

**ANNUAL SUSTAINABLE
DEVELOPMENT
AND ACTIVITY
REPORT
2011**

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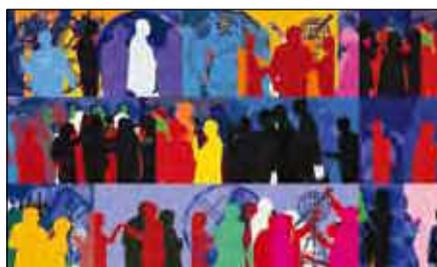
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A work of art for Andra's 20th anniversary

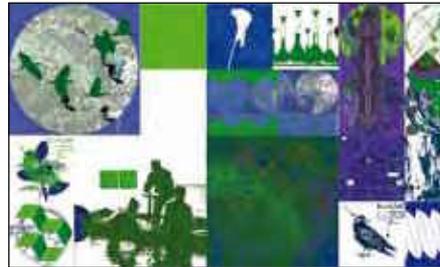
Created for the 20th anniversary of Andra, this twelve-part artistic record by Charles Giulioli, "artistic and engineer", is inspired by Andra's activities. Construction, innovation and development combine to form an original illustration of Andra's history.

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WORD OF THE YEAR

CHANGE

MARIE-CLAUDE DUPUIS,
Chief Executive Officer

2011, A YEAR OF CHANGES

If one word had to be used to describe 2011 for Andra, that word would certainly be change. Andra has undergone significant internal changes, both in the running of the Cigeo project as well as in the improvement of the quality of services to all our customers. This underlines our ability to adapt to new challenges, but the year was not just about that. In fact, 2011 was a positive year from many standpoints, and encouraged us to continue and carry through our scientific research and our technological development projects.

Throughout 2011, we were involved in intense activity, mobilising all our energies to prepare for the Cigeo industrial design phase - the future geological industrial disposal facility - and to issue the first invitation to tender, in July, for the Management System of the Project. This preparation led us to create two divisions to provide us with efficient strategic means and operational systems to best carry out one of the largest French industrial projects. Cigeo also provides a great development potential for its two host districts, the Meuse and the Haute-Marne, which has led Andra to participate in the production of an inter-district area development scheme, led by the Meuse prefecture jointly with local stakeholders.

In 2011, Andra also entered an entirely new commercial development era with the creation of the “*Industrial customer solutions*” department. Our new brand, ADS – *Andra Disposal*



Solutions – similarly involved with our International customers.

Another notable event was the beginning of clean-up operations on several polluted sites, driven by the “*Diagnostic Radium*” operation. This was one of our public service missions, laid out in the Act of 28 June 2006, for which we committed to provide information to and dialogue with the concerned populations.

Amongst the successes achieved in 2011, licenses for the activities of the Underground Laboratory was extended until 2030, permit to construct the eco-storage - the future “bank” of samples taken within the framework of the permanent environmental observatory was obtained - and the positive decision from the public enquiry committee for our collection and storage project in the Aube district for waste not generated by the nuclear power industry. These all reflect acknowledgement of Andra’s expertise.

Finally, Andra plays a major role in sustainable development. Whether it is our “*Reminder to future generations*” project or our permanent vigilance with regard to the impact of our activities on the environment and health of the population, the heart of our operations is to implement our new strategy every day in all aspects of radioactive waste management. In the years to come, Andra will face new scientific and technological challenges, especially to reduce the volumes of waste to be disposed of, and to save that rare resource: our disposal capacity. ●

WORD OF THE YEAR

DIALOGUE

FRANÇOIS-MICHEL GONNOT,
Chairman of the Board of Administrators

CONSTANT PROGRESS IN THE SPIRIT OF CO-OPERATION

In 2011, Andra celebrated its 20th anniversary. In reality, we are a little bit older, having first been created in 1979 within the CEA. The Act of 30 December 1991 made us independent from the radioactive waste producers and gave us the freedom to follow our own objectives. The achievements over these two decades are impressive, when you think that we have become a reference in radioactive waste management - both in France and internationally - and that today, with Cigeo project, we have become pioneers in the disposal of high-level and intermediate-level long-lived radioactive waste.

This success is due to a unique management model, desired by parliament and developed by Andra, observing two fundamental requirements: safety and acceptance from the local population.

The safety of our installations is a requirement that we observe with the strictest rigour and which is the subject of numerous inspections and assessments by our institutional system. The acceptance of the local population relies on a policy of openness, dialogue and transparency that we apply in the areas where our installations are located, with the desire to contribute to their economic, social and cultural development. Consultation is ingrained in our company culture and we maintain an on-going relationship with all local players. We are convinced that sustainability can only be built by



consensus and all the more so as our activities commit the future of our society.

Andra is an industrial operator, involved in research and development, spreading scientific culture and exporting its know-how. The missions entrusted to Andra have not ceased to expand over time and have provided it with a front-row seat on the international scene. The quality of its scientific work is respected well beyond the borders of France.

The introduction in 2011 of the ADS brand - *Andra Disposal Solutions* - will contribute to reinforcing the visibility of the solutions Andra proposes to its foreign customers, not only in terms of disposal concepts and technical assistance but also in terms of communication.

Finally, we have to mention the Fukushima disaster, which has brought up searching questions on nuclear safety and risk assessment. Our vigilance over protecting man and the environment has never been so high. ●

2011 IN PICTURES



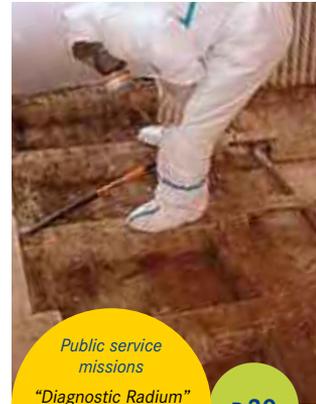
Human resources
99 people recruited in 2011

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Governance

Meuse/Haute-Marne inter-district area development scheme launched by the Meuse prefecture, in connection with Cigeo, the future geological industrial disposal facility.

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Public service missions

"Diagnostic Radium" operation: decontamination of a Parisian apartment

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Scientific policy

Signing of a partnership agreement with the National Laboratory of Metrology and Tests

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Industry

Completion of the 2nd disposal facility vault cover section for very-low-level waste

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Industry
Completion of the construction of the 8th disposal facility work section for low- and intermediate-level waste

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Environment
Permanent environmental observatory: official opening of the "flux tower" at Montiers-sur-Saulx (55)

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Sustainable development

Iron mining exhibition in partnership with the Flamanville-Diélette mines and quarries history and heritage association

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Dialogue

"From Homer to Oppenheimer", an exhibition to find out everything about radioactivity

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Technological research, experiments and developments

High-level vault instrumentation



And tomorrow?

Finalisation of the collection and storage project for radioactive waste not generated by the nuclear power industry

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International
A first complete training cycle with South Korea

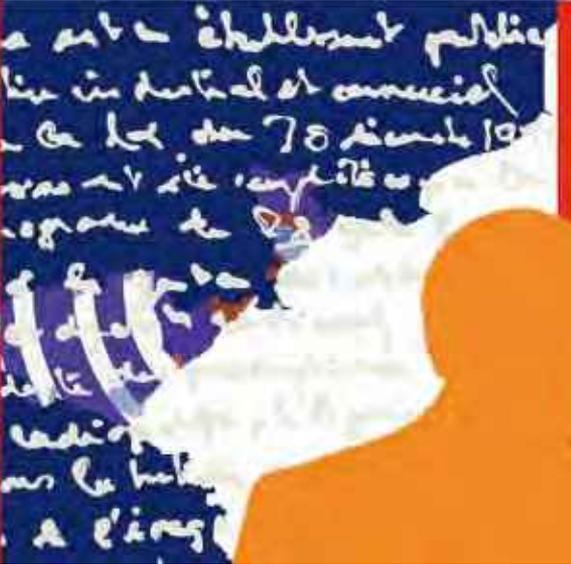
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Future generations

"Reminder for future generations" project: the industrial sapphire as a sustainable support



LEAIRE VISEE L'AR
SUBSTANCE
MATIE
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DECH
ETS RA
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Governance

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The industrial committee:
a new Andra advisory body

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Securing the financing for long-term costs

GOVERNANCE

The French National Radioactive Waste Management Agency

STATUS

Created in 1979 within the CEA, the Act passed on 30 December 1991 made Andra a public industrial and commercial establishment, independent from the radioactive waste producers, placed under the supervision of the Ministries for Energy, Research and the Environment.

The State has made the Agency responsible for implementing and guaranteeing safe management solutions for all French radioactive waste, to protect present and future generations from the risks that this waste presents.

GOVERNANCE

The governance of Andra is conducted by a board of administrators, with François-Michel Gonnot as Chairman.

The Chief Executive Officer is Marie-Claude Dupuis, who chairs the Management Committee comprising:

- Jean-Paul Baillet, Deputy Chief Executive Officer and Director of the Meuse/Haute-Marne Facility.
- Fabrice Boissier, Risk Management Director,
- Bruno Cahen, Industrial Director,
- Alain Harman, Director of Engineering and of the Cigeo Project
- Thibaud Labalette, Programme Director,
- Patrick Landais, Research and Development Director,
- Gérald Ouzounian, International Director.
- Valérie Renauld, Communication Director,
- Gaëlle Saquet, Corporate Secretary,
- Paul Talneau, Human Resources Director.

A financial committee, an industrial committee and a scientific council complete the governance of Andra.

FINANCING

Andra is financed by:

- **the radioactive waste producers:**
 - via a “research” tax over and above to the tax on basic nuclear installations, collected by the French Nuclear Safety Authority and paid into the research fund managed by Andra (approx. M€120 in 2011),
 - via commercial contracts for waste collection and the operation and monitoring of disposal facilities (approx. M€60 in 2011),
- **a grant from the state for Andra’s public service missions** (approx. M€5 in 2011),
- **Future Investments, through a M€75 fund,** for the development of projects for the treatment and recycling of radioactive waste.

Andra
Head Office
located at Châtenay-
Malabry
(Hauts-de-Seine
district)



GOVERNANCE

MISSIONS

The missions for which Andra is responsible are defined in the Environment Code (article L.542-12): Andra is responsible for the long-term management of radioactive waste. Furthermore, a four-year contract between the State and Andra sets out all the objectives to be achieved to meet the directives and time-scales laid down in the Act of 28 June 2006 and by the government-produced National Plan for the Management of Radioactive Materials and Waste (PNGMDR).

Public service and information missions

- **collect radioactive items** from individuals and local authorities;
- **clean up and restore sites contaminated** by radioactivity;
- **produce and publish every three years the National Inventory** for radioactive materials and waste in France;
- **provide clear and reliable information** on the management of radioactive waste;
- **encourage meetings and generate dialogue** with all the concerned parties.

Industrial missions

- **collect radioactive waste** from the nuclear sector, industries not generating nuclear power, national defence, research, and the health sector;
- **operate and monitor** radioactive waste disposal facilities so that they are safe for man and the environment.

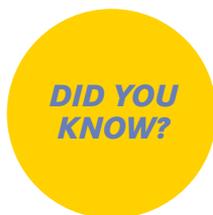
Missions to enhance know-how in France and abroad

- **develop scientific collaboration** at the National, European and International level;
- **increase the prestige of all the services offered by Andra** in France and abroad;
- **spread** scientific and technical culture as widely as possible.

Design, scientific research and technological development mission

- **study and design sustainable management solutions for radioactive waste** which does not yet have disposal solutions: high-level waste (HLW), intermediate-level long-lived waste (ILW-LL) and low-level long-lived waste (LLW-LL).

A SUSTAINABLE DEVELOPMENT STRATEGY WITH NINE CHALLENGES



To find out more, read pages 76 and 77.

GOVERNANCE

Installations



1. THE MANCHE DISPOSAL FACILITY (CSM)

This was the first radioactive waste disposal facility in France. Located at Digulleville, it took in approximately 527,000 cubic metres of low- and intermediate-level waste between 1969 and 1994. At the end of its operational life, a watertight covering was installed, and since 2003, it has entered into a phase of monitoring that will continue for a period of at least 300 years.

2. THE AUBE DISPOSAL FACILITIES

2.a • The low- and intermediate level waste disposal facility (CSFMA)

Located in the communes of Soulaines-Dhuys, Epothémont and La Ville-aux Bois, the CSFMA took over from the Manche disposal facility in 1992. Three-quarters of the low- and intermediate-level short-lived waste are small items (gloves, tools, clothing) used in the maintenance and operation of French nuclear installations. The remaining one-quarter comes from laboratories, hospitals and universities. They are disposed of at the surface in concrete structures.

2.b • The very-low-level waste disposal facility (CSTFA)

Located in the communes of Morvilliers and La Chaise, the CSTFA has been accommodating waste coming mainly from the dismantling of nuclear power plants and cleaning up of contaminated sites since 2003. This waste is in the form of earth, gravel, plastic, concrete, metal and sludge. It is disposed of in vaults dug into an outcropping clay layer.



3. THE MEUSE/Haute-MARNE FACILITY (CMHM)

3.a • The Underground Laboratory

Built in 2000 in Bure, the Underground Laboratory comprises surface installations (administrative offices, workshops, laboratories, reception building) and more than one kilometre of underground tunnels dug into the Callovo-Oxfordian shale at a depth of 445 to 490 metres. It is a unique scientific tool enabling Andra researchers and engineers to gain the knowledge to design the future geological industrial disposal facility (Cigeo), which will receive high-level and intermediate-level long-lived waste. This waste comes mainly from the recycling of used nuclear fuel. It is stored on its production sites pending the opening, scheduled for 2025, of the Cigeo disposal facility, close to the Laboratory, on condition that it is granted authorisation.

3.b • The Technological Exhibition Facility

Opened in 2009 at Saudron, a few hundred metres from the Underground Laboratory, this facility was built to present the Cigeo project to the public. It covers an area of 3,000 square metres, where, for example, prototype containers for intermediate-level long-lived waste and the robots developed for handling the high-level waste containers are displayed. ●



GOVERNANCE

Institutional representatives

THE SUPERVISING MINISTRIES

Andra has been placed under the supervision of the Ministries for Energy, Research and the Environment. Additionally, three representatives from the Ministries in charge of the budget, defence and health sit on Andra's Board of Administrators.

ASSESSORS

- **The Nuclear Safety Authority (ASN)**

The French Nuclear Safety Authority is an independent administrative authority responsible for inspecting all civil nuclear activities, to protect workers, the public and the environment from the risks related to the use of nuclear power. Its mission includes informing the public about safety. In particular, it publishes an annual report on the status of nuclear safety and radiological protection in France.

- **The Institute for Radiological Protection and Nuclear Safety (IRSN)**

The IRSN provides technical support for the French Nuclear Safety Authority. It provides expertise in research and in the analysis of radiological and nuclear risks. It performs research and makes assessments in the field of nuclear safety and protection against ionising radiation.

- **The National Assessment Commission (CNE)**

Comprised of scientists appointed for six years, the mission of the CNE is to independently assess the results of research carried out on the management of radioactive materials and waste. Each year, it produces an assessment report submitted to the Government and Parliament, then to the Parliamentary Office for assessing scientific and technical choices (OPECST).

INFORMATION AND DIALOGUE BODIES

- **Local bodies**

Local bodies have been set up for the Andra installations. They provide information and consult on nuclear safety, radiological protection and the impact of Andra's activities on people and the environment.

Within the framework of their mission, they can perform assessments and studies in addition to those provided by Andra.

Two Local Information Commissions monitor the activities of the disposal facility for low-level and intermediate-level waste in the Aube district and of the Manche disposal facility. In Meuse/Haute-Marne district, a Local Information and Monitoring Committee monitors the activities of the Underground Laboratory. Finally, a Local Information and Monitoring Commission monitors the activities of the very-low-level waste disposal facility.

- **The High Committee for transparency and information on nuclear safety (HCTISN).**

Constituted by the Act of 13 June 2006 relating to nuclear transparency and safety, and created in 2008, the High Committee is a body providing information, and allowing for consultation and debate on the risks related to nuclear activities and the impact of these activities on public health, the environment and on nuclear safety. In this regard, it can issue opinions on any question within these fields, as well as on related inspections and information.

INTERNATIONAL AGENCIES

- **The International Atomic Energy Agency (IAEA)**

The IAEA falls under the United Nations Security Council. It contributes to international cooperation and promotes the safe and peaceful use of nuclear technology and science.

- **The Nuclear Energy Agency (AEN)**

The OECD Nuclear Energy Agency fosters international cooperation to help member countries to acquire the scientific, technological and legal framework necessary for the peaceful use of nuclear energy. ●

GOVERNANCE

More than 1000 producers of radioactive waste

Customers

PRODUCERS IN THE NUCLEAR SECTOR

These are the operators of the nuclear industry (EDF, Areva and the CEA), who process and condition their radioactive waste themselves, in accordance with criteria defined by Andra, except for the high-level and intermediate-level long-lived waste that Andra takes responsibility for, which is stored on their processing site, until the opening of Cigeo, the future industrial geological disposal facility.

PRODUCERS IN THE NUCLEAR SECTOR NOT GENERATING NUCLEAR POWER

This includes hospitals, universities and research laboratories, national defence and certain industries that use the properties of radioactivity or naturally radioactive materials (manufacture of paper, fertiliser, soda, etc.). Individuals



and local authorities may also possess radioactive items (lightning conductors, radium fountains, alarm clocks and the luminous hands on watches, etc.).

All this waste is collected by Andra and taken to specific installations where it is sorted, processed and conditioned before being sent to its disposal facilities in the Aube district. Low-level long-lived waste is stored pending opening of an appropriate disposal facility.

FOREIGN COUNTRIES

Andra collaborates with its international counterparts, through cooperation agreements and service contracts covering all aspects of radioactive waste management: design of disposal facilities, rehabilitation of contaminated sites, conditioning and inspection of packages, strategies for communicating with the public, etc. ●

59% of radioactive waste comes from the nuclear power industry

THE INDUSTRIAL COMMITTEE: A NEW ANDRA ADVISORY BODY

Created on 13 October 2011, the Industrial Committee is made up of eleven members, including a Chairman nominated by Andra's Board of Administrators. Its role is to issue opinions and recommendations on all questions relating to Andra's activities and industrial projects. It

is primarily concerned with the Cigeo industrial programme - the future geological industrial disposal facility - but it also examines other industrial projects, such as setting up a recycling network for very-low-level metal waste, and studies relating to the disposal of low-level long-lived waste.

Very-low-level metal waste



GOVERNANCE



Launching of the Meuse/Haute-Marne inter-district area development scheme

A project the size of Cigeo, the future geological industrial disposal facility, requires numerous investments in land use (infrastructure, connections to the transport networks, housing, services...). Preparation for the inter-district area development scheme, led by the Meuse prefecture, involves identifying the requirements of the Cigeo project and the area, and to provide solutions to the land use and development challenges.

A CASE SUPPORTED BY THE MEUSE PREFECTURE AND MONITORED BY THE HIGH LEVEL COMMITTEE

Set up by the inter-ministerial committee for land use and sustainable development on 12 July, 2005, the High Level Committee has the role of monitoring and assisting economic development in the area around the site of the Cigeo geological industrial disposal facility. Under the auspices of the State, it brings together members of Parliament, prefects and presidents of the Meuse and Haute-Marne local councils, members of nuclear industry management (EDF, Areva, CEA) and Andra as well as the High Commissioner for Atomic Energy.

The High Level Committee met on 5 May, 2011, chaired by Eric Besson, Minister for Industry, Energy and the Digital Economy in the Fillon government, for the official launch of the Meuse/Haute-Marne inter-district area development scheme. This scheme will be drawn up under the leadership of the Meuse coordinating prefect by the end of 2012, to be presented for a public debate scheduled in 2013. Until then, the High Level Committee will regularly follow its progress.

SEVERAL STAGES OF DEVELOPMENT

2011 was dedicated to the analysis of requirements for infrastructure, housing and related services (businesses, schools, leisure, etc.) and the potential for economic development around the Cigeo project, with regard to research, higher education and clusters. Working groups were set up with all the stakeholders. The model for the distribution of tax resources related to the Cigeo installation was also studied. The end goal was the preparation of scenarios on the options for development, with a view to optimising economic development and practices taking into account environmental and heritage considerations, to be presented during public debates. ●

Graphic representation of the surface installations of the future geological industrial disposal facility, Cigeo



GOVERNANCE

The underground research laboratory role is extended to 2030



*Under the Order of 20 December 2011, Andra received authorisation to continue its research activities at the Meuse/Haute-Marne facility until 31 December 2030. Explanations from **DELPHINE HONORÉ**, Legal Expert at Andra.*

Why is this authorisation important?

Delphine Honoré: First of all, it recognises the relevance and importance of the research carried out since 1999, when the Andra Laboratory was created, which has enabled the feasibility of reversible deep disposal to be demonstrated as safe over the long term for high-level and intermediate-level long-lived waste. It also provides the opportunity for scientific and technical teams to improve their understanding and pursue international cooperation as geological disposal is recognised as the reference solution by international bodies.

What will it bring to the Cigeo project?

D. H.: Even more scientific and technical robustness. It will enable the licence application to be prepared for the geological industrial disposal facility - Cigeo - scheduled for 2015, then assistance with the construction, commissioning and start of operations of the facility scheduled for 2025. This will represent an accumulated scientific and technological acquisition of primary importance.

Is this authorisation subject to conditions?

D. H.: Yes, the Order details the objectives and the subjects for research, experiments and testing that will be carried out until 2030. It also describes the requirements that Andra must adhere to, in particular the conditions for rehabilitating the site if and when the activity ceases definitively. ●

“ This authorisation brings even more scientific and technical robustness to the Cigeo project. ”

Experimental
tunnels
in the Andra
Underground
Research
Laboratory



GOVERNANCE

2009 report on the Cigeo project

In compliance with the National Plan for the Management of Radioactive Materials and Waste, Andra submitted a report to the Government at the end of 2009 on the geological industrial disposal facility for high-level and intermediate-level long-lived waste - Cigeo - on which the French Nuclear Safety Authority gave its opinion.

This report on the Cigeo project - the future industrial geological disposal facility - submitted to the Government by Andra in 2009, was examined by the permanent group of experts convened by the French Nuclear Safety Authority (ASN) and the Institute of Radiological Protection and Nuclear Safety (IRSN). Based on these assessments, the ASN submitted its opinion in 2011. In this opinion the ASN stated that, since the study submitted in 2005, Andra had developed the main design, safety and reversibility provisions enabling risks to be controlled during the operation of Cigeo.

THE FRENCH NUCLEAR SAFETY AUTHORITY DELIVERS ITS RECOMMENDATIONS

Before Andra submits its licence application for the creation of Cigeo, the ASN has asked it to detail the provisions adopted and to analyse in greater depth some of the hazards involved in operating the installation, notably risks related to the production of hydrogen, fire and the operations for putting the packages into the vaults. With regard to safety after closure, the ASN recommends that Andra presents the elements necessary for demonstrating the industrial feasibility of sealing the disposal vaults. ●

Securing the funding for long-term costs

Unanimously approved by the Board of Administrators on 6 May 2011, the general policy adopted for asset management dedicated to securing long-term liability financing is based on an investment strategy aimed at optimising the risk/return pair whilst taking into account environmental, social and good governance aspects.

OPTIMISING THE RISK/RETURN PAIR

The assets required to secure future nuclear liabilities have been made mandatory for the operators of basic nuclear installations by the Act of 28 June 2006. They must make provisions for the expenditure corresponding to the dismantling of their nuclear installations and the future management of waste, which is under their financial responsibility, and secure this funding through suitable investments.

The investment policy adopted by Andra is to best combine the yield targeted with a sufficient level of security and liquidity. In other words, choosing investments which optimise profitability while reducing the financial risks, hoping to achieve an end result covering expenditure, some of which is spread over several hundreds of years.

FAVOURING SOCIALLY RESPONSIBLE INVESTMENTS

To take into account the environmental criteria and company social responsibility, investment products which are considered “socially responsible” will be preferred to other investments with similar risk and return profiles. Andra’s choice will also be directly in line with its sustainable development strategy. ●







Human resources

P.20 Place women and men at the heart of Andra's development

Accident prevention:
a policy bearing fruit

P.21 Andra payroll:
key figures at 31 December 2011

P.22 The "Customer Industrial Solutions"
department: for a more effective
service offer

P.23 A new approach to customer relations

P.24 Andra faces the challenge:
resources tailored for the challenges
of a major industrial project

Cigeo project review:
successful entrance examination

P.25 The next steps for the Cigeo project

HUMAN RESOURCES

Place women and men at the heart of Andra's development

Andra's human resource management policy aims to assist in development by participating in reinforcing its cohesion and enriching its skills.

REINFORCING TALENTS

As in the previous year, 2011 was marked by sustained recruitment activity. 99 people (47 managers and 52 non-management staff (OETAM)*) were recruited. Among them, 57 joined the Andra facilities, bringing its payroll to 532 as of 31 December 2011, to which should be added 20 PhD students and 3 post-doctoral researchers.

