IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Annual Report 2006

Annual Report 2006

Contents

Business report, financial facts & figures at the back of the report.

In terms of legislation, 2006 was a vintage year for the French nuclear industry, a year in which the IRSN provided good and loyal services to the national and international community

In the spring of 2006, Parliament passed two Acts that gave the French nuclear industry one of the world's most advanced legal frameworks, encompassing supervision of the sector's activities in terms of safety, radiological protection and security, the transparency of information in these fields and national governance of nuclear waste and recoverable nuclear material.

This new legislation has reinforced IRSN's position: with regard to France's new Nuclear Safety Authority (ASN), the Institute's role in independent technical support is reinforced as the law provides for a convention governing working relations between the two bodies. IRSN is also called upon to help improve transparency, by making more information accessible to the public, notably the safety and radiation protection advice given to the ASN, according to a jointly agreed process. IRSN will also take part in the development of initiatives by Local Information Commissions and Ancli, their national association, with which a framework agreement has been signed. IRSN will take part in the High Committee for Transparency.

Insofar as regards nuclear materials and waste management, the schedule laid down by the Act also confirms the importance of the Institute's research priorities in this area. The Institute's Scientific Board praised the quality of the scientific resources available to assess risks associated with geological repositories of high-level, long-lived radioactive waste. However, further research programs need to be conducted, within a limited timeframe, in order to develop the level of expertise required to issue high standard opinions within the set deadlines. These are in the process of being defined. Moreover, for the first time ever, ANDRA and IRSN have signed a framework cooperation agreement on organizing the scientific discussions required between the two bodies prior to the assessment process for future safety files that the agency will submit to the ASN.

In 2006, IRSN also signed the first contract of agreed objectives. This contract consolidates strategic directions for the coming years. It outlines the main scientific issues that need to be dealt with and sets out the milestones for the Institute's modernization process, started several years ago, the core objectives of which are scientific excellence and technical and economic efficiency.

Nonetheless, at the end of this very eventful year, IRSN's most important achievement has been to consistently provide the high-quality services expected of the Institute to all those that need them. And there are many organizations in need of support.

First of all, there are the safety authorities that receive record numbers of requests from operators and, more generally, there are the public authorities that are faced with society's increasing demand for safety. This generates more regulations, monitoring activities, more training in the management of possible major accidents, and more European and international cooperation. These authorities rely on IRSN to provide them with the technical support they need to carry out their missions effectively.

> “Success based on considerable research resources and expertise.”

Jacques REPUSSARD and Jean-François LACRONIQUE.

There are also the main players involved in nuclear industry transparency, i.e. the Local Information Commissions or Cli, and the Ancli, their national umbrella association, and, more generally, any stakeholders that require an expert opinion on certain files under debate or who simply require more detailed information. IRSN is developing its relations with these partners and continuing to develop its websites.

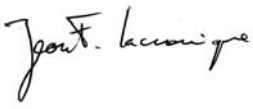
Finally, IRSN offers local authorities and large and small companies, regardless of whether they are nuclear operators or not, technical services that are compatible with the mission of technical support for public authorities. This usually involves regular services such as passive personnel dosimetry, environmental monitoring, third party appraisal of technological risks, training, certification of protective or monitoring equipment, and response to incidents of varying importance (problems involving radioactive sources, advice aimed at ensuring radiation protection, radiation assessment in the event of suspected external contamination or exposure to high levels of ionizing radiation).

Indeed, 2006 was marked by a series of operations to deal with radiation emergencies that threatened the lives of the personnel involved, following accidents in several countries (Belgium, Chile and Senegal), and for which the authorities or companies concerned requested the intervention of the IRSN. The results obtained were amazing and lives were saved. This demonstrated the tangible benefits of the years of research into radiopathology conducted by IRSN laboratories and funded by EDF, together with exemplary cooperation between specialists from IRSN and from the French Armed Forces medical services.

These success stories illustrate the extent to which it was justified to set up a single Institute that would bring together considerable research resources and the expertise of researchers and engineers specializing in defense processes and the most complex nuclear facilities, together with doctors and biologists specializing in life sciences, human sciences and ecosystems. Bringing together does not simply mean juxtaposing: at key moments – as we saw recently with the file on radiation therapy practices in Épinal – it is the multi-disciplinary nature, the responsiveness and adaptability, as well as the critical size of teams and the technical resources implemented that enable us to attain our objectives in record time.

This was also demonstrated by IRSN's analysis of the impact in France of the Chernobyl accident: after ten years of studies, the Institute's Scientific Board confirmed the scientific quality of the work conducted by the different teams and all the results were published on the occasion of the twentieth anniversary, thus putting an end to a long debate.

The 2006 results are very satisfactory, but it is possible, and necessary, to try to do even better in the future. The quality policy now implemented at all IRSN units is intricately related to such progress, seeking to measure it, identify the inevitable weak points and tackle them with determination. Moreover, in the summer of 2007, the ISO 9001 certification audit will assure us that this quality system really does comply with the canons of international good practices.



Jean-François LACRONIQUE,
Chairman of the Board
of Directors

Jacques REPUSSARD,
Director General

Interview with the Deputy Director General, in charge of defense-related missions

Michel BRIÈRE.

This year, for the first time, IRSN activities involving nuclear defense appraisals are not discussed in a separate chapter of the Annual Report, but are presented as an integral part of the major scientific and technical "challenges" which now structure the contract of agreed objectives drawn up between the Government and the IRSN.

Challenge 1: help ensure a high level of safety and radiation protection at existing nuclear facilities until the end of their service lives. To carry out its mission of assessing safety and radiation protection in the nuclear "defense" sector, the IRSN relies on all its basic scientific and technical knowledge, on experience acquired from assessing the civilian sector of the nuclear industry and on a sound understanding of defense-related facilities and activities. This justifies implementation of a suitable system to protect defense secrecy, where necessary.

In 2006, for example, at the request of the DSND authority, the Institute examined the nuclear safety aspects of:

- the design of the new, "Barracuda" nuclear attack submarine;
- the commissioning of new facilities in Valduc and Cadarache;
- the dismantling of the Pierrelatte and Marcoule plants.

This work also involved checking that the contingency plans for the Île Longue and Toulon naval bases are consistent.

Challenge 4: help prevent the proliferation of nuclear, biological and chemical weapons and control nuclear and radiological security in the face of terrorism. IRSN is conducting studies of a sensitive nature in this field to improve our understanding of the risks and ways of dealing with them. Its technical assessments serve as references in checking that current legislation is applied in the civilian nuclear industry.

Moreover, the Institute's skills in the entire field of safety, protection of sensitive material, facilities and transport operations, radiation protection for people and the environment and nuclear crisis management enable it to contribute to the development of policy on the prevention of risks related to malicious acts, both in France and internationally. Therefore, in 2006, the Institute continued its work on risk control related to radioactive sources and proposed new preventive measures to the authorities.

Challenge 5: develop IRSN's response and mobilization capabilities in view of the risk of a major radiation emergency. The Institute helps plan, organize and analyze national safety exercises aimed at checking and, if necessary, reinforcing the protection of nuclear facilities and transportation against malicious acts.

Indeed, all the Institute's capabilities contribute to the efficiency of its defense and security missions which are managed by its "Nuclear Defense Expertise Division".

Michel BRIÈRE,
Deputy Director General, in charge of IRSN defense-related missions

A brief description of IRSN

I SET UP

The IRSN was set up under Article 5 of French Act No. 2001-398 of May 9, 2001 and by implementing Order No. 2002-254 of February 22, 2002. This Order is currently undergoing revision following the adoption on June 13, 2006 of the Act on nuclear transparency and safety.

I STATUS

The IRSN is a public establishment of an industrial and commercial nature placed under the joint authority of the Ministries of the Environment and Sustainable Development, of Health, Industry, Research and Defense.

I DIRECTORS

Jean-François LACRONIQUE, Chairman of the Board of Directors
Jacques REPUSSARD, Director General
Michel BRIÈRE, Deputy Director General, in charge of IRSN defense-related missions
Philippe JAMET, Assistant General Director in charge of General Matters

I APPRAISALS AND RESEARCH

The IRSN is the expert in research and specialized assessments into nuclear and radiation risk serving public authorities.

I AREAS OF ACTIVITY

- environment and response;
- human radiation protection;
- prevention of major accidents;
- reactor safety;
- safety of plants, laboratories, transportation and waste;
- nuclear expert assessment relating to defense.

I FOUR LINES OF DEVELOPMENT

- re-engineering the research process;
- optimize technical support for public authorities;
- provide other socio-economic players with the information, appraisals, expertise, studies and training they require;
- be a driving force on the European and international scene.

I 2006 BUDGET

- revenue: €275.90 million;
- expenses: €270.75 million including €20.18 million in equipment investments.

I WORKFORCE

The IRSN employs around 1,700 people, including many specialists, engineers, researchers, physicians, agronomists, veterinary surgeons and technicians, skilled experts in nuclear safety and radiological protection and in the field of controlling sensitive nuclear materials.

I SITES

Clamart (Hauts-de-Seine), Head Office;
Agen (Lot-et-Garonne), Cadarache (Bouches-du-Rhône), Cherbourg-Octeville (Manche), Fontenay-aux-Roses (Hauts-de-Seine), La Seyne-sur-Mer (Var), Les Angles-Avignon (Vaucluse), Le Vésinet (Yvelines), Mahina (Tahiti), Orsay (Essonne), Pierrelatte (Drôme), Saclay (Essonne), Tournemire (Aveyron).

Missions

Order No. 2002-254 of February 22, 2002 relative to IRSN set out seven missions for the the Institute concerning radiological protection and nuclear safety. These are organized into three fields, as described below.

I RESEARCH AND PUBLIC SERVICE MISSIONS

Defining and implementing national and international research programs

IRSN defines and conducts research programs aimed at maintaining and developing the skills necessary for expert appraisals in its fields of activity. It either carries them out itself or entrusts them to other French or foreign research institutes. Some programs are carried out within a European or international framework.

Contribution to training in radiological protection

As an establishment carrying out research and expert assessments, IRSN has a duty to contribute to teaching in its field of expertise: nuclear safety and security and radiological protection. The radiological protection training courses it organizes are directed at professionals working in the health sector and people exposed to risk in their jobs.

Permanent monitoring in the field of radiological protection

IRSN carries out permanent monitoring in matters of radiological protection by assisting in monitoring environmental radiation, managing and processing dosimetric data on workers exposed to ionizing radiation and managing the inventory of ionizing radiation sources.

Contributing to public information and transparency

The IRSN informs the public of nuclear and radiation risks via publications, the Internet, a traveling exhibition jointly organized with France's Nuclear Safety Authority (ASN) and conferences, etc. With a view to ensuring transparency in the management of nuclear and radiation risks, the Institute continues working on initiatives with Local Information Commissions (CLI) aimed at making IRSN studies and expert assessments available and involving stakeholders in multi-disciplinary groups of experts working on the technical aspects of complex or controversial subjects.

I TECHNICAL SUPPORT AND ASSISTANCE FOR PUBLIC AUTHORITIES

Technical support with regard to nuclear and radiation risks

The IRSN provides technical support in the field of nuclear and radiation risks to the appropriate public authorities. Its scope covers civilian nuclear facilities, facilities classified as secret, the transportation of radioactive substances, the application of treaties on controlling nuclear and sensitive materials and the physical protection and safety of industrial and medical applications.

Operational support in the event of a crisis or radiation emergency

In the event of an incident or accident involving ionizing radiation sources, the IRSN suggests technical, public health and medical measures for public authorities aimed at protecting the population, workers and the environment and restoring safety at the facilities.

I CONTRACTUAL SERVICES OF EXPERT APPRAISAL, RESEARCH AND MEASUREMENT

Carrying out expert appraisals, research and studies for public or private organizations

IRSN carries out the services of appraisal, research and studies - analysis, measurement and dosing - under contract for French, European and international organizations in the public and private sectors. The Institute also provides third-party expert assessments of classified facilities for the protection of the environment outside the nuclear sector.

Activity 2006 Key figures

The Institute's activities

I RESEARCH AND PUBLIC SERVICE MISSIONS

48% of IRSN budget devoted to these activities

111 publications in scientific journals, with review committees

I TECHNICAL SUPPORT FOR PUBLIC AUTHORITIES

690 technical notices to the public authorities (excluding defense-related activities)

311 notices to the safety authorities for defense-related activities

I INTERNATIONAL ACTIVITIES

109 bilateral agreements with research and appraisal organizations

31 countries concerned by these agreements

79 international projects in progress

I HUMAN RESOURCES

1,681 people on permanent contracts on 31/12/2006, including 69 assigned to the ASN or other institutions

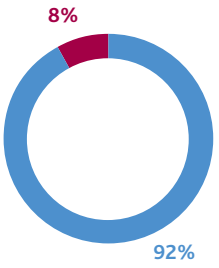
I IRSN'S INTELLECTUAL ASSETS

18 French patents in force (including one co-owned with the CEA)

10 patents in force abroad

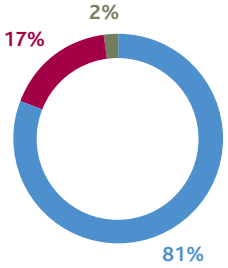
195 software applications and databases listed (24 of which are co-owned with the CEA and one of which is placed with the APP [a software protection agency] and co-owned with VUEZ, Slovakia)

The budget and its breakdown



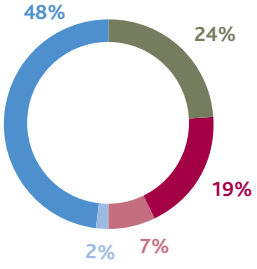
Operation/Investment expenditure

- Operation
- Investment



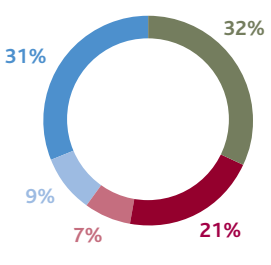
Financing resources

- LOLF 189 program subsidy
- Other French resources
- Foreign resources



French resources

- Public
- EDF, research and development
- Areva
- CEA
- Others



Foreign resources

- CCE
- Riskaudit
- GRS
- Epri
- Others

Key events

January

6
Research carried out by IRSN for the treatment of radiation burns enabled a transplant of mesenchymatous stem cells to be carried out on a seriously irradiated Chilean worker at the Percy Hospital.

