term impact of disposal on the environment.

ZOOM

CSA turns 30

Commissioned in 1992, in 2022 the Aube disposal facility celebrated its 30 years of existence. It all began on 13 January 1992 with the disposal of the first packages of low-level and intermediate-level radioactive waste, mainly short lived (LILW-SL), in a reinforced concrete structure. Since then, disposal vault lines have multiplied in this dedicated, 30-hectare zone, most of them filled with packages and closed off. In around fifty years of operation, CSA will reach 1,000,000 m^3 of disposed packages, or the maximum authorised capacity.

Acaci project: Finalisation and submission of the environmental authorisation application

As part of the Acaci project (increasing the capacity of Cires), in 2022 Andra continued with the preparation of the environmental authorisation application for the Industrial Facility for Nuclear Waste Collection, Storage and Disposal (Cires). This application was submitted to the prefecture of Aube in April 2023.

Located in Aube, Cires is mainly dedicated to the disposal of very low level waste (VLLW), with an authorised disposal capacity of 650,000 m³. Since its current configuration does not enable it to dispose of all VLLW waste volumes that should be produced, several solutions are being considered by Andra and radioactive waste producers. One of them consists of increasing the disposal capacity authorised for Cires without expanding the footprint of the site's existing disposal surface area all while preserving its level of safety. This is the challenge facing the Acaci project.

> If we obtain the authorisation, work could begin at the end of 2024 to make us ready to pursue the operation of Cires around 2029/2030.

Fanny Gérard,
Head of the Acaci project

Toward 950,000 m³ of authorised disposal capacity?

This increased capacity was made possible by the disposal optimisations implemented at Cires for several years: cell extensions, raising the disposal height, etc. These successive optimisations helped in saving part of the disposal surface area initially planned, thereby freeing up a zone that would enable processing around 300,000 m³ of additional VLLW waste. In total, if it is authorised, the Acaci project could increase Cires' disposal capacity to 950,000 m³ at equal surface area. The step of submitting the environmental authorisation application will be followed by the examination of the project by government services and a public inquiry aimed at citizens and local authorities.

ZOOM

New large-scale heat exchanger cylinders at Cires

In 2022, Cires received several dozen heat exchanger cylinders from the Chinon A3 nuclear power plant, which is currently being dismantled. This VLLW waste, referred to as non-standard due to its weight (several tonnes) or its dimensions (several metres), is disposed of in the dedicated cell for large-scale radioactive waste. Between August and December of 2022, Cires took charge of a series of 64 heat exchanger cylinders, adding to the 96 cylinders already disposed of and before the reception of the last 32 cylinders, delivered in 2023.

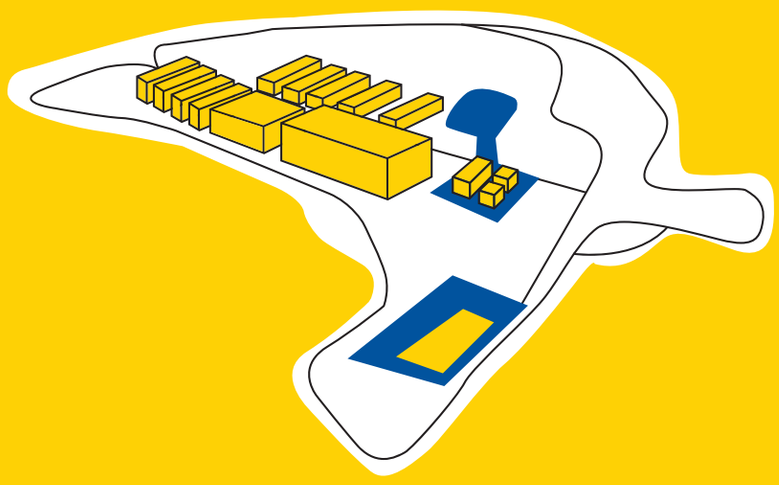
A new edition of Andra's workshops

Organised every two years, Andra's workshops enable sharing best practices between the Agency and radioactive waste producers, the goal being the continued improvement in taking charge of waste. The new edition of this event took place in June 2022 at Aube's conference centre, in Troyes, and brought together nearly 80 participants. Also on the schedule: news on Andra's industrial activities and a workshop enabling participants to exchange information on target subjects.

2022 KEY FIGURES

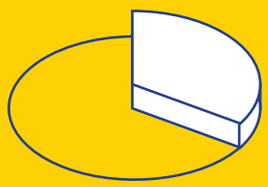
ANDRA'S INDUSTRIAL FACILITIES IN AUBE

Aube disposal facility (CSA)



Authorised capacity for packages of low- and intermediate-level waste, mainly short-lived

1,000,000 M³



37.1%
of authorised volume filled at the end of 2022

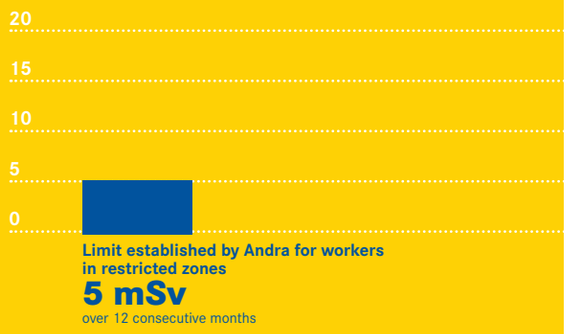
8,230 m³
of radioactive waste packages disposed of in 2022

ANNUAL DOSE OF THE MOST EXPOSED WORKERS

CSA

1.118 mSv

Regulatory dose limits per category of worker over 12 months (excluding natural radioactivity and medical uses)



mSv: millisievert
* Workers professionally exposed to ionising radiation.