These new arrivals have reinforced the skills within Andra in the areas relating to projects (design, project management, understanding of waste packages) as well as in the commercial and industrial activities related to disposal facility management (business managers, customer relations, etc.) and operation of the Underground Laboratory (47 people).

DEVELOPING TALENTS

Skills development is a challenge for Andra both in terms of economic performance and in renewal of professionalism and integration. In 2011, a budget equivalent to 5.19% of all salaries was dedicated to training. 429 people, i.e. 81% of the payroll, followed one or more training courses in 2011, representing approximately 5 days of training per person.

Other than reinforcing technical skills relating to Andra's professional activities, training also covered: individual and team management, risk prevention, customer relations management and project management.

* Employees, administrative staff, technicians and controllers

At the end of 2011, Andra launched a safety awareness campaign for its personnel.

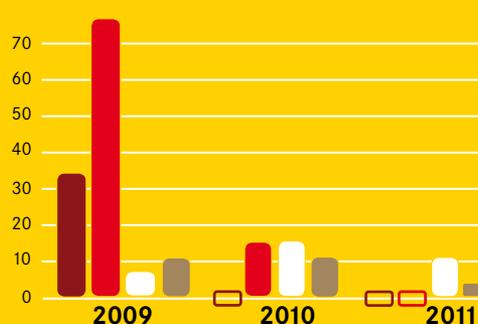


ACCIDENT PREVENTION: A POLICY BEARING FRUIT

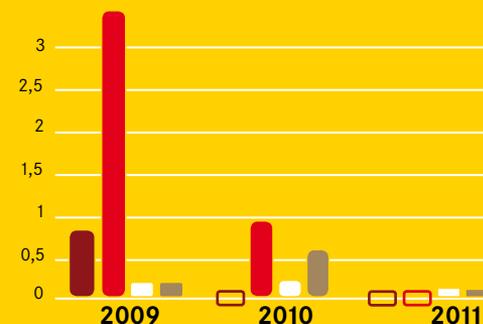
Since Andra has introduced OHSAS 18001 certification, the number and severity of work-related accidents on its sites has dropped, both for its own and for outside company personnel. In 2011, only 5 accidents were reported, only involving tripping up. These encouraging results are notably due to better detection of hazardous situations, setting up well-targeted actions against the most significant risks and better behaviour from everyone with regard to safety.

- CSM disposal facility in the Manche
- Very-low-level waste disposal facility
- Low- and intermediate-level waste disposal facility
- Meuse/Haute-Marne facility
- No accidents

FREQUENCY RATE



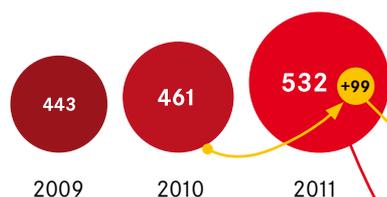
SEVERTITY RATE



HUMAN RESOURCES

ANDRA PAYROLL: KEY FIGURES AT 31 DECEMBER 2011 (EXCLUDING PHD STUDENTS AND POST-DOCTORATE RESEARCHERS)

PAYROLL EVOLUTION



PERSONNEL CHANGES PER CATEGORY

● Manual workers, administrative staff, technicians and supervisors (OETAM)

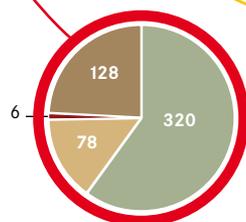
{ 95 women
83 men

● Engineers and managers (IC)

{ 95 women
259 men

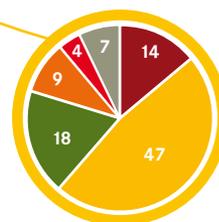
DISTRIBUTION BY SITE

- Head Office
- Aube disposal facilities
- Manche disposal facility
- Meuse/Haute-Marne facility



RECRUITMENT IN 2011 BY PROFESSIONAL ACTIVITY

- Installation operations
- Support functions
- Customer relations
- Scientific activities
- Safety, Inventory
- Engineering and projects



PROMOTING TALENTS

Against a background of personnel and skills forecasting management, whilst considering the need to bring in outside resources, Andra has implemented a voluntary internal promotion policy in compliance with the in-house agreement drawn up in 2008. Thus the organisational adjustments made during 2011 (creation of a programme division and an engineering and Cigeo project division) has given rise to several promotions.

MAINTAINING A PERMANENT SOCIAL DIALOGUE

2011 saw the signing of numerous in-house agreements: renewal of the profit-sharing agreement over the period 2011-2013, the agreement relating to patented inventions, the agreement on the conditions

for union membership and development of negotiating procedures, the collective agreement on the term of office of elected personnel representatives, the renewal of the agreement on integrating and maintaining disabled personnel in employment. A rider to the agreement relating to work organisation conditions at the Meuse/Haute-Marne Underground Laboratory was also signed in November 2011. All these agreements show the concern of Andra to listening its employees and to maintain a safe and consistent working framework. ●

HUMAN RESOURCES

The “Customer Industrial Solutions” department: for a more effective service offer

The Andra industrial division takes responsibility for radioactive waste coming from producers in the nuclear power sector (Areva, CEA, EDF) and also from producers in the non nuclear power sector (chemical and pharmaceutical industry, laboratories, hospitals, etc.) and holders of radioactive waste (individuals, local authorities). The “Customer Industrial Solutions” department was created in 2011 to advise and best respond to the expectations of the various producers of radioactive waste, offering a service adapted to their specific needs.

Within this new department, one team is especially dedicated to producers in the nuclear sector. Its role is to provide technical solutions complying with the regulations and operating conditions of the Andra waste disposal facilities. It is responsible for the approval and acceptance of their waste, and inspects the conformity and quality of packages on the production sites. This front-end advice and monitoring contributes to optimising the safety and smooth operation of the industry from the production of waste up to its disposal.

REINFORCE CLOSENESS WITH PRODUCERS IN THE NON-NUCLEAR POWER SECTOR

At the same time, a team was set up for producers in the sector not generating nuclear power. Each customer therefore has a dedicated contact providing a targeted quality of service and reducing the time taken to specify services requiring prior agreements due to the special nature of the radioactive waste concerned. This team is also responsible for approving and accepting waste.

GREATER RESPONSIVENESS

The third team created provides an interface with the customers within the framework of services in relation to the removal of radioactive waste according to guidelines established by Andra (available only in French). Its objective is to rationalise the commercial management (dealing with orders, invoicing, price tables, etc...) and to centralise the technical data of waste going to disposal facilities.

PROVIDE NEW INDUSTRIAL SOLUTIONS

Lastly, an industrial development and assessment cell deals with requests from other teams requiring special studies, to better meet the requirements expressed by waste producers. It also collaborates with other units within Andra. ●



Disposal of a low-level and intermediate-level short-lived radioactive waste package at the Andra disposal facility in the Aube district



A new approach to customer relations



Interview with
ANNIE DELISÉE,
Package Approval Manager.

How does the creation of the “Customer Industrial Solutions” department affect your activity?

Annie Delisée: We have completely changed our working methods. Previously, each business manager was

“ We have become more responsive and consistent in the way we deal with our work. Through this, we better meet the expectations of Andra customers.”

dedicated to a customer and dealt with package collection, production monitoring and customer relations. This method of working could lead to disparities in processing

methods and losing sight of customers’ expectations. Today the business managers have targeted activities, and projects are allocated according to required availability and expertise.

What is your role in the team?

A. D.: As the manager of the approval activity team, I supervise the processing of requests for package collection and check correct application of the associated procedures.

What particular improvements have you seen?

A. D.: A better distribution of tasks and responsibilities, and improved communication within the team. We have become more responsive and consistent in the way we deal with our work. Through this, we better meet the expectations of Andra’s customers. ●



The “Customer Industrial Solutions” department was created in 2011.

HUMAN RESOURCES

Andra takes up the challenge: resources tailored for the challenges of a major industrial project

Entering the industrial preparation phase for the Cigeo project (the future geological industrial disposal facility for high-level and intermediate-level long-lived waste) and preparation for the licence application of the facility in 2015 led Andra to undertake significant internal reorganisation in 2011. The scope of a large industrial project such as Cigeo, with the technological, economic and social challenges that it encompasses, requires perfect control at all levels of responsibility and at all stages of its deployment.

DEFINING THE PROJECT OBJECTIVES

The Programmes Division manages the overall “New Projects” programme, including Cigeo, research on storage and on low-level long-lived waste. It also performs prospective studies relating to the new projects, notably those related to 4th generation reactors and partitioning-transmutation. The actions that it carries out within the Cigeo project help to define the project objectives in terms of technical performance, safety, reversibility, cost control and local insertion. It checks that the technical solutions studied respond to these objectives.

The Programmes Division provides the external interfaces with the State and the waste producers. It also coordinates the interfaces with the other stakeholders. In 2011, it coordinated the production of specifications defining the requirements applicable to the Cigeo project, and which are necessary for its industrial development. At the same time, it provides the necessary elements for the preparation for the public debate scheduled for 2013 and for the licence application, which will be submitted to the Government in 2015.

AN EFFICIENT ORGANISATION FOR THE CIGEO PROJECT

Two new divisions were created in 2011, with complementary missions: the Programme Division is in charge of steering the project strategy; the Engineering and Cigeo Project Division is in charge of its operational control.

DID YOU KNOW?

CIGEO PROJECT REVIEW: ANDRA PASSED THE TEST



This project review was organised in 2011 under the auspices of the State, prior to launching the invitation to tender for the Management System of the Project. The purpose of this review was notably to examine the organisation proposed by Andra, the contracting authority, to steer the project, ensure the comprehensiveness of input data for starting the industrial design phase, examine the requirements and constraints imposed on the Management System of the Project, notably with respect to safety and reversibility, and the open flexibility to end up with the optimum industrial choices for the Cigeo project. The outside experts making up the review group were appointed in agreement with the State, customer for the project as defined in the Act of 28 June 2006, and with the waste producers (Areva, CEA, EDF), who will eventually be benefitting from the disposal facilities. This test provided validation for the launch of the first call for tender in mid-2011.



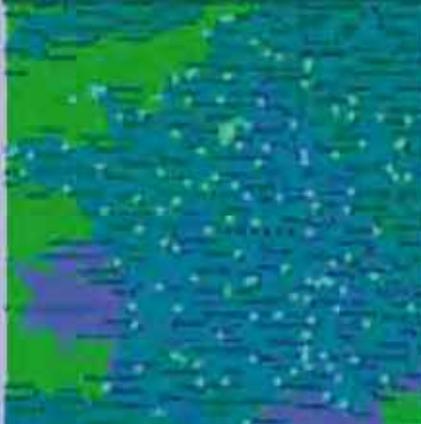
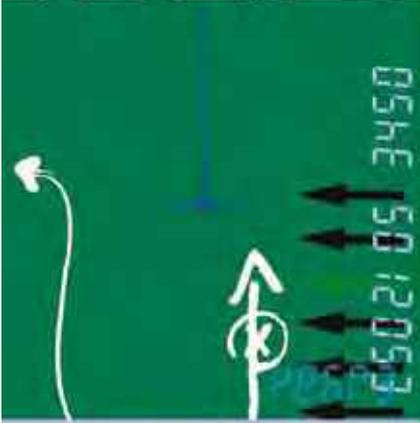
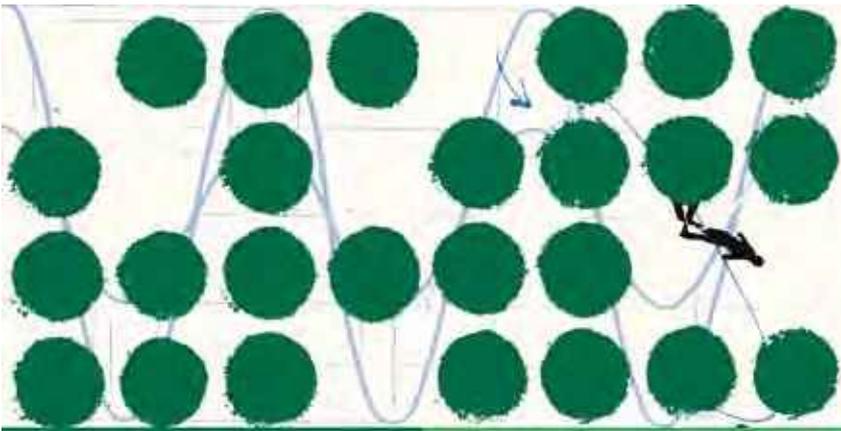
FROM DESIGN TO PRODUCTION: CONCERTED EXPERTISE

The Engineering and Cigeo Project Division is responsible for the design and production of the future geological industrial disposal facility (Cigeo). It groups together all the professional activities concerned: nuclear engineering and underground works, civil engineering, network services (electricity, ventilation...), package engineering and handling service. Technical design and computer graphics, project management, cost control and financial studies teams are also involved. Furthermore, it produces the cross-discipline technological test programme and coordinates its implementation.

In 2011, the Engineering and Cigeo Project Division produced the documents required for launching the calls for tender to select the System Programme Management for the future geological industrial disposal facility, as well as the technical assistance and the health and safety service providers. These suppliers were chosen in 2011. ●

THE NEXT STEPS FOR THE CIGEO PROJECT

- 2012** ● Launch of the industrial design phase with the System Programme Management chosen in December 2011
- 2013** ● Public Debate
- 2015** ● Licence application for Cigeo
- 2015 - 2018** ● Assessment of the Cigeo licence application
- 2025** ● Commissioning of Cigeo on condition that it was awarded a licence
- 2025 - 2030** ● First Cigeo unit





Public service missions

p.28 Andra is continuing to clean up contaminated sites

Confinement of radioactive waste on the Pargny-sur-Saulx site (51)

p.29 The clean-up of the Nogent-sur-Marne and l'Île-Saint-Denis sites increases speed

p.30 The “*Diagnostic Radium*” operation is growing in the greater Paris area

p.31 On-line declaration: a new service to prepare the *2012 National Inventory*

There are some 50,000 radioactive lightning conductors in France



Andra is continuing to clean up contaminated sites

Around twenty sites are being cleaned-up, 2 new sites opened 2011: Andra is continuing the public mission defined in the Act of 28 June 2006. Decontaminating sites polluted by radioactivity and taking responsibility for the waste arising from these activities form part of the national policy for the prevention of health risks and protection of the environment.

Most contaminated sites in France are related to past activities: extraction of radium for medical purposes, manufacture and application of luminous paint, mining operations, etc.

Over time, these sites have either been redeveloped for housing and public buildings, or left as brownfield sites. Since the end of the 1990s, the State has been setting up schemes to take them over. The sites where the concentration of radionuclides was found to represent a significant risk, for people or the environment, have been dealt with as a priority and are now pollution free or undergoing clean-up.

Since the Act was passed on 28 June 2006, the remediation of contaminated sites has been carried out within a precise legal framework, which led the Andra Board of Administrators to create the National Aid Commission on Radioactive Matters (CNAR) in 2007. This consultative committee brings together all the stakeholders: representatives of the public authorities, civic associations and experts.

Its role is to reconcile the technical and financial requirements with the points of view of the populations concerned. To achieve this, the CNAR carries out arbitration to adopt the most appropriate treatment strategies and to establish the priorities for allocating public funds. Each contaminated site has its own individual nature,

WHO FINANCES WHAT?

When the responsible party has defaulted, i.e. cannot be found, is insolvent or no longer exists, the State takes responsibility for the clean-up and waste management to make sure that the site is made permanently safe. This does not necessarily mean that decontamination is total, but it does eliminate any health risks. When the party responsible for the contamination is identified and solvent, it has to contribute financially to site remediation.

such as its location, level of radioactivity or surface area, and this leads to more or less expensive technical solutions. Similarly, the CNAR takes the volume and nature of the waste to be managed into account with respect to the cost of transport and the disposal or storage capacities. ●

DID YOU KNOW?

CONFINEMENT OF RADIOACTIVE WASTE ON THE PARGNY-SUR-SAULX SITE (MARNE DISTRICT)

Until 1997, the site housed the Orflam Plast lighter factory. The residues from the manufacture of lighter flints containing thorium, left on the site, are the cause of the radioactive contamination found on the banks of "La Gravière" lake and in buildings as well as in certain areas outside the site in public ownership. The extent of the contamination meant the banks of the lake had to be dug out in 2010 and the area known as "La Peupleraie" underwent the same treatment in 2011. At this place alone, 12,000 square metres were treated and 9,000 tonnes of clay was laid to confine the most contaminated areas.

On the site itself, demolition of the contaminated buildings, scheduled for the end of 2012, will generate around 4,000 cubic metres of waste in the form of rubble. The cost of treating, evacuating and disposing of such a volume would be prohibitive. Therefore, the decision was made to confine it on the site using earth from the banks of the lake under a waterproof clay covering guaranteeing that there would be no health impact. This last phase of site clean-up should be finished by the end of 2013.

PUBLIC SERVICE MISSIONS

The clean-up of the Nogent-sur-Marne and l'Île-Saint-Denis sites increases speed

The remediation work on these two sites saw spectacular progress in 2011, thanks to the financing it was awarded within the framework of the recovery plan set up by the Government in September 2009, which brought in around 50% of the financing for the work.

At Nogent-sur-Marne (Val-de-Marne district), the location was occupied by the Marie Curie schools group, built in the 1960s on the site of a radium extraction factory. It was closed in 1998 but clean-up only started in 2010, due to lack of funds. This is a vast 5,500 square metres site that since 2000 has required several funding phases.

The school buildings were demolished in 2011; 60% of the 2,200 square metres that were contaminated has been cleaned up, after major excavation work to a depth of 5 metres, generating 800 cubic metres of waste. 500 cubic metres were disposed of at the Andra very-low-level waste disposal facility in the Aube, and the rest, stored on site, will be dealt with in 2012.



The school buildings were demolished in 2011.

This operation uncovered the old factory, and consequently the source of the radioactive contamination in the operational structures (tanks containing effluent, laboratory, etc.). After a complete clean-up of the area, the site will house sports facilities, currently at the design stage.

At l'Île-Saint-Denis (Seine-Saint-Denis district), the site occupied by Charvet since the 1990s had housed a radium extraction plant. It had a lower capacity for radium processing than the Nogent site, and was run by the radium institute of the University of Paris from 1913 to 1927. Here again a major clean-up operation was required, involving the demolition of the last industrial buildings and radiological sorting of the rubble. In 2011, 1,000 cubic metres of rubble was sorted, of which around 530 cubic metres was disposed of at the Andra facility in the Aube district (the rest, stored on site, will be dealt with in 2012), to obtain a platform cleared of buildings on which excavation work is programmed in 2012 and 2013.

The total volume of waste disposed of at the Andra facility in the Aube from these two sites between September and December 2011 was approximately 1,000 cubic metres, amounting to around one transport convoy per work-day. ●



The area known as "La Peupleraie" was decontaminated in 2011.

PUBLIC SERVICE MISSIONS

The “Diagnostic Radium” operation is growing in the greater Paris area

Some sites may have been contaminated by Radium from activities in the past. Launched by the French State in 2010, the purpose of the “Diagnostic Radium” operation was to identify these potentially contaminated sites and, if necessary, decontaminate and remediate them.

Research carried out by the French Institute of Radiological Protection and Nuclear Safety (IRSN) before the operation started identified 134 potentially contaminated sites, 84 of them in the greater Paris area. This high concentration is explained by the fact that in the first half of the 20th century research centres and radium production plants were set up in this area.

In 2010, the IRSN identified nine sites requiring decontamination in the greater Paris area. The clean-up work carried out by Andra started in March 2011. Its duration will depend on the cause, age and extent of the contamination. To carry out this huge undertaking, Andra has been awarded a public grant of eight million euros.

A PARISIAN APARTMENT COMPLETELY DECONTAMINATED

Interview with **PHILIPPE SALAÛN**, Clean-up Technician for Andra’s public service mission department

Located in the heart of Paris, the apartment being decontaminated has been emptied and the parquet flooring has been completely removed from the hall and two other rooms, and partially removed from another room. And so the contamination is very localised?

Philippe Salaün: Yes, it only affects certain places and we have located it precisely by a thorough search. Then we took samples in the contaminated areas, and in clean areas for comparison,

and had them analysed in a specialised laboratory. It is essential to know the level of contamination to gauge the extent of the work to be performed and the volumes to be excavated.

How was the work to be performed?

P. S.: A specialized company was called in to remove the contaminated material. In this case, it was very-low-level long-lived waste, conditioned in transport drums to be evacuated before being sorted, reconditioned and stored pending the opening of an appropriate disposal facility. The excavation work lasted for four weeks. We have now moved into a validation phase and are taking new measurements. If no significant trace of radioactivity is found, we will return the place to its original condition, which will include laying a new herringbone pattern wood floor.

This apartment was occupied. What happened to the residents during the work?

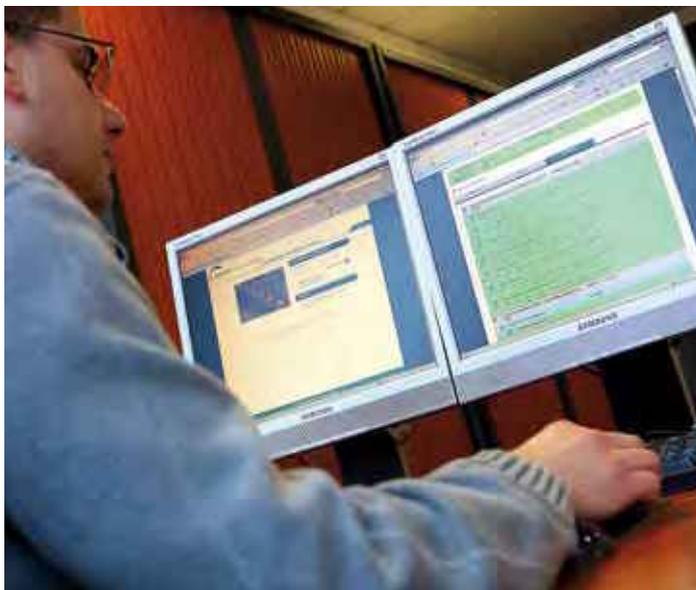
P. S. They were re-accommodated in a furnished apartment similar to their own nearby. The State took complete responsibility for the cost of the work, as well as for their rent and the cost of storing their furniture. Private property does not have to be decontaminated, but if they sell, the owners have to carry out this work at their own expense. This is why we are rarely refused. ●



PUBLIC SERVICE MISSIONS

On-line declaration: a new service to prepare the 2012 National Inventory

The updating of the National Inventory of Radioactive Materials and Waste every three years relies mainly on declarations from producers.



If EDF, Areva and CEA are well drilled in the exercise, the same does not apply for the producers in the hospital and university sector. This is why on-line declaration was launched in April 2011 to make the task easier. Training courses were organised to teach people how to use the new system, notably for qualified users working for these producers. This first experiment was successful and will enable the software to be improved for even more effective use. ●

There are
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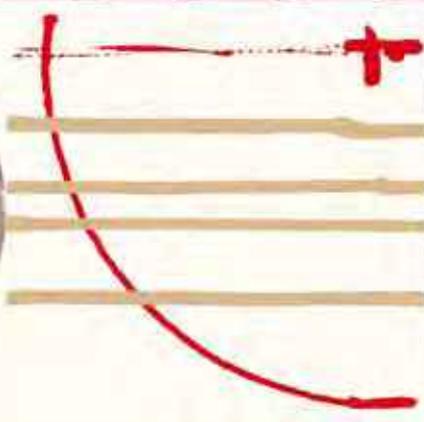
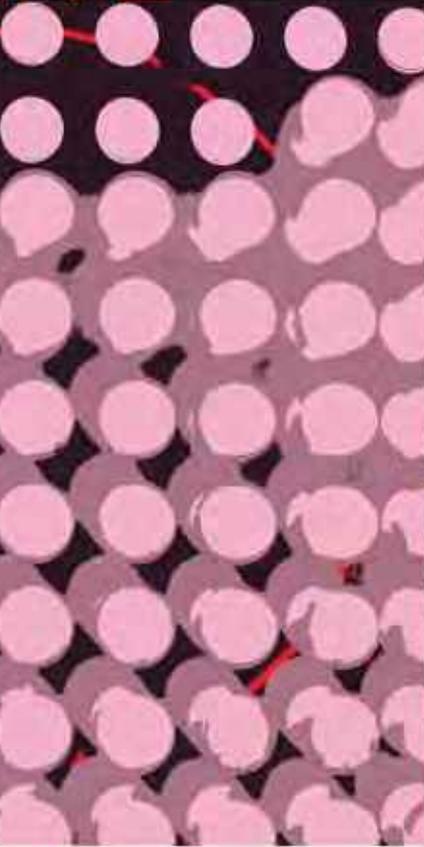
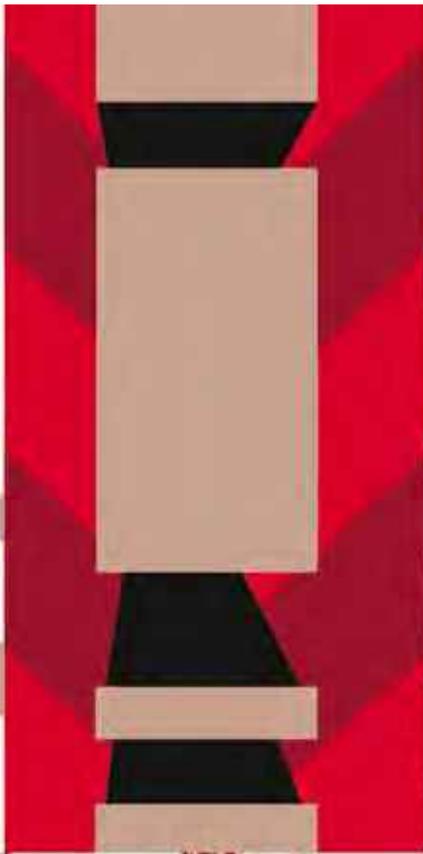


THE OTHER ASPECT OF ANDRA'S PUBLIC SERVICE MISSION AS DEFINED BY THE JUNE 2006 ACT INVOLVES COLLECTING THE RADIOACTIVE OBJECTS HELD BY INDIVIDUALS AND LOCAL AUTHORITIES.