12 and 13
The French Ministry of Education and the IRSN jointly organized a conference entitled "Radioactivity and risks: health and environmental aspects and waste management". It brought together more than 150 teachers and local school inspectors.

30
The full version of the Institute's technical notice relative to long-term disposal of radioactive waste was displayed available on the Net.
It concludes that disposal in the clay layer studied via the underground laboratory in Bure (Meuse) appears to be technically feasible.

February

14
The IRSN at Fontenay-aux-Roses received a visit from Mrs. Nelly OLIN, French Minister for the Environment and Sustainable Development.

March

14
The "Van der Schueren" award was presented to the Department of Radiotherapy at the Gustave-Roussy Institute and the joint IGR-IRSN research unit. This award honors the work carried out over the last few years on improving cancer radiotherapy, together with joint research by both Institutes into the prevention and treatment of secondary pathologies that may affect healthy tissue present in the exposure field.

27
IRSN's Scientific Board confirmed the validity of methods implemented by the IRSN to estimate atmospheric fallout in France from the Chernobyl accident.

29 and 30
IRSN and the Ancli organized a seminar concerning "international feedback on participative governance for nuclear waste management" and the first meeting of the working group on "making IRSN expert appraisals available to the public".

April

5
IRSN helped diagnose and develop a therapeutic strategy to treat a Belgian technician who was the victim of an accident involving whole body irradiation.

18
The InVS and IRSN jointly published a report entitled "Medical Exposure of the French population to ionizing radiation". It assesses the situation with a view to implementing a system that permanently provides information on the medical exposure of patients to ionizing radiation.

26
IRSN's experimental station at Tournemire (Aveyron) was visited by Mrs Marie-Claude DUPUIS, the Director General of Andra and Mr. Georges LABROYE, the Director General of INERIS. This station is one of the four European sites where it is possible to study the behavior of clay rock with a view to a possible nuclear waste repository.

26
Posting on the Net of the file entitled "Chernobyl: the basic facts" 20 years after the accident. For the first time, the IRSN published and commented on the maps produced by the SCPRI in 1986.

27 and 28
IRSN and CEA jointly organized, a seminar on the PHEBUS reactor and future experiments on severe accidents, supported by the Petton Energy Institute (Netherlands).

May

29
IRSN, GRS (Germany) and AVN (Belgium) signed a protocol to create EUROSAFE, the European network of Technical Safety Organizations (TSO). This network aims to share knowledge and skills related to nuclear safety assessment, to promote the pooling of technical practices in safety and radiation protection and to encourage the development of research projects at European level.

June

8
Emmanuel Sartorius, a senior defense representative from the Ministry for Industry visited IRSN. This visit concerned the Institute's role in monitoring nuclear safety measures and implementation in France of the international convention for a ban on chemical weapons.

12
Presentation of the first IRSN Scientific and Technical Report, which is divided into five theme-based chapters containing the results of programs that reached a key stage in 2005.

21
IRSN received a visit from Peter B. LYONS, the Commissioner of the US Nuclear Regulatory Commission (NRC).

Radioecology conference in Cadarache.

Signing the contract of objectives.

Visit from Nelly OLIN.

July

23
IRSN at Cadarache (Bouches-du-Rhône) organized a radioecology conference to take stock of radioactivity in environments close to EDF sites. EDF's future radioecology requirements were also noted during the conference.

5
Signature of first contract of agreed objectives between the Government and IRSN was signed, for the period 2006-2009. This contract defines the overall strategic approach adopted to enable the Institute to fulfill its missions and describes its main scientific and technical objectives.

5
IRSN agreed on a gradual increase in annual production capacity (from 145 to 195 metric tons of heavy metal) at the MOX fuel manufacturing plant (MELOX). However, the operator should pursue its efforts to reduce the doses received by personnel.

August

31
IRSN provided assistance and mobilized its experts to determine exposure levels and treat victims of a gammagraphy accident in Senegal.

September

18
A cooperation agreement between the IRSN and INERIS was signed for emergency situations.

from 25 to 27
Thesis Open Days, organized in La Colle-sur-Loup (Alpes-Maritimes), at which the 61 IRSN doctorands presented the progress of their works to the 150 participants

October

from 2 to 5
6th international congress on internal dosimetry, jointly organized by IRSN and the Radiation Protection Division of the British Health Protection Agency (HPA).

4
IRSN and the German Karlsruhe research center (FzK), signed an agreement on the acquisition of severe accident simulation software suitable for experimental reactors and future 4th generation reactors.

10
A meeting to launch the European FUTURAE project took place in Le Vésinet (Yvelines), as part of Euratom FP6. This project, managed by IRSN, aims to study the feasibility of implementing a radioecology network of excellence that would maintain and improve skills.

11
IRSN organized a public conference to present the results of its mapping work on fallout from the Chernobyl accident in France.

12
Mr. Xavier BERTRAND, Minister of Health and Solidarity, asked IRSN to contribute its radiopathology know-how for victims of the radiotherapy accident that occurred at the Jean Monnet Hospital in Épinal (Vosges). The Institute sent a team of radiopathology experts there to assess the medical treatment required by each victim and help improve the care given.

13
The IRSN analyzed the anomaly that affected the safety injection system of Reactor 3 at the Gravelines plant during an operating cycle. This anomaly, discovered in March 2006 when the reactor was shutdown, did not have any real impact on reactor operations, but the IRSN showed that the possible consequences could have been serious.

November

9
Radioactive waste: IRSN's Scientific Board gave its opinion on the Institute's expert appraisal capabilities.

13 and 14
The 8th EUROSAFE FORUM was organized in France (Paris) on the theme "Managing Radioactive Waste: nuclear safety and society's expectations".

24
Together with senior defense officials, IRSN took part in the 14th meeting of the European Nuclear Security Regulators Association (ENSRA), which was held in Paris and chaired by France. To date, 10 European countries belong to ENSRA.

December

4 and 5
Visit to Cadarache (Bouches-du-Rhône) by Mr. Brian W. SHERON, the Director of the Office of Nuclear Regulatory Research at the NRC (United States), who came to discuss research into the behavior of fuel, fires, severe accidents and 4th generation reactors.

18 and 19
Riskaudit, a branch of IRSN and GRS, passed the first intermediate audit successfully, one year after receiving ISO 9001 certification (version 2000).

Organization Chart
(December 2006)

BOARD OF DIRECTORS

Jean-François LACRONIQUE,
Chairman

FUNCTIONAL DEPARTMENTS

Department for Strategy, Development and External Relations

Michel BOUVET, Director
Jean-Bernard CHÉRIÉ,
Deputy Director, in charge of external relations
Yves SOUCHET,
Deputy Director, in charge of programs

- research programs;
- expert appraisal programs;
- opening up to society;
- international relations;
- secretariat for standing groups.

Department for Scientific and Technical Assessment and Quality

Joseph LEWI, Director

- teaching and training in radiation protection, nuclear safety and security;
- assessment and scientific activities;;
- quality management;
- hygiene, safety and environmental protection;
- scientific and technical knowledge engineering;
- scientific information resources.

General Secretariat

Jean-Baptiste PINTON, General Secretary

- financial matters;
- human resources;
- commercial relations and legal support;
- managing real estate holdings and corporate services;
- information systems administration.

Communications Department

Marie-Pierre BIGOT, Director

- in-house communications;
- information and relations with the media;
- programs and relations with the public.

Jean-Claude DALE,
Accountant

SENIOR MANAGEMENT

Jacques REPUSSARD,
Director General

Michel BRIÈRE,
Deputy Director General, in charge of IRSN's defense-related missions

Philippe JAMET,
Assistant Director General in charge of General Matters

OPERATIONAL DEPARTMENTS

Department for Nuclear Defense Expertise

Jérôme JOLY, Director

- international safeguards and CWC implementation;
- technical support for public authorities and studies;
- defense safety assessment;
- nuclear facility security.

Department for Human Radiation Protection

Patrick GOURMELON, Director

- radiation protection studies and expertise;
- radiobiology and epidemiology;
- external dosimetry;
- internal dosimetry.

Department for Environment and Response

Didier CHAMPION, Director

- study of radionuclide transfers into ecosystems;
- study and monitoring of radioactivity in the environment;
- analysis of risks related to the geosphere;
- sample processing and metrology for the environment;
- radiation protection response and support;
- emergency situations and crisis organization.

Department for Reactor Safety

Martial JOREL, Director

- pressurized water reactors;
- gas-cooled, fast neutron and experimental reactors;
- equipment and structures;
- systems and risks;
- thermohydraulics, cores and monitoring of facilities;
- severe accidents and radiation consequences;
- human factors.

Department for the Prevention of Major Accidents

Michel SCHWARZ, Director

- studies and experimental research on accidents;
- experimental instrumentation and engineering;
- fuel studies and modeling in accidents;
- fire, corium and confinement studies and modeling.

Department for the Safety of Plants, Laboratories, Transportation and Waste

Thierry CHARLES, Director

- fuel cycle transportation and facilities;
- laboratories, irradiators, accelerators and decommissioned reactors;
- radioactive waste;
- industrial, fire and containment risks;
- criticality;
- air dispersion of pollutants.

The Board of Directors

MISSIONS

In accordance with Article 10 of the Order of February 22, 2002, the Board deals with IRSN business through its proceedings. More specifically, it discusses the general conditions governing the organization and running of the establishment, the Institute's programs and the annual report. In terms of finance, it approves the budget, decisions involving changes, year-end financial statements and income appropriation.

IRSN's Board of Directors is made up of 24 members:

- 10 State representatives;
- 6 distinguished and qualified persons, also appointed by order and chosen for their skills in the Institute's areas of activity, including a Member of Parliament or a Senator from the Parliamentary Office for the evaluation of scientific and technological options;
- 8 elected IRSN staff representatives.

The term of office for members of the Board of Directors is five years which can be renewed once for the six distinguished, qualified persons.

The Board of Directors meets at least four times a year.

Six new directors were appointed in 2006.

MEMBERS (DECEMBER 2006)

State representatives

Patrick AUDEBERT, Head of the Major Risks Office, in the Directorate of Civil Defense and Security, representing the Minister in charge of Civil Security

Jocelyne BOUDOT, Assistant Director for the Management of Environmental Risk, representing the Health and Social Affairs Minister

Jean-Denis COMBREXELLE, Director of Labor Relations, representing the Minister for Employment

Frédéric EYRIES, Inspector General for Armaments, representing the Defense Minister

Dominique GOUTTE, Director of the Energy, Transportation, Environment and Natural Resources Division, representing the Research Minister

André-Claude LACOSTE, Director General of Nuclear Safety and Radiation Protection (until he is appointed President of the Nuclear Safety Authority)

Marcel JURIEN de la GRAVIÈRE, in charge of nuclear safety and radiation protection for activities and installations related to defense

Édouard de PIREY, Ingénieur des Mines, representing the Budget Minister

Guillaume SAINTENY, Director of Economic Studies and Environmental Assessment, representing the Environment and Sustainable Development Minister

Cyrille VINCENT, Branch manager of the nuclear industry, General Directorate for Energy and Raw Materials, representing the Industry Minister

Qualified personalities

Jean-François LACRONIQUE, Professor of Medicine, nominated by the Health Minister, Charmain of the Board of Directors

Claude BIRRAUX, Vice-President of the Parliamentary Office for the evaluation of scientific and technological options

Jean-Marc CAVEDON, Director of the Division for Research into Nuclear Energy and Safety at the Paul Scherrer Institute in Switzerland, nominated by the Minister for Research

Georges LABROYE, Director General of the Institute of Industrial Environments and Hazards, nominated by the Environment and Sustainable Development Minister

Maurice LAURENT, former French National Assembly Head of Department, nominated by the Industry Minister

Jean RANNOU, Air Force General, nominated by the Defense Minister

Employee Directors

Mireille ARNAUD, Hervé BOLL, Betty CATANIA, Jean-Marc DORMANT, Thierry FLEURY, Dominique MARTINEAU, Xavier MOYA, François ROLLINGER

Key figures present by right

Laurent MICHEL, Director of Pollution and Risk Prevention and Government Commissioner

Daniel RACINET, State Controller

Jacques REPUSSARD, Director General

Michel BRIÈRE, Deputy Director General, in charge of IRSN missions related to defense

Jean-Claude DALE, Accountant

Philippe BOURACHOT, Works Committee Secretary

The Steering Committee for the Nuclear Defense Expertise Division

I MISSIONS

The Steering Committee for the Nuclear Defense Expertise Division (DEND) at IRSN examines this Division's program of activities before it is submitted to the Institute's Board of Directors. It is consulted when the Board of Directors is called upon to make decisions specifically concerning the organization or running of this Division and it provides guidance on these activities to the Board of Directors.
This committee is made up of 10 members .