MONITORING THE ENVIRONMENT AT CSA

2,735 samples taken from the environment for **16,960 radiological and physico-chemical analyses**

0.000,000,21 millisievert: the cumulative radiological impact of CSA's liquid and gaseous discharges assessed on a theoretical control group for 2022: a dose far below the regulatory limit and the impact of natural radioactivity

LANDMARKS

0.06 mSv	**1 mSv**	**1.5 mSv**	**3 mSv**
Paris-New York City round-trip flight	Annual dose limit for the population in addition to natural and medical radioactivity	Average annual exposure resulting from medical use in France	Average annual exposure to natural radioactivity in France

2022 RESULTS OF THE SURVEY OF RADIOACTIVE WASTE PRODUCERS

QUALITY OF THE RELATIONSHIP

97%
SATISFACTION

RADIOACTIVE WASTE MANAGEMENT

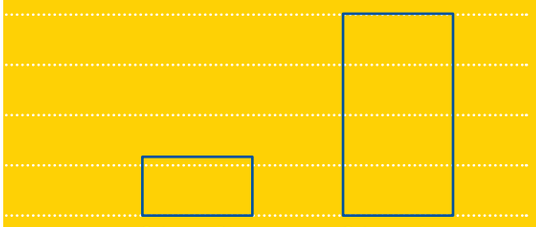
96%
SATISFACTION

SUITABLE AND JUSTIFIED ADVICE UPSTREAM OF MANAGEMENT

96%
SATISFACTION

Cires

0.287 mSv



Category B*
6 mSv
over 12 consecutive months

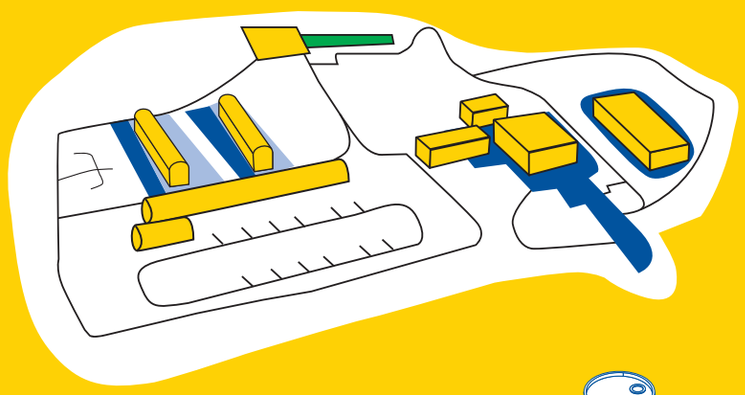
Category A*
20 mSv
over 12 consecutive months

ENVIRONMENTAL MONITORING AT CIRES

977 samples taken from the environment for **5,772 radiological and physico-chemical analyses**

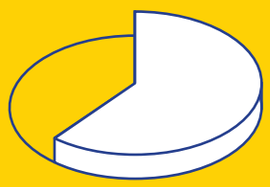
Absence of detectable artificial radionuclides added by Cires's activities in the environment

Industrial Facility for Nuclear Waste Collection, Storage and Disposal (Cires)



Authorised capacity for packages of very low-level radioactive waste

650,000 M³



69.4%
of authorised volume filled at the end of 2022

21,389 m³
of radioactive waste packages disposed of in 2022

163 m³
of radioactive waste packages from non-nuclear power activities received in 2022 in the collection building

25 m³
of radioactive waste packages with low- and intermediate-level long-lived waste received in 2022 in the storage building

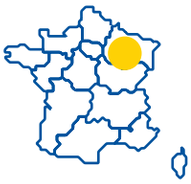
5 mSv
Average annual exposure to natural radioactivity in Brittany

10 mSv
Abdominopelvic scan

20 mSv
Maximum annual admissible dose for category A nuclear workers

PART 3

SCIENTIFIC AND TECHNICAL KNOWLEDGE



MEUSE/HAUTE-MARNE UNDERGROUND RESEARCH LABORATORY

New experiments in the underground laboratory

At the Meuse/Haute-Marne Underground Research Laboratory, Andra is actively continuing its experiments for the production of the Cigeo project, notably for optimisation and continuous improvement. This entails a range of activities, from excavation of the disposal cell demonstrators to setting up various monitoring tools.

End of excavation of the disposal cell prototype for ILW-LL waste 1 (GRD6)

The year 2022 saw the completion of excavation of the experimental "OMA" cell (structure for packages of intermediate-level long-lived waste - ILW-LL) in the so-called "GRD6" drift. This demonstrator, at Cigeo's scale (nearly 80 metres long for a diameter of 10 metres), must be able to test its feasibility in real conditions and study behaviour over time of this type of underground structure, which would be reproduced in more than 20 copies in Cigeo.

OMA's excavation was performed using a hydraulic hammer and required more than two years of work. Two successive steps were required: first the excavation of the upper part, then that of the lower part, since the excavation equipment available in the underground laboratory made it impossible to excavate such a large diameter in a single pass.

In the coming years, the demonstrator will make it possible to set up various types of liners (an initial liner in cast concrete with thickness of 50 centimetres over a length of 40 metres and a second liner combining a cast concrete thickness of 50 centimetres and a compressible material of 15 centimetres, 40-metres long as well), but also to monitor the changes in the mechanical and hydraulic properties of the rock after excavation. For Andra, this is novel at this scale, even though the damage phenomena of the rock induced by the excavation are well understood through 20 years of experience feedback at the underground laboratory *via* structures with the smallest diameters.

