Visiatome: The French Discovery and Information Center on Radioactive Waste Management

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ABSTRACT

The French radioactive waste management act of December 30, 1991, included two key provisions. It initiated a major research program with three areas of investigation concerning high-level long-lived radioactive waste management routes, and called for the Government to submit a legislative proposal to Parliament within 15 years (by 2006) specifying the policy guidelines adopted. Considering the sensitive nature of the subject, the questions surrounding the issue of radioactive waste, and the social, economic and environmental concerns for present and future generations, the Government has inaugurated, in 2005, a nationwide public debate on these issues between the submittal of the research reports and the parliamentary discussion of the proposed law.

In this context, the CEA has decided to concentrate at Marcoule the expertise and experience acquired in the area of radioactive waste management and to make it available to stakeholders and to the public. A scientific cultural center, *Visiatome*, has been built to inform the public and facilitate the acceptance of nuclear energy and radioactive waste management by presenting the subject in a manner adapted to the level of knowledge of the visitors. A modern, fun and interactive exhibition of 600 m² allows visitors to find out more about energy, waste products, sources of radioactive waste, their treatment and where they are stored, natural and artificial radioactivity , effects of radiation on mankind. It also offers a media library, an auditorium for group discussions and teaching rooms for school groups with the aim of encouraging students to discover science through enjoyment.

Visiatome has received several thousand visitors since it was opened to the public on April 10, 2005, and the initial results of this experience can now be reviewed: the design principles of the center and its permanent exhibits, the characteristics of the visitors and their perception of the subjects presented.

INTRODUCTION

Optimizing radioactive waste management consists in separating and recycling reusable energy-producing materials, and in reducing, conditioning and disposing of the ultimate wasteforms arising from the production of nuclear energy in France.

Reprocessing spent fuel not only reduces the radiotoxicity of the waste compared with the spent fuel by removing and recycling the plutonium—which is both a major energy-producing material and the main contributor to long-term radiotoxicity—but also reconditions the long-lived waste in safe and durable form occupying a considerably smaller volume.

Nevertheless, the time necessary for radioactive decay of this waste is extremely long. Public concern over the issue of long-term waste management led the French government to suspend the creation of a geological repository in 1990 and submit a legislative proposal that was passed by the Parliament on December 30, 1991, initiating a fifteen-year research program on long-lived high-level waste. In order to address this concern, the CEA commissioned a public information center on radioactive waste management, *Visiatome*, which opened on April 10, 2005. The number of visitors, their demographic background, and their perception of Visiatome can be assessed after a year of operation.

NUCLEAR ENERGY, THE FUEL CYCLE, AND WASTE MANAGEMENT

Today 440 nuclear reactors produce 17% of the world’s electricity. Eighty percent of these are “light-water” reactors, in which the core is cooled by ordinary water: this is the case for the 58 pressurized water reactors (PWRs) currently operating in France to meet nearly 80% of the country’s electricity requirements.

Typically, after producing energy for three or four years in the core of a PWR, spent uranium oxide (UOX) fuel contains 94% uranium and 1% plutonium—both of which are recyclable energy-producing materials—and 5% waste fission products together with 0.1% minor actinides. Because of its very high and persistent radioactivity, spent fuel management is a core issue not only for public acceptance of nuclear energy but also as a technical problem. The radiotoxicity of spent UOX fuel is much higher than that of the natural uranium ore used to fabricate the initial fuel. The additional radiotoxicity is due mainly to the fission products for about three hundred years, to the minor actinides for about twenty thousand years, and to plutonium for about three hundred thousand years.

The waste is managed with the objective of durably protecting the human population and the environment from the resulting hazard. From this perspective, two main management routes (or fuel cycle options) can be considered for these materials:

- A closed fuel cycle, in which spent fuel is processed to separate the remaining reusable materials from the ultimate waste. In this option, the radioactive waste elements are incorporated into a glass matrix protected by a metal canister. The resulting waste packages are first placed in interim storage (industrial facilities designed for safe waste management for periods of fifty to a hundred years). Following this period, one option is to dispose of the packages in deep geological formations to ensure long-term immobilization, i.e. to isolate them durably from the human population and the environment so that they cannot migrate into the biosphere before their residual health-related and environmental impact is negligible—just as the impact of nuclear electric power plants and fuel cycle facilities is negligible today.
- An open fuel cycle, in which spent fuel is considered as waste and is packaged directly in canisters. Following an interim storage period, they could be placed as waste in deep geological formations with same objective as in the closed fuel cycle.