Radioactive lightning conductors figure amongst these objects. Manufactured from the 1930s up to 1983, these lightning conductors contained radionuclides used for their ionising properties. As long as they stay in position and their condition does not deteriorate, they present no danger.

Andra recovers around 500 of them every year. Classified in the low-level long-lived waste category, they are conditioned in drums and stored pending an appropriate disposal facility (in the planning stage). Since March 2011, a web site has set up an inventory of radioactive lightning conductors, produced with the assistance of "hunters", volunteers who locate and photograph them. This citizen's initiative is, of course, supported by Andra.

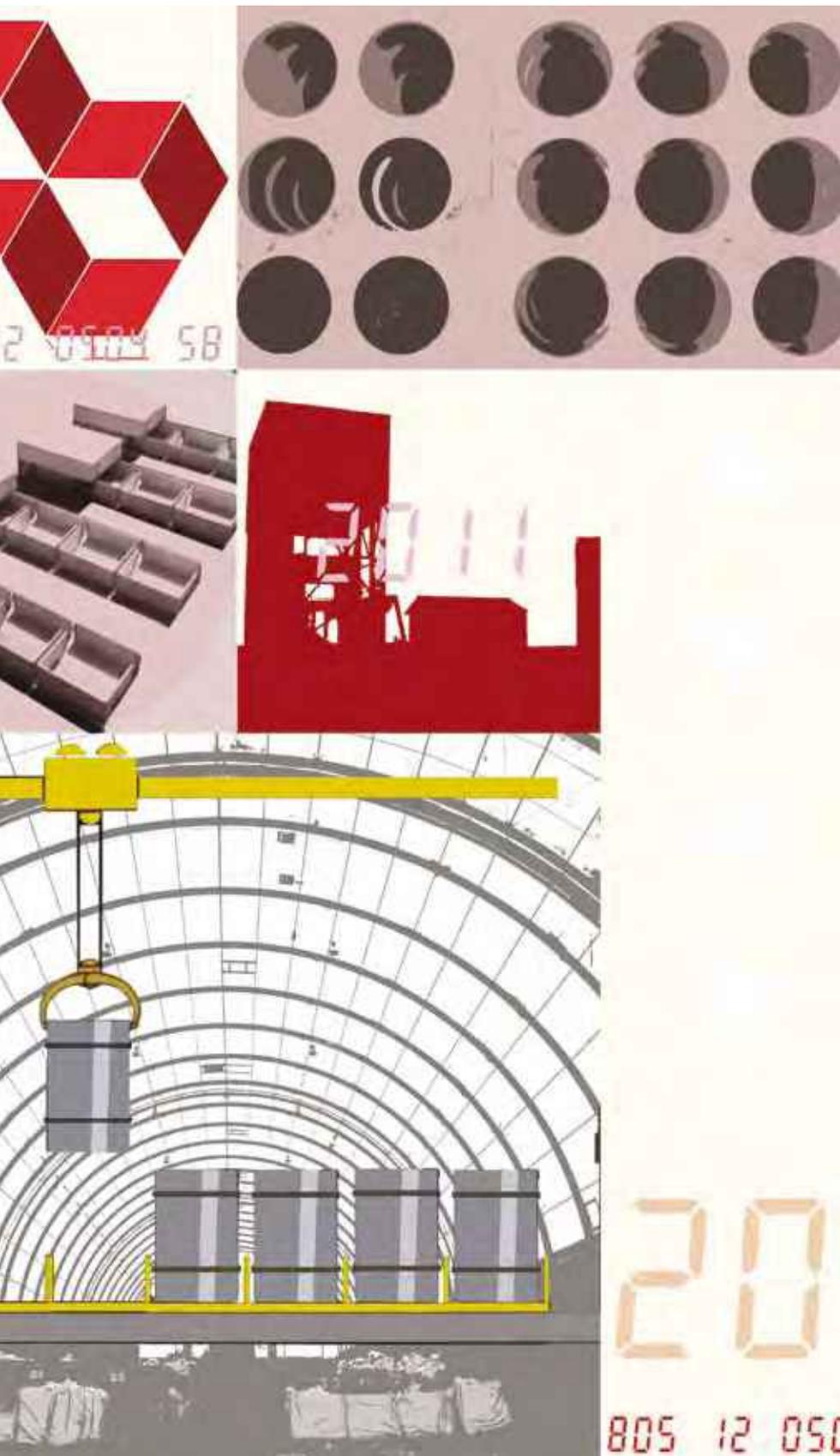
To find out more: www.paratonnerres-radioactifs.fr



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Industry

- P.34** Preparing to enter the industrial design phase for the Cigeo project
- P.35** Manche disposal facility: little by little, the outline of the slopes is softened
- P.36** Very-low-level waste disposal facility in the Aube district: from package to final cover, an operation under control
- Fire simulation
- P.37** A 700-tonne capacity crane to move a roof-canopy
- P.38** Low- and intermediate-level waste disposal facility in the Aube district: non-stop operation
- P.39** Customer satisfaction: a priority objective
- P.40** Crisis communication tested
- P.41** Nuclear Safety Authority inspections: the report is positive

Preparing to enter the industrial design phase for the Cigeo project

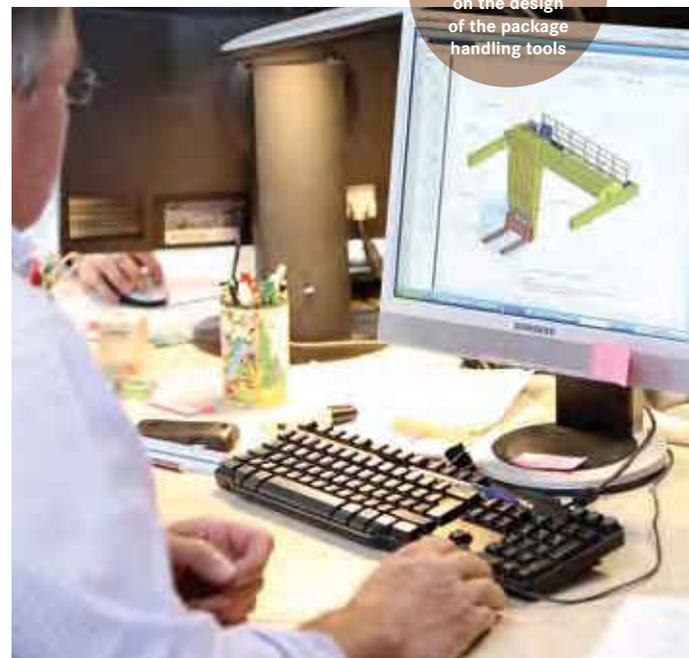
2011 was marked by intense activity, preparing the documents necessary to launch, at the end of the year, the first invitation to tender for the Management System to be used for the Cigeo project, the future geological industrial disposal facility.

At the start of 2011, the preparation phase for the requirements applicable to the future Cigeo geological industrial disposal facility, which will accommodate high-level and intermediate-level long-lived waste if it receives its licence, consolidated the results from design engineering, research and experiments carried out by Andra since 1991 to define the functional specifications and the technical choices governing the project design.

WHAT ARE THE REQUIREMENTS FOR CIGEO?

Very long-term safety relies on the installation of the disposal facility within the Callovo-Oxfordian shale. It also strongly relies on the underground architecture chosen, on the specifications for the high-level waste disposal containers and for sealing and backfilling.

Operational requirements also concern the health and safety of workers (fire, radiological protection equipment, radiological zoning...) as well as protection of the surrounding population and the environment. They also apply to the industrial processes of excavating the disposal vaults and disposing of the waste packages. This will help in the search for the optimal economic and technical solution and in meeting the requirement for reversibility, which must be guaranteed for at least one hundred years. Reversibility depends on the design of the underground structures, the disposal containers and the handling systems. It also means maintaining the greatest possible flexibility in starting disposal operations. As the disposal system is implemented, package inspection, monitoring and observation systems will be developed. All these requirements have been broken down according to the type of waste to be disposed of



The reversibility of disposal mainly depends on the design of the package handling tools

and when they are scheduled to arrive on site, specified in the waste management disposal programme set up in 2011, which defines the waste that will be received in Cigeo.

FIRST CALLS FOR TENDER FOR CIGEO

On this basis, Andra launched the calls for tender for the project management system, project management assistance and regulatory controls. The system prime contractor was chosen in December 2011. He will have to produce an overall industrial offer (operational aspects, civil engineering, equipment, site organisation) and to estimate the total turnaround times and cost of construction. ●

Manche disposal facility: little by little, the outline of the slopes is softened

The Manche disposal facility has been in the monitoring phase since 2003. Work to make the cover permanently watertight started in 2010 on the eastern side was continued in 2011: after the East slope, the incline on the North slope was softened in 2011.

The watertightness of the cover of the Manche disposal facility is subject to permanent monitoring, which contributes to the safety of package disposal. The work undertaken since 2009 aims at stabilising the cover and providing optimal management of the rainwater that infiltrates under the surface topsoil. The physical behaviour of the cover is monitored by topographical readings being taken, enabling any ground movement to be detected. In addition, the volume of water collected in the drains located between the topsoil layer and the watertight bituminous membrane is monitored, to characterise its hydraulic behaviour.

Very slow slippage of the peripheral slopes required consolidation work, and the slope on the northern side was reduced in 2011. This slippage was visible at the peak of the slope in the form of cracks, which were regularly repaired.

With regard to water management, the first analyses of the measurements made throughout 2010 showed that the cover is watertight. However, work became necessary in the separating network after detection of the abnormal presence of infiltrated rainwater at the edge of the east part. The separating network, which is located in the underground tunnels along the disposal facility, collects the very small quantity of water that can go through the surface layers of the cover. The water was analysed before being evacuated. The analyses

performed in 2011 confirmed that the quantity of radionuclides that it contained remained significantly lower than the authorised values. ●



INDUSTRY

Very-low-level waste disposal facility in the Aube district: from package to final cover, an operation under control

The disposal facility for very-low-level waste is unusual in that it incorporates all the operating phases concurrently, from the excavation of the disposal vaults up to installing the cover after their closure. Look back over a year of industrial operations.

COMPLETION OF THE SECOND SECTION OF THE COVERING WORK

The final covering of the disposal vaults is added as they are filled, in sections of two, three or four vaults (the site uses one vault per year). The second phase of the final covering, protecting the equivalent of two vaults, was completed in September 2011. It applies the principle used for the first section completed in 2007/2008. This principle consists in laying successive layers of material, separated by watertight geocomposite membranes. There are seven of these layers, each playing a precise role in the watertightness of the vaults and the drainage of rainwater, notably the compacted clay layer which is at least one metre thick.

● FIRE SIMULATION

The safety drill triggered the internal operational plan (POI), applicable if external resources have to be called in.

Following detection of a fire in the maintenance building compressor room, the fire service quickly intervened to prevent the fire spreading to a neighbouring room where chemicals were stored. The difficulty of the exercise lay in the fact that the fire service had to deal with a succession of sprinkler network failures, which finally required them to connect their equipment to the storm water basin. The exercise was satisfactory.

All the materials used, with the exception of the drainage geocomposite, were already on the site. They came from the excavation operations performed when the vaults were dug out.

A NEW PACKAGE INSPECTION INSTALLATION

In 2011, Andra decided to provide the very-low-level disposal facility with a new detailed examination workshop, which will complete the monitoring mechanisms, set up since the opening of the facility.

Installed within the processing building, this workshop can receive all types of packages with weights up to 6 tonnes: drums for compaction, big-bags, metal crates and reusable containers. One area is reserved for non-destructive testing.

These inspections include dimension and weight measurements, visual, endoscopic and radiographic checks and humidity measurements. If necessary, they are completed by gamma



The new very low-level package inspection workshop was commissioned in 2011.



**A 700-TONNE CAPACITY CRANE
TO MOVE A ROOF-CANOPY**

While they are in use, the disposal vaults are protected by roof-canopies. These are regularly moved from filled vaults, which are temporarily covered pending their final cover, to new vaults.

At the very-low-level waste disposal facility, the roof-canopy was moved from vault 10, which has since received its final cover, to vault 12, which is currently being dug. A new technique was devised for this operation. In fact, for the first time, a single crane, with a capacity of 700 tonnes, was used, instead of the two 300 tonne cranes used previously. The seven sections making up the roof-canopy were moved one by one and put into position.

spectrometer radioactivity measurements. The other area is reserved for destructive testing, in particular to check the package contents.

ACTIVITIES SUSPENDED BECAUSE OF... GRENADES!

The very-low-level waste disposal facility interrupted its activities for several days in October 2011 following an alert from the Grenoble CEA warning of the discovery of ammunition dating from the First World War on a Grenoble clean-up site.

Two hundred and thirty-five big-bags coming from an area close to this site were already disposed of and fifteen were waiting to be disposed of at the Andra facility in the Aube district.

The Champagne-Ardenne region mine-clearing unit performed a check on the packages that had not yet been processed and discovered two grenade fragments, but with no detonator or explosive material, and therefore not presenting any risks.

At the same time, the Rhône-Alpes region mine-clearing unit examined the grenades found on the site and, in view of their poor condition, arrived at the same conclusion.

After approval from the Aube prefecture and the regional department for the environment, planning and housing, activities were able to continue. ●

INDUSTRY

Low- and intermediate-level waste disposal facility in the Aube district: non-stop operation



The largest works programme since the opening of the site

26,200 cubic metres of reinforced concrete

3,580 metric tonnes of steel

16.5 million euros budget

Construction of the 8th work section for low- and intermediate-level waste was completed in 2011.

After more than one and a half years of work at the Andra disposal facility for low- and intermediate-level waste in the Aube, the construction of disposal structures was completed in 2011, permitting continued operation. This was the largest works program carried out since it opened.

SECTION 8 STARTS OPERATING

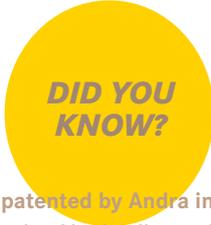
This new section of 33 structures completes the 121 existing structures, with 29 structures for metal packages in concrete and 4 structures for concrete packages in gravel. The work started in 2010 and involved twelve companies. Modifications were made to the design of the structures to reinforce the walls and to improve the anchoring system for the closing slabs of filled structures. In addition to the traditional packages, the new structures can receive non-standard packages, such as the lateral neutron protection packages from nuclear power stations. Operation of the first structure started in November 2011.



**DISPLAY THE RIGHT RISK AT THE RIGHT PLACE:
NEW RADIOLOGICAL ZONING**

The original radiological zoning was defined when the disposal facility was commissioned. Feedback from radiological monitoring has shown that the real risks had been over-estimated. As over-estimation can lead to risk being discounted, new zoning was tested in 2011, in order to reflect the actual radiological risks.

This change required the personnel to undergo awareness training. This was accompanied by an improvement in the signage and an increase in the number of inspection devices. After a successful test phase, the new zones were validated in September 2011 by the Health and Safety Committee. They not only optimise working conditions but also costs, as part of the installation has been able to be opened to smaller sub-contractors, whose organisation did not allow them to work in an ionising environment. ●

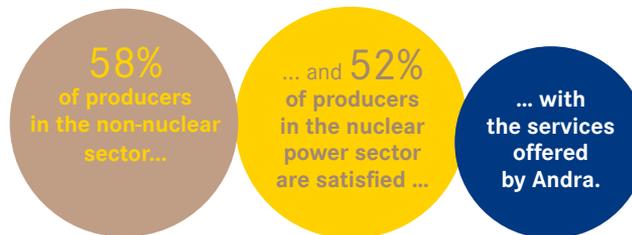


**REAL TIME DISPOSAL MONITORING
THANKS TO STOCKVIEW**

Stockview is modelling software designed and patented by Andra in 2011. It provides a 3D display of the packages contained in the disposal structures, to check the location of the package, to count them before each operation (pouring concrete or gravel into the structures) or to access information concerning each package.

**CUSTOMER SATISFACTION:
A PRIORITY OBJECTIVE**

A survey was carried out in 2011 with Andra customers to assess their level of satisfaction and to pinpoint the expectations to which they attach most importance with regard to the services offered by Andra.



The producers of radioactive waste from the nuclear power sector placed their operating constraints at the top of the list to be considered. They also requested greater responsiveness and standardisation of treatment. For the producers from the non-nuclear sector, it was the price list and communication, especially on the future of waste, which appeared in their points for improvement. The results of this survey gave rise to the production of a customer satisfaction improvement action plan. The first measures taken in 2011 were the creation of the “Customer Industrial Solutions” department, customer managers appointed to improve the closeness of the relationship with the customer and increase the responsiveness, as well as professional sector managers to obtain, amongst other things, standardised treatment*.

* Read pp 22-23

Crisis communication tested



*Test how well Andra react when communicating in emergency situations; this was the objective of the safety exercise performed at the Aube disposal facility in June 2011. Feedback from **THIERRY PROT**, Head of the safety and radiological protection department at the facility*

What did this exercise consist in?

Thierry Prot: We started from the following scenario: four people visiting the site suddenly started to demonstrate their opposition to Andra's activities. Two of them chained themselves to some metal framework, while the other two showed their opposition more peacefully. At the same time, journalists, made aware of the operation,

arrived at the site or contacted the Communication Department of the Aube disposal facilities.

“ **Guarantee safety, whatever happens and keep everyone informed** ”

So what happened?

T. P.: The crisis communication cell was activated, together with the communication management at Head Office, to manage the situation quickly without letting it get out of hand, and giving the press and public an accurate as possible assessment of the significance of this incident.

Was the test a success?

T. P.: Overall, the situation was well controlled. As for all safety exercises, we made a complete report to identify lines of progress. This type of exercise is useful to check whether our internal organisation reacts quickly, is in control of exchanges and reporting, and manages the operational interface with the outside emergency services satisfactorily. The end aim is to guarantee safety whatever happens and keep everyone informed. ●



INDUSTRY



Nuclear Safety Authority inspections: the report is positive

The French Nuclear Safety Authority (ASN) checks all the civil nuclear installations and activities in France. In this regard, it performs several annual inspections, which may be scheduled, unannounced or reactive inspections following a notified incident to check how it was managed. Overall, the inspections performed on Andra sites in 2011 were satisfactory.

The low- and intermediate-level disposal facility in the Aube district was the subject of five inspections, none of which found any deviations. They did give rise to requests for corrective measures concerning the traceability of approvals monitoring in the inspection of packages and the storage conditions of the buried gravity separation network water containers (collector recovering the water infiltrating the buried disposal structures in contact with the packages).

Two inspections were carried out at the Manche disposal facility. One was based on the archive room and the buried gravity separation network located under the disposal structures to recover infiltrated water; the other was on maintenance and periodic inspections. The latter inspection found a deviation relating to the quality of the backfill compacting in the operations to soften the inclines on the North slope. Corrective action was also requested. It concerned equipment being left on the metal supports of a pipe.

At the Meuse/Haute-Marne facility, to which the Underground Laboratory belongs, the French Nuclear Safety Authority carried out two inspections. The first was on the design, excavation and support of the tunnels and galleries, as well as the organisation set up for quality management. The second concerned progress in research and the control of measurement and monitoring equipment. No deviations were found and there were no requests for corrective actions.

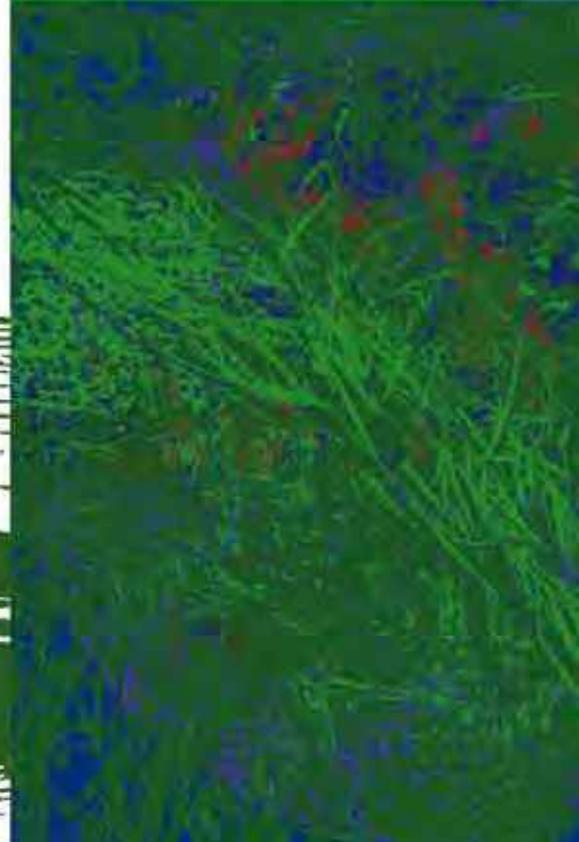
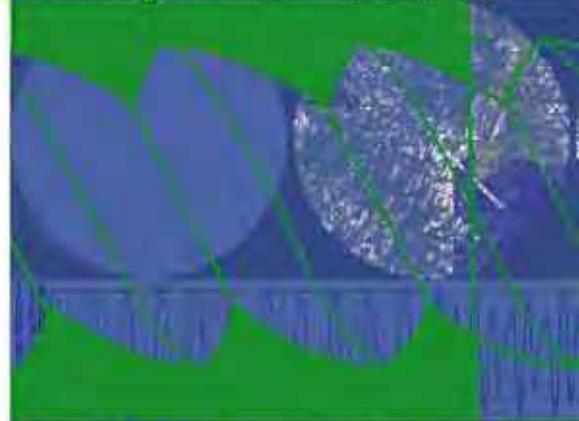
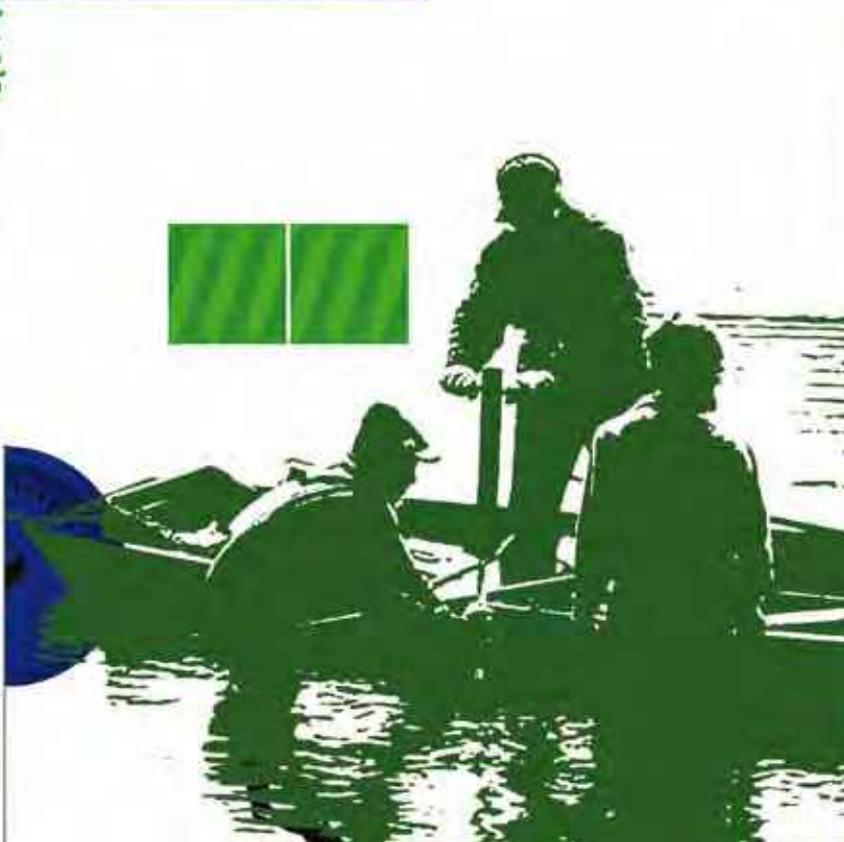
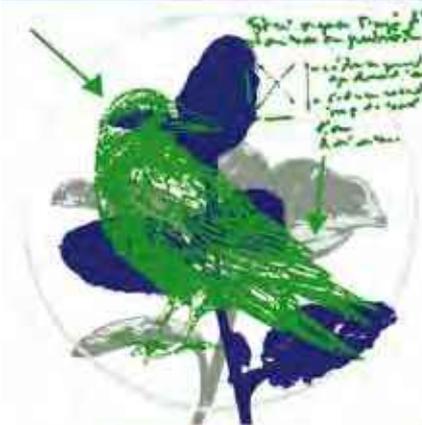
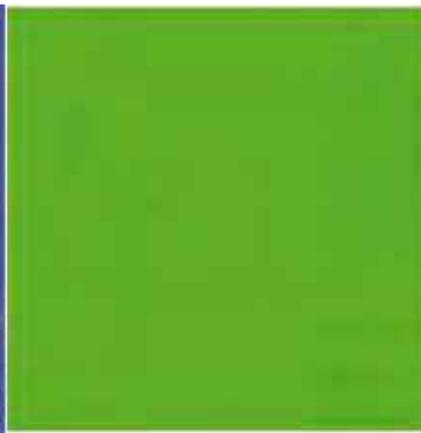
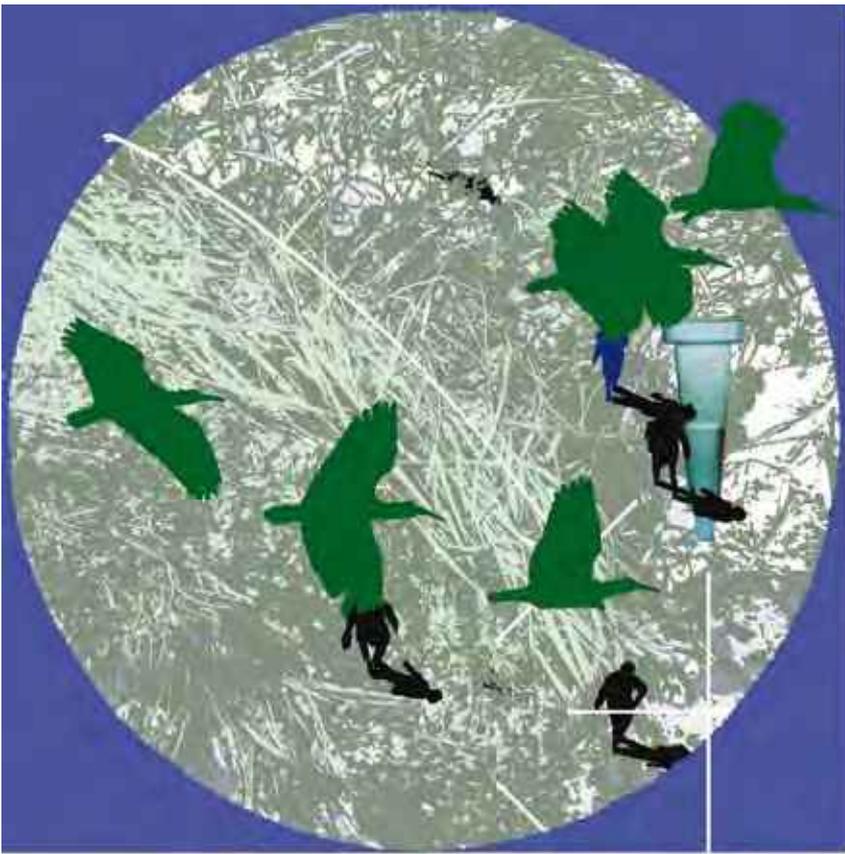