Acquisition of geophysical data 1 (GRD6)

A geophysical system was installed in OMA to measure the propagation of waves using sensors positioned both in the walls and in the borehole. These measurements must characterise the damaged zone created around the structure during excavation and monitor how it changes over time. To achieve this, the teams of Andra and its partners use acoustic and temperature sensors installed on an optical fibre. This method can be used to take measurements along the fibre's length. Fibre optic cables also offer the advantage of remaining in place between tests and thus of being reusable and even prolonged as excavation proceeds.

"Seismic reflection" to characterise the subsoil 1 (GRD6)

An unprecedented experiment took place in the GRD6 drift in January 2022. Its principle: emit vibrations and record their propagation using geophones (seismic wave sensors) to create an "image" of the subsoil. This "seismic reflection" operation must enable finely localising the base of the Callovo-Oxfordian clay layer, the geological formation to receive Cigeo, making it possible to refine the geological model. This technology could be considered in Cigeo's underground structures to assess with improved precision their positioning relative to the Callovo-Oxfordian layer and thus ensure a sufficient thickness of rock between the level of the drifts and the base of the geological layer.

> We needed to refine our level of knowledge with a drift at Cigeo's scale. The core samples extracted from boreholes and the sensors installed along 80 metres of the OMA test will enable finding answers to these questions.

Sarah Dewonck,
Director of the underground laboratory department of the Meuse/Haute-Marne facility

GRE drift excavated and instrumented 2 (GRE)

The excavation work of the new drift of the underground laboratory called “GRE” was completed in May 2022. It was monitored by the installation of sensors before the concrete liner was completed in view of a seal test planned for 2025. Andra is testing various technical solutions in view of closing Cigeo. The GRE drift test will entail setting up a bentonite core (swelling clay) and an adjacent backfill before artificially saturating them with water. The sensors will monitor the hydro-mechanical behaviour (deformation, compaction, pressure, etc.) of the rock and liner as well as the interactions with the bentonite core and the backfill during the test.

> One of the requirements was to feed all the sensor cables directly into the liner along the full length of the drift. The idea is to minimise the impact of the customised instrumentation and the performance of the experiments.

Jan Cornet,
Geomechanics engineer

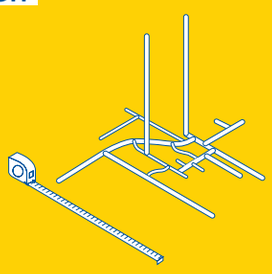
New demonstrators of disposal cells for HLW waste 3 (GAN)

Two new demonstrators of high-level waste (HLW) disposal cells were produced in the drift called “GAN” in 2022. The first, 40 metres in length, checked the feasibility of setting up a welded sleeve that improves the overall leaktightness of the cell. Welding techniques, implemented on the pipelines, were adapted to the underground environment. Once produced, the 17 welded junctions underwent inspections that checked their compliance with the required quality level. The second demonstrator, 80 metres long, with a standard sleeve (interlocked junctions), was highly instrumented with monitoring systems. The objective is to monitor thermomechanical behaviour and corrosion of the sleeve to ensure it preserves its robustness. Both demonstrators were then closed and equipped with systems for monitoring their internal atmosphere.

EVACUATIONS ALONG, AROUND AND THROUGH

-490
metres in depth

More than
1,000
meters of HLW cells



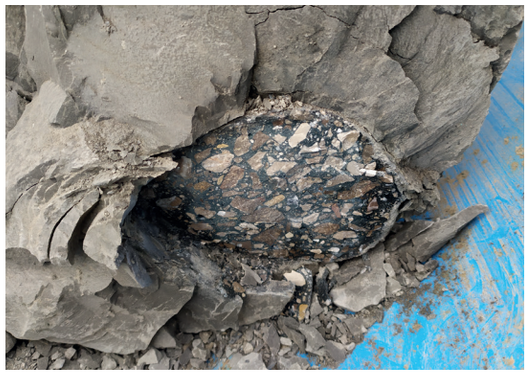
A MASS OF TECHNOLOGICAL AND SCIENTIFIC KNOWLEDGE AND KNOW-HOW

2.6 million
data collected per day

Around
6 billion
data collected since the 2000s

Hydraulic binder study: A second dismantling carried out 4 (GED)

