



DISPOSAL
FACILITIES:
PRESERVING
A COLLECTIVE
MEMORY



... for future generations



ANDRA

A statutory industrial and commercial establishment

The French National Agency for Radioactive Waste Management (or Andra), created by the Act of Parliament of 30 December 1991, is responsible for managing all the radioactive waste produced on French Territory. It is supervised by the French Ministries of Industry, Research and the Environment.

Andra operates two surface disposal facilities in the Aube District: the CSFMA disposal facility for low- and intermediate-level short-lived waste and the CSFMA disposal facility for very low-level waste.

It monitors a third facility (CSM disposal facility) located in the Manche District, that stopped accepting waste in 1994.

Andra also organises the feasibility studies into a high-level long-lived waste (HLLW) reversible repository in a deep geological formation being conducted at the Meuse/Haute-Marne Underground Research Laboratory.

Double ISO 9001 and ISO 14001 certification

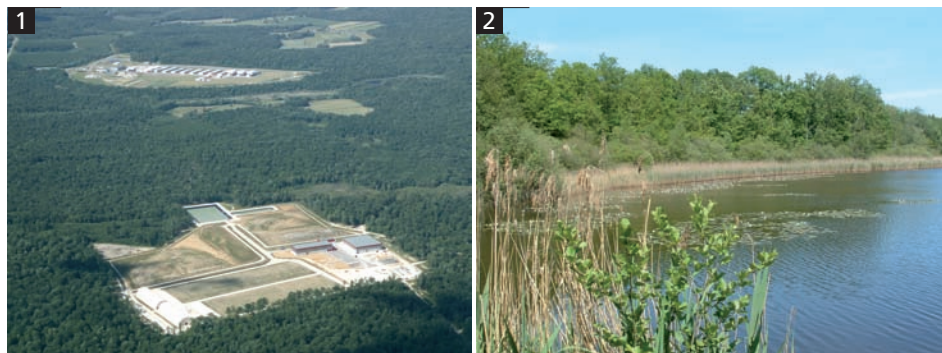
Andra obtained double ISO 9001 and ISO 14001 certification in 2001 for all its missions. Each of these ISO certifications were confirmed in April 2006. The ISO 9001 standard is primarily geared to quality and the attention afforded to its business customers. The ISO 14001 standard covers all the Agency's environmental protection and impact mitigation activities in respect of its current facilities and the preparative work for its future facilities.

Constructing a collective memory of the repositories

Radioactive waste repositories are designed to be **intrinsically safe (the lowest possible impact, lower than the threshold set by the Safety Authority) throughout the lifetime of the wastes.**

Andra seeks to preserve its repository records as long as possible, while providing for the risk that they will be lost after a statutory monitoring period. These records are intended for future generations to:

- ▶ inform them of the site's existence and contents, particularly in view of the risk of human intrusion,
- ▶ make it easier for them to understand the observed phenomena (especially surface installations) and if necessary, help them carry out any remedial action in favourable conditions,
- ▶ allow them to take decisions about the site's future, primarily regarding modifications or redevelopment in line with technical and societal developments.



Collective memory and Andra's heritage

Knowledge of the current situation will be posterity's heritage. The needs of those who will come into this knowledge in centuries to come will have to be imagined as fully as possible. Subsequently the solutions and research and access methods to today's knowledge will follow. Andra has delved into the heritage passed down from previous centuries to back up its analyses of robust solutions at the scale of time. How much have we been able to safeguard? What is our understanding of it? How has this heritage been preserved and how has it transcended war and revolution? How clear is it to us today given language developments? And so on.

The answers to these questions demonstrate, with a high level of confidence, that it is possible to prepare for heritage transmittal over long time scales. A number of ancient institutions, such as the Académie Française, have achieved this. Andra must manage, then pass on to posterity:

- ▶ general knowledge about the radioactive waste present on French soil (the National Inventory),
- ▶ the location and composition of the radioactive waste accommodated in its repositories,
- ▶ an environment that is preserved by reliable long-term technical solutions.