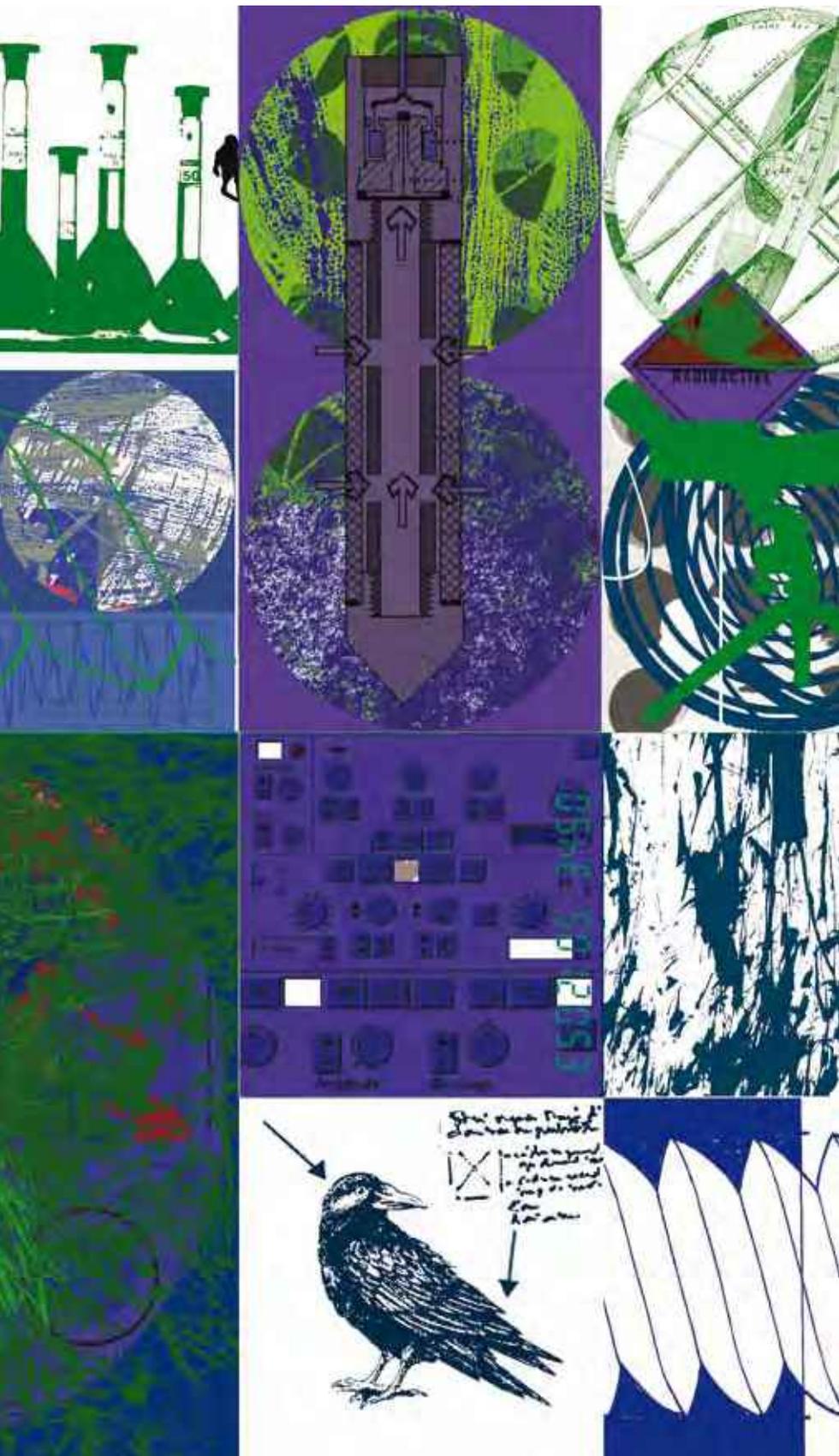
The buried gravity separation network was inspected in 2011.

The collection facility operated by Andra on the CEA site at Saclay (Essone district), contains radioactive waste collected from hospitals, pharmaceutical laboratories or research centres, before it is taken to a dedicated disposal facility. This storage building was inspected by the French Nuclear Safety Authority under the subject of radiological protection. Two corrective actions were requested concerning insufficiently documented responsibilities of the licensee and the operating entity, and acceleration of the process of retrieval for spent sealed sources.

At the Andra Head Office, an inspection was performed with regard to the approval inspection conditions for a type of package. This inspection found a deviation relating to reception and acceptance, by the Aube disposal facility, of six packages that, even though conforming to specifications, did not appear on the approval form supplied by the producer. Corrective actions relating to the approval conditions for this type of package were requested after this inspection.

Finally, the French Nuclear Safety Authority inspected “La Peupleraie” site at Pargny-sur-Saulx (Marne district), a contaminated site being cleaned-up by Andra. This inspection was not the subject of any remarks on the provisions set up at this site. ●





Environment

p.44 The permanent environmental observatory:
a unique research and observation tool

Two observation installations inaugurated
in 2011

p.45 Why a SOERE label?

p.46 Disposal facilities:
very low radiological impact

p.47 The industrial division analysis laboratory
becomes a department

Nuclear safety:
opening the debate after Fukushima



The permanent environmental observatory: a unique research and observation tool

Created by Andra in 2007 for use in the preparation of the environmental monitoring aspect of the Cigeo project (the future geological industrial disposal facility), the permanent environmental observatory (OPE) is both an essential monitoring device for an exceptional industrial project and a unique multi-field scientific research tool that integrates all aspects of the environment.

AN EXCEPTIONAL DEVICE

The primary role of the permanent environmental observatory (OPE) is to set up observation and monitoring tools to accurately describe, over ten years, the status of the environment before the start of construction of the geological industrial disposal facility, Cigeo. The data collected will enable the most relevant indicators to be defined for monitoring,

over the long-term, the changes to the various environments observed while the facility is in operation. This device is exceptional in three aspects; the duration of observation, the surface area concerned and the diversity of the parameters studied. The OPE should in fact provide environmental monitoring over one hundred years. This monitoring covers an area of 900 square kilometres hosting three distinct land-based ecosystems (forest, prairie and agricultural) as well as aquatic ecosystems (rivers, ponds). With regard to the fields of study, these encompass all the environmental factors (soil, fauna, flora, water, air, climate and also human activities) as well as the exchanges between these different environments.

AN ENVIRONMENTAL RESEARCH BASE

Andra's ambition is to create a real base for environmental research so that the data collected and analysed by the OPE can be used as widely as possible within the scientific community. Andra is therefore collaborating with local scientific facilities (University of Lorraine), as well as fifteen national research laboratories (CNRS, Inra, LNE, IRSN, Météo France...) and numerous specialised design offices. It has also included around ten national and European monitoring networks. The SOERE label (long-term observation and experimentation system for environmental research) provides the OPE with numerous means to take a front row seat in the national scientific community.

A LOCAL AND REGIONAL INTEGRATION MODEL

A scientific programme of such breadth, related to this unique industrial project, can only develop with the participation of all the local and regional stakeholders. Andra has therefore worked closely with the shooting and fishing federations, the chambers of agriculture and other associations, and has signed agreements with agricultural operators and owners, mainly to have access to the land in the area studied. ●

TWO OBSERVATION INSTALLATIONS INAUGURATED IN 2011

These installations permit continuous measurements to be made and are operated in conjunction with several scientific partners.

AN ATMOSPHERIC STATION AT HOUDELAINCOURT (MEUSE DISTRICT)

This installation is dedicated to climate and air quality monitoring. The equipment, part of which is installed on a 120-metre-high mast, is used for collecting meteorological data and for continuously measuring the quantity and chemical composition of particles in suspension in the atmosphere, as well as the concentration of greenhouse gasses and contaminating reactive gasses.



A FOREST ECOSYSTEM MONITORING DEVICE IN MONTIERS-SUR-SAULX (MEUSE DISTRICT)

The device consists in three experimental plots equipped with instruments dedicated to the study of transfers in the various forest ecosystems (soil, air, trees) and a "flux tower" equipped with sensors to monitor greenhouse gasses and exchanges between the various features studied (soil/air, vegetation/air).



Why a SOERE label?



Some answers from
ELISABETH LECLERC,
Deputy head of the Observation
and Monitoring Department of the Andra
Research and Development Division
and manager of the OPE

Can you explain
what a SOERE is?

Elisabeth Leclerc: It is a system most often organised in a network composed of a set of observation and experimentation sites, all studying the same subject or sharing observable and measurable data. The OPE is an original SOERE in that it makes up a node of the observation and experimentation network belonging to different subject networks. SOEREs are assessed by Allenvi, the Alliance of environmental research organisations, and is part of the research and innovation strategy, defined by the Minister for research, to perform long-term environmental monitoring.

How does this seal of approval benefit the OPE?

E. L.: First of all, it is the recognition that the OPE is a leading tool in national environmental research, over and above the requirements of Andra itself. The label enables it to benefit from financial support to develop research programmes with scientific partners. In 2011, we were able to launch tenders for projects and to finance three



1 metric
tonne
of samples has
been taken and
analysed

research programmes. We are also going to develop our collaboration with higher education and will shortly be creating a Chair on sensors at the University of Lorraine. In all, around ten research programmes are in progress.

How do they operate?

E. L.: Five Andra engineers and technicians are working full-time on the OPE. Research laboratories, design offices and federations support them in their day-to-day tasks. Since 2007, an annual general assembly brings together the main participants and service providers to present the results obtained and direct operational management. Since receiving the seal of approval in 2010, we have set up a scientific steering committee to take into account recommendations and assessment from institutions, local authorities and Andra assessors, such as the National Assessment Commission, the Andra Scientific Council and the French Nuclear Safety Authority. ●

ENVIRONMENT

Disposal facilities: very low radiological impact

The management of radioactive waste disposal facilities generates very small quantities of radioactive residues, subject to very strictly regulated thresholds. As a responsible industrial operator, Andra tries to limit the radiological effects of its activities as much as possible.

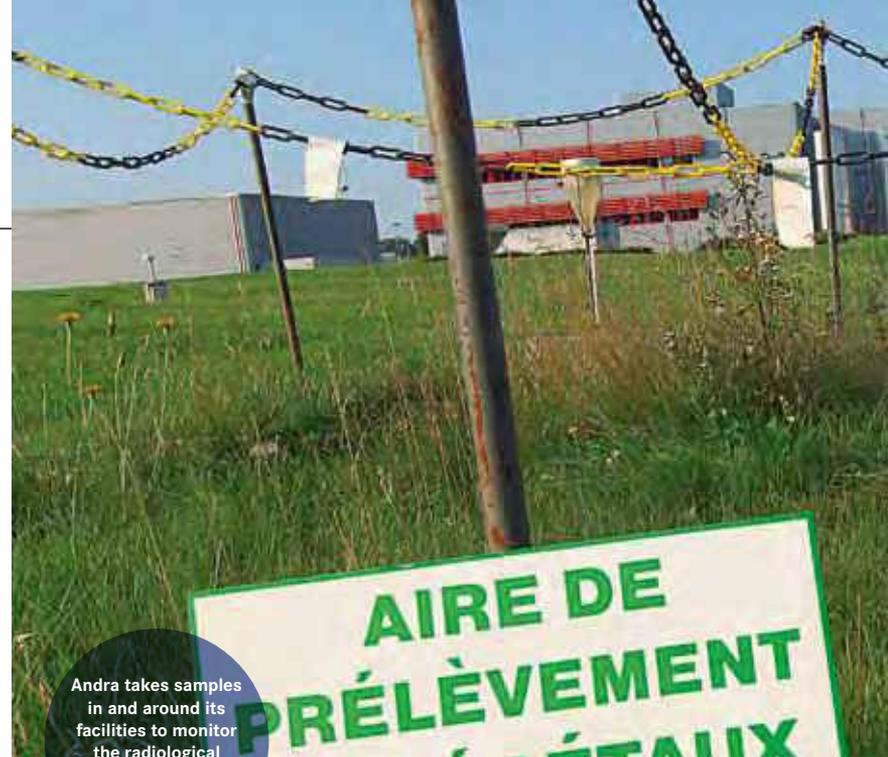
PERMANENT MONITORING AND INSPECTION

Each disposal facility runs an environmental monitoring plan, in and around its premises, with rigorous monitoring of the water, air and land-based and aquatic ecosystems. In 2011, there were close to 10,000 radiological analyses and 2,000 physical/chemical analyses performed at the Manche disposal facility, and around 2,000 radiological analyses and 1,000 physical/chemical analyses performed at the very-low-level waste disposal facility in the Aube district.

Taking a sample
of milk around
the Andra
disposal facility
in the Aube district



* To find out more, the Andra facilities reports are available on the internet www.andra.fr publications section.



Andra takes samples
in and around its
facilities to monitor
the radiological
impact of its
activities

At the low- and intermediate-level waste disposal facility in the Aube district, more than 11,000 radiological analyses and more than 3,000 physical/chemical analyses were performed, plus those performed by the French Nuclear Safety Authority. During an inspection dedicated to environmental monitoring, samples are taken from the air and water, and analysed by two approved independent laboratories, for comparison with the results transmitted by Andra.

PRACTICALLY NEGLIGIBLE IMPACT ON THE ENVIRONMENT

The 2011 environmental results from the Manche disposal facility and the Aube disposal facility highlighted, as in previous years, their very low impact on the environment and on the health of the population.* ●



Nuclear safety: opening the debate after Fukushima

The three local information committees in the Cotentin (for the Flamanville nuclear power plant, la Hague spent fuel reprocessing facility and the Manche disposal facility) organised an extraordinary general meeting in April 2011 to debate the safety of local nuclear installations with their operators.

LEGITIMATE QUESTIONING

130 people attended the general assembly, they asked EDF, Areva NC and Andra, numerous questions on the safety of their installations and expressed their worries with regard to the Fukushima disaster. How can we be sure that the design of the structures in the nuclear facilities in the Cotentin will enable them to withstand these kinds of events? This question raises the issue of risk assessment.

OVERALL REFLECTIONS

The three local information committees decided to collectively think about the overall issues through a working group made up of 25 people from civil society. Its mission consists in identifying all the questions and raising all the subjects related to nuclear safety. The work performed would complete the post-Fukushima audit carried out by the French Nuclear Safety Authority, concerning the capacity of French nuclear installations to resist natural risks.

OBTAINING CLEAR ANSWERS

The aim was to raise all aspects of Cotentin installation nuclear safety, avoiding no subjects. A debate is planned for 2012 with Christian Bataille, Member of Parliament for the North district and nuclear energy specialist, in his role as member of the Parliamentary Office for assessing scientific and technical choices. ●

THE INDUSTRIAL DIVISION ANALYSIS LABORATORY BECOMES A DEPARTMENT

In 2011, the Analysis and Inspection Laboratory became a department in its own right within the Andra Industrial Division. This will enable it to guarantee that the approval delivered by the French Nuclear Safety Authority (ASN) is maintained, to reinforce its interface role with all Andra's departments and external partners, and to consolidate the reliability of its practices.

Every year the laboratory performs 13,000 individual radiological analyses on around 6,000 samples, coming from the Andra disposal facilities (service air monitoring filters), and the surrounding environment (water, soil, air, fauna, flora, food chain, etc.).





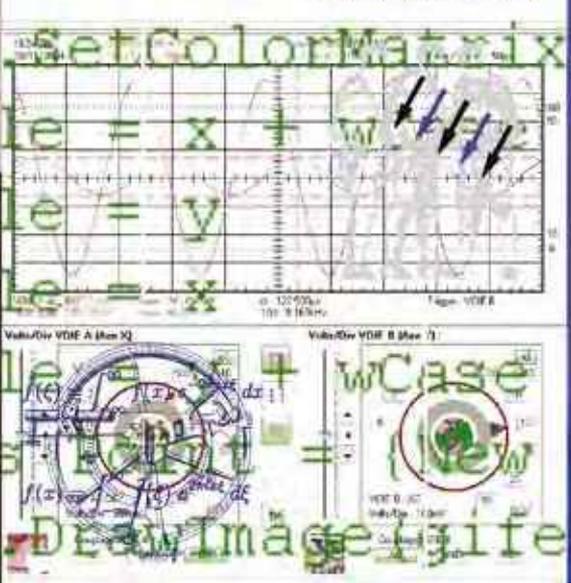
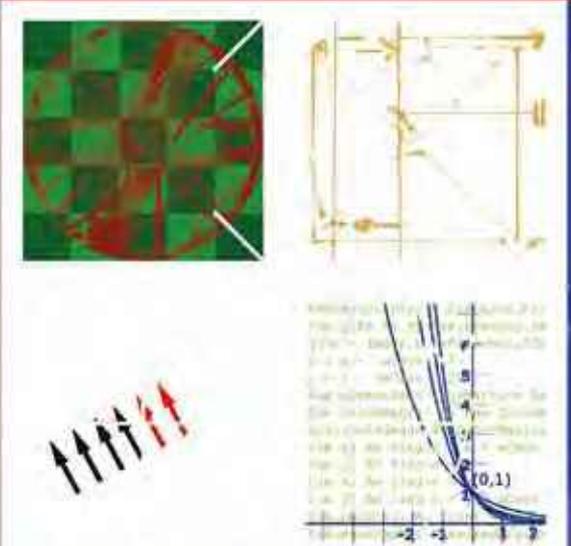
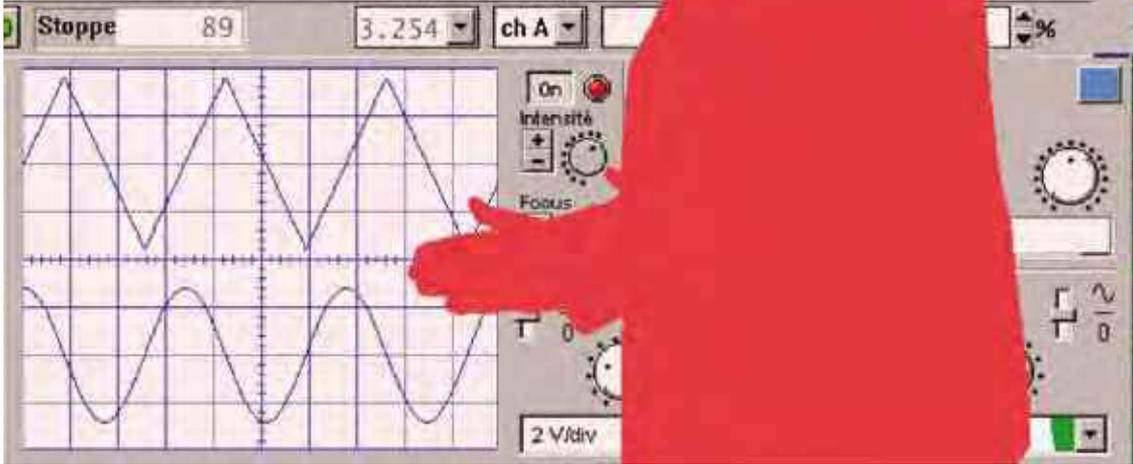
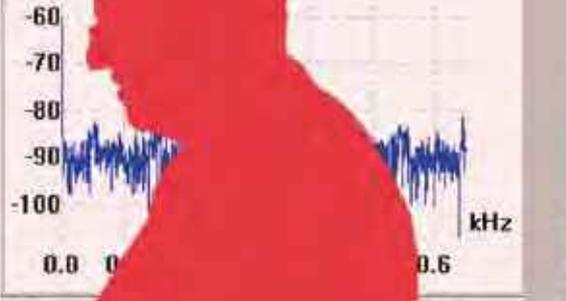
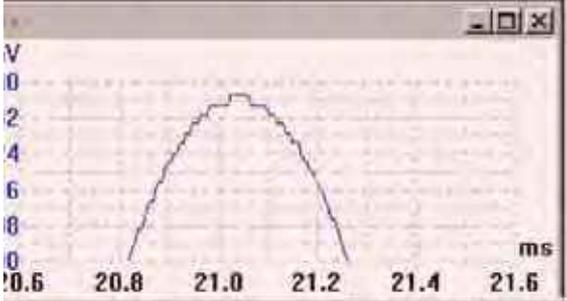
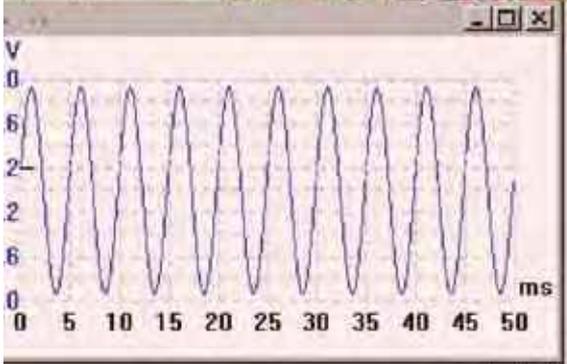
$$\int_S \sigma_{ij} n_j dS + \int_V F_i dV = \int_V \rho v_i dV$$

$$\int_V \partial_j \sigma_{ij} dV + \int_V F_i dV = \int_V \rho v_i dV$$

$$f(x) = \frac{1}{(2\pi)^n} \int_{\mathbb{R}^n} \hat{f}_2(\omega) e^{i\omega \cdot x} d\omega$$

$$\frac{d}{dt} \int \rho v_i dV = \int \frac{\partial(\rho v_i)}{\partial t} dV + \dots$$

$$\frac{d}{dt} \int \rho v_i dV = \int \left(\frac{\partial v_i}{\partial t} + \dots \right) dV$$



$$\int_S \sigma_{ij} n_j dS$$

$$\int_V \partial_j \sigma_{ij} dV$$

$$\frac{d}{dt} \int \rho v_i dV$$

$$\frac{d}{dt} \int \rho v_i dV$$

$$\frac{d}{dt} \int \rho v_i dV$$

$$\int_V \left[\frac{\partial}{\partial t} (\rho v_i) + \dots \right] dV$$



Scientific policy

- P.50** A very fruitful year
- P.51** IGD-TP: production of a strategic research agenda
- P.52** Special relationships with higher education
- P.54** Clay under the microscope
 - From centimetres to nanometres, clay reveals its structure
- P.55** Andra research studied by independent experts

The CNE report: in phase with Andra's strategic choices

SCIENTIFIC POLICY

A very fruitful year

For several years, Andra has been participating in several French and European research programmes either as leader or active member. In this respect, 2011 was a particularly busy year, enabling Andra to contribute the results of its own extensive and wide-ranging research to multi-disciplinary projects.