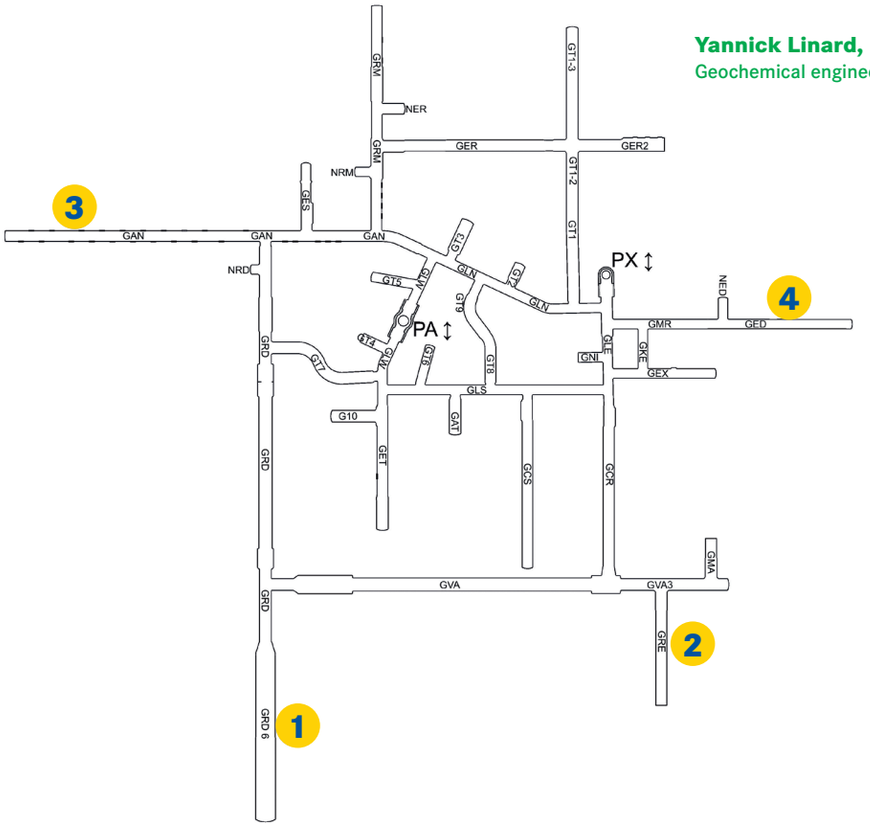
Launched in 2009, the “materials – hydraulic binders” (MLH) experiment aims to study, over several decades and in the conditions of Cigeo’s future underground facilities, the behaviour of cement-based materials when they are in contact with Callovo-Oxfordian clay. For this purpose, five boreholes filled with concrete cylinders interposed with bentonite were completed in the so-called “GED” drift and must be sampled at various points in the timeline. After an initial dismantling in 2012, the second took place end-2021/start-2022. Its analysis must supply information on the coupled chemical changes in the rock, the bentonite and the cement-based materials.



> Sampling zones to be analysed all while preserving their integrity is a complicated operation, but it was successful.

Yannick Linard,
Geochemical engineer

DRAWING OF THE UNDERGROUND LABORATORY



“PRE-INDUSTRIAL” INFRASTRUCTURE

More than
160 linear km
of cables

Nearly
250
liners (prefabricated elements that support the drifts)

AN UNDERGROUND LABORATORY OPEN TO THE WORLD

Nearly
35,000
visitors who went down in the underground laboratory since 2000, including

More than
1,500
foreign visitors

PERENNIAL OBSERVATORY OF THE ENVIRONMENT

New development works in the atmospheric station

Renovation work on the Perennial Observatory of the Environment (OPE) was completed in 2022. It must enable measurements of higher quality.

Launched in 2022, the renovation worksite of the atmospheric station aimed to replace the old prefabricated facilities with a surface area of 36 m², by a new permanent construction. The station is now housed in a 110-m² building offering optimal control of thermal and hydric conditions to ensure even more precise measurements. It was inaugurated in May 2022 in the presence of partners, elected officials and Andra employees.

A station integrated in the OPE

Installed in the higher regions of Houdelaincourt (Meuse), the atmospheric station is one of the systems set up by Andra as part of OPE. OPE's mission is to specify the state of the current environment around Cigeo project site and monitor changes over time.

Excellent observation equipment

Due to a 120-metre tower equipped with meteorological sensors and air samplers linked to ground analysers, the atmospheric station continuously measures particles in suspension in the atmosphere, the levels of the main atmospheric pollutants as well as the presence of greenhouse gases. The objective is to establish a "zero state" of the atmosphere in the region where the Cigeo project is located, before any construction, then to assess any modifications. Containing reference equipment for the scientific community, the atmospheric station is also used by the French Institute for Radiological Protection and Nuclear Safety (IRSN) to take measurements of radioactivity in the ambient air or by Atmo Grand Est to identify the chemical components of the pollutants. More broadly, it is part of a European network called the *Integrated Carbon Observation System* (ICOS) for monitoring greenhouse gases. It also opens its doors to Andra's partners to conduct their own projects.

> The atmospheric station offers the advantage of sharing the work of scientific teams. In this way, everyone's work is mutually beneficial.

Sébastien Conil,
Engineer at the OPE

Video of the atmospheric station
https://vu.fr/oJFK

ZOOM

Insect inventory

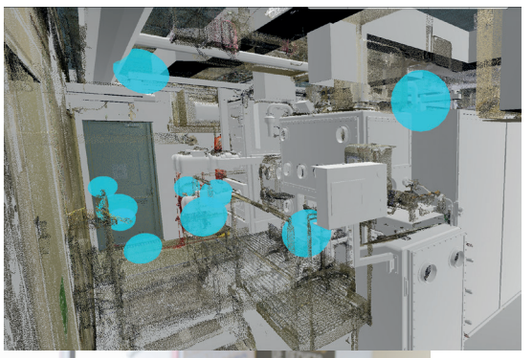
A campaign to inventory insects present in OPE's zone was conducted in the spring of 2022. Samples of targeted species (Coleoptera, syrphids, butterflies) were collected, sorted and analysed in the laboratory. Insect inventories, carried out regularly since 2012, contribute to detailing the reference initial state of the environment around Cigeo. They also ensure monitoring of the populations present in the project's regional location.

Water quality: Long-term monitoring

Sampling equipment was installed in 2022 in four waterways situated near Andra's Meuse/Haute-Marne facility (CMHM): the Saulx, the Orge, the Ormançon and the Ornain. Main objective: measure the presence of some pollutants present in low concentrations (pesticides, pharmaceutical substances and contaminants resulting from the combustion of wood, coal, fossil fuels or waste). These measurements supplement occasional and continuous monitoring conducted by Andra around CMHM.