I MEMBERS (NOVEMBER 2006)

Chairman: Emmanuel SARTORIUS, Senior Defense representative at the Ministry for Economy, Finance and Industry

Marcel JURIEN de la GRAVIÈRE, in charge of nuclear safety and radiation protection for activities and facilities related to defense

Rear-Admiral Bernard MERVEILLEUX du VIGNAUX, Nuclear Weapons Inspector

Brigadier-General Paul FOUILLAND, representing the Joint Chief of Staff

Engineer General, Frédéric EYRIES, representing the DGA, the French defense procurement agency

Captain (N) Philippe COINDREAU, representing the administrative Secretary General of the Defense Ministry

Édouard de PIREY, representing the Budget Director

Hugues de LONGEVIALLE, representing the Director of Strategic Affairs, Security and Disarmament at the Ministry of Foreign Affairs

Serge POULARD, qualified person

Jean-Baptiste FLEUTOT, qualified person

The Scientific Board

RESPONSIBILITIES

IRSN has a Scientific Board whose responsibilities are defined in the Order dated February 22, 2002 setting up the Institute. The Board advises on IRSN programs, assesses results and can make recommendations on future activities. Its advice and recommendations are submitted to the Board of Directors and the Institute's supervisory Ministries. It issues an opinion on the Institute's Annual Report and can be consulted by the Chairman of the Board or by supervisory Ministers on any subject relating to its areas of expertise. Its advice may be sought on any issue or operation undertaken by IRSN.

In 2006, the Scientific Board held two plenary meetings (in May and November). At the same time as these meetings, some members of the Scientific Board visited the Tournemire experimental station (Aveyron), set up to study underground radioactive waste repositories, together with the facilities for environmental monitoring and radiation testing at the Le Vésinet site (Yvelines).

The Scientific Board carried out two specific assessments in 2006:

- the first assessment, dedicated to IRSN's work into reconstructing fallout in France from the Chernobyl accident, resulted in setting up a commission partly made up of experts who are not members of the Scientific Board. The Scientific Board took this commission's assessment into account and issued its opinion on March 27, 2006;
- the second assessment involved the Institute's studies and research into deep disposal of radioactive waste; the Scientific Board issued its opinion on November 9, 2006.

The two opinions issued by the Scientific Board and related assessment reports are available on IRSN's scientific website:
www.irsn.org/net-science

The Scientific Board is made up of 12 members chosen in light of their scientific and technical skills and appointed for five years by a joint order from the supervisory Ministers. It should be noted that four members were replaced in the first quarter of 2007 (Order of June 8, 2004 amended by Order of April 25, 2007).

MEMBERS (APRIL 2007)

Chairman: Michel QUINTARD, Director of Research at the Toulouse Institute of Fluid Mechanics, nominated by the Research Minister

Bernard SEVESTRE, Engineer General for Armaments, Deputy Director at the CEA, nominated by the Defense Minister

Pierre LAROCHE, Chief Medical Officer of the French armed forces, Head of the Medical Division of the Armed Forces' Radiation Protection Department, nominated by the Defense Minister

Ethel-Esther MOUSTACCHI, Scientific Director for the Atomic Energy High Commissioner, nominated by the Environment and Sustainable Development Minister

Victor TESCHENDORFF, Head of Department at Gesellschaft für Anlagen und Reaktorsicherheit (GRS, Germany), nominated by the Environment and Sustainable Development Minister

André AURENGO, Professor of Medicine and Head of Department at the Pitié-Salpêtrière Hospital, nominated by the Health Minister

The qualified person nominated *by the Environment and Sustainable Development Minister will be appointed shortly.*

George YADIGAROGLU, Professor of Nuclear Engineering at the Swiss Federal Institute of Technology, nominated by the Industry Minister

André PINEAU, Professor at the Paris Ecole des Mines, nominated by the Industry Minister

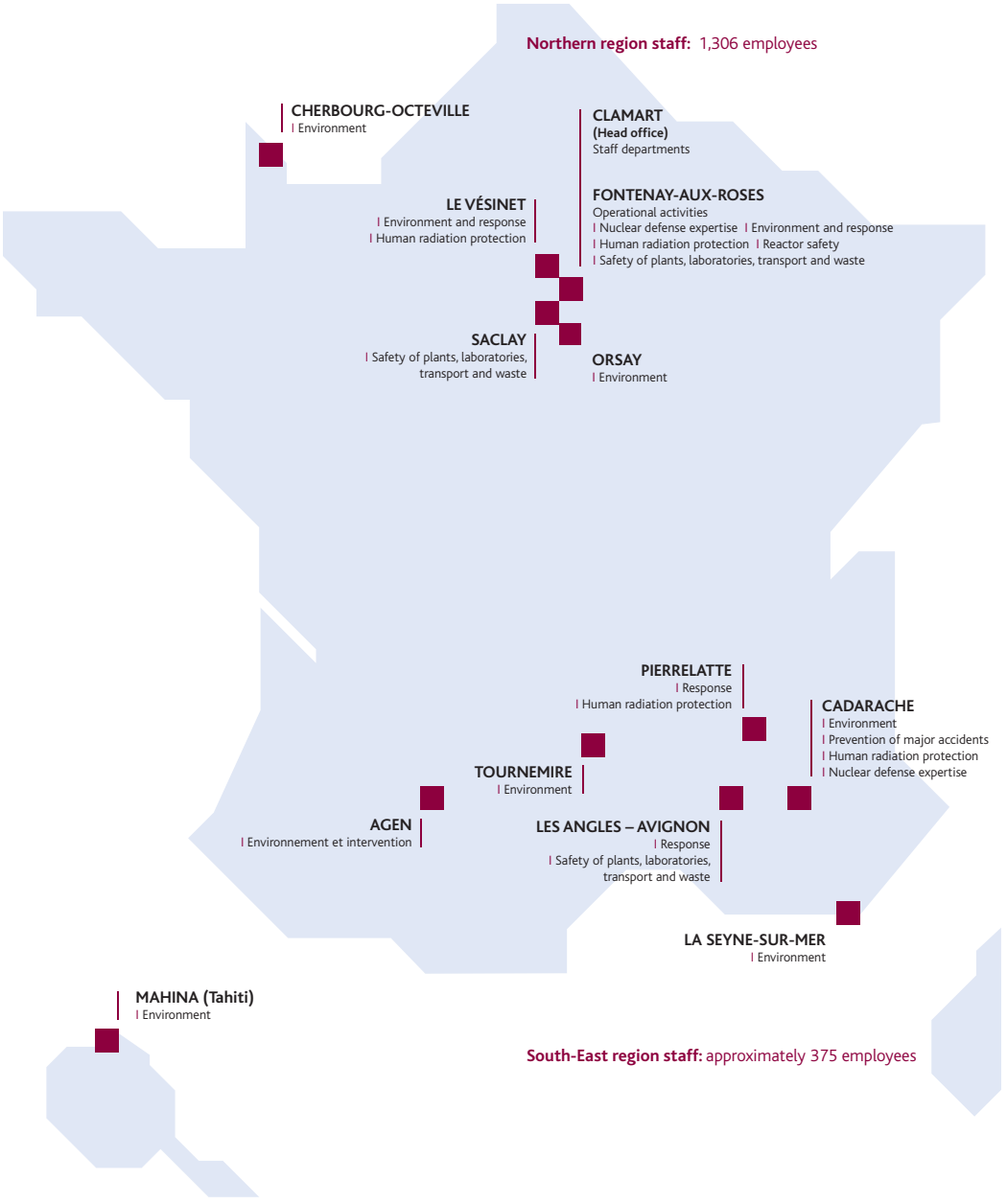
Philippe LECONTE, Physicist, former Director of the CEA's radioactive waste management research program, nominated by the Research Minister

Jean-Claude ANDRÉ, Director of Research at the French National Research and Safety Institute (INRS) for the prevention of work-related injuries and illnesses, nominated by the Employment Minister

Pierre CATILINA, Doctor specialized in occupational pathologies and member of the occupational illnesses commission, nominated by the Employment Minister

Dietrich AVERBECK, in charge of radiation protection at the Curie Institute research centre (CNRS), nominated by the Health Minister

Sites
(December 2006)



■ **Details of all IRSN sites can be found** on the flap at the back of the report.

IRSN in 2006 : report and outlook

"Contributing to nuclear plant safety also means working to ensure safety for people and property. This is a strong commitment that requires teamwork wherein research, expertise and a wide range of disciplines meet."

Patricia DUPUY – Engineer, Systems and Risk Protection Assessment Department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The strategic approach for implementing IRSN missions

The year 2006 saw the adoption of three major Acts that will have a significant impact on IRSN's activities.

■ The Act on transparency and nuclear security (June 13, 2006) sets out the principles for nuclear safety in the broadest sense of the term. It provides a legal framework for inspecting civilian nuclear facilities and sets up a Nuclear Safety Authority (ASN) as an independent administrative body. Consistent with existing practice, the Act states that this new authority will be based on the scientific expertise of the IRSN, with which it will have an agreement. Finally, it lays down the rights and obligations regarding access to information and sets up a High Commission on transparency.

■ The Program Act on nuclear waste (June 28, 2006) sets out the schedule for major projects involving back-end fuel cycle management and defines the methods to be implemented to manage reusable nuclear waste and materials. IRSN will have to conduct its research and appraisal actions within this context and, with this in mind, is developing research partnerships in France and Europe and, in conjunction with Andra, is drawing up a scientific cooperation agreement aimed at regulating information exchanges and, if necessary, the involvement of both organizations in joint research programs, in particular at the Bures laboratory site (Meuse).

■ Finally, the Program Act on research (April 18, 2006) creates new instruments for directing public research in France, such as the National Agency for Research (ANR) and the Institute of Higher Studies in Science and Technology, with which IRSN works closely.

In this changing context, the users of IRSN services have almost fully expressed their satisfaction with the quality of the response to their needs. Considerable effort has been devoted to mastering all performance and support processes, and this should continue with ISO 9000 certification in 2007. In the wake of signing the four-year contract of agreed objectives in the summer of 2006, IRSN still needs to perfect how it manages its medium- and long-term development, in a particularly complex institutional, scientific and economic environment.
The contract of agreed objectives defines four lines of strategy for IRSN's development, namely research, technical support missions for the public authorities, the policy of opening up to society and international action.

A medium and long-term plan (MLTP), dealing with the 2007-2015 period, which started in the autumn of 2006, will be added to the contract of agreed objectives following approval by the Board of Directors.

Implementation of this strategic tool will enable progress in two key areas:

- management of the Institute's activities in the form of projects, which, together with stricter analytical accounting, will provide a clearer picture of the objectives targeted and their corresponding deliverables, the resources devoted to the various missions and the results achieved in view of the resources effectively used;

- the definition of specific multi-year strategies for each of the seventeen topics defined to implement the seven scientific and technical challenges mentioned in the contract of objectives. In terms of resources, this will mean providing a vision of the future use of IRSN's subsidy under the LOLF (Budget Act) 189 program, which deals with "research in the field of risk and pollution", and which accounts for the majority of the Institute's financial resources. This program comes under the responsibility of the Ministry for Ecology and Sustainable Development (MEDD).

For several years, the Institute has seen this subsidy simply carried over in current euros. Over the years, this has insidiously but significantly curtailed its capacity for action. However, as part of the process set out for the contract of objectives, in-depth dialogue between IRSN, its supervising authorities and the main beneficiaries of its expertise and research, should clarify the public financing requirements, in particular as regards large-scale experimental resources (research reactors for example).
The MLTP will also define lines of strategy for developing the IRSN's own resources.

Furthermore, the emphasis currently placed on the need for greater transparency in the area of nuclear safety has led IRSN to speed up changes in practices:

- regarding communications tools, and not forgetting the scientific publications mentioned in another chapter, IRSN has continued to develop its websites, which are now a major operational tool for making information available. These sites are visited by well over a million visitors a year. At the beginning of 2006, the Institute launched a monthly newsletter sent to MPs, ministries, supervisory authorities and major partners. Reception has been very positive and *La Lettre de l'IRSN* is now an integral part of IRSN communications;
- discussions have been set up with the ASN in view of defining the procedure for publishing the official notices submitted to the Safety Authority on the Internet in the future. This will develop gradually and an initial positive trial was conducted at the start of 2006, with the publication on its website of the full version of the Institute's notice on the Andra report regarding the feasibility of a geological HLLL waste repository at the Bures site.

www.irsn.org

more information

A new DSDRE at IRSN

The Department of Strategy, Development and External Relations (DSDRE) was reorganized in March 2006. Why was this necessary?

IRSN was officially set up by the Order of February 22, 2002 and its organization was established in the course of the following year. The duties of a Strategy Department in the early days of any new organization are not necessarily the same after it has been in existence for several years. For example, the State/IRSN contract of objectives has now been signed for four years and the work that led up to this contract has demonstrated the advantages of project-based management of IRSN activities.

The notion of strategic programs has therefore changed.

How is the new organization structured?

The contract of agreed objectives is based on four lines of strategy (research, expert appraisal, opening up to society and international relations) and the DSDRE has taken account of this division in its organization.
It is now structured into four divisions, corresponding respectively to each of these four lines of development:

- research programs;
- expert appraisal programs;
- opening up to society;
- international relations.

What is the role of the DSDRE?

Acting mainly on behalf of the Director General, the DSDRE leads and coordinates actions, enabling the Institute in the short, medium and long-term to:

- conduct its missions under the best possible conditions in light of available or planned resources and the expectations of all concerned;
- consolidate its position with regard to the scope of its activity as an independent reference institution in drawing up and communicating notices and recognized by society as credible given its specialised scientific, technical and operational know-how.