WIDER SCIENTIFIC PARTNERSHIPS

In 2011, Andra signed two new partnership agreements. The first, with the LNE (National Laboratory of Metrology and Tests), is a five-year research programme on observation and monitoring instrumentation, mainly for thermal and deformation measurements. The second, with IFSTTAR* (French Institute of Transport Science and Technology), concerns the upgrading of tools, examination methods and monitoring of underground structures, as well as civil engineering research.

Andra has also consolidated its collaboration with BRGM (French Geological Survey), by renewing a partnership initiated twelve years ago for another four years on the subjects of geoscientific research, modelling and observation and monitoring technology.

PARTICIPATION IN THE CNRS NEEDS PROGRAMME

Already in a collaborative scientific programme with PACEN (Back end cycle and nuclear energy programme), Andra continued its collaboration with the CNRS in 2011 within the framework of the preparation for the new NEEDS programme (*Nucléaire Energie-Environnement-Déchets-Sociétés*: nuclear power, environment, waste and society), which brings together a wide range of skills (nuclear data, radiolysis, physical chemistry, applied mathematics, human and social sciences) to perform studies and research encompassing all aspects of the nuclear sector.

* After combining the Central Laboratory of Bridges and Roads and the National Institute on Transport Research and Safety into a single entity



Partnership agreement signed between Andra and IFSTTAR



Andra will lead two projects within this inter-disciplinary programme, one looking at waste treatment and conditioning, and the other looking at the description and microscopic and nanoscopic characterisation of porous media. Andra will play an active role in three other projects: “Impact of nuclear activities on the environment”, “Materials for the nuclear industry” and “Risk and society”.

PRESENTATION OF RESULTS FROM DRILLING TO THE TRIASIC

In 2006, together with the CNRS, Andra launched an invitation for projects to the geoscientific community to be associated with a scientific experiment never before performed: analysing the data acquired from a 2,000-metre-deep drilling operation reaching the Triassic layer, a 250 million year old geological formation.



Drilling platform
to reach
the Triassic layer at
a depth
of 2,000 m

Twenty-five laboratories, within a research programme led by Professor Maurice Pagel (*Paris-Sud* University), responded to the invitation for projects. The main results of the studies performed were presented during the 13th congress of French sedimentologists in Dijon, in November 2011. These studies were based in particular on the paleogeographic reconstitution of the various geological periods, the understanding of diagenesis – i.e. the transformation of sediment into rock – and the past circulation of fluids. These results will be published in prestigious scientific reviews.

● **IGD-TP:
PRODUCTION OF A STRATEGIC
RESEARCH AGENDA**



Launched in 2009, on a request from the European Union, the IGD-TP (Implementing Geological Disposal-Technological Platform) has 12 national radioactive waste management agencies on its executive committee and around sixty organisations.

This platform is based on the shared vision that in 2025 the first geological radioactive waste disposal sites will begin to operate in Europe in a safe manner. It was necessary to define a common R&D roadmap to set out the main steps enabling this objective to be reached. Under Andra's presidency from September 2010 to January 2012, a strategic research agenda and a deployment plan were produced. These documents will enable the European Commission to set broad objectives for research, in particular within the "2020 horizon" programme for research and innovation in the European Union. It will also add new impetus to exchanges between member countries to share the best skills and search for common priorities.

Special relationships with higher education

The very active collaboration policy that Andra carries out with French universities and colleges contributes to the national effort to reinforce links between education and business, encouraging research projects and innovative teaching. It also allows Andra's scientific expertise and knowledge to be promoted.

FUNDING FOR THESES

Each year Andra launches an invitation to tender for universities in France and abroad, to fund thesis on subjects covering a wide range of scientific fields, including earth and environmental sciences, applied mathematics, chemistry and materials physics.

The purpose of the procedure is not to obtain immediately applicable results, but to deepen understanding on fundamental questions. In 2011, Andra received twenty-five candidatures and selected ten files on the criteria of subject relevance and candidate level. The doctoral students are employed for three years and they carry out their research in a research laboratory, under the supervision of an Andra representative and in conjunction with their thesis supervisors.

CREATING MASTERS DEGREES IN RADIOACTIVE WASTE DISPOSAL

Andra wants to contribute to the development of strong university bases. Therefore, since 2010, it is the sponsor of the industrial chair created with the Nantes School of Mines and based on the physical and chemical transport mechanisms of elements. This chair is held by Professor Andreï Kalinitchev, molecular modelling specialist, and Andra scientists give lectures. The course started in 2011 at the Master 2 level



Invitation to thesis candidates

THE ANDRA SCIENTIFIC COUNCIL, A MAJOR BODY

Made up of 13 people representing the scientific community from France and abroad, and appointed by Ministerial Decree, the Andra Scientific Council gives its opinion on Andra's scientific policy, directions and research results: it presents them in an end of year report to the Board of Administrators. In 2011, the scientific council examined numerous subjects such as the policy with regard to higher education and Andra's international policy. It also gave its opinion on more technical and scientific subjects, for example, consolidation of the geological conceptual model or the updating of the hydro-geological models of the Meuse/Haute-Marne site and the disposal facility in the Aube district.

on subjects relating to radioactive waste management. This advanced training is specifically aimed at students from countries which are developing nuclear power, such as China and India.

Andra also wants to be a stakeholder in the development of universities in the regions where it has installations. With this in mind, it participated in 2011 in the creation of two new additional and associated industrial chairs. The first is based on the development of management techniques and the interpretation of measurements obtained within the disposal observation and monitoring framework, with the Troyes University of Technology; the second on the development of environmental sensors with the University of Lorraine. These two chairs should become operational in 2012.

DID YOU KNOW?



The eco-repository in progress

Aerial view of the Meuse/Haute-Marne facility

CONTRIBUTE TO THE DEVELOPMENT OF THE INTERNATIONAL INSTITUTE OF NUCLEAR ENERGY

Created by Catherine Cesarsky, Atomic Energy High-Commissioner, in 2011, on a request from the French Government, the International Institute of Nuclear Energy brings together all the entities involved in the French nuclear network and twenty-five other interested parties (universities, *Grandes Écoles*, industrial groups, research organisations, Ministers).

Its mission is to promote the nuclear safety and security culture developed by France to foreign partners through high-level education and training. Andra is already an international reference in radioactive

waste management and naturally has its place within this body, which is set to become a centre of excellence.

LAUNCHING A CAMPUS PROJECT IN MEUSE/Haute-MARNE

A project to create a campus was conceived in 2011. It will be on the site that is already home to the Underground Laboratory and the Permanent Environmental Observatory, and which will be receiving the eco-repository and the Memory Centre in 2013. Called SOMET – Structure for observation and memory of the environment and the Earth – it aims to have a considerable capacity and to provide high-level training courses well beyond the field of radioactive waste management.

In conjunction with the project for a national geological core samples storage managed by the BRGM, the campus could contribute to the Meuse/Haute-Marne inter-district area development scheme. ●

Clay under the microscope



In September 2011, the Clay Club met at Karlsruhe in Germany for a working seminar dedicated to new image acquisition technologies in the research into clay behaviour.*

*Update with **NICOLAS MICHAU**,
Physical-chemist and engineer at Andra.*

Where are these new technologies today?

Nicolas Michau: They have improved a lot and allow us to go further inside the rock, to resolutions around one nanometre. Using the images obtained and mathematical calculations, we can study the minerals contained in the clay on a very small scale, and see how the material is structured and how it may change.

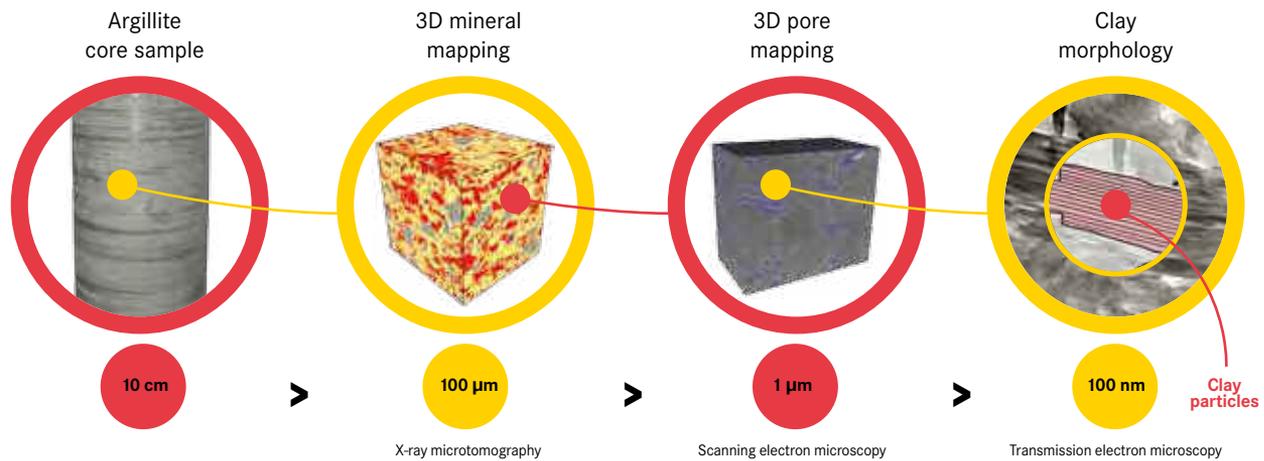
What scientific purposes is the collected data used for?

N. M.: The aim is to reconstitute the structure of the clay digitally with all its properties, to be able to model it and study the transformation undergone by the material in long duration disposal conditions. The information collected is used both by mechanical engineers and by chemists.

How have you developed these new imaging means?

N. M.: We call on European laboratories that have developed microscopy techniques and have suitable technology, so that the sample study conditions do not modify the material and that the work on image processing enables access to the properties that interest us. ●

FROM CENTIMETRES TO NANOMETRES, CLAY REVEALS ITS STRUCTURE



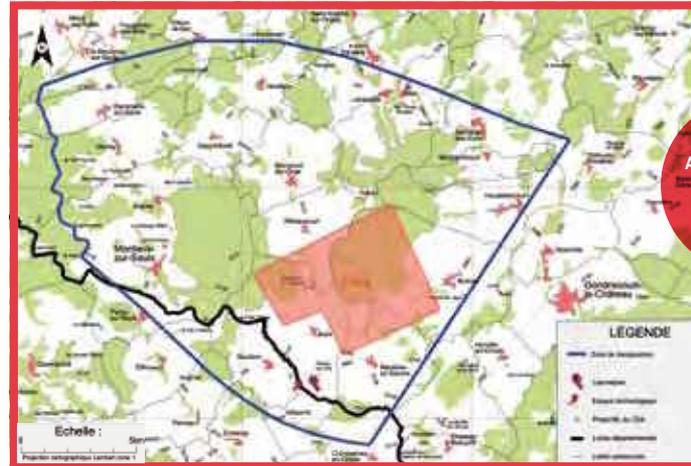
*The Clay Club, organised under the auspices of the OCDE and chaired by Andra, bringing engineers and researchers together. It operates as a think tank for sharing knowledge about clay media.

Andra research studied by independent experts

The studies and research performed by Andra, especially within the framework of the Cigeo project - the future geological industrial disposal facility - are regularly assessed. In 2011, Andra responded to a report by American experts, ordered by the Local Information and Monitoring Committee (Clis) of the Underground Laboratory.

IEER REPORT: RECOMMENDATIONS ALREADY TAKEN INTO ACCOUNT

In 2010, the Local information and monitoring committee (Clis) of the Underground Laboratory wanted an assessment of the research work performed by Andra to decide where to install the Cigeo facilities.



Area of interest
for in-depth
investigation

CNE REPORT: IN PHASE WITH ANDRA'S STRATEGIC CHOICES

The National Assessment Commission published its annual report in November 2011 on the research performed by Andra into the storage and disposal of radioactive waste.

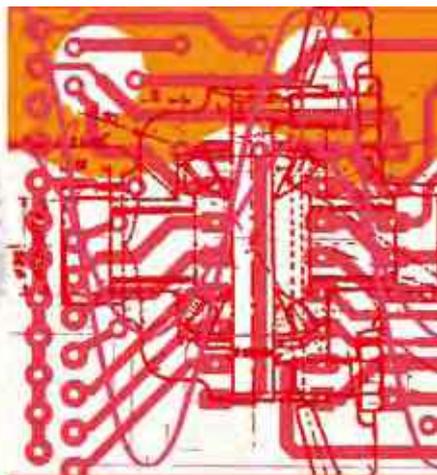
It underlined the scientific research work that was remarkable both by its scope and its quality, and the progress made in the subject of reversibility. It also issued a certain number of recommendations, which are in phase with Andra's strategies. They bear mainly on the governance of the Cigeo project, remembering that it is up to Andra to fully assume the responsibilities given to it in law, working hand in hand with the producers.

The Commission also stressed the priority to be given to safety objectives, on cost concerns, on the need to set up a precise inventory of the waste concerned by Cigeo, in view of the 2013 public debate, to continue the modelling efforts and to perform full-size tests in the Underground Laboratory.



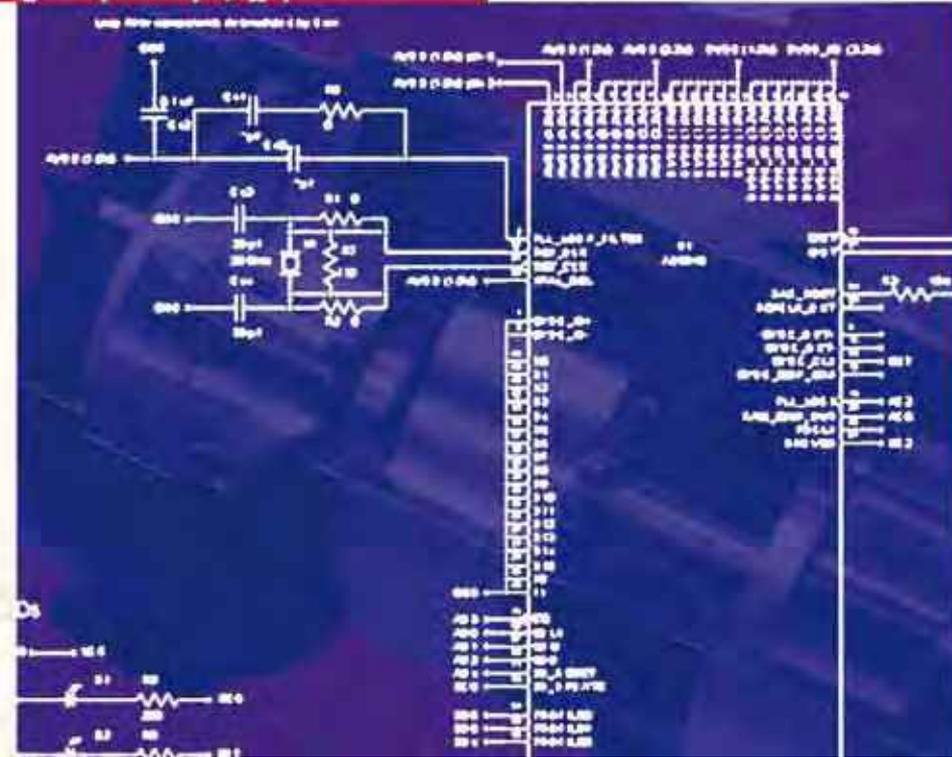
The assessment was performed by *the Institute for Energy and Environment Research (IEER)*. In its report, issued in 2011, the IEER gave a generally positive assessment of Andra's work, stating that it had applied to good effect the geological criteria for determining the area liable to be suitable for more detailed investigation prior to being used for the Cigeo underground installations.

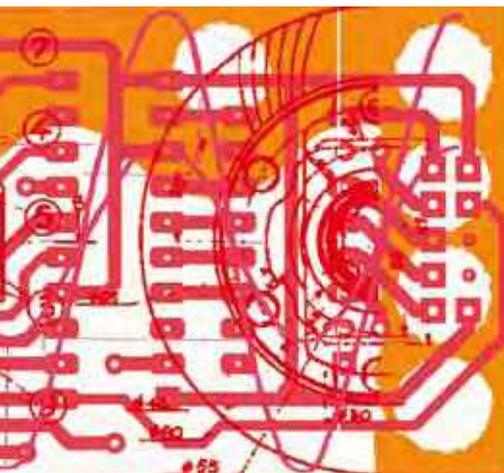
The institute did, however, express reservations on the methodology used in the analysis carried out by Andra, on the capacity of the site to receive spent fuel and on the implementation schedule, considered too tight. Andra gave scientific answers to each of these points in a fifty-page document submitted to the Clis. It emphasised that practically all of the IEER's recommendations corresponded to actions already undertaken or scheduled within the preparation framework for the Cigeo licence application request. ●



$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx$$

$$f(x) = \int_{-\infty}^{\infty} \hat{f}(\xi) e^{2\pi i x \xi} d\xi$$





$$\int_V \nabla_j v_j dV + \int_V F_i dV = \frac{d}{dt} \int_V \rho v_i dV$$
 Using the Gauss's divergence theorem to convert a surface integral to a volume integral gives (see p. 58)

$$\int_V \partial_j \sigma_{ij} dV + \int_V F_i dV = \frac{d}{dt} \int_V \rho v_i dV$$
 Now we only need to take care of the right side of the equation. We have to be careful, since we are dealing with a continuum body in taking place (the body is not necessarily solid), the volume we are integrating is

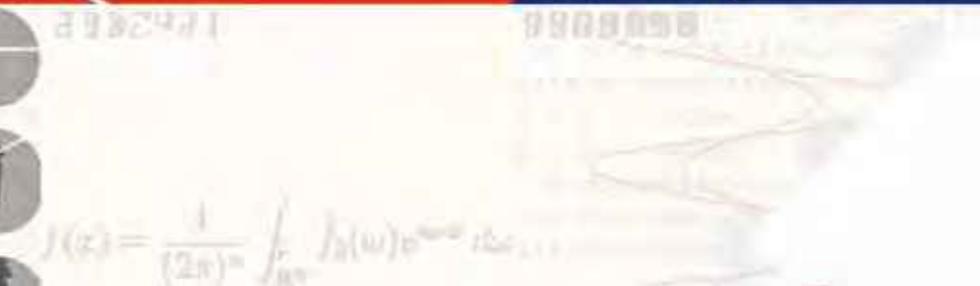
$$\frac{d}{dt} \int_V \rho v_i dV = \int_V \frac{\partial(\rho v_i)}{\partial t} dV + \int_V \rho v_i v_j n_j dA$$
 Performing the differentiation in the first part, and applying the divergence theorem on the second part

$$\frac{d}{dt} \int_V \rho v_i dV = \int_V \left[\rho \frac{\partial v_i}{\partial t} + v_j \frac{\partial \rho}{\partial t} + \partial_k (\rho v_i v_k) \right] dV$$
 Now the second term inside the integral is $\partial_k (\rho v_i v_k) = \rho v_k \cdot \partial_k v_i + v_i \partial_k (\rho v_k)$. Plug

$$\frac{d}{dt} \int_V \rho v_i dV = \int_V \rho \left[\frac{\partial v_i}{\partial t} + v_k \partial_k \right] v_i dV + \int_V \left[\frac{\partial \rho}{\partial t} + \partial_k (\rho v_k) \right] v_i dV$$
 We can easily recognize the two integral terms in the above equation. The first integral contains the mass in time. Now let's assume that there are no sinks and sources in the system, that is, mass is

$$\frac{d}{dt} \int_V \rho v_i dV = \int_V \rho \frac{Dv_i}{Dt} dV$$
 Putting this back into the original equation

$$\int_V \left[\partial_j \sigma_{ij} + F_i - \rho \frac{Dv_i}{Dt} \right] dV = 0$$



Technological research, experiments and developments

- P.58** New experiments in the Laboratory
- P.59** A patent in metrology
- P.60** More than one kilometre of tunnels
- P.61** Effective and innovative computer tools
- P.62** Knowledge on the geology of the Meuse/Haute-Marne districts: more and more precise detailed modelling
- P.63** Underground Laboratory: a unique internal assessment
- P.64** Radioactive waste behaviour in the disposal situation
 - Special case of spent fuels and graphite waste
- P.65** Intellectual property: a strategic challenge

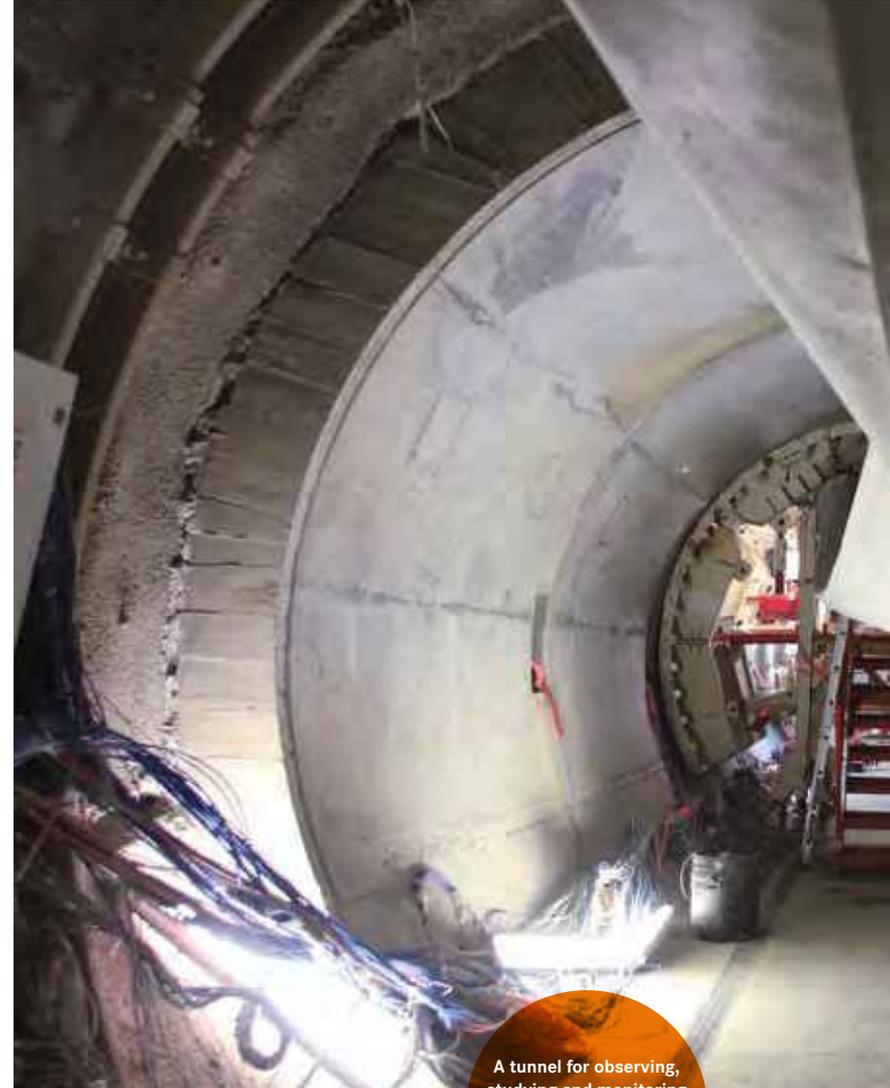
New experiments in the Laboratory

In 2005, Andra demonstrated the feasibility of safe and reversible disposal for high-level and intermediate-level long-lived waste in a clay layer located at a depth of 500 metres underground in the Meuse/Haute-Marne districts. Since then, Andra has carried out full-scale technological tests and experiments to check its scientific understanding, confirm its results, develop and refine the procedures that will be used to construct and operate Cigeo, the future geological industrial disposal facility. In 2011, the studies and tests carried out in its Underground Laboratory covered the behaviour of the rock, the design of the structures and their instrumentation.

CONCRETE TUNNEL LININGS UNDER STUDY

With a length of 48.5 metres and a final diameter of 4.30 metres for an excavated diameter of 5.40 metres, the purpose of the rigid design experimental tunnel, called the GCR tunnel, is to study the effect a concrete lining, approximately 30 centimetres thick, cast in place six months after the tunnel was dug. It also aims at studying the mechanical behaviour of the rock. Three combinations of supporting walls and linings were tested on three sections of the tunnel.

On the first two sections, the supporting walls built during excavation at the start of 2011, were made up of two layers of pneumatically placed concrete with a total thickness of around 20 centimetres, into which were inserted compressible concrete blocks enabling the supporting walls to compensate for deformation due to settling of the rock during the first six months. A different strength class of concrete was used on each section. On the last section, the supporting walls did not have compressible blocks.