Start of the digital twins project Ci2ANum

Initiating and testing the implementation of digital twins in Andra's industrial facilities in Aube is the objective of the Ci2ANum* project, which won the call for projects around the recovery programme for industry called "Supporting investment and modernising industry".



Digital twins consist in developing a realistic digital representation of an object, system, process, etc., with data connections enabling convergence between physical and digital states. They also integrate several technological building blocks with specific functionalities, such as the *scan to BIM (Building Information Modelling)* and virtual reality.

Optimising maintenance operations...

At the Industrial Facility for Nuclear Waste Collection, Storage and Disposal (Cires), digital twins will involve the processing of scintillation vials, performed in a confined enclosure. The operators, which have manual and maintenance operations to do, could thus work in virtual reality and check the necessary equipment. At the Aube disposal facility (CSA), the mixer room used for processing some packages before disposal will be digitalised to simulate its dismantling and the installation of new equipment.

...and supporting new projects

The whole CSA site will also be modelled to support studies and simulate various options under consideration as part of the design of new disposal structures or the construction/modification of buildings. A 3D scan of the site will be performed in 2023 in view of digital modelling.

> This project is part of Andra's global BIM approach. At CSA, digital twins enabled us to test various configurations, and even simulate the future disposal facility.

Émilie Bernard,
BIM manager and coordinator of the Ci2ANum project

ZOOM

Forty projects selected for innovation in radioactive waste management

In December 2022, as part of the "France Recovery" investment plan and its nuclear component, the French government announced the winners of the call for projects to promote innovation in radioactive waste management. Led by Bpifrance, with Andra's scientific and technical support, this call for projects led to a selection of 40 projects, representing nearly 135 million euros of investments. The winning projects involve three areas of research: development of innovative processes and techniques, recycling and reuse of radioactive materials, and exploration of alternative and complementary solutions for the geological disposal project.

ZOOM

Publication of *Essentials 2022* of the *National Inventory of Radioactive Materials and Waste*

Like every year, *Essentials 2022* presents changes in volumes at the end of 2020 of radioactive materials and waste produced in France, in addition to the *National Inventory*, published every five years. *Essentials 2022* also mentions the "prospective inventories" of the last edition of the *National Inventory*: estimates of quantities of materials and waste according to several different scenarios related to the future of the facilities and France's energy policy in the long term. The *National Inventory* is a valuable tool for guiding French policy on radioactive waste and materials management.

Consult *Essentials 2022* of the *National Inventory of Radioactive Materials and Waste*

https://vu.fr/qFFR

*Collective project backed by Andra and drawing on the expertise of Assystem, ATFF, ATIS.cloud, Human Game and SPARTE.

EUROPEAN PROJECTS

Positive step forward in the EURAD programme

During the mid-point assessment of the EURAD programme, led by Andra, the European Commission highlighted its relevance and its good governance.

eurad
European Joint Programme on Radioactive Waste Management

Launched in 2019 for five years, the EURAD programme (*European joint programme on radioactive waste management*) has the two-pronged goal of developing scientific and technical knowledge on radioactive waste management and structuring a scientific community at the European scale in this area.
Under Andra's leadership, it now brings together 115 participants from 23 European countries divided into three colleges: organisations in charge of radioactive waste management, organisations offering technical support for safety and research organisations.

Mid-point results

The official assessment conducted by the European Commission in May 2022 confirmed the utility of the programming, which aims to share knowledge more effectively and to focus research on common interest subjects. For example, these subjects involve engineered barriers ensuring the confinement of radioactive waste, near-field interactions in disposal facilities, monitoring facilities, and waste management solutions. The assessors highlighted the programme's effective management as well as the transparency and clarity of the governance process. These conclusions strengthen Andra's role as coordinator. The working themes were judged to be relevant and the initial scientific results very significant. Based on this initial assessment, the European Commission has already initiated the programme's renewal after 2024.

> One of EURAD's successes has been bringing together various types of actors so they can work together. From the programme's launch, each project had to be supported by at least two of the three colleges to be selected. This approach has led to more dialogue between the different colleges, contributing to improved understanding of the challenges.

Louise Théodon,
Research and innovation engineer at Andra and coordinator of the programme

ZOOM

Focus on the CORI working group

At the midpoint of the EURAD programme, the working group *Cement-Organic-Radionuclide Interactions* (CORI) is seeing its first results. Its objective? Improve comprehension of the role of organic compounds and their influence on the migration of radioactive substances in the cement-based materials of disposal facilities (geological disposal facilities and surface disposal facilities). Organic materials are present in some radioactive waste or used as additives in cement-based materials present in the disposal facility. For example, four families of organic materials are studied: cellulose, PVCs, ion exchanger resins and cement-based additives. The various tests make it possible to observe their degradation processes over time and their behaviour. The knowledge already acquired or to come will supplement all the knowledge on radioactive waste behaviour.

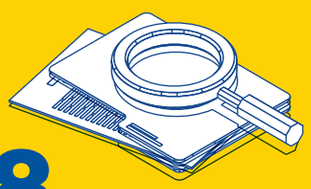
Today, EURAD brings together

115 participants,
including 51 European actors in radioactive waste management appointed by their governments (23 countries represented), three international partners (Australia, Canada and Japan) and some 60 third-party organisations.

€60 million budget
over five years, 55% funded by the European Commission.