THE RECORDS OF THE MIDDLE AGES

Andra has delved into the conservation of manuscripts from the Middle Ages through partnerships with specialist bodies, to help it plan for heritage conservation over a millennium. They enable Andra to analyse how and why past archives and works have been conserved through the centuries, and also how much of this past survives to this day, and the reasons why that heritage has deteriorated and been destroyed. The analyses support Andra in making its choices.



HERITAGE OF THE ACADEMIE FRANÇAISE

The Académie Française, founded by Cardinal de Richelieu in 1635, has 40 members elected by their peers. Over 700 members have been appointed since its foundation. One of its missions is to publish the official dictionary of the French language, whose first edition was published in 1694, the last appearing in 1992. Work on the publication of the ninth edition is in progress. The Académie Française has been organised to structure and transmit its heritage since it was created. Over its almost four centuries of existence it has:

- ▶ kept its institutions going and operating on a regular basis (except for an interruption from 1793-1803, with no information destroyed),
- ▶ kept and transmitted all its knowledge such as the papers of its individual members or all the work carried out on each of the dictionary's nine editions.

PHOTOS :

- 1 Aerial view of the Aube District disposal facilities (2004)
- 2 The Étang des Cailles watercourse near the Aube District disposal facilities (2006)
- 3 Pierre Comestor, *Histoire scolastique* (13th century), the Gospel according to Luke
- 4 Nicolas de Lyre, *Postilles sur l'Ancien Testament* (15th century), a theological address

The CSM disposal

How to go about constructing a collective memory

Andra has defined scenarios relating to potential changes to the disposal facility environment by applying the Centre's safety approach, to preserve CSM disposal facility records. It has analysed the individual scenario data that future generations will need to understand these changes and their associated risks and take appropriate measures as required. It has selected then prioritised this information, supplementing it with historical data. It has also verified the readability and intelligibility of its efforts. Finally, it was all transferred onto a medium that will last for several centuries.



CONTRIBUTIONS MADE BY THE TURPIN COMMISSION

In February 1996 the French Government set up an independent commission to audit the CSM disposal facility, to dispel public disquiet. This audit commission, chaired by *Ingénieur général des Mines* Michel Turpin, supported the existing choices and made recommendations on the Centre's safety and developments. It backed the use of paper as the only durable medium for record keeping and recommended that a précis should be widely circulated, that rights of way restrictions should be implemented and communication lines to the public and local monitoring committee be kept open throughout the post-closure monitoring period.

Two types of records on permanent paper

The requirements analysis concluded that two records of the Centre needed to be prepared for posterity:

- ▶ two copies of a detailed tree-structure record for managing the Centre and potentially using the site in the future (one stored at the Centre and the other in the French National Archives),
- ▶ a précis presented as a single volume aimed at decision-makers and the general public, suggested by the "Turpin" Commission (there are about a hundred copies stored in various locations: town halls, notaries' office, associations...).

Andra has specified the meaning of the symbols used and provided a glossary to aid comprehension in the future. It has also clarified the archive architecture and produced an abstract of each section in layman's terms. These two records have been reproduced on permanent paper and handled using gloves to avoid any risk of pollution.

THE CSM DISPOSAL FACILITY MONITORING COMMITTEE (CSCM)

The CSCM, made up of representatives of the public was established in 1996, and is chaired by the Prefect of the Manche District. Its mission is to check that the Centre operates correctly and inform the local population about the monitoring phase. It therefore also takes part in keeping the Centre's records alive.

facility experience

Content of the detailed records

The detailed records of the CSM disposal facility for the period 1969-2003 comprise 10,732 documents (that is 442,938 pages taking up 60 linear metres). These records include data on the nature of the site, the construction of the various repository structures, the packages accommodated (inventory and map), the extent of the installations, the operating and monitoring methods, the main incidents and how they were dealt with, the major exchanges with the relevant authorities... Centre monitoring currently requires only about one hundred of these documents (1%). Documentation work started in 1984 and the records were transferred to the French National Archives in 2004.