A tunnel for observing, studying and monitoring the effect of concrete lining on the rock mechanical behaviour

Significant instrumentation was installed at all stages: before excavation of the tunnel, during excavation operations, during construction of the supporting walls and then for the linings. The sensors were installed at more than 900 measurement points. Some of the sensors were being specifically tested for the observation and monitoring of the future geological industrial disposal facility - Cigeo.

The measurements collected enabled the disturbance caused by excavation of the tunnel in the surrounding rocks to be observed, as well as the loading and deformation of the different types of supporting walls and linings under the effect of the settling rock.

STRUCTURES FOR DEMONSTRATING THE FEASIBILITY OF OBSERVING AND MONITORING FOR CIGEO

Observation and monitoring of the future geological industrial disposal facility - Cigeo - aims to supply the knowledge required for running the disposal facility and its reversible management, as well as for safety analyses during its service life and after it is closed. This should make it possible to operate and control the installation correctly, in compliance with applicable specifications and safety regulations, and also to acquire feedback which will be used for the design of the structures and sections for the parts of the installation yet to come.

For the design of the instrumented systems that will be used in Cigeo, technology is being qualified for various stages, from the test laboratory for implementing controlled conditions at the surface to the underground site conditions. In this regard, the system for observing the linings and supporting walls installed in 2011 in the GCR tunnel comprises 260 sensors complementing those installed for monitoring at the experimental stage. Their durability and suitability for Cigeo requirements will thus be able to be assessed. Housed in the boreholes at the interface between the rock and the linings, or in the linings themselves, they take temperature, water content and deformation measurements.

A PATENT IN METROLOGY

In 2011, after signing a partnership agreement in the metrology field, Andra's and the LNE's cooperation quickly took the form of a patent for a calibration device for an optic fibre temperature sensor. The fibre is surrounded by a system that enables calibration *in situ* of the sensor by comparing the temperatures it displays with qualified temperature measurements. This innovation helps to control the phenomenon of measurement shift over time.



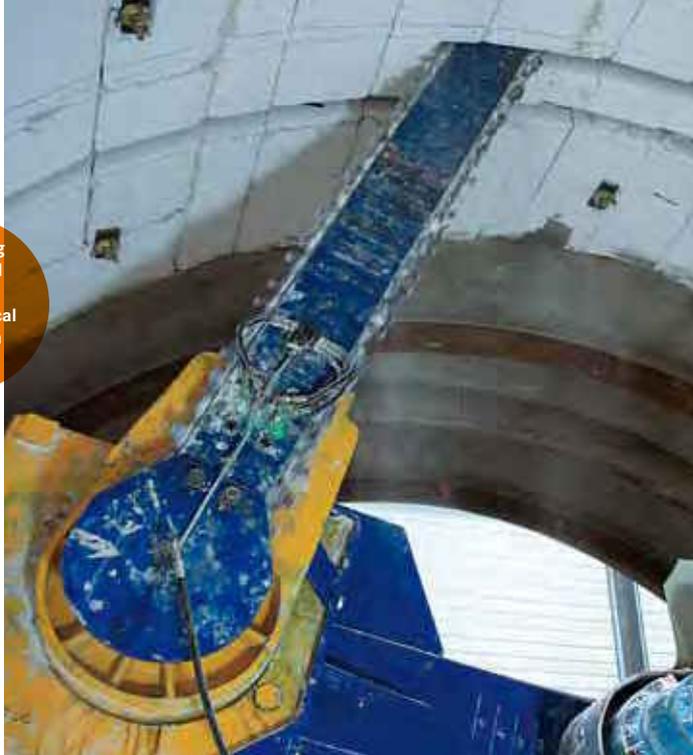
Some of them call upon innovative technology as a response to the specific features of deep, reversible disposal. Many of the features have never been encountered before. This work is carried out with the National Laboratory of Metrology and Tests (LNE), which participated in upgrading the *in situ* calibration systems of optic fibre sensors able to take accurate and spatially dispersed measurements in the structures.

CONTINUING TESTS ON THE DESIGN OF VAULT ANCHORING MECHANISMS

When a tunnel is dug into rock, this generally causes significant damage to the rock. In the Underground Laboratory at a depth of 490 metres, this damage is revealed by cracking in the shale walls where water can run faster than in undamaged rock. The anchoring mechanisms made of bentonite - a clay that has the property of swelling when it absorbs water - contribute to significantly reducing the water draining through the tunnels and also in the damaged area by compressing the fractures generated during excavating operations.

In 2011, two experiments were set up in the Underground Laboratory, one based on the way this cracked area can be interrupted by a water-tight barrier and the other to assess its properties when it is rehydrated and subjected to pressure (phenomena occurring when installing the anchoring mechanism).

Excavating
a channel
in the
Technological
Exhibition
Facility



The purpose of the first experiment was to define a barrier to interrupt the network of cracks and significantly limit the circulation of water by digging trenches all around the periphery of the tunnel to a depth exceeding that of the cracked area, and filling them with bentonite. A 2.5 metres deep and 30 centimetres wide trench was made to check the feasibility of this type of work. At the same time, tests were initiated in the Technological Exhibition of the Meuse/Haute-Marne Facility on an industrial method of filling a trench with bentonite, similar to that performed in the Underground Laboratory.

The second experiment consisted of subjecting the damaged rock to mechanical pressure over a surface area of one square metre using a jack. Successive pressure cycles of 200, 300 and 400 tonnes were performed, followed by a sudden release of the pressure. This pressure simulates the effect of bentonite swelling in the anchoring mechanism. The measurements made highlighted a thousand-fold reduction in gas permeability under 400 tonnes of pressure. The forced hydration then produced showed that the permeability of the damaged area had considerably dropped from the start and continued to diminish over time.

HIGH-LEVEL-VAULT-LINING TESTS

These horizontal vaults with an effective diameter of around 70 centimetres, dug into the clay at a depth of 490 metres, are similar to those intended for the disposal of high-level waste packages in the future geological industrial disposal facility - Cigeo. The principle adopted for their construction is the installation of steel tube liners, fitted one inside the other, at the same time as the digging operations.

Two vaults of this type were dug in 2011. The purpose of the first test was to check the head of the vault, made of a 77.5-centimetre exterior diameter lining, which has to be installed with a clearance of 1.6 centimetres between the lining and the vault, instead of the 4 centimetres adopted for the previously performed test in 2010. This lining reached a length of 8 metres. The second test was based on understanding the hydro-mechanical behaviour of the clearance between the lining and the vault. In order for the laboratory to be in complete control of the experimental conditions, the lining was made waterproof by injecting resin into the joints of the sections and by laying a base plate. The instrumentation installed directly on the lining (inner side and outer side) would enable the processes occurring when the rock and the lining came into contact, and the arrival of water (coming from the rock) to be observed. These processes are very slow- and the experiment will therefore have to be monitored over several years. ●

MORE THAN ONE KILOMETER OF TUNNELS

In 2011, 170 metres of tunnels were dug at a depth of 490 metres, the one kilometer threshold of the underground tunnel linear length, reaching 1,130 metres at the end of the year, was therefore exceeded.

Effective and innovative computer tools

Year after year, Andra continues to adapt and develop its activity-specific databases and softwares.

THERMOCHIMIE, AN EXHAUSTIVE DATABASE SUPPORTING DIGITAL SIMULATIONS

ThermoChimie is a thermodynamic database that lists all the intrinsic data of radionuclides and minerals. Developed by Andra over fifteen years, it has been available in its v8 version since the end of October 2011. Operated with digital calculation codes, the database enables the changes to clay or concrete under disposal conditions to be taken into account.

It also includes data relating to the chemical behaviour of radionuclides and toxic chemicals, necessary to produce safety and assessment performance for the existing or planned disposal facilities. Its development is supported by dedicated, fundamental research and prediction models performed in collaboration with several organisations (Amphos XXI, BRGM and CNRS) within a laboratory group set up and led by Andra since 2006.

Today, ThermoChimie provides a store of exhaustive information with regard to Andra's requirements. It is the subject of growing interest by entities in other countries concerned by the management of radioactive waste.

MODEFRONTIER, A NEW TOOL SERVING DIGITAL SIMULATIONS

In 2011, Andra acquired ModeFrontier, the reference in modelling software. This optimisation software can be used to integrate one or more calculation tools to provide different sets of input data



Andra has developed a complete method of managing its samples.

and to study the variability of the results. The aim is to integrate all the calculation tools dedicated to the safety of waste storage and disposal facilities within a few major calculation chains, and to automate the transfer of data from one calculation tool to another.

A COMPLETE SAMPLE MANAGEMENT METHOD

In twenty years of research, Andra has acquired solid experience in the management of rock and liquid samples taken from surface and deep boreholes. This has enabled it to develop the Gestech software, the source codes of which were registered in 2011.

Gestech guarantees the traceability of each sample from its date and place of sampling up to its possible destruction. This software is also used to manage the "core library" where the Meuse/Haute-Marne Facility samples are kept. This internal know-how is used to develop the environmental sample management system of the future eco-library.

At the same time, Géosciences, an internal portal, offers the scientific community access to the data relating to each sample and the history of the operations carried out on each borehole.

Lastly, Geovisionary, a graphic interface developed in partnership with the British Geological Survey, provides the 3D physical location of each sample taken. ●

TECHNOLOGICAL RESEARCH, EXPERIMENTS AND DEVELOPMENTS

Knowledge on the geology of the Meuse/Haute-Marne districts: more and more precise and detailed modelling

Geometry, structure, mechanical resistance, water circulation... All the knowledge acquired on the properties of shale in the area likely to house the future geological industrial disposal facility, and more widely, the Paris basin, were modelled in 2011.

FROM SEISMIC RECONNAISSANCE TO GEO-PHYSICAL MODELLING

In 2010, Andra carried out a three dimensional geo-physical reconnaissance campaign on the land in the area where Andra may be building the underground installations of the future geological industrial disposal facility - Cigeo. The purpose of this campaign was to investigate in a non-intrusive way the geometry and properties of the sedimentary layers and in particular the shale layer at a depth of approximately 500 metres, where Cigeo may be installed.

After several data processing and interpretation phases in 2011, the initial results from this reconnaissance campaign confirmed that this layer is continuous and regular, with an average thickness of 148 metres, and a very gentle slope of around 1° to the north-east. The results obtained in 2011 also showed that no faults were detected within the shale layer or where it comes into contact with the geological layers above and below.

A CONSOLIDATED HYDRO-GEOLOGICAL MODEL

The hydro-geological model of the Meuse/Haute-Marne sector is a fundamental element in the creation of the radioactive waste deep geological disposal project. It consists of an overall representation of water drainage (directions and associated gradients) and the

transport of dissolved elements within the geological formations that surround the shale layer likely to house the Cigeo underground installations.

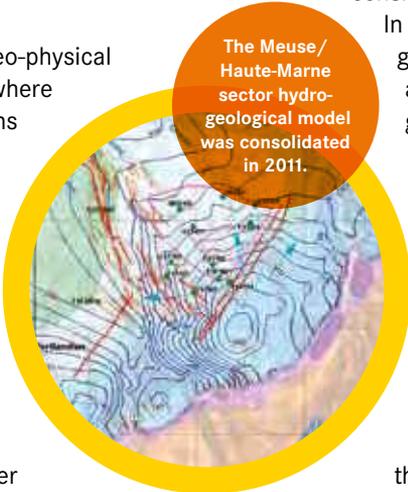
It is an integrated model ensuring that the scale of water drainage from the area likely to house the Cigeo underground installations is consistent and continuous with that of the Paris basin.

In 2011, a much more detailed geological and hydro-geological representation of the geological layers and faults across the Paris basin enabled this hydro-geological model to be consolidated.

A NEW GEOLOGICAL MODEL OF THE MEUSE/Haute-MARNE SITE

Since the end of 2011, a new “Meuse/Haute-Marne site geological design model” has been available to Andra. This model uses detailed knowledge of the geographical and climatic context in which the area studied for the creation of the deep disposal facility was formed and the subsequent geological events that modified it. It shows how each property of the rock - permeability and porosity, migration of dissolved elements, heat propagation, mechanical resistance - depend on the way these components are made up and arranged.

It can also propose a precise spatial representation of the Callovo-Oxfordian formation and its properties, in particular over the entire area which will be covered by the in-depth survey, where the underground installations of the future geological industrial disposal facility, Cigeo, are likely to be sited. These elements will mainly be used for the detailed design of the disposal facility architecture, as well as for the Cigeo safety analysis that will be submitted with the licence application in 2015. ●



The Meuse/Haute-Marne sector hydro-geological model was consolidated in 2011.

Underground Laboratory: a unique in-house assessment



On 1st January 2011, Andra decided to source its Laboratory “Underground installations operation” activity which had previously been undertaken by a sub-contractor. The reasons for this change and the first report from **DIDIER PANOT**, Underground laboratory operations engineer.

Why was this activity brought back in-house?

Didier Panot: The experience acquired by the teams operating the Underground Laboratory is a rare skill that Andra wanted to retain, to use this unique know-how for preparing for the future geological disposal facility.

How was this done?

D.P.: Andra has taken on around thirty people who were previously working for

its service providers. The main reason for this decision is due to the fact that these personnel are totally operational and we wanted to maintain team cohesion.

How did their integration go?

D.P.: Very well. We set up a new organisation and training to further reinforce safety in the underground environment. Altogether the new organisation optimises our operational activities and, through this, our credibility with our customers and service providers. ●

“Andra has taken on around thirty people who were previously working for its different service providers.”



Andra has been directly operating the underground installations of its Laboratory since 1st January 2011.

Radioactive waste behaviour in the disposal situation



SPECIAL CASE OF SPENT FUEL...

Studies have mainly covered the development of a more realistic alteration model of spent fuel in disposal facilities, with the production of a report in December 2011 within the framework of The National Plan for the Management of Radioactive Materials and Waste.

This complex model integrates fuel radiolysis, water chemistry and in particular the oxidation-reduction potential via an electrochemical approach. It will eventually take into account the influence of the surrounding materials.

... AND GRAPHITE WASTE

Graphite waste studies confirm that the carbon-14 released in the gaseous phase is mainly in an organic form or as carbon monoxide, but in very low quantities.

Research on the behaviour of radioactive waste and materials in the disposal situation was continued in 2011. Summary of the most notable results.

CLOSE-UP ON THE ALTERATION OF GLASS

With regard to vitrified waste, studies have highlighted a particular behaviour of glass. In a humid atmosphere, the long-term alteration rate of glass is ten times faster than in pure water, but nevertheless significantly slower than its short-term alteration in pure water.

Experiments were also carried out to find out why the short-term alteration rate of glass in clayey water is slightly faster than that measured in pure water: they highlighted an effect from the alkaline compounds and alkaline earth as well as from the ionic strength.

In the case of vitrified intermediate-level long-lived waste, the major role of pH and the concentration of calcium on the alteration of glass in an environment containing cement was demonstrated.

GAS PRODUCTION

In 2011, studies on intermediate-level long-lived waste, mainly focussed on the production of gas, with numerous results on the corrosion of different metal alloys present in this waste (aluminium alloys, magnesium alloys, nickel alloys, zirconium alloys, stainless steel) and the acquisition of radiolytic outputs enabled the production of the main gasses (H_2 , CO_2 , CO , HCl) coming from the radiolysis of different polymers (used in the manufacture of gloves, absorbent paper, cables, etc.) to be assessed. ●

Intellectual property: a strategic challenge

Since the end of 2009, Andra has deployed its intellectual property policy. In this connection, Andra actively protects its technological development and its specific know-how relating to the safe management of radioactive waste both for its current disposal facilities and for its future installations, such as the future geological industrial disposal facility - Cigeo.

The breadth and diversity of the technology implemented in its different existing and future disposal facilities have led Andra to make up a portfolio of patents, which reinforces its R&D and operational capacity, and gives it independence with regard to suppliers.

Possessing a portfolio of patents is also a major asset for Andra on the international scene. In the coming years, Andra will be able to transfer some of its technologies in complete security to countries desiring to adopt its disposal methods. Finally, some of the patents may be exploited in fields other than disposal, in particular in civil engineering.

THREE MAJOR FIELDS OF TECHNOLOGICAL INNOVATIONS TO BE PATENTED

These three fields concern disposal procedures, the instrumentation necessary for observation and site monitoring, and the modelling on which disposal facility management safety rests in the very long-term.

The design of structures and machines specific to deep disposal in a shale layer alone represents a very wide engineering field. It concerns the development of equipment and handling techniques for packages, from their transportation to their placing in vaults and also their retrieval. Similarly, the disposal of high-level waste in cylindrical vaults gives rise to the development of specific excavation techniques.



Since the end of 2009,
Andra has registered
13 patents
including 5 in 2011

Instrumentation also calls upon leading edge technology, especially in the field of sensors, which are used in the Underground Laboratory to study the properties of the rock and to perform measurements essential to the design of the disposal facility. The developments are mainly based on the miniaturisation of sensors for detection of gas in the vaults, on optics fibres for temperature measurement and on vibrating wire sensors to measure structural deformations.

Finally, the modelling work based on the design of calculation software enables reliable measures to be obtained over very wide time scales, concerning data such as temperature, hydrogeology or deformation. ●



International



p.68 Andra creates its reference brand for the international market

The Andra internet site in Spanish:
www.andra.fr/internacional

p.69 A first complete cycle of training with South Korea

p.70 Disposal, priority in Eastern European countries

p.71 Two new cooperation agreements with Hungary and Morocco

p.72 An active presence on the international scene: the major meetings on the 2011 agenda

p.73 European directive on radioactive waste

INTERNATIONAL

Andra creates its reference brand for the international market

Present on the international scene, Andra is considered as a reference in radioactive waste management. In 2011, it created its international brand, ADS (Andra Disposal Solutions), presented at the ICEM conference in Reims.

ALL OF ANDRA'S EXPERTISE IN FOUR PRODUCT LINES

The Act of June 2006 required Andra to share its knowledge abroad. This covers not only meetings and exchanges, but also a commercial presence, which Andra is continuously refining and improving its visibility by creating the *ADS brand*.



Under this name, four product lines were created in 2011, three of them dedicated to disposal solutions: *ADS Geological*, for the deep disposal of highly radioactive waste, *ADS Surface*, for waste disposal designs for low- and intermediate-level short-lived waste and very-low-level waste and *ADS Near Surface* for low-level long-lived waste.

The fourth product line, *ADS Management*, concerns all the activities connected to disposal: the methodology developed for producing an inventory of radioactive materials and waste, the remediation of contaminated sites, collection from waste producers and holders of radioactive objects, and also development of the means for communicating with the general public.

ADS therefore covers all the fields of Andra's expertise.

MADE-TO-MEASURE OFFERS FOR EACH CUSTOMER

ADS deals with all of Andra's services and is thus able to assist any foreign organisation, whatever their specific requirements. As needs are significantly different from country to country, depending on both previous nuclear practices and the nature of the waste to be treated, as well as on the geological, sociological and political contexts. ●

THE ANDRA INTERNET SITE IN SPANISH

www.andra.fr/internacional

Andra has to be international! Due to the number and frequency of contacts with several South American countries, Andra decided in 2011 to communicate more closely with them... On the "gestión de residuos radioactivos".

INTERNATIONAL

A first complete cycle of training with South Korea



*South Korea operates around twenty reactors and is in the process of constructing a further five plants with the aim, between now and 2020, of producing approximately 50% of its electricity by nuclear power. The country's national radioactive waste management agency (KRMCA), created in 2009, signed a cooperation agreement with Andra in May 2010. Details from **ROBERTO MIGUEZ**, Business manager in Andra's international division.*

What is the level of cooperation with your Korean counterpart?

Robert Miguez: KRMCA wanted to design the surface disposal sites for low- and intermediate-level operational waste with our support. The first stage in our collaboration was the setting up, in October 2011, of a two-month training course for four Korean engineers, who came to Andra.

This is not the first time that Andra has organised training sessions. How was this different from the others?

R.M.: Until then, Andra had never undertaken such a long and comprehensive training course. Of course, it was focussed on the design and management of surface disposal facilities. But we also looked closely at less technical subjects

concerning communication and relationships with stakeholders, the social and political aspects associated with our specific activities.



Korean engineers during their training at the Manche disposal facility

We called upon all the Andra units and sites. Our visitors also visited all of our facilities.

What did you learn from this experience?

R.M.: We are going to give training a more structured form by creating modules and proposing them to our other trading partners. For Andra, this is an enhancement of its service offer that can only reinforce its expert image. ●

DID YOU KNOW?

INFORM, ADVISE, SHARE

Andra, a reference in the management of radioactive waste, is actively pursuing its role as expert advisor to countries who seek its help. Its involvement in seminars and conferences or in playing host to delegations is based as much on the problems of informing and consulting the general public as on technical solutions. This was the case in 2011 with Brazil, Mexico, Poland and Angola, which, due to its oil industry activities, wanted information about the management of naturally occurring radioactive waste.

INTERNATIONAL

Disposal, priority in Eastern European countries

Andra is in partnership with Ukraine, Lithuania and Slovenia for the modernisation or design of disposal facilities to manage the radioactive waste coming from the operation and dismantling of the nuclear sites constructed on their soil in the Soviet era.



Kick-off
meeting for the
Buryakovka site
modernisation
contract

MAKING THE UKRAINIAN BURYAKOVKA SITE SAFE

Andra has two cooperation contracts in progress with Ukraine. The first, which is almost completed, concerns the Buryakovka disposal facility that receives waste from the dismantling and clean-up of the Chernobyl site. In 2011, Andra worked on making the site safe by proposing a list of equipment necessary to check the acceptability of waste and to classify it into families by establishing an identity card for each item.



The second contract, financed by the European Union, concerns the revision of the classification of waste. To achieve this, in 2011 Andra defined generic criteria for acceptability and management processes, treatment and conditioning for the future disposal sites.

GREEN LIGHT FOR A DISPOSAL FACILITY IN LITHUANIA...

The closing of two major nuclear power plants was a condition of Lithuania's entry into the European Union. In return, Europe undertook to finance the shut-down, dismantling and radioactive



Assessment of the Lithuanian disposal facility project by the International Atomic Energy Agency

waste management. Andra and Areva TA were selected to design a low- and intermediate-level waste disposal facility, via a three-year contract signed in 2009. As the site was already selected, Andra and its partners performed a study of its geological characteristics, organised an inventory of the waste to be disposed of and produced the disposal facility design. At the end of 2011, the project was assessed by the International Atomic Energy Agency, on request from the Lithuanian Government. The experts concluded that the project was reliable and it was implemented in compliance with the international regulations in force.



TWO NEW COOPERATION AGREEMENTS WITH HUNGARY AND MOROCCO

Andra signed a cooperation agreement with PURAM, its Hungarian counterpart, for the management of radioactive waste. This agreement is primarily based on information exchange and the possibility of undertaking common studies.

With Morocco, which does not have any nuclear reactors, but which manages radioactive waste coming from research and the medical sector, Andra is involved in helping the Moroccan Nuclear Research Centre (CNESTEN) to become a reference for the management of radioactive waste in Africa.

... AND SHORTLY IN SLOVENIA

Slovenia has one reactor, which it shares with Croatia. It called upon Andra's expertise, within the framework of a project management assistance contract signed in March 2010, for the design of a facility receiving low- and intermediate-level waste.

The disposal facility design is now defined and 2011 was mainly devoted to operational safety and the long-term safety analyses of the site once it is closed. ●

INTERNATIONAL

An active presence on the international scene: the major meetings scheduled during 2011

Within the framework of its mission to share its knowledge abroad, Andra participated in various working groups within international bodies (European Commission, Nuclear Energy Agency, International Atomic Energy Agency). Its role was to promote its expertise, research, results obtained and the designs that it has developed. Andra was also involved in the main international conferences and events to promote French know-how.

FEBRUARY-MARCH

Phoenix • Arizona

François-Michel Gonnot, chairman of Andra's Board of Administrators, was at the opening of the conference of waste management in front of more than 2,000 people to present the institutional and operational sides of the radioactive waste management system implemented by Andra. Andra was also involved in individual sessions on technical and scientific subjects, and on the social and political aspects relating to the problems of radioactive waste.

APRIL

Albuquerque • New Mexico

The International High-Level Radioactive Waste Management Conference, is a conference dedicated to the disposal of high-level radioactive waste. Andra gave seven presentations on the safety and disposal designs developed within the framework of the Cigeo project (the future geological industrial disposal facility for high-level and intermediate-level long-lived waste).

MAY

Osthammar • Sweden

The Forum on Stakeholder Confidence, a group of the Nuclear Energy Agency (AEN), brought together representatives from 13 countries in 2011. The purpose of this forum is to exchange thoughts and experiences on ways to set up real dialogue with stakeholders and to establish relationships of confidence in the safety and security of radioactive waste disposal, as well as in its conformity to society's values and aspirations.

After several presentations on the Swedish nuclear waste management programme, 2 themes were opened for discussion:

- Dialogue, exchange of information and transparency with the general public and the stakeholders (elected representatives, associations, producers...).
- The added value brought by a disposal facility to an area, in terms of economic development and the development of training and infrastructure.