SHARING KNOWLEDGE AT ANDRA: 2022 WAS A PROLIFIC YEAR

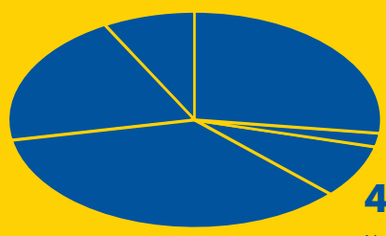
Publications



48

scientific articles published in rank-A scientific journals (international journals with peer review).

THEME AREAS



9
Thermohydrome-chanical (THM)-gas behaviour of under-ground structures and the surrounding geological medium

4
Radionuclide transfer

13
Geology, surface area and continental interfaces

1
Measurement, information processing and databases

4
Numerical simulation

17
Natural materials and engineered components

Doctoral research

2

theses defended in collaboration with French university laboratories.

17 theses were underway as of 01 October 2022.

1
on digital simulation

1
on the thermohydromechanical (THM)-gas behaviour of underground structures and the surrounding geological medium

Events

36

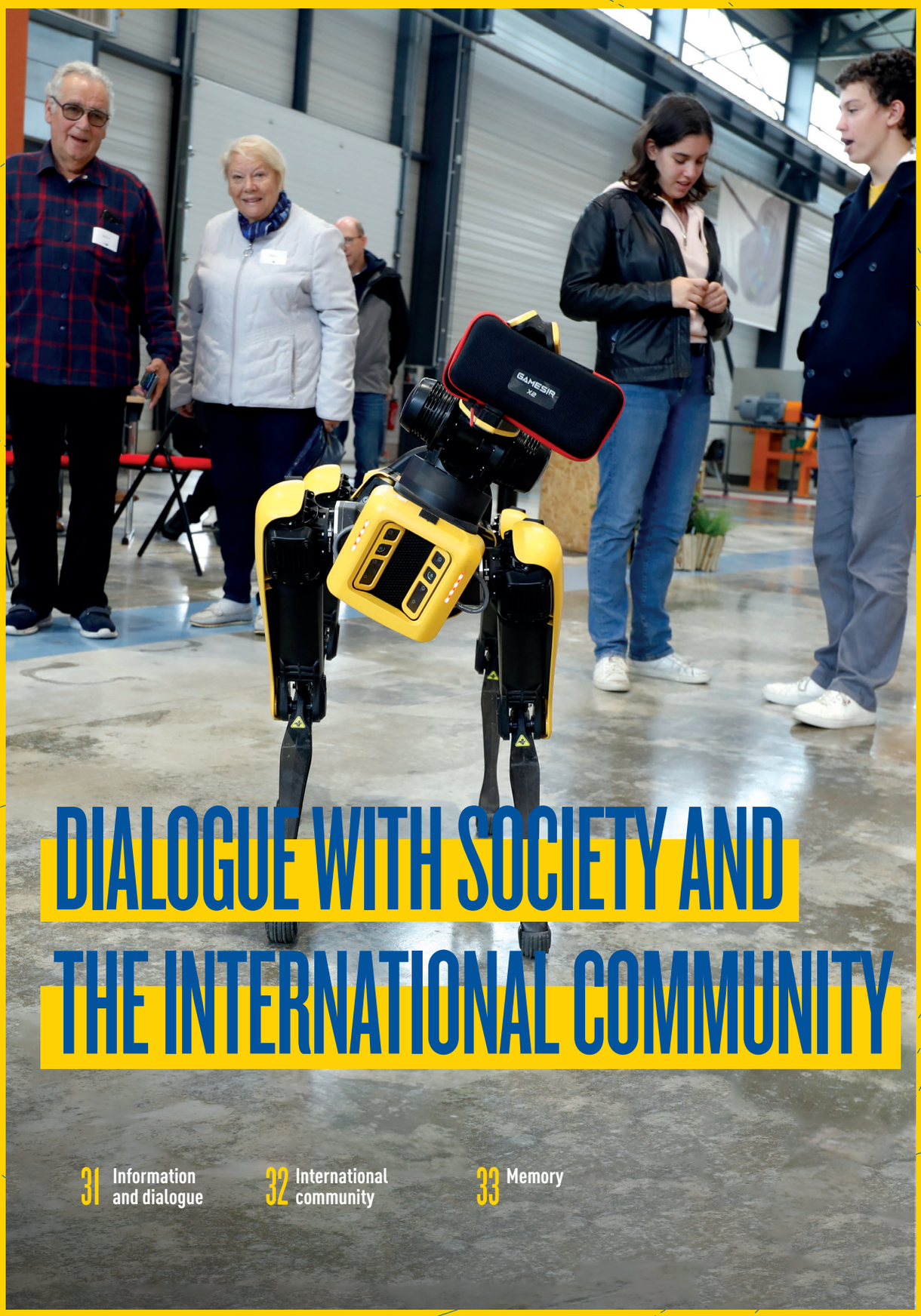
scientific events in which Andra's scientists participated.

22 international events

14 French events

56 communications (oral and posters)

PART 4



DIALOGUE WITH SOCIETY AND THE INTERNATIONAL COMMUNITY

Andra is enriching its approach to information and dialogue

In view of dialoguing with the broadest public, Andra is deploying numerous tools, forming partnerships, creating opportunities for coming together, etc., to focus attention on radioactive waste management in society. 2022 highlights.

Throughout the year, Andra's employees reach out to the public to present radioactive waste management as well as their own professions, notably during presentations in schools or for student associations. Once again aiming to encourage young people to become interested in the subject and in keeping with its partnerships with YouTubers, in 2022 Andra also supported making videos shared by Les Frères Poulain and Mister Geopolitix on TikTok and participated in a TwitchLive of @Defend intelligence on the Scar robot and the Cigeo project.