Michel Bouvet,
Director of the Department of strategy, development and external relations

1

Research at the service of appraisals

The research programs conducted by IRSN should enable it to develop the skills required for its expert appraisals and to prepare the groundwork for future improvements in assessing the risks related to nuclear activities.

MANAGING MULTI-YEAR PROGRAMS

2006 saw the launch of eight-year plans for the Institute's research work and the organization of this work in the form of projects based on the subjects identified (radiation protection of workers, fuel, etc.). This way of working is designed to enable IRSN to present its research objectives more clearly and improve control (lead times, costs, etc.) of the programs it conducts or finances.

in the words of

Michel BAUDRY,
Head of the Research Program Division

"Research activity at IRSN meets the Institute's need to have access to its own skilled personnel, knowledge base and tools required for expert appraisals. It must also provide answers to the questions asked by public authorities and society on issues related to the environment, the impact of radiation on the population or nuclear safety in the broadest sense. In order to be relevant and "prepared in advance", it must anticipate these questions and keep abreast of new developments. In particular, it must take account of changes planned in industrial tools. IRSN's choices regarding research plans are limited both by the cost of the resources to be implemented and by the duration of the programs undertaken.

It is for these reasons that the Institute operates a policy of partnerships, with research bodies, industry, and usually within the framework of international programs (FP and OECD, etc.)."

15%
of research programs are jointly funded by external revenue *(14% in 2005)*

TAILORING RESEARCH TOOLS

In order to successfully conduct research work, the Institute funds or possesses equipment that it renews or maintains in order to remain pertinent and competitive on the national or international scientific scene. The cost of some of this equipment, qualified as "heavy-duty", and the time required to conduct the associated programs have led IRSN to analyze the need for research making use of such equipment and how it is funded (programs using such tools currently involve numerous partners, are international in scope and last several years).

In 2006, this analysis continued actively, focusing, in particular, on:

- the work of the international group in charge of leading the CEA and IRSN study on the possible future uses of the PHEBUS reactor; two meetings discussed a possible line of research in the fields of serious accidents and loss of primary coolant;
- the review drawn up by the Institute, in conjunction with the CEA and EDF, on research into serious reactor accidents, conducted in France and abroad to identify future perspectives in this field. This report, available on the Internet, shows that significant doubt remains concerning certain phenomena. This includes the erosion kinetics of containment enclosure foundations in the event of a melted core melting through the vessel or the behavior of iodine in the primary circuit and in the containment enclosure. Additional research will be conducted in this area in coming years (OECD-MCCI project, IRSN-SOURCE TERM project, etc.).

www.irsn.org

Furthermore, the renovation of facilities and preparation of the equipment needed for the international CABRI-CIP program continued. Nevertheless, the discovery of unforeseen technical constraints led the CEA, operator of the CABRI reactor, to propose a more extensive

Future uses of the PHEBUS reactor are currently being studied.

renovation plan to IRSN, which funds the facility. To ensure that the deadlines of this program are met, the CEA has also significantly increased the funds allocated to the project. Cost control will remain a priority for the Institute in 2007.

DEVELOPING PARTNERSHIPS

Developing national or international partnerships is also one of the Institute's priorities since this enables IRSN to share the costs of research, promote its areas of expertise and provides a guarantee of the relevance of some of its programs.

Industrial partnerships

Two of the IRSN's principal cooperation agreements with its major French partners in terms of R&D were renewed in 2006: the first with the CEA and EDF (for five years) and the second with Areva NC (for three years). These agreements contribute a significant proportion of the Institute's external R&D resources.

Institutional partnerships

IRSN has many partnerships with French research institutes (CNRS, universities, Inserm, etc.). Most of these are based on official cooperation agreements. In 2006, some were renewed and others were created: renewal of the agreement between IRSN and INERIS, signing of agreements with the École Normale Supérieure in Cachan, the Central Laboratory for Civil Engineering, the CNRS and the University of Provence, etc.

In 2006, the Institute was also considerably involved in the "risk management and territorial vulnerability" competitiveness cluster. Four of these projects in the area of the environment have received certification from this cluster (PRIME, PRISME, MULTISTRESS and EXTREMA). The CLARA II project, coordinated by the École des Mines in Alès and in which the Institute is involved, has also been certified.

www.net-science.irsn.org

International partnerships

Following the SARNET network of excellence and the Alpha-Risk project, the European Commission appointed IRSN to coordinate the FUTURAE project (feasibility study regarding implementation of a European network of excellence in radioecology). Also in 2006, a large number of foreign partners joined IRSN's PRISME program on confined and ventilated fires, under the aegis of the OECD.

in the words of

Jacqueline LECOURTIER,
Director of the National Agency for Research

"The Pact for Research, drawn up in 2005, must meet various challenges.
The aim is to provide a strategic medium- and long-term vision of research activity in France, to clarify its organization, to give it greater flexibility and reactivity and to endow it with harmonized evaluation criteria. It was in this context that the ANR was set up to support research relating to priority issues, such as energy or information and communication science and technology.
The ANR must also contribute to helping new research concepts to emerge and encourage partnerships between research and industry. Within this new system, an applied research body such as IRSN plays a crucial role. Because it is already involved in partnerships with industry and public research, and because it wants to open up to different issues which also concern us: safety, protecting the environment, etc.
It can also make a useful contribution to the project committees and strategic analysis groups that we are currently forming."

2

Technical support: continuing contractual relations

IRSN's missions include providing technical support to the public authorities and public service projects are one of the lines of development written into the 2006-2009 Government-IRSN contract of agreed objectives. The Institute is adapting its resources and the way it is organized to satisfy the demand for technical support. However, increasing demand for hi-tech skills will require changes in the future.

INSTITUTIONAL PARTNERS

Technical support activities represent about half the subsidy granted by the Government to the Institute. It is mainly the IRSN's institutional partners that benefit:

- nuclear safety and security authorities (ASN, DSND, HFD of the Ministry of Finance);
- ministerial departments (DPPR, DGT, DGS, DDSC);
- health and safety institutes and agencies (InVS, INRS, Afssa, Afsset, Afssaps, etc.).

FORMAL RELATIONS

In application of the Order setting up the Institute, projects undertaken in implementation of the mission to provide technical support to the public authorities are subject to formal multi-year agreements with the various partners and divided into annual technical protocols.

In 2006, this policy was pursued with a view to defining the scope of these support actions and allocating the related annual resources. It was also a year in which links were established between the Institute and health and safety agencies, such as Afssa and Afsset. These links should lead to agreements being signed in 2007.

In this regard, IRSN presented the actions conducted as part of the Cancer Plan, defined by the DGS and that of the National Environmental Health Plan (PNSE) coordinated by the Afsset.

FIELDS OF ACTION IN 2006

- **Nuclear facilities**

In the field of nuclear safety and radiological protection, such protocols were signed to define the priorities of appraisal studies for 2006, particularly relative to support for the ASN. Priorities included nuclear power plant ageing, dismantling civilian nuclear facilities, radioactive waste management and examining safety files for the future EPR reactor.

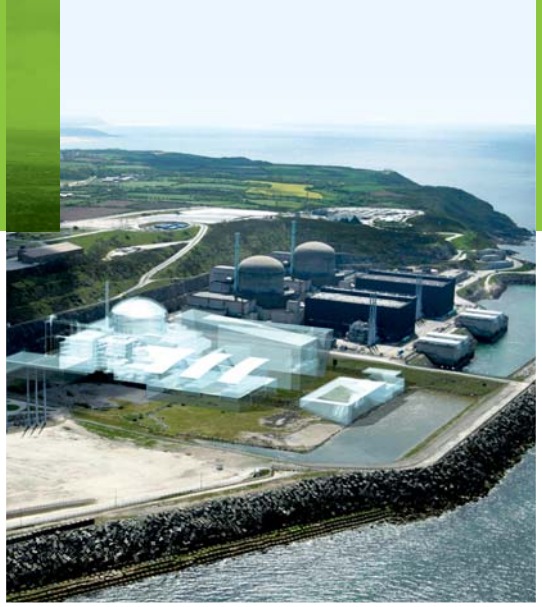
These actions for the ASN accounted for the majority of IRSN resources, particularly human resources, devoted to providing technical support to the public authorities.

in the words of

Sylvie SUPERVIL,
Head of the Appraisal Programs Division

"In order to formalize relations, many of which have existed for several years, IRSN has, since its foundation, drawn up and signed framework agreements with institutional partners to which it provides technical support. The aim of these agreements is to identify the issues and the nature of the work to be carried out. They enable the priorities to be fixed and the resources allocated to this work to be distributed.

Technical support work for the public authorities and public service missions represent almost 50% of the State subsidy paid to the Institute. In order to ensure the availibilty of the knowledge and resources required to perform quality appraisals, the Institute relies on its research and anticipates future expertise needs, for example for future facilities (4th generation reactors) or ageing and decommissioning of existing facilities."



IRSN provides support for the work of a public debate commission on the EPR reactor.

Workers

As part of its radiation protection mission, the Institute continued to implement the information system for monitoring professional exposure to ionizing radiation (SISERI). IRSN's involvement in changes to the legislation, and in providing technical recommendations for the approval of monitoring organizations, contributed to State missions for the General-Directorate of Labor (DGT).
Finally, as part of their public service mission, through scientific cooperation on the assessment and management of risks in the workplace, the Institute and the INRS pooled their technical and scientific tools and conducted knowledge transfers, in particular regarding metrology of fine particles and epidemiology.

www.irsn.org

Information systems for better individual protection.

The population

The Institute was entrusted with providing support to the InVS in assessing exposure and risks associated with the use of ionizing radiation. Both organizations are working on monitoring population groups that are likely to be exposed. In 2006, implementation of an information system to monitor the medical exposure of patients to radiation was launched.

The environment

The Institute provides support to the DPPR in the field of environmental protection. These actions are strategic for the Institute and some also overlap with the issues dealt with as part of opening up to civil society. The 2006 protocol, dealing mainly with appraisals, also includes actions concerning the radiological impact of classified facilities and of polluted soils, together with a radiological review in the vicinity of former uranium mine sites.

Civilian safety

The Institute provides operational support to the DDSC. The signing of the 2006 protocol was the occasion for the Director of Defense and Civil Security to recall the importance of IRSN's contribution to the national scheme implemented to deal with a radiological or nuclear emergency.
Preparedness for crisis management, response operations in an emergency situation and training personnel in decentralized State departments all benefited from IRSN assistance in 2006.

in the words of

Jean-Christophe NIEL,
General Director of the Nuclear Safety Authority (ASN)

"The effectiveness of ASN inspections requires high-quality technical expertise. Today, the ASN is satisfied with IRSN's work, even though, in order to improve performance, we are planning to review the joint charter on safety at basic nuclear facilities and to extend it to other areas, such as medical radiation protection.
The set up of the ASN and the changes planned under the terms of the Act on transparency and nuclear safety will strengthen the system that exists between the ASN and IRSN. Thus, the ASN wants to support the reinforcement of IRSN resources concerning it (71 million euros in 2007) in some areas. In particular, this concerns new projects, such as EPR and ITER, shutdown and decommissioning of nuclear facilities, proximity nuclear (radiotherapy, etc.) and new legislative requirements."

3

Opening up to society

As part of its policy of opening up to society, IRSN is developing various initiatives: specific studies and research, concerted pilot actions, reference documents aimed at the general public and promotional operations. The aim is to eventually take account of society's expectations in all Institute activities and thus improve the quality and credibility of its work.

Studies on the perception of risks aim at a better understanding of society's questions: although the public is often consulted, in particular when drawing up the IRSN barometer, few surveys of a similar nature questioning scientists are carried out. The results of the PERPLEX survey (perception of risks by the public and experts) in which IRSN, INERIS, Afssa, Inra, InVS, Ademe and Ifen were associated, and which finished in 2006, complete those obtained for the 2006 edition of the barometer on the perception of risks.
www.irsn.org

in the words of

Annie SUGIER,
Head of the Division in charge of opening up to society

"Contemporary society is increasingly attentive to and vigilant about environmental issues. The future of nuclear waste and the construction of a new reactor are subjects that create debate. In such circumstances, what the public expects of an organization such as IRSN is that it makes available objective information regarding the risks involved in these projects, which will enable the public to take a stand in the debate. It expresses its requirements in terms of transparency, access to information and multi-disciplinary expertise. Public debates are privileged moments of participative democracy.

By taking part in organizing these debates, IRSN is encouraging direct dialogue between the various stakeholders and demonstrating its commitment to transparency and opening up to society.

Personally, I participated in the debate on the EPR reactor project and witnessed heated discussion which was a measure of the public's expectations and vigilance concerning this new generation of reactors."

One central objective of this approach is to contribute to changing practices regarding transparency and skills in dialogue undertaken by the various actors (operators, experts, authorities, associations, elected representatives, etc.), by making the Institute's expertise accessible and by offering to construct a technical dialogue between experts from various disciplines on certain complex and potentially controversial issues. Such a change may, in particular, be facilitated by the practice of pluralistic expertise together, enabling shared learning. Apart from a desire for an exhaustive critical analysis of the issues dealt with by these bodies, this type of approach makes it possible to go beyond the usual scope of an expert appraisal when the aim is to answer the public's questions concerning risk assessment. Thus, within the framework of the new pluralistic expertise group on former mines in the Limousin region, IRSN offers use of methods still being developed at European level, to assess the impact of mining residues on the existing environment (fauna and flora), without limiting itself to the health impacts required by legislation.