France has opted for the first step in closing the cycle by reprocessing spent UOX fuel and recycling the extracted plutonium in PWRs in the form of MOX fuel.

No country to date has yet commissioned a deep geological repository for spent fuel or vitrified waste packages. Like the waste radiotoxicity, the residual thermal power in the waste arises mainly from the fission products during the first century, and from plutonium and americium for the next few centuries. The feasibility of geological disposal with a degree of initial heat depending on the nature of the waste and on the duration of the prior interim storage, requires a conclusive demonstration and guarantee that any release of significant quantities of radioelements into the biosphere is impossible.

Even after the technical feasibility demonstration, however, the actual construction of a repository—assuming the decision is made—requires a strong public commitment from the beginning of the project, and must address public concerns related not only to waste management but also to the socioeconomic and environmental implications for present and future generations. Informing and educating the public about radioactive waste management options thus acquires significant or even crucial importance.

HISTORICAL CONTEXT OF RADIOACTIVE WASTE MANAGEMENT IN FRANCE

After the Second World War, France undertook a major defense and commercial nuclear program. At the same time, the CEA developed conditioning technologies to stabilize the waste pending the development of a definitive solution. The vitrification option was chosen for long-lived high-level waste (LL-HLW) arising from spent fuel reprocessing. Comparable developments were achieved for long-lived intermediate-level waste (LL-ILW), for which CEA researchers developed conditioning processes by bituminization and cementation. All these processes were implemented by COGEMA at the Marcoule and La Hague industrial sites.

The French national radioactive waste management agency (ANDRA) was created as part of the CEA in 1979, with the mission of defining the strategy for long-term management of long-lived high-level nuclear waste. The concept initially selected by ANDRA was disposal in a deep impermeable geological formation (clay, salt, or granite). This concept is the subject of a broad international consensus. It rapidly initiated the preliminary studies, but in the late 1980s at the sites for which the first boreholes gave promising results the Agency encountered increasing hostility from the local populations.

In 1989 the government therefore declared a moratorium on these studies and entrusted a parliamentary inquiry to Christian Bataille that led to the radioactive waste management act of December 30, 1991.

In 1992, in compliance with this law, ANDRA became an agency independent of the CEA. Its missions as defined in the law include:

- participation in the definition and contribution to the research and development programs concerning long-term management of radioactive waste, notably in cooperation with the Commissariat à l'Énergie Atomique (CEA);
- management of long-term disposal centers;
- design, siting and construction of new centers and performance of all studies necessary for this purpose, in particular the construction and operation of underground laboratories to study deep geological formations;
- definition of specifications for conditioning and storage of radioactive waste in compliance with safety rules;
- inventorying the condition and location of all radioactive waste in France.

The same year, the Centre de l'Aube, operated by ANDRA for the final disposal of short-lived low-level waste (SL-LLW) replaced the Centre de la Manche, which had reached saturation a few months earlier.

During the same period, the CEA continued to prepare its facilities for the research programs assigned to it under the terms of the 1991 law. Major investments were budgeted to carry out certain experiments. The Atalante complex, commissioned progressively beginning in 1992, was equipped for separation and conditioning experiments on highly radioactive materials.

In 1998 the government ordered the shutdown of the SuperPhenix fast breeder reactor in which researchers had planned to carry out transmutation experiments. Phenix was the only remaining fast neutron reactor available in France for these experiments

Concerning its energy policy, the French government organized a national energy debate in 2003 to prepare a legislative proposal defining strategic orientations for the next thirty years. Following this debate, and while declaring that the future of nuclear energy implies that the process initiated with the 1991 nuclear waste management act must be pursued to its conclusion, the government reaffirmed its determination to keep the nuclear option open; it also stated that the necessary technologies must be available when the time comes to replace the existing reactors, and that it is therefore indispensable to proceed with the construction of a demonstration third-generation nuclear reactor (European Pressurized Reactor: EPR).