Major comeback of in-person channels

While the web and social media are a preferred means for exchange with the public, in-person channels have come back strong after the restrictions of the public health crisis. The open days on 18 and 25 September thus attracted more than 1,400 visitors to the Manche, Aube and Meuse/Haute-Marne facilities. Also in September, the "Citizens and science: how to have confidence regarding controversial subjects?" conference, organised in partnership with Youmatter – a media group for ecological and social transition–enabled some 40 citizens to think about the dialogue between science and civil society. Finally, because the inhabitants in the regions where Andra is located are the most impacted, it regularly leads information and dialogue initiatives, notably working with local media and actors. A partner with the web radio "Troyes Aube Radio" since its creation, the Agency has continued to host a monthly show making science more accessible, renamed in 2022 "Get scientific with Andra". On the playlist: radioactivity, environmental monitoring, geology, etc. Since September 2022, the show is also broadcast on the FM band. Once again in Aube, the local TV channel, Canal 32, broadcast a special show on the 30-year anniversary of the Aube disposal facility (CSA).

> The open days are one of the best ways for members of the public to understand on their own the reality of radioactive waste management and exchange views with Andra's employees.
>
> **Thierry Pochot,**
> Head of communication

158
meetings with university actors, students, prestigious higher eduction schools, etc.

Nearly 160
local projects supported

11,751
visitors at Andra's facilities

47,382
consultations of Andra's newsletter

1,005,498
copies of Andra's magazine distributed to inform all local residents

1,302,240
views of *Andra's posts* on social media

ZOOM + Promoting scientific and technical culture

Andra regularly organises events, often linked to scientific, technical or environmental meetings (science festival, nature festival, etc.). This programming is part of its efforts to provide information and aligns with its commitment to openness and its desire to promote scientific and technical culture. In 2022, the Meuse/Haute-Marne facility proposed a new exhibition, "The secret of bees", which links with the activities of the Perennial Observatory of the Environment. Environmental questions were also the through-line of the year at the Aube facilities with the organisation in May of a night-time outing to discover the flora and fauna around CSA, as part of the nature festival; then the organisation of a workshop, "Climate fresco", in October as part of the science festival. The latter event resulted in Andra's presence in the science village of Cherbourg-en-Cotentin (Manche) to present its activities and help participants discover a fog chamber*.

*Particle detector that works by making invisible radioactive traces observable.

INTERNATIONAL COMMUNITY

International conference on clay: Summit meeting

Nearly 450 international experts participated in the 8th *Clay Conference*, organised in June 2022 in Nancy. This was a major scientific meeting dedicated to rocks and clay-based materials applied to geological disposal of radioactive waste.

> This gathering was an opportunity to share on a worldwide scale scientific and technical knowledge concerning clay and its uses for radioactive waste disposal. It also reviewed the advances in various disposal projects underway in the world.
>
> **Marie-Anne Bruneaux,**
> Head of the recovery, innovation and coordination department for research projects

Postponed for two years due to the public health crisis, this year the *Clay Conference* has reunited with its public. Countries conducting research on the disposal of radioactive waste have been looking forward to this 8th edition, organised by Andra. Because of its properties that enable retaining chemical and radioactive substances, clay is one of the host rocks selected by several countries for their disposal project. And the *Clay Conference* is the only scientific gathering in the world entirely dedicated to this subject. In attendance were 450 international experts specialised in the field who came together to learn and exchange information, such as Andra's counterpart organisations, scientists from the academic world, or the world of public and private research.

A full panorama

All the main theme areas linked to clay were covered—geomechanics, geochemistry, excavation techniques, monitoring systems, digital tools, migrations of radioactive and gaseous elements, etc.—including all phases of disposal facilities from design to post-closure. Andra experts were also able to present the most recent advances in the scientific and technical studies concerning the Cigeo project, which is now backed by more than 30 years of research. Finally, aside from the presentations, time for exchanging ideas was organised to facilitate the sharing of knowledge and experience.

ZOOM

Younger generations are central to the international debate

In October 2022 in Belgium, the annual meeting of the *Forum on Stakeholder Confidence* (FSC), the group of OCDE's Nuclear Energy Agency, took place. The FCS is in charge of analysing the role of stakeholders in radioactive waste disposal projects. Local actors, students and experts from various countries came together to exchange ideas, particularly about the role and participation of younger generations in these projects over the long term. Andra was present with a French delegation and presented its dialogue approach, notably on social media, to broaden the modes of expression about radioactive waste and further open the debate on the subject.

ZOOM

International discussions on geological disposal

The 6th edition of the International Conference on Geological Repositories (ICGR) took place in Finland at the start of April, 2022.
This event was organised by the OCDE's Nuclear Energy Agency and reviewed progress around the world in the area of geological disposal of radioactive waste. More than 200 participants from all over the world came together to exchange ideas and information on the edition's theme: turn designs of geological disposal facilities into operating sites. The Andra delegation was there to deliver presentations on the contribution of the Meuse/Haute-Marne Underground Research Laboratory, on the technical maturity of Cigeo and on maintaining skills and dialogue. In addition, an emphasis was placed on young professionals, since intergenerational transmission is of particular importance for these long-term projects.

Supporting foreign countries in radioactive waste management

Andra is sharing its experience acquired in France with countries not as advanced on the subject. Through this aid, it enables them to acquire effective equipment and resources for safe management of their radioactive waste. Focus on two examples of Andra's support in 2022.