SHARING EXPERIENCE FEEDBACK

The partnership developed by the Institute with the National Association of local information commissions (Ancli) is one of the key elements in IRSN's strategy. Within this context, a seminar was held on the feedback from international experience in terms of managing radioactive waste, jointly organized by IRSN and the Ancli. (*see page 51*). Another joint decision was to set up a working group with the aim of experimenting on the practical ways in which the Ancli and Cli can have access to the Institute's expertise.

In order to share concrete experience feedback with external partners, IRSN was involved in the European COWAM2 and Trustnet In Action programs, that were completed at the end of 2006. To compare case studies and define common approaches in the area of opening up to society, IRSN collaborated with four other expertise agencies or

On October 11, 2006, IRSN organized a public conference presenting its work on mapping fallout in France from the Chernobyl accident.

institutes (Afsset, InVS, INERIS and Inrets). This led to the organization of a seminar in February 2006, following which the five General Managers made a statement expressing their commitment to continue their joint study of "the role of national expertise institutes faced with changes in the governance of activities and situations of risk to man and the environment".

Finally, setting up a strategic monitoring system will enable the Institute to better identify the needs of economic and social players likely to be interested in the contractual services offered by the Institute, developing the economic potential of its know-how.

ACTIVITY IN RELATION WITH CURRENT AFFAIRS

As well as the operations mentioned above, whether carried out in-house or with different partners, 2006 was a busy year for news related to the nuclear debate, and this provided the Institute with several opportunities to manifest its desire to open up to society.
Thus, on the occasion of the twentieth anniversary of the Chernobyl accident, IRSN published a report on its website, summarizing the lessons learned from this accident in the following areas:

- assessment of the impact and protection of individuals;
- transparency and public information;
- crisis management;
- power plant safety.

www.irsn.org

Furthermore, IRSN provided extensive support to the work of the two special public debate commissions devoted respectively to the EPR reactor and to nuclear waste.
www.irsn.org

Within this framework, the study ordered by IRSN from WISE-Paris and the CEPN on "access to information on nuclear safety in a selection of western countries" was a useful contribution to the debates of both these commissions. An agreement was signed in November 2006 between EDF, the Flamanville (Manche) Cli and the Ancli on access to the EPR safety report as a direct consequence of this. It provides a framework in which local actors in particular can call on the expertise of IRSN.

in the words of

Georges MERCADAL,
Vice-Chairman of France's National Commission for Public Debate

"By its very nature, public debate is an occasion to build up trust between those in charge of a project and the public. This is fundamental, particularly when the subject of the debate is a difficult one, giving rise to a sentiment of fear in the population. This trust depends on the quality of interaction between the public and the project owner, who must provide as many answers as possible to its questions. These answers must also be backed up by advice provided by institutions such as IRSN, or by those opposed to the project. It is this pluralistic debate that we managed to establish during the public debate organized in 2006 on nuclear waste. The public was thus given a stereoscopic vision of the subject and accepted the report written following the debate.

I believe that IRSN's initiative on opening up its appraisal processes to experts from other disciplines is an extremely positive step for the nuclear sector. It is bound to enhance the trust that the public may have in it."

4

IRSN, a key player in international cooperation

For a research and expert appraisal institute specializing in nuclear risk, international affairs are an essential aspect of developing the knowledge and skills required to carry out its missions.

FURTHERING KNOWLEDGE

In 2006, IRSN continued its efforts to internationalize its research programs. The Institute signed new agreements with American (NRC) and Swiss (PSI) partners for the SOURCE TERM program and with Canadian (AECL) and Japanese (JNES) partners for fire research programs (PRISME and PICSEL).
IRSN also stepped up its initiatives at European level. It was involved in ten new projects under FP6 and actively contributed to preparing FP7, launched in 2007.

The Institute also participated in extensive research projects conducted abroad, particularly under the aegis of the OECD Nuclear Energy Agency (NEA), in fields such as thermohydraulics (Japan and Germany), corium-water interaction (United States), the reliability of nuclear fuel and human factors (Norway).

On the 20th anniversary of the Chernobyl accident, IRSN, GRS and their Ukrainian, Russian and Belarusian partners, presented the final results of the French-German Initiative for Chernobyl (IFA) regarding the safety of the sarcophagus, the accident's environmental impact and its effects on public health.

In addition, the safety and radiation protection organizations involved in the EUROSAFE approach - AVN (Belgium), CSN (Spain), GRS (Germany), HSE (United Kingdom), IRSN, SKI (Sweden) and VTT (Finland) - organized the eighth EUROSAFE forum in Paris, in 2006, and published Issues 8 and 9 of the EUROSAFE Tribune. They also participated in launching working groups to draw up a European safety assessment guide, on identifying research needs for expert appraisals and on the management of scientific and technical knowledge.
www.eurosafe-forum.org

120 men/year equivalent time spent *(100 in 2005)*

58 instances of IRSN involvement in international expert groups *(58 in 2005)*

18 European projects in progress *(10 in 2005)*

48 visits from foreign scientists *(21 in 2005)*

in the words of

Jean-Bernard CHÉRIÉ,
Deputy Director in charge of external relations, and head of the division of international relations

"The international relations developed by IRSN play an essential role in maintaining and developing scientific excellence and a high level of expertise within the Institute. They also enable it to become actively involved in drawing up guidelines and recommendations, and promote the sharing of best practices in radiation protection, safety and security. Finally, they help to spread the Institute's reputation in France and on the international scene.
At European level, IRSN initiatives can be seen in its close cooperation with the GRS, its German counterpart, and in the set up in 2006 of the European network of technical safety organizations, with the GRS and AVN, the Institute's Belgian counterpart. Internationally, the decision was taken in 2006 to host the first international conference of technical safety organizations in France, organized in 2007 by the IAEA in liaison with IRSN.
Furthermore, in the field of bilateral relations, cooperation between IRSN and its American (NRC and DOE), Japanese (JNES) and Russian (MRRC and IBRAE) partners was consolidated."

Finally, IRSN, the GRS and the AVN founded the European TSO network aimed at bringing together European technical safety organizations, with a view to actively harmonizing safety policies and technical expert assessment practices.

DRAWING UP INTERNATIONAL REFERENCE DOCUMENTS

In 2006, IRSN was actively involved in the continuing process to draw up the new general recommendations of the ICRP, in the work of the UNSCEAR scientific committee, in the groups set up under the Euratom treaty or the ISO standard and, in support of the ASN, in the committees in charge of IAEA standards projects. In addition, two new IRSN experts were sent to the European Commission and three to the IAEA.

In support of the ASN, the Institute also participated in preparations for and work on the second review meeting of the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management, which took place in May at the IAEA and was attended by the countries and organizations that have signed the Convention.

IMPROVING RADIATION PROTECTION, NUCLEAR SAFETY AND SECURITY ABROAD

In 2006, in liaison with the ASN, IRSN continued its technical dialogue with STUK on the safety of the EPR reactor and extended it to the NRC. It conducted cooperation initiatives focusing particularly on the transfer of computation software and experience sharing, especially with its Chinese (NNSA-NSC, CNNC) and Indian (BARC) partners, and on consolidating the Vietnamese safety authority (VARANSAC) and its technical support agency (VAEC).

In partnership with GRS, IRSN also took part in implementing European Commission and EBRD programs designed to improve safety at nuclear facilities in Eastern Europe. In the context of contracts managed by RISKAUDIT, a subsidiary of IRSN and GRS, IRSN cooperated with other European technical safety organizations, participating in around thirty projects in Armenia, Bulgaria, Lithuania, Romania, Russia and the Ukraine.

Finally, the Institute stepped up its contribution to planning and implementing initiatives decided by Russia and France as part of the global G8 partnership, mainly aimed at reducing the risks of proliferation by reinforcing security at naval bases and improving monitoring of radioactive sources.

The EUROSAFE forum held in Paris.

in the words of

Lothar HAHN,
Director of the GRS

"I see our relations with IRSN as being of great importance. We have gone from occasional cooperation to a long-lasting partnership, which enables Management of our two entities to meet twice a year to define their medium- and long-term strategy in all areas of activity undertaken by our institutions.

GRS and IRSN form the core of the EUROSAFE network, in association with their Belgian counterpart, AVN. Together, we coordinate this network, drive its development and plan to extend it to other specialist organizations in order to create synergy and share resources. Technical safety organizations are irreplaceable for maintaining skills and know-how. Together, we will continue to harmonize technical safety practices.

The European network of technical safety organizations is not a substitute for our bilateral partnership, which will continue to develop between the 2,000 or so experts at GRS and IRSN, with a view to setting up more and more joint projects with a European framework. The excellent relationship I have personally established with Jacques REPUSSARD can only contribute to this."

IRSN: valued knowledge and know-how

Faced with a constant State subsidy in current Euros, IRSN is pursuing its efforts to develop its own resources, in a context marked by a reduction in revenues associated with major international safety research programs.

54,262 euros of revenue from the sale of licenses

1,518,412 personal dosimeters provided and used *(1,610,000 in 2005)*

47 third-party surveys and critical analyses of hazard studies *(42 in 2005)*

738 services to analyze drinking water *(856 in 2005)*

150 services to analyze foodstuffs *(145 in 2005)*

174 operational radiation protection services *(127 in 2005)*

The Institute's own resources comprise, on the one hand, joint funding for international research projects or studies conducted within the framework of industrial partnership programs and, on the other hand, contractual services financed by clients. Clients are a growing source of income, implying the need to adapt our organization in line with the clients' expectations and market needs. This requires the integration of a commercial culture which contributes to growth in the Institute's own resources, in compliance with its missions. Contracted services include studies, the sale of catalogue services, promoting research results in the form of licenses, patents and the sale of digital products such as computational software and databases of experiment results. These services can be provided either within a regulatory framework (radiological inspection of water, radioprotection of workers, etc.) or not (radiation protection in the medical field, safety studies for Eastern European countries, etc.).

A DIVERSIFIED OFFER

The services proposed by IRSN are based on over 20 years' of know-how developed by its researchers, engineers and technicians in the field of facilities safety and human and environmental radiation protection. It may be specific to the nuclear industry, as in the case of radiation protection for workers or the environment, inspections of radiation protection and measurement instruments (α, β, γ and neutrons), radiological surveys of the environment, radiological emergency procedures, or management of radioactive sources, etc.

Some of this know-how is also accessible to industry outside the nuclear sector. This includes, for example, the characterization of particle transfer at industrial facilities, the behavior of containment equipment in the event of fire, simulation of the behavior of industrial ventilation systems, third-party assessments, critical examination of hazard studies on SEVESO facilities, the evaluation of olfactory nuisances, etc.

The Institute's range of commercial services has been available on the website since July 2006. A selection of these services, referenced by the technology transfer networks, promotes the development of links with SMEs, as a driving force in innovation.

www.irsn.org - Services section

www.rdt-france.org

FILING PATENTS

Another source of financial resources involves making use of research results by filing patents and selling licenses to industry.

In 2006, the terms and conditions under which inventors are remunerated were defined and raising awareness at laboratories encourages teams to include filing patents when promoting the results of their research. Hence, as well as publishing the first IRSN patent application in November 2006, two other patents have been filed and two others identified. These are now part of the portfolio developed before the Institute was set up as an independent establishment.

CHANGES IN OWN RESOURCES

The overall level of the Institute's own resources remained stable, with a slight drop in 2006 due to less involvement from the Institute's major traditional partners, such as CEA, EDF and Areva.

However, the provision of services for other clients has grown substantially, corresponding to contracts won on a competitive market.

Training at the service of risk prevention

One of the public service missions assigned to IRSN is to contribute to training in radiation protection for health professionals and people exposed to radiation in the course of their work.

In 2006, with the set up of a teaching delegation, new initiatives were launched to consolidate teaching and training within IRSN. These activities are now an integral part of programs to develop IRSN's scientific and technical excellence.
Transmitting IRSN knowledge is one of the factors that helps to promote the quality of the Institute's work and attract recognition among the scientific community and civil society.

At the same time, new training programs have been designed and others updated to better meet the needs of those concerned by exposure to ionizing radiation. **www.irsn.org**

Special training courses adapted to various medical techniques.

New in 2006: a training for people specializing in radiation protection and who are responsible for ensuring safety for workers likely to be exposed to ionizing radiation. According to the stricter legislation regarding radiation protection for patients and the obligations now incumbent upon health professionals, the Institute is increasingly called upon to carry out appraisals and provide training. In order to satisfy their requirements, training programs were reviewed this year to take better account of the specific nature of various medical techniques that use ionizing radiation. In the field of nuclear safety, an international training course was launched, on methods for managing serious accidents which could occur at nuclear plants, as part of the European SARNET network. Finally, the induction course for safety engineers opened itself to a wider public in order to provide a generalist approach to nuclear safety.