From September 2005 to January 2006, a national public debate on radioactive waste management was organized by the National Commission for Public Debate, an independent administrative authority, at the request of the Ministers of Industry and of Ecology and Sustainable Development. It named a Special Commission for Public Debate consisting of prominent figures from all walks of life, to prepare, organize and conduct the debate throughout the country. Fifteen public meetings were organized at a regional and national level in twelve cities.

RADIOACTIVE WASTE COVERED BY THE 1991 LAW

Radioactive Waste Classification and Inventory

There are several categories of radioactive waste depending on the level of radioactivity and on the radioactive half-life of the constituent radionuclides. "Long-lived" radionuclides are those with half-lives exceeding thirty years; the others are "short-lived". The French classification defines the following categories:

- very low-level waste (VLLW), containing a very small quantity of radionuclides that distinguishes it from conventional waste;
- short-lived low- and intermediate-level waste (SL-L/ILW), in which the radioactivity level will be comparable to that of natural radioactivity in less than three hundred years;
- long-lived low-level waste (LL-LLW), consisting of "radium-bearing" waste from the extraction of rare earth elements in radioactive ore and "graphite" waste from the first generation of reactors;
- long-lived intermediate-level waste (LL-ILW), covering a wide range of origins and types, arising mainly from spent fuel structural components (hulls and end pieces) or from the operation and maintenance of nuclear facilities;
- high-level waste (HLW) containing fission products and minor actinides separated during spent fuel reprocessing and incorporated in a molten glass matrix. About 120 m^3 of nuclear glass are poured each year. Vitrified waste contains most of the radioactivity and consequently is subject to considerable heat release that will remain significant for several centuries.

The total quantity of radioactive waste conditioned in France represents less than 1 kg per person per year, broken down as follows:

- more than 90% short-lived low- and intermediate level waste, containing only 5% of the total radioactivity;
- almost no long-lived low-level waste;
- 9% long-lived intermediate-level waste;
- less than 1% high-level waste.

Current Principles of Long-Term Radioactive Waste Management

The objective of long-term management of radioactive waste is to protect the human population and its environment against the effects of their constituent materials, and particularly against radiological hazards. This implies preventing any emission or dissemination of radioactive materials by isolating the waste from the environment. Basically, the following management principles are applied:

- produce the smallest possible quantities of waste;
- reduce the hazardous properties of the waste whenever possible;
- take into account the specific features of each waste category;
- implement provisions to minimize the burden (surveillance, maintenance) for future generations.

The challenge of the research programs initiated by the 1991 law is to provide the scientific and technical basis for determining the most suitable long-term management approaches to control the risk of long-lived intermediate- and high-level waste.

The CEA is responsible for topics 1 (separation-transmutation) and 3 (conditioning, long-term interim storage) defined under the terms of the law, and has broken down the subjects into operational issues with research programs addressing the following issues:

- Which long-lived radioactive elements can be separated? From which types of waste? And how?
- What can be done with these elements once they have been separated?
- Which separated elements can be transmuted into stable or short-lived elements? And how?
- What would be the long-term characteristics of the resulting waste?
- Is there a conditioning process capable of reducing the waste volume?
- How resistant is the conditioned waste to aggressive phenomena over time?
- Must the conditioned wasteform be protected by containers, and if so, what types of containers?
- Is interim storage a viable solution? For what duration?
- Which waste management scenarios can be proposed? How can they be assessed?

To investigate these issues, the CEA has mobilized considerable human, technical and financial resources, and has established new cooperation programs with French, European and international bodies. Several hundred persons have been working since 1992 in a wide range of areas of investigation identified by the 1991 law.