WHAT IS PERMANENT PAPER?

Paper was manufactured from rag until the middle of the 19th century. At the beginning of the industrial age it changed through the widespread use of wood pulp and rosin in the gluing. These elements tend to produce acids and the paper is destroyed in the space of a few decades.

In the 1950s, British, followed by North American papermakers, started manufacturing long-life paper albeit without setting any precise rules. The first standard for permanent paper dates back to 1975 in the United States. This was followed by the first international standard in 1994 (ISO 9706: requirements for permanence¹) followed by a second standard in 1996 (ISO 11108: requirements for durability¹). These two standards incorporate over a century of feedback from the main international archive services. Permanent paper is manufactured from pure cellulose free of mechanical wood pulp, recycled paper, compounds or pulp blends. Its pH² is slightly alkaline (7.5 – 8.5); its Kappa index³ is less than 5; its tear-resistance is higher than 350 mN⁴ for a current weight of 80 g/m². Its stability should be ensured over several centuries, provided precautions are taken when handling it and it is stored in suitable conditions (low temperature and humidity variations).

1 – Permanence: capacity to remain stable over time;
durability: capacity to resist normal wear and handling.

2 – pH is measured from 0 - 14. Ordinary white paper tends to be quite acid (4 - 6) because of the bleaching process used.

3 – It characterises the oxidation resistance on a scale of 0 - 100. The Kappa index of ordinary white paper is 25 - 50 before bleaching.

4 – This resistance is 20-50% higher than conventional paper.

PHOTOS :

- 1 Concreting of a disposal cell at the CSM disposal facility [CSM] (1988)
- 2 Covering the CSM (1995)
- 3 General view of the CSM cover in the final stages of construction (1997)
- 4 Reproducing the detailed records of the CSM onto permanent paper (1998)
- 5 Checking the quality of this duplication (2000)
- 6 Example of one of the boxes containing detailed CSM records (2004)

The Aube District disposal facilities (CSFMA and CSTFA)

Nowadays everyday information management is computerised at Andra as it is in many other businesses. For instance, Andra has dedicated databases for managing repository waste inventories and environmental measurements. Andra also uses "electronic" document management (EDM) for locating and viewing the content of its thousands of documents. The documents can be rapidly and efficiently accessed from any point using this digitized information and knowledge system. The daily backups carried out in different locations provide maximum security. It is also highly compact and offers a useful relatively short-term archiving solution.

From all-digital to all-paper

New information technologies change rapidly, therefore some solutions become obsolete both in hardware and software terms within ten to twenty years. Upgradability presents a major problem for long-term conservation of the records. This is because it is not certain that future generations will still have the resources to keep abreast of the changes to information systems (especially their migration from one solution to another). Andra applied the principle of precaution to deal with this risk when conserving the CSFMA disposal facility records (using the same structuring method as for the CSM disposal facility). Andra has printed all the essential repository records from its digital files onto permanent paper. Thus, this solution will stand the test of technical changes.



COMMUNICATION AND LAND REGISTRY

The presence of a radioactive waste disposal facility must also be firmly set in the collective memory of the local population and its representative bodies. Accordingly Andra and consultation bodies such as local committees, made up of representatives of the relevant populations and authorities, will continue issuing information even after repository closure (a site journal for example) on principle.

The purpose of the rights of way (or land-use plan) restrictions is to limit or ban use of the land after the disposal facility has closed, for example to prevent boring or construction taking place there. Thus the site records must be kept at the land registry and the site's integrity must be preserved, so that any work or developments carried out there are made in full knowledge of the facts.