55 training sessions conducted in radiation protection *(41 in 2005)*

725 hours of training given in 55 sessions

900 people attended training in radiation protection *(600 in 2005)*

1,610 hours of training given externally by IRSN employees

in the words of

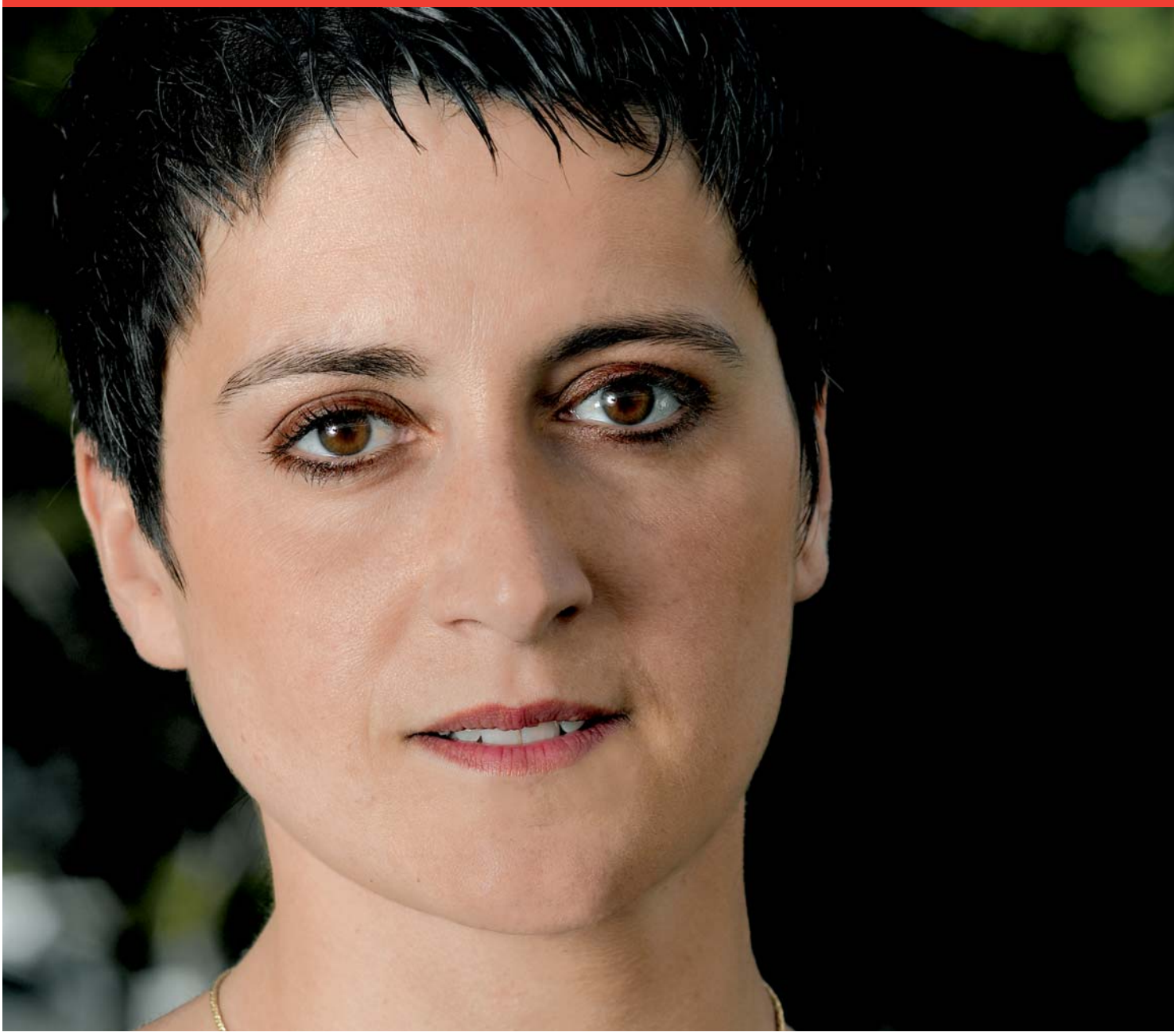
Jean-Luc REHEL,
Engineer in the medical radiation protection expert unit

"The request for training in radiation protection from health professionals is growing significantly, given the development of radiological imaging techniques and concern regarding the risks of patient exposure to ionizing radiation.

One of the Institute's tasks is to contribute to developing a culture of radiation protection, by organizing training courses adapted to the specific constraints in the healthcare sector. Thanks to its knowledge of radiation protection in hospital environments, IRSN held numerous training sessions for health professionals.

As experts in this field, it is our duty to place our know-how and our skill at the disposal of all concerned. These training courses are obviously a reciprocal source of enrichment. They also enable us to develop our knowledge of the difficulties facing the healthcare sector in optimizing use of ionizing radiation, while at the same time improving patient care."

IRSN Activities



"Our commitment also implies knowing how to mobilize our know-how and technical resources as quickly as possible to be able to respond at key moments, as we did in the case of radiotherapy practices at Épinal Hospital."

Agnès FRANÇOIS – Researcher, radiopathology laboratory

1

Making progress on safety

Maintaining a high level of safety at existing nuclear facilities calls for constant vigilance. In this context, IRSN examines the reasons given by operators for any changes planned, to their facilities, their operating practices or to the organizational procedures they implement. These critical analyses, followed by submission of technical notices to the relevant authorities or of reports to the relevant standing advisory group of experts, concern reactors, fuel cycle plants, laboratories, transportation of radioactive materials, dismantling and waste management. Furthermore, special attention is focused on analyzing incidents that have occurred during facility operating, based on information provided by the operator, in order to learn from the experience and avoid repetition in the future. In 2006, 905 incidents were notified by the various operators.

To fulfill these missions in a satisfactory manner, IRSN conducts research programs which enable it to develop useful knowledge and bring about technical or organizational changes to achieve better control of nuclear risks. These research actions are largely conducted through national and international cooperation.

Monitoring facilities

The technical support provided by IRSN to the authorities concerns, in particular, the safety of reactors, fuel cycle plants, laboratories and dismantling, for which the Institute studies the technical files submitted by operators.

630 inspections of basic nuclear facilities *(630 in 2005)*

22 meetings held by standing advisory groups *(25 in 2005)*

690 technical reports to ASN *(688 in 2005)*

9,870 radioactive source movements recorded *(10,000 in 2005)*

ANOMALY IN THE SAFETY INJECTION SYSTEM OF GRAVELINES REACTOR 3

During the shutdown of Reactor 3 at the Gravelines (Nord) power plant in April 2005, the operator was faced with the temporary unavailability of the reactor's automatic trip breakers, preventing performance of the regular safety injection system test. In order to carry out this test within the time allowed by the plant unit shutdown schedule, the operator disconnected two electric wires in the instrumentation and control system (one on each train) to simulate the closing of the corresponding breakers. This type of action (using temporary provisions and resources) may be resorted to in exceptional circumstances. After carrying out the periodic test, the inspections performed by the operator were unable to detect that the wires had been left unconnected, thus preventing the safety injection system from operating correctly. EDF discovered and declared this anomaly in March 2006 during the subsequent shutdown of the reactor following an operating cycle.

This incident did not have any real impact while the facility was in operation, but analysis conducted by IRSN in 2006 showed that its possible consequences could have been serious. Indeed, this analysis gave a clearer picture of all the functional consequences of the anomaly. In particular, it was found that the automatic switching of the safety injection system into circulation mode on the sumps would not have been possible on either of the system's trains. Using its SIPA post-accident simulator, the Institute concluded that operators would not have had sufficient time to manually modify the system configuration in a number of accident situations. The safety injection system would then have been irretrievably lost due to destruction of its pumps. In the absence of safety injection, prolonged dewatering of the fuel results in core meltdown.

In its analysis of the causes of this incident, IRSN revealed that the temporary provisions and resources had been implemented as a matter of urgency and without complying with the applicable rules. The use of temporary provisions and resources is the cause of a substantial proportion of incidents, and errors in their implementation (fitting and removal) can have serious consequences. The Institute drew attention to the essential provisions that must be complied with when using temporary provisions and resources.

Another of the lessons learned thanks to analysis of this incident was that this anomaly was not detected by regular

Skills, a vital link in the safety chain for facilities.

tests. IRSN stated that EDF should take steps to correct this failing to avoid similar incidents occurring in the future. Given its importance in terms of safety, this matter is being closely followed up by the Institute.

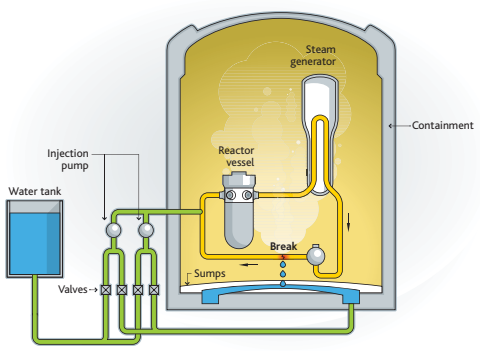
more details

The safety injection system

The main purpose of the safety injection system is, in the event of a break on the primary cooling system, to remove the residual heat which continues to be released by the fuel after reactor shutdown.

At a first stage, this system injects water into the reactor from a large-capacity water tank. When this tank is nearly empty, suction by the injection pumps is automatically switched to sumps located in the reactor containment which collect water exiting the primary cooling system in order to continue to provide reactor cooling.

The safety injection system comprises two redundant trains.



MANAGING THE SKILLS OF OPERATING PERSONNEL AT EDF PRESSURIZED WATER REACTORS

EDF set up a skills management system to define professional specialization paths that are geared more to the individual and to anticipate demand for skills more effectively. In 2006, IRSN examined the principles adopted by EDF, the management arrangements made in its departments and its management practices regarding skills management. This investigation revealed that, although the EDF management system is satisfactory on the whole, improvements should nevertheless be made in some areas. Firstly, arrangements facilitating the presence of managers on site should be reinforced, to identify needs and check that skills are correctly used. Furthermore, although the management system appears to be efficient within departments, skills management at local level has not yet been finalized in the case of temporary activities carried out within project frameworks.

FRONT END CYCLE FACILITIES

IRSN drives improvements in the safety of facilities at the front end of the fuel cycle

■ Romans-sur-Isère plant (Isère) – French-Belgian fuel manufacturing plant

During the safety review of the nuclear fuel manufacturing facility for research reactors, IRSN felt that the operation feedback from this facility was, on the whole, satisfactory but it nevertheless considered that the operator should continue its efforts to reduce fire risks, improve waste management and reconsider the hypotheses it had adopted regarding criticality risks.

As regards renovation work on the nuclear fuel manufacturing plant for power reactors, IRSN considered that the modifications made to the hydrofluoric acid condensation station, conversion furnaces, sintering furnaces, pelletizing presses and pellet storage facilities were helping to improve safety.

Melox facility in Marcoule (Gard)

In examining the request to increase the production capacity of the Melox fuel manufacturing plant from 145 to 195 tons of heavy metal a year, IRSN considered that the increase in production should be made on a gradual basis and that the validity of some of the hypotheses of the safety demonstration, concerning the radiation protection of workers, could only be verified by feedback on actual experience. In this context, the Institute felt that the operator should step up its analysis of failures in the containment provided by glove boxes and of changes in received doses.

Furthermore, IRSN considered that proposed modifications of an automatic system to monitor fissile material masses were a means of improving facility safety and should be rapidly implemented.

Plutonium technology workshop – CEA facility at Cadarache (Bouches-du-Rhône)

IRSN transmitted an initial recommendation to ASN on November 14, 2006 following the incident that occurred on November 6, 2006 at the Cadarache plutonium technology shop, involving the treatment of fuel manufacturing waste and the removal of this waste. The Institute considered that the actions which resulted in the placing of a double load of fissile material in a machine could have led to a loss of control of fissile material masses at workstations, and that this control was crucial to prevent criticality risks. IRSN considered that the operator should swiftly take corrective action regarding procedures and human factors. The relevant activities were suspended by the operator

The Melox facility in Marcoule.

EPR reactor

In May 2006, EDF submitted a request for authorization to set up an EPR nuclear reactor at the Flamanville site (Manche). The safety files concerning the EPR reactor submitted for this purpose were assessed by IRSN.

In the first half of 2006, IRSN completed its assessment of the corresponding technical files and presented its conclusions to the standing advisory group for reactors. These conclusions concerned the following points, in particular:

- the qualification of equipment for accident conditions;
- the prevention of spent fuel pit drainage accidents;
- the risk of clogging safety injection water intakes into sumps;
- the principles of computerized control;
- protection against certain hazards (fire, internal explosion, external flood risk, lightning and extreme cold weather conditions);
- probabilistic safety analysis;
- methods of assessing the radiological consequences of accidents;
- the production and treatment of radioactive effluent and waste;
- the characteristics of the Flamanville site.

The Institute also drew up a report on the steps taken by EDF in light of its undertakings and in response to ASN requests regarding all the files previously examined.

In the second half of 2006, IRSN sent a recommendation to ASN regarding draft technical instructions to be linked to the authorization to build the reactor.

Protecting facilities from flood hazards.

Naturally-occurring hazards

Natural hazards constitute a risk for nuclear facilities. In 2006, IRSN focused, in particular, on earthquakes and flooding due to external causes.

REVIEW OF BASIC SAFETY RULES REGARDING PROTECTION AGAINST EARTHQUAKE AND FLOOD RISKS

In February 2006, IRSN presented its conclusions on a draft review of the basic safety rule regarding seismic calculations for civil engineering structures to the standing advisory groups for reactors and plants. After a number of amendments, the document was released in the form of a guide in June 2006.

In addition, since Autumn 2006, IRSN has been leading a working group tasked with identifying phenomena which could result in flooding of nuclear facilities due to external causes (storms, continuous heavy rain, tides, tsunamis, etc.) and examining methods to characterize rare or extreme events which may be caused by such phenomena or combinations of them. This group, which comprises representatives of nuclear operators, ASN and IRSN, along with experts from MEDD, Minéfi, CETMEF, CEMAGREF, SHOM, Météo-France (the French meteorological service) and CNR, is to draw up a draft guide which will replace the current basic safety rule on flooding due to external causes, applicable to pressurized water reactors only. Its work will be continued in 2007.