In 2002, the CEA created a center of expertise on conditioning and interim storage of radioactive materials at Marcoule with the following objectives:

- consolidate CEA research and development expertise and resources for managing radioactive materials at a single site to make them available to users, regulators and decision-makers;
- provide a test bed and a scientific and technological facility for developing and qualifying practical management solutions for radioactive materials;
- set up a permanent exhibition to inform the public, elected officials and associations of activities in this area. This was the objective behind the creation of a public information center called Visiatome.

In addition to mandating the performance of research programs addressing the three areas of investigation, the 1991 Radioactive Waste Management Act also included provisions to ensure the involvement of all the stakeholders in a transparent process—not only during the 15-year research period, but also at the end of this program. The government, through the Ministry of Research and public research organization, is not only required to carry out the necessary studies, but must also submit annual progress reports to the French Parliament.

Moreover, to favor the quality of the work and the transparency of the process, the 1991 law created a National Evaluation Commission responsible for analyzing the results obtained, highlighting the progress or shortcomings, and for preparing an annual report for the government which is submitted to the Parliament.

The issue of waste—of whatever nature—is one of the most intractable problems facing any society, as exemplified by the age-old dream that human activities can leave nature intact for future generations.

COMMUNICATION WITH THE PUBLIC

Scientific progress, industrial risks, and ethical issues raise questions among citizens and strengthen their resolve to better control progress. If the advances of science and technology are to meet the needs and gain the acceptance of the citizens, quality information must be available along with unhindered access to this culture.

In the last half-century, science and technology have lost much of the aura that had made them the principal values of human progress. After the trauma of the nuclear bombardment of Japan at the end of the Second World War, the major accidents at Three Mile Island in the United States and Chernobyl in Ukraine altered the popular perception of commercial nuclear energy and made the general population aware of the danger it entails.

With hindsight it is now clear that the problem was largely compounded—at least in France—by a tradition of communication in which the public is given only partial information destined above all to reassure the population and convince it of the soundness of scientific and technical orientations that are presented as unavoidable. The fears raised by nuclear energy—the risks for workers in the industry, or for those who live near production sites—have thus been supplemented by denunciations of the hazards involved in the transportation and disposal of radioactive waste, even though these activities have been subject to no major accident to date.

Environmental issues are true priorities. These highly complex issues call for major efforts to provide information and scientific education in the face of the legitimate concerns of the population and elected officials.

In a knowledge-based society, democratic governance must provide citizens with the means to participate knowingly in defining the orientations made possible by responsible scientific and technological progress.

These are the concerns addressed by Visiatome at Marcoule. In a context where the future of nuclear energy—and in particular radioactive waste—is a subject of nationwide public debate until 2006 and where the prospect of decommissioning aging power plants is now taking shape, its ambition is to objectively inform the public about nuclear energy and the disposition of industrial nuclear waste.

Communication about the nuclear industry and radioactivity is a difficult undertaking, both conceptually and politically. The designers of Visiatome have attempted to formulate and structure the responses to legitimate public questions, ensuring a simple approach to an understanding of the issues, while preserving the freedom of opinion of the visitor.

Visiatome attracts three types of visitors:

- Individuals: family outings by local inhabitants or vacationers.
- Groups of adults: mainly professionals visiting Marcoule, but also groups of retired persons or local associations.
- Schoolchildren: from primary school to high school, accompanied by their teachers, who participate in learning activities.

Different activities are proposed for each segment of the public, but with a common factor: human contact. It is particularly important in the case of a sensitive subject such as radioactive waste, that the visitor be able to discuss the issues with Visiatome personnel, ask questions or express concerns. Groups of adults or schoolchildren are always accompanied during the visit. In the case of individual visitors arriving separately, the problem was to find ways to interact with them. This is possible by means of short educational animations directly in the exhibition areas, or by films projected in the auditorium and leading to a discussion. Our objective is that each visitor should have a unique experience, and be able to say on leaving the building: “Now I know what radioactive waste looks like, and what is done about the problem.”

In a word, the goal is not to convince the public or have it adopt one particular viewpoint rather than another, but to inform visitors objectively by showing the advantages and drawbacks of the possible solutions. In sum, our purpose is never to separate the scientific and technical issues from their social and human consequences, never to hide the dangers or the medium- or long-term consequences of the proposed solutions.