Geological repository studies

Andra plans to apply the same type of provisions to a potential long-lived waste repository in a geological formation as it does to its surface facilities for the first centuries. Nonetheless, preserving records, at the scale of several millennia, calls for other types of response. If we refer to our past heritage, cave paintings, parchment scrolls and man-made features (megaliths, pyramids, bullrings, and so on) have survived over similar periods. International forums have discussed the possibility of similar markers to these man-made features being constructed on the surface above the geological repositories. Even after withstanding erosion or vandalism, future generations would need to make sense of these features (would they be able to deduce that these surface features mark the presence of a geological repository?). International discussions continue on this issue.



CAN THE EXISTENCE OF A DISPOSAL FACILITY BE FORGOTTEN?

Through gradual radioactivity decay, it takes just a few centuries for low- and intermediate-level short-lived waste to drop to a radioactivity level that no longer presents any danger for mankind. Therefore, losing the records of their surface disposal will no longer present a significant risk. Nonetheless, the aim is to preserve these records as long as possible.

Long-lived waste radioactivity will last for much longer periods. In the case of some radionuclides, surface markers would be insufficient because the records must be kept for hundreds of millennia. It should be possible to lose sight of a geological repository after five to ten centuries without jeopardising its safety. This possible obliviousness is incorporated into the repository design and the populations would be protected from the radioactivity emanating from this waste because:

- ▶ the geological layer, in which the radioactive waste packages would be located, would be sufficiently impervious to limit radionuclide migration to very low levels through outlets likely to rise to the surface,
- ▶ the repository would be sited at such a depth as to prevent any risk of the waste being exposed at surface level through natural erosion,
- ▶ the choice of a site devoid of known natural resources (no ores, oil, gas, etc.) would considerably limit the risk of human intrusion (drilling, mining, etc.). Furthermore, the repository would be compartmentalised, hence an intrusion would only affect a small fraction of the inventory stored. These highly unlikely risks of intrusion are subject to specific safety studies,
- ▶ the repository can be made totally passive (no installation maintenance) after a reversibility phase and closure.

PHOTOS :

- 1 *Barcoding provides waste package traceability (2004)*
- 2 *Waste packages being disposed of at the CSFMA disposal facility (2005)*
- 3 *Temple of Inscriptions, the tomb of the most important suzerain, Pacal Votan (died in 683), at the Palenque site (Mexico)*
- 4 *Stelae, altars and monuments (dating from 700 - 800) dedicated to the Snake-god on the Copán site (Honduras)*
- 5 *The Step Pyramid at Saqqarah (dating from 2700 B.C), The first Egyptian pyramid constructed by King Zoser's architect, Imhotep*



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Some of Andra's publications are available in English.

Essential Series

In a few pages, documents in the Essential Series provide simple and illustrated explanations with a view to furthering knowledge on radioactive waste and Andra.



Reference Series

With standard information concerning Andra methods and progress reports on its investigations or activities, the Reference Series presents various technical and other information, especially on the location of radioactive waste.



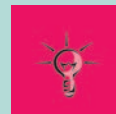
Periodical Series

On a regular basis, Andra publishes various brochures relating to the environmental monitoring of its disposal and research facilities. The Periodical Series includes those publications as well as the respective news bulletins of each site.



Discovery Series

Videos, CD-ROMs, synthesis images and comic strips... are worth more than a thousand words. The Discovery Series uses vivid illustrations to explain to a broad public the underlying principles of radioactive-waste management.



Science and Technology Series

Taking stock of current knowledge, presenting ongoing research as well as the Agency's methods and approaches constitute the objectives of the Science and Technology Series. Intended for a specialised public, it provides various syntheses and monographs published under the aegis of Andra or in partnership with other scientific organisations.



Report Series

Summaries, reports and seminar proceedings published in the Report Series highlight the advances of Andra's ongoing investigations.



Industrial Practices Series

The Industrial Practices Series includes documents dealing with the transfer of responsibility for and the management of radioactive waste.



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pour la gestion des déchets radioactifs