From 2016 to 2020, Andra led a European project to support Iraq in dismantling its nuclear facilities and managing its radioactive waste. After an initial implementation phase, the project was continued in November 2022 to strengthen the capacities of the Iraqi Radiation Protection Institute in radioactive waste management. Andra is once again involved in this second three-year phase. Ultimately, the project must enable Iraq to have the most compliant operation relative to international standards set by the International Atomic Energy Agency and to the European Union's best practices.

Project review in Australia

In 2022, Andra also organised a project review for a surface disposal facility for low- and intermediate-level radioactive waste in Australia. Andra's counterpart, ARWA (*Australian Radioactive Waste Agency*), highlighted the review's very constructive approach along with French proposals and recommendations. It now plans to call on Andra to train part of its staff.

Remote training for China

Training is a major area in the relations between Andra and its foreign partners. This is notably the case with China and the subsidiary of the *China National Nuclear Corporation, Everclean*. Due to restrictions on travel between the two countries, the Agency reorganised its training programme on disposal facility safety to offer it as an entirely remote version. During three weeks in 2022, this programme enabled some ten Andra experts to contribute, all while taking account of the constraints of the time change and ensuring good training consistency.

ZOOM

Promoting a high level of safety in radioactive waste management

Between the end of June and the start of July 2022, Andra participated in the 7th meeting for examining the common agreement on managing spent fuel and radioactive waste. This event brought together 76 contract partners in Vienna at the headquarters of the International Atomic Energy Agency (IAEA). For France, this meeting marked the completion of significant collective work between the French Nuclear Safety Authority, the French Institute for Radiological Protection and Nuclear Safety, and Andra, with the handover of French representation to IEAE. The French report highlighted the progress made over recent years. Andra conducted a socioeconomic study of the Cigeo project that was highlighted as having exemplary "best practices" at the international level.

ZOOM

Strengthened cooperation with the United Kingdom

As in France, the United Kingdom is interested in the properties of clay for the deep geological disposal of the most radioactive waste. With its British partner, Nuclear Decommissioning Authority (NDA), Andra thus boosted the cooperation agreement signed in 2019 between the two public organisations. After a first leadership committee organised in October 2022 at the Meuse/Haute-Marne facility, some fifteen meetings between Andra and the NDA took place on a variety of subjects: science and technology, project management, engineering, safety, communication, etc.

MEMORY

Artistic creation central to the conversation on memory

As part of its programme, “Memory for future generations”, in 2022 Andra organised, in association with Le Signe, the French national centre for graphic design in Chaumont, the second edition of the artist residency, “Graphic design prospectives”.

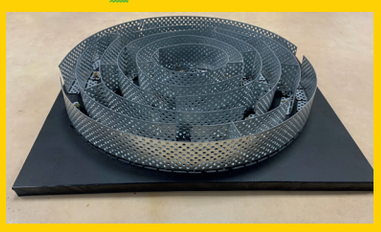
The artist residency programme, “Graphic design prospectives", aims to explore ways to inform and alert future generations about radioactive waste. In this way, it is contributing to the preservation and transmission of memory, which is one of Andra’s missions. The residency, lasting five months, gives artists, graphic designers and other specialists of visual culture the opportunity to delve into the subject. After the first edition in 2020, focused on conversations around a sustainable sign system in relation to the harmfulness of radioactive waste, Andra wanted to renew the project.

Shadow play

Juliette Nier, an independent graphic designer and author, was selected in January 2022 for the second edition of the residency, based on the educational question (study of knowledge acquisition). Starting in March 2022, the artist set out to imagine a poetic and pedagogical narrative on radioactive waste and its origin. The fruit of this work was a shadow play that brought symbolic, stainless steel objects to the stage: energy, electricity, radioactivity, radioactive waste packages, etc. This nuclear “technogony” (techno- for “technical” and -gony for “genesis”), as named by Nier, is intended to be spread widely so that it can become anchored in our collective memory. A performance was also organised in September 2022 during the open days at Andra’s Meuse/Haute-Marne facility, then at the Agency and finally in a cultural space, *La Générale*, in Paris. Other representations are planned in 2023 in schools.

> Andra’s “Memory for future generations” programme is part of an ethical and intergenerational conversation. It aims to reflect on solutions for prolonging as far ahead as possible the memory of radioactive waste disposal facilities.
>
> **Florence Poidevin,**
> Head of the “Memory for future generations” programme

ZOOM



An educational project on the identity of a disposal site

Initiated by their teachers in technology and visual art and with the support of Andra, 85 middle school students in Brienne-le-Château (Aube) made artwork about the preservation and transmission of memory of radioactive waste disposal sites. Their creative work was presented in June 2022 at an ephemeral exhibition. This project thus aims to maintain as long as possible the collective awareness of the existence of radioactive waste disposal facilities.

ZOOM

A photo competition driven by memory

In 2022, Andra and the World Art Institute of Youth – Centre for Unesco (IMAJ) invited all amateur and professional photographers to participate in the fourth edition of the “Capture your industrial heritage in the Grand Est region” competition. This initiative aims to enhance and pass down the memory of the industrial heritage in the region. The jury, composed of professional photographers, specialists and enthusiasts of industrial heritage, and Andra and IMAJ representatives, had to choose between 150 pictures to select seven winners.

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Design & production CIMAYA.
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This report was printed on PEFC certified paper (PEFC/ 10-31-1588) with organic inks; the printer is certified Imprim' Vert.

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