The objectivity and straightforward approach of Visiatome have beyond any doubt made a decisive contribution to the discussion and to the relevance of the choices that will be made in France and in Europe.

VISIATOME: A DISCOVERY AND INFORMATION CENTER ON RADIOACTIVITY AND ITS FUTURE

The CEA, a public-funded research organization in the fields of energy, defense, information technologies and health services, has been present at Marcoule since the mid-1950s, where today it employs about 1200 people including 800 researchers, engineers and technicians.

Marcoule is the CEA's center of reference concerning the back end of the nuclear fuel cycle, i.e. the management of spent fuel that has been used to produce energy in power reactors. Conservation of resources (recycling) and limitation of environmental impact (waste management) are the core research activities at Marcoule.

On November 15, 2002, the CEA decided to establish a "Center of expertise for conditioning and interim storage of radioactive materials" (CECER), to consolidate at Marcoule the CEA's scientific competence and experience in this area, and to share its knowledge with others involved in the field and with the general public. It was in this context that the idea of a scientific cultural center took shape. Visiatome opened its doors to the public on April 10, 2005.

Fig. 1**.** Visiatome: attractive and harmonious design

Visiatome and its Missions

The creation of Visiatome addresses four essential missions:

- House a permanent exhibition on radioactive waste management and organize temporary exhibits on topics related to energy in general—and nuclear energy in particular—as well as on radioactivity and its applications.
- Propose pedagogical and scientific activities suitable for a wide range of visitors: schoolchildren, university students, local inhabitants or tourists, scientists, journalists, associations, etc.
- Create a multimedia documentation center.

- Organize a meeting place for exchanges and debates among scientists, nuclear stakeholders and the public.
- Open a new tourist site in the Rhône Valley.

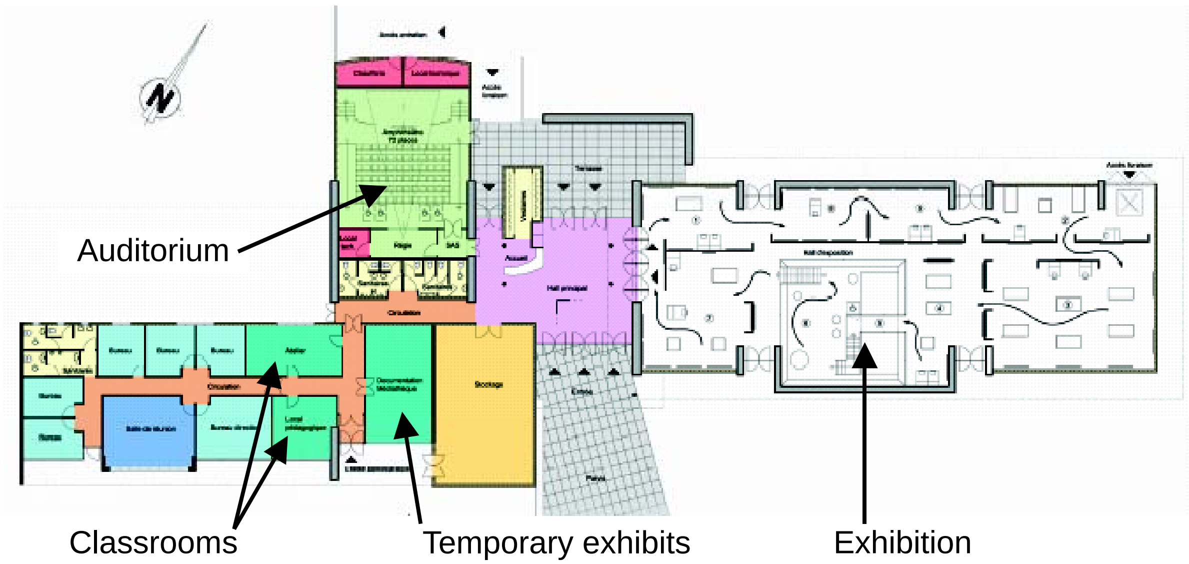

Fig. 2. Visiatome floor plan

Major Issues Concerning Energy and Radioactivity

Visiatome deals with energy and radioactivity in a variety of ways:

- Energy sources, production, transport and sustainable development.
- Waste in general: origins, production, harmful aspects, management methods, etc.
- Radioactive waste sources produced not only by the nuclear industry but also by other activities (research centers, hospitals, food processing industry, military programs, etc.), and applicable management procedures.
- Treatment and disposition of radioactive waste, illustrating different immobilization processes, interim storage and disposal concepts.
- Radioactivity in our natural and industrial environment: its discovery, its properties and its applications are presented through experiments (cloud chamber, measurement of natural elements, etc).
- Effects of ionizing radiation: biological effects on cells and on man; radioactivity, a medical resource.

Special Conditions for Schoolchildren

On July 1, 2004, a partnership agreement was signed between the regional educational authority (Académie de Montpellier), the French national information office on teaching and professional activities (ONISEP) and the CEA, to promote science and the research professions, and to disseminate scientific and technical culture—notably concerning the issues of nuclear energy and waste. Teaching workshops are proposed by Visiatome in relation with the topics covered in the exhibition. They are targeted at different educational levels: primary school, middle school and high school. Each workshop lasts about 90 minutes, with groups split between the workshop and the exhibition visit.

Fig. 3. Energy workshop

The following workshops are proposed:

Separation by Liquid-Liquid Extraction

Using colored powder samples, the students perform and observe the conversion of matter during a chemical separation cycle between two elements. These chemical operations, which are the basis for radioactive waste management, are presented to the students in a visually attractive manner.

Concepts explored: Mixing – Dissolution – Miscibility/Immiscibility – Extractant molecule – Separation by liquid-liquid extraction – Precipitation

Construction of Molecules

The students first build molecules from everyday life using molecular models, then create a computer model to view its microscopic structure. Games allow them to understand the concept of a chemical reaction.

Concepts explored: Atom – Molecule – Chemical bond

Structure of Matter

What are the building blocks of matter? The students manipulate scale models of atoms and simple molecules to create atomic structures. Games are proposed to give them a notion of scale of the different constituents of matter.

Concepts explored: Composition of matter – Atom – Molecule – Chemical bond

Demonstrating the Properties of Radioactivity

How can we perceive the invisible radiation surrounding us? In this workshop, students can identify the type of radioactivity in different natural samples and some objects from everyday life, and observe their interactions with different materials (a sheet of paper, aluminum foil, lead). Using the "Radon Kit" (educational material provided by Jeulin), the students determine the radioactivity of a natural sample and plot its distribution histogram. A dice game teaches them the random nature of radioactivity and allows them to discover the radioactive decay curve.

Concepts explored: Alpha/beta/gamma radiation – Matter – Radioactive decay law – Histogram

Energy

The workshop begins with questions and answers concerning renewable and nonrenewable energy sources. The students then assemble components and by so doing are able to identify the elements of an energy chain. They are then faced with the challenge of building a wind generator or a battery using fruit: an amusing opportunity to review the elementary notions of electricity covered in the classroom.

Concepts explored: Energy sources – Energy chain – Receiver converter – Work (mechanical and electrical) – Radiation

Glass like You Have Never Seen it Before

Glass: a solid or a liquid? The students become familiar with glass by comparing a crystalline rock (basalt) and its glassy equivalent (obsidian). They discover the difference between glass and crystalline solids by visual or microscopic observation and by touch. Simple experiments on the crystallization of sugar and vanillin lead them to ponder the conditions under which glass is formed.

Concepts explored: Crystalline state – Vitreous state – Ordered solid – Disordered solid – Crystallization

Glass is Forever

By measuring the time necessary to dissolve various powder samples, the children determine the dissolution rate of each one, and observe a few parameters that can cause the rate to vary. Older students measure the weight loss of a material during dissolution and then compute the maximum dissolution rate.

Concepts explored: Dissolution – Dissolution rate

Exposure: Multiple Discovery Zones

The general direction of the visit forms a loop, with a separate entrance and exit.