REVIEWING THE IAEA SAFETY GUIDE ON FLOOD RISKS

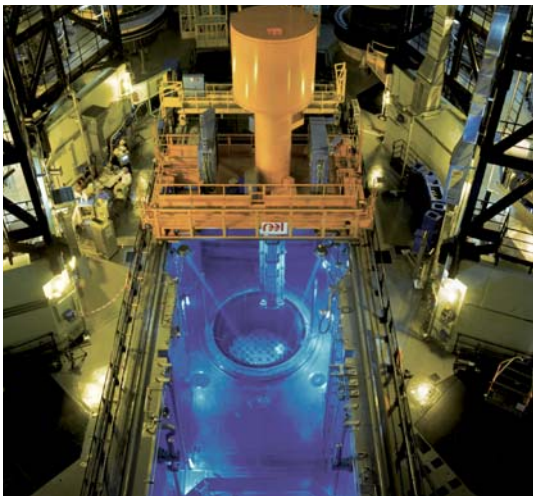
Following the tsunami that swept the coasts of the Indian ocean at the end of 2004, the IAEA formed an international working group in May 2006 to examine the need to review the agency's guides on the subject of protecting nuclear facilities against external flood risks and to propose improvements considered necessary. France was represented by IRSN, owing to its knowledge on this subject and, notably, on improvements made to French nuclear power plants since the partial flooding of the Le Blayais site (Gironde) in December 1999. All the experts stressed the need to review IAEA guides.

international

Improving the safety of nuclear facilities in East European countries

Cooperation programs in this field continued at a steady pace in 2006. These programs concern the modernization of safety-related systems, such as reactor control and protection systems and emergency cooling systems, as well as the examination of safety analyses such as studies of normal operating situations and accident situations.

For RBMK reactors, IRSN continued its participation in two projects regarding Reactor No. 2 of the Iganlina power plant in Lithuania. One of these projects concerns the installation of new motors on the rods of the reactor control and protection system and the other concerns severe accident analyses.
For VVER reactors, the Institute took part in about 10 projects in Armenia, Bulgaria, Russia and Ukraine. In the field of dismantling and waste, IRSN participated in projects in Bulgaria, Lithuania, Russia, Ukraine and Kazakhstan.
An important part of all these projects is dedicated to the transfer of western safety approaches and methods to the safety authorities and technical safety organizations in the countries concerned.



The new Alcade management system extends operating cycles.

New reactor fuels and their management

The study of the thermomechanical behavior of reactor fuel rods in the event of an accident involving control rod ejection or loss of primary coolant is aimed at ensuring their mechanical strength. Work is currently focused on new advanced claddings and fuels envisaged by operators and on new operating conditions in reactors.

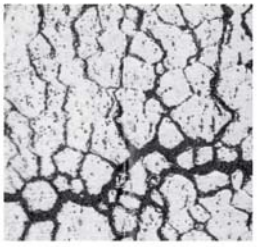
EXAMINING THE NEW ALCADE FUEL MANAGEMENT SYSTEM FOR 1,450 MWE REACTORS

The acceptability of the new Alcade fuel management system proposed by EDF for 1,450 MWe reactors was examined by IRSN between the end of 2005 and mid-2006. This management system has the effect of extending operating cycles by increasing the initial enrichment of the fuel and the number of new fuel assemblies reloaded on each shutdown. For the corresponding safety demonstration, EDF employed new methods based, notably, on the use of 3D computing tools and also the use of M5™ alloy as the material for the cladding and structure of fuel assemblies.

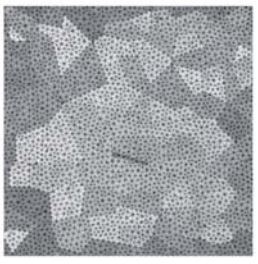
On completion of this study, IRSN presented its conclusions to the standing advisory group for reactors in September 2006. The Institute's reservations, taken up by the standing advisory group, mainly concern the assumptions adopted by EDF in dimensioning certain systems, especially those used for monitoring control rod insertion and protection against boiling crisis. Furthermore, IRSN considered that the technological limit of M5™ alloy as regards the failure of fuel rods due to pellet-cladding interaction had not been demonstrated. Further studies and, in particular, test results with power ramps are therefore required from EDF before the Alcade management system can be implemented.

GOOD PROGRESS ON FUEL BEHAVIOR IN ACCIDENT SITUATIONS

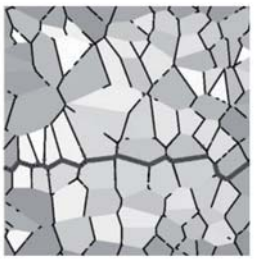
Drawing up of a safety standard for future fuel management systems calls for the development and validation by IRSN of various software packages used to assess the behavior of these fuels in accident situations.



a) Examining a cracked fuel sample

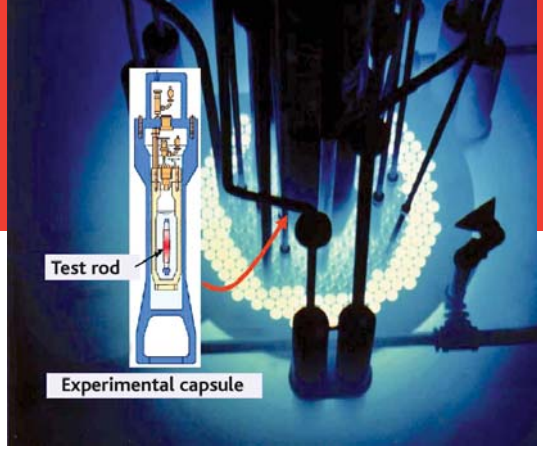


b) Discretization of the computation area



c) Simulation of crack propagation

Cracking of UO_2 fuel under mechanical loading in the presence of fission gas at grain boundaries.



Test enclosure for NSRR.

In this context, the purpose of SCANAIR software, jointly funded by EDF, is to model the behavior of a fuel rod subjected to a sudden power change. It is used in France by IRSN and EDF, as well as in Japan (JAEA), the United States (NRC), Belgium (AVN) and Spain (CSN), for control rod ejection accidents. Version 5 of this software, supplied at the end of 2006, takes into account all the results of the CABRI program and of the Japanese NSRR program, and its ability to predict the various failure modes for a cladding during a transient rod ejection accident has been demonstrated.

DRACCAR software, whose development began in 2005, is aimed at modeling the deformations that occur in fuel rod assemblies in the event of a loss of primary coolant accident. A new interpretation of the results regarding mechanical and thermal interactions observed between rods during PHEBUS tests was put forward on the basis of the calculations already performed.

Furthermore, operations for the detailed modeling of the thermomechanical behavior of claddings and fuel pellets were conducted in the context of close cooperation with CNRS and various university laboratories. These have resulted in significant progress, especially in understanding the basic phenomena of clad cracking during accidents of the above-mentioned types. The effects of irradiation and fission gases on the behavior of UO_2 porosities were also modeled.

CLOSE COOPERATION BETWEEN FRANCE AND JAPAN IN THE FIELD OF REACTIVITY ACCIDENTS

In the context of the international CABRI-CIP program focused on the study of the behavior of fuel during a reactivity study, close cooperation between IRSN and JAEA involves the secondment of IRSN staff to Tokaimura in Japan over a period of several years. A test program jointly defined by JAEA and IRSN, dedicated to the study of the dynamic behavior of fission gases present in highly irradiated fuels, is under preparation. In addition, the detailed analysis of tests performed in the Japanese NSRR reactor made it possible, using SCANAIR software, to model heat exchanges between claddings and water in NSRR fast transients.

This cooperation has also given IRSN access to the results of certain tests conducted for the Japanese ALPS program, and these will also be analyzed and interpreted in close liaison with those of the CABRI-CIP program. All these tests, concerning advanced fuels (UO_2, MOX with high burnup rate, fuel with additives, etc.) and new cladding alloys (M5™, Zirlo, etc.), are aimed at studying the effect of the microstructure of highly irradiated fuel and the energy injection rate on the strength of claddings, and the consequences of rod failure.

in the words of

Alain CHABOD,

Head of the department responsible for the assessment of thermal-hydraulics, control, cores and fuels

"Fuel management presents major technological, industrial and financial challenges. EDF wishes to optimize the operation of its power plants by extending the length of cycles and increasing the burnup rate of fuel assemblies. These developments may have an important impact, in terms of safety, on the behavior of fuel and its cladding (the first barrier). As a provider of technical support to the safety authority, IRSN is responsible for assessing the various files submitted by the operator. In order to be able to give appropriate recommendations on proposed developments, the Institute must possess expertise in many different areas: mechanics, thermal-hydraulics, material physics and neutronics. To support this expertise, IRSN conducts important research and development work in order to obtain better knowledge of fuel limits in the most hypothetical situations and to be an authoritative source of proposals regarding the development of safety requirements."

Fire and dispersion of radioactive materials

Controlling the risk of dispersion of radioactive materials is a major safety objective. Fire can damage the containment, ventilation and filtration systems designed to prevent dispersion. In these areas, IRSN is developing assessment tools and conducting studies and research in cooperation with various partners.

PICSEL: HOW DO ELECTRICAL CABINETS BURN?

The PICSEL program, launched in 2004, is jointly financed by IRSN and Areva NC. Its purpose is to study the dynamics of fire occurring in a nuclear environment: in a laboratory, workshop or plant. Following two test campaigns on fire phenomenology in various types of electrical cabinet and on the breakdown of glove box components and waste drum elements, tests were conducted in 2006 to study an electrical cabinet fire in an isolated room and, thereafter, in a room connected to other premises via a ventilation system with calibrated openings. For these tests, carried out in the DIVA facility, actual or simulated cabinets were used, with and without doors. In the tests with the cabinet door closed, a sudden ignition phenomenon was noted along with excess pressure in the premises where the fire occurred, resulting in a reversal of air circulation in the air inlet duct, thereby affecting target rooms in a configuration involving several rooms.

PICSEL experimental team.

opening up to society

Cooperation with the French National School for Fire Service Officers and the Paris Police Headquarters Central Laboratory

IRSN organizes meetings with non-nuclear parties that may be interested in some of its research topics.
In this way, areas of cooperation in research and training were identified with the national school for fire service officers (ENSOSP), and this has already been followed up by organizing practical action exercises in a hot laboratory at the Cadarache center (Bouches-du-Rhône).
A framework agreement for cooperation is being prepared.
Shared interest in developing simulation tools and databases in the areas of fire and explosion have already resulted in a cooperation agreement signed between IRSN and the Paris police headquarters central laboratory (LCPP).
Work has started on two projects: comparison of the results of large-scale fire simulation using the FDS software (LCPP) and ISIS software (IRSN) and a study on the conditions and mechanisms of ignition of electrical and electronic equipment.

Search for contamination in a hot cell.

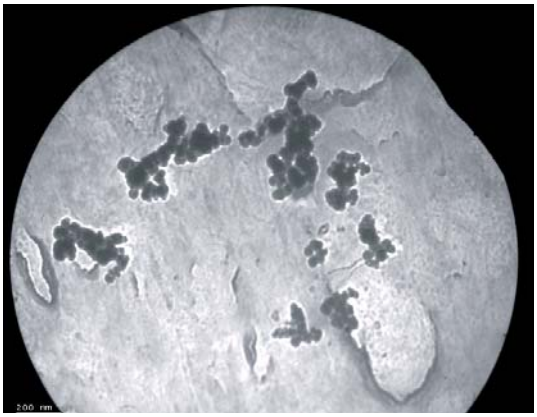
Fire scenarios in the DIVA facility.

ULTRAFINE AEROSOLS: NANOPARTICLE METROLOGY, EMISSION CHARACTERIZATION AND FILTRATION

The use of lasers during dismantling and clean-up of nuclear facilities results in the emission of ultrafine aerosols liable to cause specific problems insofar as concerns measuring, containing and filtering them as well as radiological hazards for service personnel.

In order to assess the risks generated by these ultrafine particles, appropriate measuring equipment is required and the emission sources must be characterized. In addition, suitable containment systems should be used. A study conducted at IRSN, in cooperation with CEA and Areva NC, aims to characterize the particles produced by laser paint stripping. The size of the particles formed is between 5 and 100 nm. A relation between the number of particles and the energy deposited per unit area (known as fluence) by the laser on the material was noted. This will be used to facilitate the design of suitable containment devices.

In a more general context, the development of nanotechnologies raises questions on the risks associated with nanoparticles measuring between 1 and 100 nm. Recent studies show that, to assess their toxicity, it would be more appropriate to think in terms of deployed area than in terms of weight. At IRSN, work was started in conjunction with INRS on the metrology of the deployed area of nanoparticles. Initial studies in 2006 identified physical mechanisms that could be used to assess this area, such as the fixing of ions on the surface of particles. This method, which was validated for the case of ideal spherical particles, is being studied for the case of particles that are representative of real industrial conditions, such as nanoparticle aggregates.



Particles produced during the synthesis of SiC nanopowder.

Some recent studies may, moreover, show a reduction in the air cleaning efficiency of conventional fibrous filters for particles smaller than 25 nm, which would contradict existing knowledge of filtration. IRSN can provide a better understanding in this field by proposing a meticulously validated method together with development of a bench for the production of standard nanoparticles between 3 and 40 nm and the use of ideal filters (calibrated metal screens) whose performances can be easily modeled. The first results obtained in 2006 did not show any decrease in the air cleaning efficiency of the ideal screens for particles smaller than 25 nm.

international

PRISME: how does fire propagate in rooms?