INTERNATIONAL

SEPTEMBER

Vienna • Austria

Annual policy meeting of the nuclear sector, the general conference of the International Atomic Energy Agency brings together diplomats, decision makers, experts, industrialists, representatives of the safety authorities and also universities and NGOs. For the first time, the main French firms in the nuclear sector came together on the same stand to present their services in technology, training, safety, security, assistance to project development and radioactive waste management.

Reims • France

ICEM is the international conference dedicated to the technical solutions deployed for environmental clean-up and radioactive waste management. In 2011, Andra, who was there as an organising member, was involved in around twenty sessions and inaugurated a stand for the official launch of *Andra Disposal Solutions (ADS)*.



EUROPEAN DIRECTIVE ON RADIOACTIVE WASTE

On 19 July 2011, the Council of the European Union adopted a new directive, which set up a European framework for the safe and responsible management of radioactive waste and spent fuel. This directive requires each member state to present a national management programme to the European Commission by August 2015.

Andra, already associated with preparation of the directive during the 6th European Nuclear Forum, participated in the working group in charge of writing the baseline document. This document will permit member states to establish their own management programmes, responding to appropriate specifications. The new directive covers all aspects of radioactive waste and spent fuel management, from production up to long-term disposal, in particular with the establishment of an inventory and a management plan strictly responding to the safety standards set up by the International Atomic Energy Agency. Similarly, it required member states to legislate a reliable and transparent policy for informing the general public, who should be involved in the decision-making process.



The Andra stand at the ICEM conference in Reims





Sustainable development

p.76 Going further: a new sustainable development strategy

An undertaking with 9 challenges

p.78 Be a player at the heart of the development of the area

p.79 Close-up on two local contracts

Compute Mode: optimising the use of computer resources

p.80 An active sponsorship policy

New partnerships in 2011

p.81 A new sponsorship charter

Going further: a new sustainable development strategy

Andra safely manages radioactive waste, protecting man and the environment from their impact both in the short and long term. It does this in conjunction with stakeholders and provides information to shed light on the choices to be made by the public and the authorities. This mission is part of an overall sustainable development process. Andra updated its strategy in 2011.

A new version of the Andra sustainable development strategy was published in December 2011. It is based on the French national Sustainable Development Strategy (2010-2013) and on the principles

and undertakings of the companies and public establishments sustainable development charter that Andra signed in 2008.

Andra brings its core business contribution to the nine national challenges. It also set its own objectives, such as the “Reminder to future generations” project, the entry of the Permanent Environmental Observatory into the long-term observation and experimentation system for environmental research (SOERE) or the creation of the eco-library, the future “library” of samples taken within the framework of the Permanent Environmental Observatory. ●

An undertaking with 9 challenges



1.

Take environmental and social aspects into account in the products consumed and the activities sub-contracted out.



2.

Contribute to technical and scientific training and information, as well as informing future generations.



3.

Involve all the entities concerned (State, local authorities, holders and producers of radioactive waste, associations) in choosing between the solutions proposed.

SUSTAINABLE DEVELOPMENT



4.

Improve Andra's energy efficiency, reduce its carbon footprint and encourage the development of renewable energy.



5.

Reduce the distances staff travel and encourage the modal shift and transport complementarity by choosing more environmentally friendly means of transport.



6.

Study ways to economise on rare disposal facility resources and participate in developing understanding of biodiversity and its conservation.



7.

Predict and control the risks to environmental protection and the inhabitants around disposal facilities, for current and future generations.



8.

Take into account the impact on the economy and equilibrium of areas with disposal facilities when Andra staff arrives.



9.

Participate in international agency work and thus allow underprivileged countries to benefit from the expertise of countries with nuclear facilities.

Play a leading role in the development of the area



“Dialogue day” with companies from the Aube, Manche, Meuse and Haute-Marne districts

€ 15,134,845
Total amount spent in the Manche, Aube, Meuse and Haute-Marne districts in 2011

Andra has a long-term involvement in the areas where its installations are located, by implementing an active participation policy in the development of local economic, social and cultural activities. In 2011, Andra reinforced its links with companies and associations.

STIMULATE THE LOCAL ECONOMY

Andra’s policy is to contribute to the development of commercial relationships with the companies located in the Manche, Aube, Meuse and Haute-Marne districts. Andra regularly organises meetings to inform those involved in the local economy of the possibilities available for sub-contracting. It particularly encourages small and medium enterprises to respond to invitations, which most do not do, thinking that it is difficult to obtain orders from a national operator. To aid in this procedure, Andra works mainly with Energic 52/55, an association which federates the companies located in the Meuse and Haute-Marne districts.



Such a “Dialogue day” was organised in November 2011, bringing together more than 70 companies from the Aube, Manche, Meuse and Haute-Marne districts. Andra is using this same procedure with the building and civil engineering federations of the Meuse, Aube and Haute-Marne districts.

ENCOURAGE PROFESSIONAL INSERTION

The convention signed in 2011 with the vocational high school in Wassy is an example of Andra’s approach to fostering understanding of its work and encouraging young people to enter sectors where professional outlets exist. Within this framework, courses on industrial safety (fire, environmental protection, etc.)

have been organised on its sites and those of its sub-contractors for students in the safety and risk prevention sector.

CLOSE-UP ON TWO LOCAL CONTRACTS



A new High Quality Environmental building for the Meuse/Haute-Marne Facility

This new building, which was given planning permission in April 2011, is intended to receive visitors to the Underground Laboratory and also to house offices on the first floor. The invitation for project management was issued to local companies who were requested to observe the HQE approach and anticipate the “2012 thermal regulations”, targeted at limiting the energy consumption of new buildings.

A test prototype for disposal of intermediate-level long-lived waste packages in vaults

Within the framework of the Cigeo deep disposal project, Andra started initial studies in 2007 for the design of an automatic installation able to receive and place intermediate-level long-lived waste packages into vaults. An invitation to tender was set out, based on these studies. In 2009, Andra signed a contract with Comex Nucléaire, a company located at Saint-Dizier (Haute-Marne districts) to produce a prototype and perform technical tests. The prototype was built in 2011 and the tests have started to either validate the principle or point the research towards other solutions.

Andra is also going to deliver practical working sessions on its sites, during which students will be observers or active participants. The purpose is to develop the trade networks for which there is a need in its disposal facilities or for which its sites may act as a training ground. ●



COMPUTE MODE: OPTIMISE THE USE OF COMPUTER RESOURCES

How can all the internal resources be organised to deal with peaks of activity during the calculation campaigns carried out on safety, scientific research and engineering? The answer comes from software developed in 2007 by the National Institute of Computer and Automated Research (Inria), which was adapted by Andra in 2011 as part of a cooperation agreement signed with the institute two years earlier.

The idea is to use office computers during the night and at weekends to perform calculations and thus provide support to the processors operating 24/7. In August 2011, the source codes for the new Compute Mode software version were registered with the Agency for the Protection of Programmes. The first deployment tests were promising, allowing use of the capacity of several computers from the Research and Development division to back-up calculations performed and to retrieve them according to their use planning function, all through a network without interaction with the hard drives of these computers. Eventually this innovative technical solution will make the computer pool more profitable, avoiding the costs that could be incurred by extending the existing infrastructure.

An active sponsorship policy

A new sponsorship charter (read interview opposite) and the numerous projects and events supported in 2011 are evidence of Andra's involvement in local life. Here is a selection from the projects sponsored in 2011.

KEEP THE MEMORY OF A QUARTIER ALIVE...

In the Hauts-de-Seine district, the Théâtre Firmin Gémier-La Piscine held the initiative of Diane Calma and Alain Grasset aimed at “reviving memories of the past” of the garden-city of Châtenay-Malabry, where Andra has its head office. The two designers-producers went out to meet the inhabitants, shopkeepers and associations to film their report. They then called upon 4 directors and 4 actors to perform 8 different and original portraits, chronicling the life of 8 inhabitants. Constructed as a confrontation between the real and the imaginary, these plays (performed at the theatre in 2012) combine truth and fiction, past and present.

... A REGION...

In the Manche district, the Cherbourg National Society of Natural Sciences and Mathematics designed an exhibition entitled “*Tribute to Normandy chemists*”.

... AND A PROFESSION

In Meuse/Haute-Marne district, the “*Les Amis de la Pierre*” association promoted the memory of quarry workers and their social environment. In spring 2011, they opened a former underground quarry in the village of Brauvilliers (canton of Montiers-sur-Saulx) to the public. Through guided tours, the public discover the working methods and the tools used by the quarry men and stonecutters during the 20th century.



TRAVEL AND ENTREPRENEURSHIP

In the Aube district, a new on-demand transport service called *Tinéa* was launched by the Briennois district council in February 2011. The *Young Entrepreneur Center*, set up by the Aube Technology Centre to help students to realise their projects, started its development. ●

NEW PARTNERSHIPS IN 2011

Not content with just supporting projects, Andra also actively participates in forming partnerships.

Thus in 2011, Andra was partner for the first time with the Research Prize, the aim of which is to promote scientific and technological excellence across the board in all fields by associating industrial and public research organisations. Bringing its institutional support, along with 5 other partners, Andra awarded the special Jury Prize, thereby affirming its undertaking to encourage the recognition of high-level innovative research.

In the Manche district, Andra formed a partnership with the “*History and heritage of the Flamanville-Diélette mines and quarries*” association, which produced a temporary exhibition on the subject of iron, presented in the Manche disposal facility public reception building.

Finally, the Aube disposal facility was partner to the Nogent-sur-Seine sustainable development forum, where Andra had a stand presenting radioactive waste management during the sustainable development week held in April 2011.

A new sponsorship charter



*In June 2011, Andra revised its sponsorship charter, established in 2000. An analysis of these changes with **CATHERINE COBAT**, Manager for External Relations in the Andra Communication Division.*

What were the reasons that led you to revise the charter?

Catherine Cobat: To be more in phase both with the requests coming from local entities and with our new challenges in terms of sustainable development. Andra only sponsors projects or events within precise fields, which we have redefined.

In 2011, **84** sponsored events or projects for a total sum of 152,902 euros

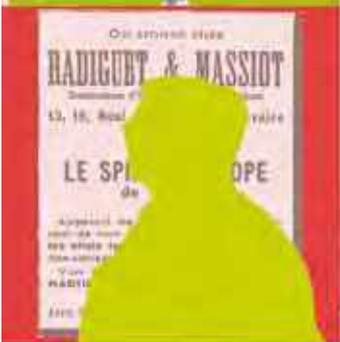
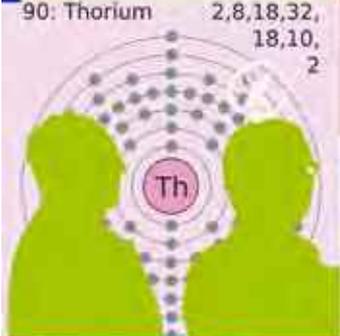
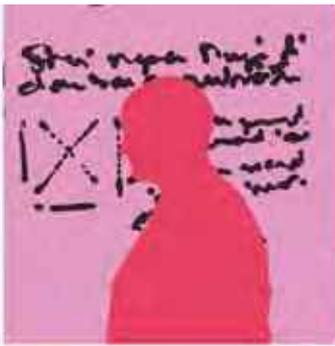
What are these fields?

C. C.: There are five fields, concerning the promotion and spreading of scientific and technical culture, the environment and discovering nature, memories and preserving heritage, solidarity between the generations and finally local civic actions. As you have stated, these subjects are directly linked to our sustainable development strategy and to the projects developed by Andra concerning, amongst others, preservation of biodiversity or transmission of memory.

How are these projects selected?

C. C.: We have set up a selection committee made up of representatives from each Andra facility and chaired by the Deputy Chief Executive Officer. To be selected, the projects have to fall into one of the defined fields and be organised in the areas where Andra installations are located. ●

“ To be more in phase both with the requests coming from local entities and with our new challenges in terms of sustainable development. ”





Dialogue, transparency and communication

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Privileged communication with the younger generation

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Eleventh National Waste Conference

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DIALOGUE, TRANSPARENCY AND COMMUNICATION

Dialogue at the heart of Andra's policy

Site visits, participation at local events, organising exhibitions or presence on social networks: Andra is multiplying its initiatives to create direct links with citizens, encouraging regular dialogue to achieve openness.

A GREAT "OPEN DAY" IN THE AUBE AND MEUSE/HAUTE-MARNE DISTRICTS

On its twentieth anniversary, Andra opened the doors to its disposal facility in the Aube district and its facility in the Meuse/Haute Marne districts. In total, close to 1,500 visitors were welcomed by Andra personnel.

At the Aube disposal facility, the public could discover the journey undertaken by radioactive waste packages from transport up to their disposal and the measures for monitoring the environment inside and outside the site. At the Meuse/Haute Marne facility it was, of course, the Cigeo project that held all the public attention, with a presentation

Full-house
in the Aube district
for the open day



of the deep disposal concept, the studies performed in the Underground Laboratory and the prototypes and robots for handling containers. There was also interest in the Permanent Environmental Observatory and the research it performs.

"OPEN TUNNEL" VISITS AT THE UNDERGROUND LABORATORY

Since 2009, Andra has organised "open tunnel" days several times a year to enable the general public to discover the underground installations of the Laboratory, at a depth of 490 metres. Each time, around one hundred people attend, on a reservation-only basis as places are limited and demand is high. There were three "open tunnel" visits organised in 2011.

SOCIAL NETWORKS TO REACH THE WIDEST POSSIBLE AUDIENCE



"Open tunnel"
visit at the
Underground
Laboratory



Clay workshop during the Science Festival

Since May 2011, Andra has its own page on Facebook and is present on Twitter, Dailymotion, on discussion forums and media comment spaces. This entry in force onto the social networks will enable Andra to make its role and activities known to a wide audience and to get involved in debates already in progress on the future of radioactive waste, with the desire not to cover anything up and to correct false ideas. These social networks are managed by Andra employees who make personal contacts and engage in completely open dialogue.

SCIENCE FESTIVAL: A NOT-TO-BE-MISSED EVENT

Organised by the Ministries for Higher Education and Research, this regionally organised annual event enables the general public to meet entities from the scientific world through exhibitions, conferences, open days and educational workshops. Andra has participated for several years with local partners from the areas where it is present.

- In the Aube district, following the International Year of Chemistry, Andra organised a conference titled “*Marie Curie, an exceptional woman*” at the Brienne-le-Château arts centre, retracing the life and work of the scientist on the centenary of her winning the Nobel Prize for Chemistry.

- In the Manche district, in partnership with the Ludiver planetarium at La Hague, Andra led workshops on the theme “*From earth sciences to environmental sciences*”. Visitors were able to use a cloud chamber to observe alpha and beta rays, discover how to measure the height of the water in the water table using a dummy piezometer or how to observe the structure of the clay sampled around the Manche and Meuse/Haute-Marne facilities using a binocular magnifier.
- At Montier-en-Der (Haute-Marne district), for the fifth consecutive year, Andra organised the “Montier-en-science” scientific week, with the Pays de Der tourist office, on the theme of the forest. Treasure hunts, outings and stories were on the programme.
- Finally, at the Andra Laboratory, fossils and clay were presented, with sculpture workshops, a ceramics exhibition and a guided tour of “*Fossils, the footprints of time*” which had been on display since 2010 in the visitors centre building. ●

ANDRA INVESTS IN MOTORWAY REST AREAS IN THE MANCHE DISTRICT

In January 2011, Andra took part in the “Welcome to our Companies” operation organised by the local government of the Manche district, in the south of the district, in the Gouvets motorway rest area, to make the activities and know-how of the district more widely known. The experiment was repeated the following summer in a motorway rest area at Mont-Saint-Michel.



59,800
visitors

WOMEN OF SCIENCE HONOURED IN THE AUBE DISTRICT

On the 8th March 2011, international day of women’s rights, a theatrical piece called “*Steps in the snow, 20th century women researchers, in the tracks of Marie and Irene Curie*” was presented in the village hall at Morvilliers, where the very-low-level waste facility is located. This original creation by the Palamente Company evoked through two illustrated examples, the place of women in fundamental research.

DID YOU
KNOW?



TNS Sofres survey: reinforce close communication

In June and July 2011, TNS Sofres surveyed people living more or less close to the Aube and Meuse/Haute Marne facilities. The purpose of this survey was to find out local opinions and the need for information in order to better respond to their expectations.

1,916 people resident in the Aube, Meuse, Haute-Marne, south Marne and west of the Vosges districts were surveyed. Initial findings: Andra's sites "neighbours" have confidence in the way radioactive waste is managed in France.

RECOGNISED BENEFITS

With regard to the economy, more than three-quarters of residents recognised the benefits that Andra sites brought in terms of sustainable sources of income and employment for the regions. However, 54% expressed concerns with regard to the value of nearby land and housing and with regard to the impact of Andra installations on health and the environment.

WORRIES ABOUT CIGEO

The Cigeo geological industrial disposal facility did not worry 40% of the people questioned, but 25% said that they were very worried. Amongst the concerns: the technical control of the project, its impact on the environment and the daily lives of residents, the risks of accidents and transparency of information.

A SIGNIFICANT NEED FOR INFORMATION

The expectation for information on the operation of the activity and the risks incurred remains high. Residents also want direct contact and public meetings. Most of them consider Andra to be a credible information source. ●

Privileged communication with the younger generation

Inform, train, transmit: Andra pays very special attention to school children and students, who are very aware of environmental questions and, in this connection, concerned by the management of radioactive waste.

VISITS AND EDUCATIONAL WORKSHOPS FOR SCHOOL CHILDREN

In 2011, Andra welcomed groups of school children to its sites as part of their geography or life and earth sciences curriculum. It also organised interactive workshops at its exhibitions during the school holidays; in 2011, the Underground Laboratory offered an initiation into geology and fossil research, within the framework of the "Fossils, footprints of time" exhibition. There was a similar approach in the Manche district with the magnetic field discovery workshop presented with the Ludiver planetarium as part of its "Iron in all its states" exhibition.

HELP STUDENTS DISCOVER ANDRA'S PROFESSIONS

In 2011, Andra organised close to sixty seminars enabling university and *Grandes Écoles* students to discover the professions related to the management of radioactive waste, to which their studies could lead. The visits were organised on a case-by-case basis, according to the subjects studied (geology, chemistry, engineering, radiological protection, environmental sciences, etc.).

Also, at the Aube disposal facility, a practical case of project management was offered to students in their last year at the Nantes School of Mines engineering college (nuclear option) whereas engineering students from the Nancy School of Geology did their final internship with Andra's Underground Laboratory staff. ●

A policy of permanently consulting local stakeholders

Andra practices a policy of dialogue and attentive listening with regard to the general public and their representatives in the areas where they have sites. This attitude belongs to Andra's company culture and its sustainable development strategy.

CONTINUING THE EXCHANGE PROCESS FOR THE INSTALLATION OF CIGEO

Continuing its approach of dialogue with the political, social and economic players of the Meuse and Haute-Marne districts, Andra presented the scenarios studied for the location of the surface installations of Cigeo, the future geological industrial disposal facility, at the 2011 general assembly of the Underground Laboratory Local Information and Monitoring Committee (Clis). The exchanges arising from this presentation will feed into the production of an Inter-districts Development Plan, led by the Meuse prefecture, aimed at identifying the requirements of the Cigeo project and the area, and to provide solutions to land use and development challenges.

CREATION OF A LIAISON COMMITTEE WITH CLIS

The liaison committee which met for the first time on 9 May 2011, was created to strengthen communications between Andra and the Underground Laboratory Local Information and Monitoring Committee at a time when the Cigeo project was entering its industrial design phase. Andra undertakes to transmit technical documentation as soon as it is published, and Clis will feed back questions asked by the public.

THE DIGULLEVILLE MUNICIPAL COUNCIL VISITS THE EAST OF FRANCE

In September 2011, Andra invited the town council of Digulleville to visit the Aube and Meuse/Haute Marne disposal facilities. Thus, the councillors from the area of Andra's pioneer site in the Manche district

The Digulleville town council visited the Andra disposal facilities.



were able to measure the technological progress made in terms of disposal design and industrial processes, in particular for package reception, traceability and vault filling.

With regard to the visit to the Underground Laboratory, they were plunged, in all senses of the word, into a space which has witnessed more than fifteen years of high-technology scientific research and innovative developments.

ANNUAL MEETING WITH LOCAL REPRESENTATIVES

In 2011, Andra's twentieth anniversary, the traditional meeting with the local representatives for the areas where its installations are located (Manche, Aube, Meuse and Haute-Marne districts) was slightly different. Andra had in fact invited them to the French parliament for a privileged visit followed by a debating session before meeting up to share with them the latest news on its facilities. ●

“Radioactivity from Homer to Oppenheimer” or how to know everything about radioactivity



Created by Andra for the International Year of Chemistry and celebrating the hundredth anniversary of Marie Curie winning the Nobel Prize for Chemistry, this travelling exhibition opened its doors at the end of September 2011 at Brienne-la-Vieille where it received more than 1,000 visitors.

AN ENTERTAINING AND EDUCATIONAL APPROACH

We talk about it a lot, but what does it really mean? Radioactivity, a topic on which there are many preconceived ideas, was the main theme of an exhibition entitled “Radioactivity from Homer to Oppenheimer”. Open to everyone, this exhibition produced by Andra aimed at providing easy to understand and comprehensive information on the subject to the general public.

It was organised in four sections (how does it work, how was it discovered, what does it do and what are the risks?), with a look at science-fiction heroes (Superman, Spiderman, Hulk...) and the inimitable Homer Simpson. Visitors were able to make some surprising discoveries and find out about scientific subjects.

This was certainly the case for the youngsters, thanks to a journey reserved for them with their guide, Tom the atom, a small cartoon character.

A WIDELY SUPPORTED INITIATIVE

The exhibition benefited from the support of the ministers in charge of national education, higher education and research, ecology and sustainable development as well as the Institute of Radiological Protection and Nuclear Safety and the Curie Institute. This is a travelling exhibition, which will tour France until the end of 2014. ●

● ELEVENTH NATIONAL WASTE CONFERENCE



Organised in Nantes on the 14th and 15th September 2011, this conference brought together everyone involved in waste management to share their experiences and good practice with regard to measure taken by their companies to reduce waste production and maximise recycling.

Andra presented its very-low-level radioactive waste management disposal facility at a workshop, with the system being recognised by the participants as mature and effective.

Andra had to point out that production of this waste would considerably increase over the next thirty years due to the dismantling of numerous nuclear installations and that studies are in progress with all the entities concerned to reduce the volume and space for the disposal facilities that are required.

Support resident's initiatives



An ecology project initiated by residents will resurrect a plot of land on the contaminated Coudraies site at Gif-sur-Yvette.

*Talking about this initiative with **NICOLAS BENOIT**, Responsible for clean-up at Andra.*

Can you explain the context to us?

Nicolas Benoit: The inhabitants of Coudraies consulted us on the location of a uranium extraction plant that closed in 1957. The radiological diagnosis carried out in 2000 by the authorities found a level of contamination that presented a health risk on four properties, two of which have been remediated. One was demolished in 2010 after being purchased by

the Ministry for Environment, the other will be demolished in 2012.

How did the residents react?

N. B.: Obviously, they were worried, even though their properties were not concerned. We were there to answer their questions, providing precise answers and reassuring them. They also asked for a lot of

information on the actions we would undertake in the area. For that reason, we organised a public meeting at the town hall in June 2010 before the first demolition work began. We updated them on the state of contamination of the site, the clean-up operations we would carry out and explained why it was necessary to demolish the first house. We will repeat this initiative before all future rehabilitation work

What happened after this meeting?

N. B.: The residents were asked to express their expectations with regard to the future of the site. In 2011, they proposed an original plan for the plot: creation of a wildflower meadow promoting biodiversity, equipped with wooden shelters to house wild bees.

Is this project viable?

N. B.: Yes, we studied the feasibility, together with the town hall, the National Office of Forests and the Office for Insects and their Environment, all of whom showed interest. In 2012 we will submit a remediation project that would make the site compatible with this plan to the Nuclear Safety Authority and then to the National Commission for Aid in the Radioactive Field. ●

“ We were there to answer their questions, providing precise answers and reassuring them.”

Environnement	Nom de site	1999	2000
Terrain industriels en friche		<ul style="list-style-type: none"> • Dampierre (14) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Saint-Rémy-de-Provence (13) • Saint-Rémy-de-Provence (13) • Saint-Rémy-de-Provence (13) 	<ul style="list-style-type: none"> • Dampierre (14)
		<ul style="list-style-type: none"> • Saint-Casimir (13) • La Rochelle (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Valpuy (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) 	<ul style="list-style-type: none"> • Dampierre (14)
Terrain industriels actuellement occupés ou installations d'exploitation		<ul style="list-style-type: none"> • Saint-Casimir (13) • La Rochelle (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Valpuy (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) 	<ul style="list-style-type: none"> • Dampierre (14)
		<ul style="list-style-type: none"> • Saint-Casimir (13) • La Rochelle (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Valpuy (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) 	<ul style="list-style-type: none"> • Dampierre (14)
Site d'abandon (1 à 3)		<ul style="list-style-type: none"> • Saint-Casimir (13) • La Rochelle (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Valpuy (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) 	<ul style="list-style-type: none"> • Dampierre (14)
		<ul style="list-style-type: none"> • Saint-Casimir (13) • La Rochelle (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) • Valpuy (13) • Dampierre (14) • Saint-Rémy-de-Provence (13) • Pignatier-Saint-Denis (14) • Pignatier-Saint-Denis (14) 	<ul style="list-style-type: none"> • Dampierre (14)






Future generations

P.92 “Reminder to future generations”
what heritage for the coming centuries?