- The subject of waste in general (household, industrial and radioactive waste) is introduced in the vestibule.
- After crossing a footbridge, the visitor reaches a central space covering the issue of radioactive waste and its disposition, explaining the existing industrial solutions and the ongoing research in France and abroad. The “waste square” channels the visitor into specialized areas that can be discovered at leisure, in no predetermined order:
  - a knowledge bubble presenting natural and artificial radioactivity;
  - an arched pathway presenting the main sources of energy used to produce electricity, and describing the energy-related issues facing the planet;
  - a room explaining the origins of radioactive waste.
- On leaving the exhibition, visitors are invited to put what they have learned into perspective for a responsible approach to the issues by means of an interactive simulation.

Educational and Entertaining Exhibition Setting

As Visiatome will be seen by people of all backgrounds and with very different degrees of knowledge in this area, it has been designed with the aid of scenographers, teachers and researchers in the social sciences to appeal to several levels of comprehension.

The content of the exhibition was developed with the help of CEA researchers and with the assistance of the French national radioactive waste management agency (ANDRA), AREVA, EDF, the Radiological Protection and Nuclear Safety Institute (IRSN) and the National Center for Scientific Research (CNRS).

The scientific content of the exhibition was confirmed by a Scientific Advisory Board created in January 2004, presided by Michel Petit, a specialist in climate change and president of the French Meteorological

Society, and including eight experts: Pierre-René Bauquis (Associate professor at the IFP – Energy economist), Jean-Claude Artus (Head of the nuclear medicine department – Regional Cancer Center Val d'Aurelle – Montpellier), Bernard Delay (CNRS – Director of the Functional and Evolutionary Ecology Center), Pierre Bonnefond (Regional Higher Education Authority, Toulouse – Pedagogy and Adult Education Delegation), Uli Windisch (Sociologist, Professor at the University of Geneva), Saïda Engström (SKB, Sweden) and Yves Caristan (CEA, Director of Material Science Division). The Scientific Advisory Board supervises the quality of the teaching activities and the information proposed by Visiatome.

The exhibition is presented in a contemporary manner: transparent spaces, colorful, diversified and spectacular presentations. The scenographic experience is intended to immerse the public in an attractive and entertaining media environment appealing to all the senses: sound, vision, touch and play.

The achievements, technologies, research and issues in the area of nuclear energy and radioactive waste are clearly presented to stimulate a dialog with the visitors.

PUBLIC IMPACT: RESULTS AFTER ONE YEAR OF OPERATION

The purpose of this evaluation is to assess Visiatome visitor statistics for the first 8 months after it opened (April 10 to December 18, 2005), to analyze the visitors to date by categories and the statistical variations in the number of visitors at different periods of the year.

Since Visiatome opened on April 10, 2005, it has received 10 701 visitors, or an average of about 1340 visitors per month.

The visitors can be broken down into 4 categories:

- 4156 individual adults visitors (of which 901 opted for the visit in English),
- 1387 individual child visitors,
- 2103 schoolchildren in 78 groups,
- 2965 adults in 151 groups (including professional visits).

Table I shows the monthly variation of each category of visitors.

Table I. Monthly Variation of Visitors by Category

Visitors	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Individual adults (incl. English speakers)	744 (7)	383 (14)	239 (11)	495 (20)	603 (11)	350 (1)	1147 (7)	190 (2)	95 (17)
Individual children	298	55	25	220	229	38	464	45	13
Groups of schoolchildren	13	217	214	49	37	49	940	317	246
Groups of adults	203	402	498	105	294	603	359	351	171
Total	1258	1057	976	869	1163	1040	2910	903	525

Although it was open for only 21 days in April (April 10 to 30), Visiatome received 1258 visitors—including notably 1042 individuals. This result is easily attributable to the billboard campaign in the communities surrounding Marcoule (Bagnols-sur-Cèze, Avignon, Nîmes, Orange and Montélimar) together with five articles published in the regional daily newspapers.

The peak attendance was observed in October (2910 visitors) with Science Day and an open-house weekend for the families of site personnel to celebrate the fiftieth anniversary of Marcoule. Visiatome was open only 18 days in December (from the 1st to the 18th), hence the relatively limited number of visitors (525, including only 108 individuals).

Fig. 4 shows the average distribution by categories of visitors to Visiatome in 2005.

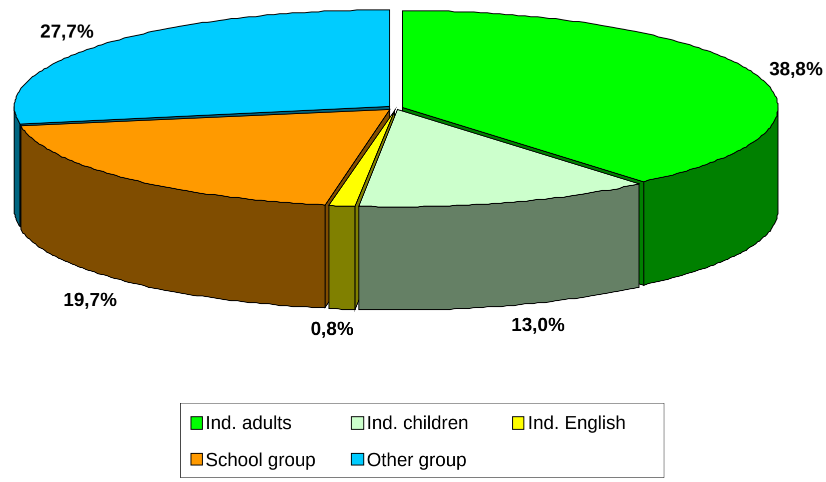

Fig. 4. Distribution of visitors by category from April 10 to December 18, 2005

Individuals accounted for more than 50% of the total number of visitors. The "language" tickets distributed at the entry to the exhibition[1] allow us to count the people who chose to visit the exhibits in English: they represented less than 1% of the total visitors and less than 2% of the individual visitors. These figures are not indicative of the number of foreign visitors, however, as many of them chose to listen to the French audio tracks.

Groups of adults accounted for more than 30% of the total number of visitors. Most of these were "professionals" who came specifically to see Visiatome alone or in combination with other facilities at Marcoule.

Schoolchildren represented more than 20% of the total number of visitors. This figure has continually risen since Visiatome was opened to the public. One of the prime objectives of Visiatome was to attract school-age children, who accounted for a few percent of visitors in April and nearly 50% in December.

VISITOR FEEDBACK

We collect visitors' remarks in two ways: through an evaluation questionnaire and in the visitor's book. Both are freely available to all visitors.

The visitor's book contains many congratulatory remarks by professionals, but also from the general public, as shown by a selection of excerpts:

- "Fascinating!"
- "An excellent introduction to sustainable development and energy-related problems in general."
- "Just one wish: to come back!"
- "Very interesting. I plan to come back with my classes."

[1] These tickets are used to select audio clips at specific exhibits in the selected language (currently only French and English are available).

- "Very fine exhibition, well presented, excellent reception!"
- "Superb, both for the esthetic and scientific content. A real pleasure, and a very friendly staff. Great!"
- "Excellent!" "Very interesting" "A fine exhibition".
- "Very pedagogical for children as well as for adults"
- "I learned a lot—we will come back with our friends."
- "Lots of information, real food for thought!"
- "A fine way to discover the nuclear arena that sheds light on certain issues. An enjoyable setting—It will be a pleasure for me to come again."
- "Absolutely remarkable. It will take several visits to see and understand everything."
- "A family visit that is worth pursuing. We now have a completely different perception of the atom and its potential. We will be back."
- "Bravo to the designers and organizers."
- "An original and entertaining presentation that keeps us always attentive."
- "The exhibition is very inspiring, we need something similar in the USA (ANS)"
- "Very impressive! May it lead to a collective awareness of the need to preserve our planet"
- "A good job for the communication! Everything begins at school: children are our future, they will know how to protect themselves and our planet."
- "Congratulations for this very educational and remarkably well documented presentation."
- "Very interesting, learnt a lot …"