Copy and bring memories alive:
a test on Facebook

P.93 The eco-library, conserving environmental
memories for Cigeo

P.94 Leave a trace, but how?

P.95 Transmit clear information that everyone
can understand

P.96 Human and social sciences
for a multi-dimensional approach
to geological disposal

Conference on governance and confidence

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Environmental Observatory

Reversibility and risk



FUTURE GENERATIONS

“Reminder to future generations” what heritage for the coming centuries?

How can we conserve and transmit to future generations the information they must have on the subject of radioactive waste disposal facilities? The “Reminder for future generations” project was launched in October 2010 with the aim of calling upon the most diverse means of expression and communication. Here is an overview of the actions undertaken in 2011.

THE NEED TO REMEMBER: A SOCIAL IMPERATIVE

This imperative is even more sensitive as it will be around for a very long time. The disposal facilities will not always be as visible as they are today. Once they have been covered and planted, like the Manche facility, how will they be distinguished from simple hills two, three or more centuries in the future?

And what about Cigeo, the future geological industrial disposal facility, designed to remain safe for a million years?

COPY AND BRING MEMORIES ALIVE: A TEST ON FACEBOOK

The social networks on the internet provide an opportunity to bring people together on a large scale on areas of common interest.

The spread of information, paperless formats, and the appropriation of the subject by internauts are all factors promoting conservation of memories. Andra will, for example, test the potential benefits of social networks, in particular Facebook, to share the memories of the Aube and Manche disposal facilities for several years.

It would be unrealistic to imagine that the memory of these places could be conserved for thousands of years. It is therefore important to organise transmission of memories from generation to generation, to set up reliable solutions for the first centuries and to think about credible solutions on the scale of a few millennia. The thought processes of Andra over twenty years run along two lines: the institutional conservation of data and the role of transmission that local people could play.

The “Reminder for future generations” project will add to these thoughts on various themes, such as the life span of languages and symbols, the perception of large time-scales, archaeology, art as a vector for memory or the use of social networks and new information technologies.

CONSERVE DISPOSAL FACILITY DATA

Two hardcopies of all data about disposal facilities have been put into storage, one at the National Archives in Fontainebleau, the other at the site concerned. Permanent paper, which can be kept for 600 to 1,000 years, was used. These documents contain the detailed memories of the facilities (technical, environmental and social data) and thus provide information about the exact history of the disposal facility, and how it was designed and operated.

A temporary summary memory of the Manche disposal facility has been produced and is available on the internet. Andra is exploring other possibilities for archiving on different permanent supports, such as industrial sapphire.

MAKE THE INHABITANTS MEMORY CARRIERS

The populations that live close to disposal facilities and who work there have a role to play for memory transmission. In 2011, Andra started to set up think tanks on each of its sites to collect their criticisms and ideas.



These groups bring together local people, elected officials, artists and representatives of associations and professions interested and involved in the conservation of memory. In the Manche district, an additional initiative concerning an inter-generational transmission project will culminate in a story about the memory of the disposal facility written by children. Andra does not dismiss any initiative and other paths will be studied in the years to come.

THE ARTISTIC APPROACH AS A MEANS OF STUDY AND THOUGHT

Works of art can transcend time and inform people on history or a way of life thousands of years old. This is where the idea of using contemporary art to transmit the memory of the disposal facilities came from.

To achieve this, Andra has signed a four-year partnership with the Contemporary Art Centre / Passages of Troyes, including the financing of an annual grant and hosting an artist in residence. Every year a new artist will contribute to this reflection. The purpose of these artistic studies is primarily to bring the different proposals together over the years; the plastician Veit Stratmann inaugurated this arrangement in 2011. ●

THE ECO-LIBRARY, CONSERVATORY FOR THE ENVIRONMENTAL MEMORY OF CIGEO

The eco-library will open its doors in 2013 in Meuse/Haute-Marne districts. It will conserve samples (fauna, flora, soil, sub-soil, atmospheric particles, etc.) taken over a period of at least one hundred years within the framework of the Permanent Environmental Observatory. This structure, unique in France, is one of the most developed eco-libraries in the world, like that of the Fraunhofer in Germany and the National Institute of Standards and Technology in the United States.

This building, whose construction began in 2011, will initially conserve samples taken between 2007 and 2017, for which analysis will mainly enable the reference data to be constituted on the initial state of the site likely to house Cigeo, the future geological industrial disposal facility. The eco-library will also conserve samples from sampling campaigns performed periodically throughout the operating life of Cigeo.

FUTURE GENERATIONS

Leave a trace, but how?

Two creators, two approaches, two responses that are evidence of the richness of the reflection and force of expression that the artistic work on the radioactive waste disposal facility memory has opened.

THE RITE, GUARDIAN OF THE LIVING MEMORY

The German plastician Veit Stratmann is the first artist to have thought about the memory of the disposal facilities within the framework of the Andra “Remember for future generations” project. His study is based on the low- and intermediate-level waste disposal facility in the Aube district, for which the memory must remain intact for over 300 years.

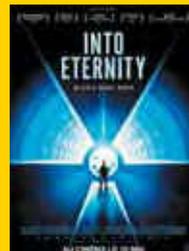
At the end of 2011, he submitted his report, called “The hill”. To combat losing the memory, he proposed the performance of a rite every 30 years. The final cover of the disposal facility will be regularly raised.

At the end of 300 years monitoring, the final cover will have reached a height of 57 meters and will have become a hill. The rite proposed by Veit Stratmann is comparable with that performed by Shinto monks who, every 20 years since the 7th century, dismantle and then rebuild an identical main temple of Ise sanctuary in Japan, the memory of this ancestral know-how has thus been kept alive.

EMOTION, UNIVERSAL VECTOR OF MEMORY

How can future generations be warned of the dangers represented by radioactive waste, which must remain isolated from all contact for 100,000 years? This is the question asked by the Danish producer Michael Madsen in his film “Into Eternity” in the world of the Onkalo deep disposal facility, the Finnish equivalent of Cigeo.

The film producer Michael Madsen led a study group on memory at the Meuse / Haute-Marne facility.





“ The hill ”
designed by
Veit Stratmann

Invited to the Meuse/Haute-Marne facility in November 2011, the film producer led a study group on memory, bringing together a dozen participants from the area. He asked them to imagine how to communicate over a time scale of a thousand years.

The consensus was reached that it would be necessary to leave a simple message, redundant and changing to remain understandable by everyone over the centuries. For Michael Madsen, the emotional factor is primordial: it is through art and the emotion that it generates that we can hope for universal understanding, beyond language and across time. This emotion must also be able to be transmitted by a rite or a legend from generation to generation. ●

● TRANSMIT CLEAR INFORMATION THAT EVERYONE CAN UNDERSTAND

.....

A working group from the Local Information Commission gave its opinion in 2011 on the summary memory document for the Manche disposal facility. It is primarily attached to standardising the style and adopting a precise reference vocabulary. Its recommendations particularly bear upon a more educational approach to radioactivity, notably with respect to measurement units and radionuclide decay. All of these recommendations will be included in a new version of the document that Andra will submit to the Nuclear Safety Authority in 2013.



Human and social sciences for a multi-dimensional approach to geological disposal

The human and social science laboratories group created by Andra in 2011 calls upon multi-disciplinary expertise to lead the research into radioactive waste management, particularly reversible geological disposal. The research is notably directed towards the subject of the long time-scales involved in this project.

REVERSIBILITY, A TRANSVERSE SUBJECT

The reversibility of geological disposal is a civic desire, a political decision and a technological challenge. It is at the cross-roads between very varied fields (scientific, technological, economic and social) which interact in a complex manner.

Andra has made it one of its main research themes in human and social sciences, covered in numerous studies and meetings, in particular with the publication in 2010 of the work *“Make radioactive waste governable - Deep disposal takes up the reversibility challenge”* and in 2011 with a thesis on the economic assessment of the Cigeo project, the future geological industrial disposal facility.

CIGEO PROJECT GOVERNANCE

Reversibility is an approach to decision-making based on a progressive process, to be tackled in steps, starting from clearly established social, political and technical bases.

The line of “governance” research adopted by the laboratory group notably observes the links between this approach and the development of techniques and knowledge and the reversibility of decisions. In 2011, a thesis was started, in partnership with the Institute of Political Sciences in Paris, on the different timelines

CONFERENCE ON GOVERNANCE AND CONFIDENCE

Andra participated in an international conference organised in May 2011 in Stockholm by SKB, its Swedish counterpart. The conference, dedicated to the social aspects of radioactive waste management, was attended by over a hundred and thirty participants, researchers, industrialists, political decision makers, around the themes related to governance, confidence in the stakeholders and the reconciliation of everyone's interests and values.

involved in the decision-making process related to the management of Cigeo and their implications from an organisational point of view.

UNDERSTANDING THE FUTURE

The management of high-level waste implies very long time-scales in comparison with other industrial fields. As the half life of certain radionuclides may be as much as one million years, it is easy to see the difficulty in understanding such a time-scale. The “know-how and memory” line of research endeavours to analyse how the technical, political and social devices are able to anticipate events over very long periods in order to control them. Work is based mainly on scientific knowledge acquired from modelling and digital simulations. Understanding the long time-scales is also studied with the collaboration of social anthropologists. ●

A project with the Permanent Environmental Observatory



*During a scientific futures day in March 2011, the Permanent Environmental Laboratory launched an invitation for projects to researchers in human and social sciences. Explanations with **LUIS APARICIO**, Andra Human and Social Science Research Manager*

What is this?

Luis Aparicio: The Permanent Environmental Observatory wants to deploy multi-disciplinary observation networks for the area and its dynamic in socio-economic terms.

What is the purpose of this approach?

L. A.: The purpose is to better understand the factors that influence the occupation and

use of areas, and the practices that may have repercussions over the more or less long term on biodiversity (such as agriculture or urbanisation).

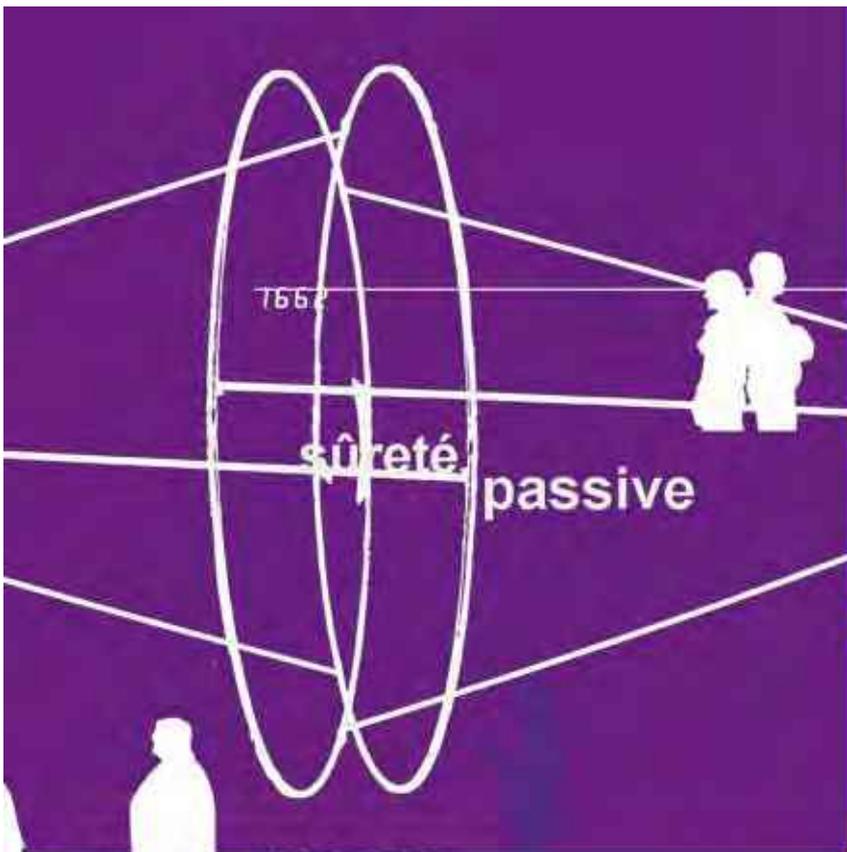
What does your mission consist of?

L. A.: Andra wants to make effective tools available to represent the area, its dynamics and their effects on the players and ecosystems. For example, we will study and characterise agricultural activities, study the rural character of the area and its involvement in much larger social, political and economic systems. ●

REVERSIBILITY AND RISK

During the international conference on “Feedback on the risk society” organised in September 2011 at Cerisy-la-Salle, Marie-Claude Dupuis, Chief Executive Officer of Andra spoke on the theme of nuclear waste disposal reversibility as management of the uncertain. Also, a debate was organised with the managers of the Basse-Normandie region and the Manche district in risk management at local level, notably concerning radioactive waste disposal. The main public questions are based on the site monitoring phase and on the transmission of its memory to future generations.

“Deploy multi-disciplinary networks for observation of area socio-economics and its dynamics.”





What about tomorrow?

- P. 100** Finalisation of the collection and storage project for radioactive waste not generated by the nuclear power industry
- P. 101** RAPP13: reorganise the “small-scale producers” network

LLW-LL Project: spread over new bases
- P. 102** Cigeo: updated inventory
- P. 103** Future Investments
- P. 104** Define and set up new networks

WHAT ABOUT TOMORROW?

Finalisation of the collection and storage project for radioactive waste not generated by the nuclear power industry

2011 was an important year for the project, with two new buildings scheduled to be built within the facility grounds where very-low-level waste is disposed of in the Aube district, to receive the waste not generated by the nuclear power industry.

BETTER CONTROL OF WASTE COLLECTION

Radioactive waste not generated by the nuclear power industry comes from hospitals, research laboratories, universities, industry, local authorities and individuals (lightning conductors, luminous clock dials and hands, medical instruments...).

It is managed by Andra, which today collects the majority (approx. 5, 000 packages per year) in a building located on the CEA site at Saclay, before sorting it and sending it to a disposal facility, treatment or storage facility. A small part of this waste (approx. 250 cubic metres per year), not yet having a disposal facility, is stored in the Vaucluse and in other CEA installations.

The two buildings to be built, one for collection and the other for storage in a single place, on Andra's very-low-level waste disposal facility, will enable optimised management of radioactive waste not generated by the nuclear power.

PROCEDURES CARRIED OUT SUCCESSFULLY

A public enquiry was conducted on this project during the autumn of 2011. Meetings were organised and sessions were held at the Morvilliers and La Chaise town halls. After the enquiry closed, the enquiry commissioner submitted a report taking account of the opinions expressed by the public and the responses made by Andra to the Aube Prefect. The conclusion of the enquiry was positive. ●

Collection of waste not generated by the nuclear power industry before sorting, treatment and disposal or storage



K€3,490
turnover

88
tonnes
waste treated

WHAT ABOUT TOMORROW?



RAPP13: reorganise the “small-scale producers” network

RAPP13 (re-establishment of “small-scale producer” activities) is a project over five years, launched in 2011, the first results of which are expected in 2013. Its purpose is to optimise the management solutions for radioactive waste not coming from the nuclear power industry.

A FRAGILE ACTIVITY

In September 2011, a serious industrial accident occurred at the Socodet plant, which was then shut down. This subsidiary of EDF had the only incineration plant for radioactive waste in France; this is where the majority of radioactive waste not generated by the nuclear power industry was incinerated. Shut-down of its activities caused an interruption in the network and led Andra to find temporary storage solutions.

IMPLEMENTING RELIABLE, PERMANENT AND PROFITABLE SOLUTIONS

The RAPP13 project aims to re-think the network to best control it and offer better quality of service to producers.

It includes the construction of storage and collection buildings, with the setting up of industrial solutions controlled by Andra, so as to offer a service best adapted to the needs of producers of non-nuclear-power radioactive waste. ●

1,500
active
customers

230
collection
points



LLW-LL Project: starting out anew

In a report made public in October 2011, the High Committee for Transparency and Information on Nuclear Safety (HCTISN) formulated its recommendations for pursuing research for a site likely to receive low-level long-lived waste (LLW-LL).

INSTALLATION OF NEW DISPOSAL SITES: A DELICATE QUESTION

In 2008, the State and Andra undertook a wide search for a low-activity long-lived waste disposal site. Around forty towns offered to house the site. The two towns chosen by the State in 2009 were finally withdrawn under pressure from opponents. This failure, despite a progressive and open process, led the High Committee to set up a working group to obtain feedback and propose recommendations.

AN ENQUIRY IN THE FIELD TO INCREASE UNDERSTANDING

In 2010, the High Committee, in conjunction with the National Committees and Local Information Commissions (ANCCLI), heard from all the stakeholders: elected officials and local entities, organisations and the operators involved.

RECOMMENDATIONS FOR PROJECT FOLLOW UP

The High Committee published its report in October 2011. The report highlighted the “public utility” character of low-level long-lived waste disposal and reminded those concerned that safety is the main factor for site selection. It recommended that the project be adapted to the area and that the main contact cover more than one town, with support from the State and large community groups. Andra will use these recommendations to establish the report in which it will propose directions for following up the process with the Government at the end of 2012. ●

Cigeo: updated inventory



*Throughout 2011, Andra coordinated the updating of the provisional inventory of waste to be received at the future geological industrial disposal facility, Cigeo. This inventory will contribute to specifying the facility's terms of operation. Here are the main lines of this work, explained by **MICHÈLE TALLEC**, Head of the Inventory and Planning Department in the Andra Risk Control Division.*

What was the nature of your work?

Michèle Tallec: We established a precise inventory of the waste scheduled to be disposed of in Cigeo. The high-

level waste (HLW) and intermediate-level long-lived waste (ILW-LL) produced by current nuclear facilities or by installations for which a licence has been requested, and by the treatment of spent fuel from French nuclear power plants, account for a volume of approximately

10,000 cubic metres for the HLW and 70,000 cubic metres for the ILW-LL respectively.

Currently, 30% of the HLW and 60% of the ILW-LL to be processed by for Cigeo has already been produced.”

How will this inventory influence the operation of Cigeo?

M. T.: You have to remember that Cigeo is scheduled to run for over a century. The disposal structures will be built in successive sections, which means that we have to know the volume and the characteristics of the packages to be disposed of and to be able to schedule their delivery. The sizing of the site and the industrial equipment necessary to receive, check, condition and dispose of the waste as it arrives depends on these data.

How are any changes to the inventory in the future managed?

M. T.: The decree for the creation of Cigeo will set down the authorised inventory for disposal. Any change in the inventory will therefore involve applying for a new licence. In this respect, it will have to be the subject of a new public enquiry. This process will be presented during the public debate on the project scheduled for 2013. ●

“ **Currently, 30% of the HLW and 60% of the ILW-LL to be processed by Cigeo has already been produced.** ”



Future Investments

Within the framework of the Future Investment programme, launched by the Government in 2010, Andra has been allocated a budget of seventy-five million euros to develop solutions targeted mainly on saving space for the disposal of radioactive waste in France. Two projects, included in the National Plan for the Management of Radioactive Materials and Waste 2010-2012, are in the development phase.

R&D PROJECT: TREATMENT OF HIGHLY ORGANIC RADIOACTIVE WASTE

This waste comes from the manufacture of MOX fuel (mixture of plutonium and uranium oxides) within installations operated by Areva. It contains organic and inorganic materials (metals, glass.). Due to its organic content, its behaviour in the disposal situation leads to significant production of gas, the formation of corrosive substances (leading to a risk of premature package corrosion) and complex molecules likely to promote the transport of radionuclides.

This waste, for which there is not yet a disposal solution, is conditioned in drums and stored at la Hague. The purpose of the project developed by Andra is to refine a process that enables safe disposal, with a significant reduction in the volume in relation to the envisaged methods of conditioning.

This process will have to be able to treat the waste without prior separation between the organic and inorganic materials, which is a real technological challenge. The adopted solution consists of fusing the metals by induction, leading to the fusion of the glass together with a mineralisation of the organic materials using a plasma torch process.

The glass matrix thus obtained is intended to provide an optimised confinement of the radioactivity. These solutions will also be applicable to other chemically complex waste that does not currently have a disposal solution, such as waste made up of organic liquids. This project was the subject of numerous exchanges between Areva and Andra in 2011.

THE INDUSTRIAL PROJECT: STEEL RECYCLING

Very-low-level metallic waste, mainly containing steel, comes from the operation and dismantling of nuclear installations. The adopted recycling principle is that of manufacturing cast iron containers with this steel, which will replace the concrete packages currently in use for the disposal of low- and intermediate-level waste. The advantage of cast iron over concrete is its power to reduce the disposal volume for the same quantity of waste.

In 2011, the project gave rise to a market analysis to study the profitability potential on the complete network, from taking responsibility for the waste up to the sale of the recycled product. It was also analysed in terms of industrial development: the creation of sorting and pre-treatment installations and a foundry with an estimated production of 4,000 t/year. Exchanges have been undertaken with producers of radioactive waste to examine how these containers could be integrated into their conditioning workshops. ●

Define and set up new routes

The 2010-2012 National Plan for the Management of Radioactive Materials and Waste included several projects to be dealt with by Andra concerning the management of radioactive waste without solutions, notably to define new routes and to optimise existing ones.

TRITIATED WASTE

Tritiated radioactive waste mainly comes from the CEA's defence activities. Operation of the Iter reactor, planned on the Cadarache site, will also produce tritiated waste. A very small part comes from industrial activities and medical and pharmaceutical research. A certain amount of this waste has a high level of radioactivity and for this reason is not acceptable for disposal without storage for tritium decay possibly after preliminary processing.

In 2011, the State asked Andra to study, with the CEA, the terms of accepting tritiated waste coming from civil research in the Iter storage installations.

RADIOACTIVE LOW-LEVEL LONG-LIVED WASTE (LLW-LL)

This includes several waste families:

- radium-bearing waste, mainly coming from ore treatment (for example in the extraction of rare-earth elements),
- graphite waste that comes from the operation and dismantling of first generation EDF reactors and the CEA experimental reactors,
- certain bituminous waste,
- miscellaneous waste such as spent sealed sources (mainly used in fire detectors) or lighting conductors.

Following their withdrawal in 2009, the two candidates selected by the Government in the search for potential shallow disposal sites, the State asked Andra to re-open the different management options for LLW-LL,

mainly by studying the separated management of radium-bearing and graphite waste, and pursuing discussions with the previous candidate towns, allowing time for consultation. Andra will submit a report on these different possible management scenarios to the Government in 2012.

For the radium-bearing waste, the main scenario consists of disposal at around fifteen metres depth. Andra continued to study this scenario in 2011 to prepare the technical requirements that could be applied to disposal facility design studies.

For the graphite waste, recent development in the treatment process and changes in the radiological characterisation led Andra to study treatment and waste sorting scenarios in 2011, at the same time as a study for a disposal facility at a depth of one hundred metres. As with the graphite waste, several management scenarios will be studied for bituminous waste and other LLW-LL. As a precaution, space for receiving any waste from the sorting/treating of graphite and bituminous waste was scheduled in the Cigeo inventory.

SPENT FUELS

Today in France, spent fuels are not intended to be disposed of. The materials they contain (plutonium, uranium) can be recycled to manufacture new MOX-type fuel (mixture of plutonium and uranium oxides).

On the other hand, waste from the treatment of these materials performed by Areva in its plant at la Hague, is scheduled to be disposed of in the future geological industrial disposal facility, Cigeo, being designed by Andra.

If, in the future, certain spent fuels were no longer treated, they would then become waste that would have to be disposed of. The studies



Spent fuel
is not scheduled
for disposal.

presented in the Dossier 2005 have already taken into account the possibility of their disposal at depth and the feasibility of this solution was already demonstrated. As a conservatory measure, the National Plan for the Management of Radioactive Materials and Waste asked Andra to check that the disposal facility designs (in particular the design of the ramp and shafts) remained compatible with the direct spent fuel disposal hypothesis.

OTHER MATERIALS

Other materials containing uranium or thorium, are the subject of studies on the possible management solutions in the case where these materials were qualified as waste in the future. In 2010, within the framework of National Plan for the Management of Radioactive Materials and Waste, Andra produced a study of the possible systems for managing thorium containing materials for Areva and Rhodia. Andra submitted its final report in February 2011. ●

ACKNOWLEDGEMENTS AND CREDITS

CHARLES GIULIOLI, *Artistic and engineer*

Charles Giuliani studied engineering at the École Centrale before working as a researcher for CNRS. Throughout 2011, Andra's 20th year, he used digital simulation techniques and mathematical calculations to create twelve pictures making up the work of art designed to change, through his inspiration, and a "machine" into which have been inserted new photos and new data, illustrating the values and events in Andra's life.



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