In order to improve our understanding of how fire propagates through a series of rooms connected by doors and a ventilation system, IRSN proposed an international research program, known as PRISME, which has been launched for a five-year period. This program, carried out under the aegis of the OECD, is supported by Belgium, Canada, Finland, Germany, Japan, the Netherlands, Spain and Sweden, and these countries may soon be joined by the United States and South Korea. On the French side, IRSN is partnered by EDF and DGA, and discussions are in progress on CEA joining this partnership. The program started in 2006 with the PRISME DOOR test campaign (on propagation through doors), with the aim of characterizing the transfer of heat, gas and soot through an open door separating two or three rooms, one of which contains a fire. These tests are mainly being conducted by IRSN at its DIVA facility. The project partners will be able to use the results to compare their calculations with the experimental results and so evaluate the ability of various models to simulate fire scenarios.

more details

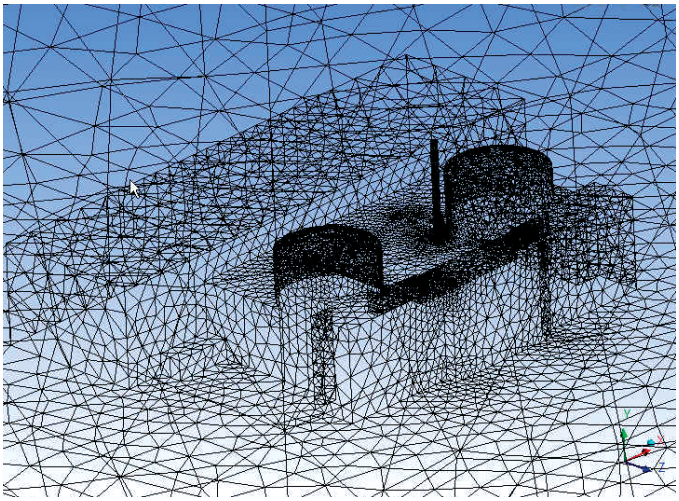
Multi-year program on the effects of wind on containment of radioactive materials in buildings

Modeling of the effects of wind on air flows in facilities and exchanges with the outside is currently inadequate insofar as concerns the effects of pressure and negative pressure on buildings and owing to the lack of qualification of air flow models. A multi-year research program was launched by IRSN in order to improve assessment of the influence of wind on contamination transfers.

The first step entailed assessing the capability of the CFX multidimensional software to find the pressures obtained during wind tunnel tests in 2005 on two mockups representing, respectively, buildings of the "reactor" type and "laboratory and plant" type. Satisfactory results were obtained when comparing the experimental results and the digital results in 2006.

Wind tunnel tests must be continued for a new facility mockup including a ventilation network.

The experimental results will be compared with those obtained using SYLVIA software.



3D modeling to simulate the effects of wind on buildings.

Core meltdown accidents

The aim of research carried out into core meltdown accidents is to develop an adequate understanding of the phenomena involved in order to assess the associated risks including, in particular, predictable releases of radioactive materials into the containment and then into the environment. This primarily concerns radioactive iodine which is the main short-term radiological risk for the population.

NEW TESTS FOR BETTER MODELING OF SEVERE ACCIDENTS

Analysis of current results from the international PHEBUS FP and SOURCE TERM programs, both focused on the study of releases which may result from a core meltdown accident in a pressurized water reactor, was continued throughout 2006.

Unexpectedly, FPT3, the last PHEBUS FP test during which a boron carbide control rod was used (similar to those used in 1,300 MWe and 1,450 MWe reactors and the EPR reactor), revealed the presence of considerable quantities of gaseous iodine in the containment as from the beginning of fuel degradation. This gaseous iodine was not retained by the filters and therefore presented a high potential for dispersion in the environment (*see box opposite*).

The SOURCE TERM program saw completion of the CHIP test devices used to study the chemistry of iodine in the primary cooling system and carried out the following tests:

- two series of tests at the EPICUR facility concerning the radiolysis of iodine in the aqueous phase and the formation of organic iodides in the gaseous and aqueous phases. The results will be used for future assessments of possible iodine releases;
- a series of tests regarding the study of the chemistry of ruthenium: this revealed the presence of significant quantities of volatile ruthenium oxide in the containment in certain conditions;
- several MOZART test campaigns on the oxidization by air of fuel claddings of Zircaloy-4 or M5™ alloy. These showed that the models used until now do not take all the phenomena observed into account;

A new assessment standard to protect man and the environment.

- a first test series on the study of the oxidisation of boron carbide/steel mixtures in the presence of steam. This showed that material transfers must be taken into account in reactor core degradation models.

All these results are used to improve the ASTEC software for the simulation of a core meltdown accident in a pressurized water reactor.

Radiological consequences of accidents

IRSN analyzed the new standard for the assessment of radiological consequences, which covers both assessment of the activity released outside the containment and the dosimetric impact on man and the environment.

EXAMINATION OF THE NEW STANDARD FOR THE ASSESSMENT OF RADIOLOGICAL CONSEQUENCES OF ACCIDENTS

In 2006, IRSN analyzed the new standard proposed by EDF for the assessment of the radiological consequences of accidents. This new standard will be applicable to reactors in service and to the EPR reactor project. The Institute examined the radiological objectives and the marker values proposed by EDF for design basis accidents for reactors in service, as well as the methods and hypotheses adopted to assess radioactive releases associated with the various accident situations not leading to core meltdown. For the EPR project, IRSN also carried out a detailed appraisal of accident situations involving core meltdown aimed at factoring them in at the design stage. In addition, the Institute analyzed the method and hypotheses proposed by EDF to assess the impact of accidental radioactive releases on man and the environment. IRSN's analysis was presented to the standing advisory group for reactors in June and July 2006. EDF will make improvements, in terms of methods or hypotheses, to the standard initially proposed.

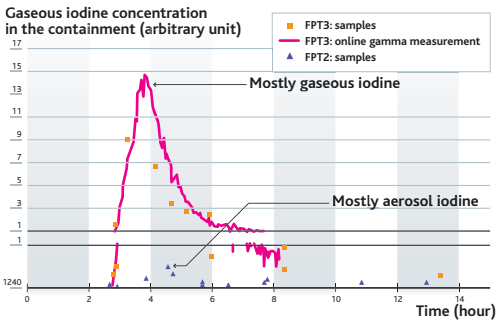
more details

PHEBUS FPT3, unexpected behavior of iodine

In assessing possible releases or radioactive elements into the environment in case of a reactor core meltdown, special attention is paid to iodine which makes a major contribution to calculated doses in the short term. Iodine can be released in the containment in the form of particles or in gaseous form, these forms being more prone to leakage to the outside.

As from the beginning of core degradation during the FPT3 test, 80% of the iodine present in the containment was in gaseous form, this value being much higher than expected.

This test shows that gaseous iodine is rapidly trapped on painted surfaces of the containment. In a radioactive environment, the interaction of gaseous iodine with paints leads to the formation of volatile organic iodides which are then partially destroyed to form less volatile compounds. For this reason, after a few hours, the concentration of gaseous iodine in the containment returns to the levels measured in previous tests. Studies are now being conducted to assess the impact of these results on calculations of radioactive releases in case of a severe accident.



Evolution of gaseous iodine in the containment.

The CEA decided to install a new facility for processing and storing type B, low and medium radioactive waste. This new facility is the CEDRA project, "Radioactive waste conditioning and storage".

Decommissioning and waste

IRSN assesses the safety of final shutdown operations followed by dismantling of old reactors and old fuel cycle facilities. It also examines the safety of facilities for the storage of short-lived, low- and medium-level waste, operated by Andra.

EXAMINATION OF THE APPROPRIATENESS OF CEA'S DISMANTLING STRATEGY FOR CIVILIAN FACILITIES

On December 6, 2006, IRSN presented the standing advisory group with its assessment of the appropriateness of CEA's civil facilities clean-up and dismantling plan for 2015.

The Institute examined the safety aspects of CEA's strategy and its application to the facilities in question as well as the means planned for implementation (waste and effluent management, management of waste packages and transport containers, organization and financing methods).

IRSN considered that the strategy adopted by CEA, backed by the provision of a special fund, was globally satisfactory from the safety point of view and that the stated clean-up operations and dismantling schedules should ensure an acceptable level of safety for the relevant facilities through to their the termination of the licence. However, IRSN drew attention to difficulties regarding program implementation and project management which, in the past, have led CEA to face difficulties to comply with some of its commitments, especially as regards the recovery of waste temporarily stored in pits in the CEA storage site in Cadarache (Bouches-du-Rhône).

REVISING THE SAFETY REPORT ON THE AUBE DISPOSAL CENTER

IRSN examined the revised version of the final safety report on Andra's disposal center at Aube, together with the related new operating rules. Its conclusions were presented to the standing advisory group on June 20, 2006. The Institute's examination focused primarily on the following points:

- feedback on the quality of waste packages received at the center;
- exposure levels for workers and the general public;
- fire hazards;
- progress on the study of design regarding the covering of the storage facility;
- the definition and justification of "items that are important for safety".
- feedback of the first years of operating

Overall, operating safety at the center appeared to be satisfactory. Nevertheless, IRSN drew attention to the need for some improvements concerning, in particular, package specifications, target performances for the storage facility's coverage, analysis of fire and explosion hazards and dose rates inside and around the transit building. Furthermore, modifications planned by Andra were also examined. The planned extension of the storage area and the reception of large packages appeared to be acceptable subject to certain additional supporting evidence. On the other hand, IRSN expressed opposition to the reception of packages containing sealed sources with a half-life of more than 30 years.

Aerial view of the Aube disposal facility.

AMETHYSTE nuclear attack submarine (RUBIS type).

ABOUT DEFENSE

ASSESSING THE SAFETY OF MILITARY NUCLEAR SYSTEMS, BASIC NUCLEAR FACILITIES AND DEFENSE-RELATED TRANSPORT SYSTEMS.

Action in this field is undertaken by IRSN in the context of technical support to the Delegate for nuclear safety and radiation protection of defense-related facilities and activities (DSND), an authority that comes under the supervision of the Defense and Industry Ministers.

SAFETY OF SUBMARINES, AIRCRAFT CARRIERS AND DEFENSE-RELATED MILITARY OR CIVILIAN FACILITIES

The assessment carried out by the Institute covers every stage in the life cycle (from design through to dismantling) of these facilities used by the armed forces, CEA, Areva or EADS. It also covers major changes made at these facilities for the purpose of future activities.

Design and construction

In 2006, IRSN examined the safety of:

- *nuclear submarines in the Barracuda program* (see box opposite),
- *the future treatment unit for alpha-emitter contaminated waste at the Marcoule facility (Gard).*

The Institute also examined the plan to renovate part of the facility at CEA's Cadarache center (Bouches-du-Rhône) dedicated to the manufacture of fuel for naval propulsion reactors. The renovated workshop will accommodate a new production line, the design of which must comply with current safety standards including, in particular, those regarding earthquake risk.

The Institute also examined adaptations to the Marcoule vitrification shop[1] proposed by the operator for the purpose of receiving alpha-emitter contaminated waste.

Operation

The level of safety at a facility depends not only on its design but, in particular, on the quality of maintenance and servicing operations. For this reason, IRSN was asked, in 2006, to examine the file concerning the first scheduled downtime for maintenance and repairs (IPER)[2] of Le Triomphant, a French nuclear-powered ballistic missile submarine (SNLE). IRSN assessed the preventive maintenance policy implemented, paying special attention to the submarine's safety systems, instrumentation and control, and power generating plant. The IRSN's report covered the following points in particular:

- *inspection programs for equipment contributing to the containment of radioactive substances,*
- *the standard preventive maintenance schedule for equipment related to nuclear safety.*

Furthermore, for the purposes of the periodic safety review, IRSN reassessed the safety of a facility using tritium at the CEA center in Valduc (Côte-d'Or), especially with regard to fire, explosion and earthquake risks. It gave its position

(1) High-activity liquid waste treatment process

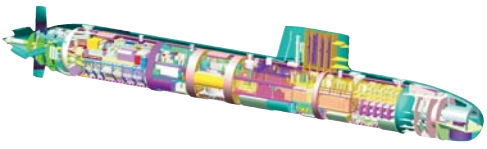
(2) Scheduled downtime for maintenance and repairs (IPER) entails the periodic overhaul of all onboard equipment, including the nuclear reactor and its auxiliaries. This procedure verifies that all equipment comply with approved safety requirements and clears them for operation until the next scheduled downtime for maintenance and repairs.

more details

Barracuda Program

The purpose of this major Defense Ministry program is to bring six new nuclear attack submarines into service as from 2017.

In the first half of 2006, IRSN completed its assessment of the general safety objectives and of the preliminary safety report for this new type of submarine. Its assessment of this report noted that significant progress had been made compared with previous submarine generations by taking into account hazards and core meltdown accidents as from the design stage.



Barracuda Project: model of nuclear attack submarine (SNA).

107 technical notifications to the Defense nuclear safety authority (DSND) *(132 in 2005)*

8 meetings held by safety commissions *(13 in 2005)*

on the appropriateness of improvements planned by CEA to ensure the safe operation of this facility for the coming ten years.

■ ***Dismantling***

IRSN continued its assessment of the safety of operations to dismantle a number of facilities at the CEA site in Marcoule in 2006. In particular, this focused on the safety of operations to decommission and dismantle the UP1 plant (see box below), the decladding shop and MAR 400 shop.

IRSN also issued reports on dismantling SUPERPHENIX reactor sub-assemblies and on the storage of fuel rods from the PHENIX reactor at the irradiated fuel assembly monitoring facility (ISAI). The bitumen waste drum recovery and packaging containment (ERCF) at the liquid effluent treatment plant (STEL) was also examined.
Furthermore, regarding the Areva NC facility in Pierrelatte (Drôme) and the facilities located there, the Institute issued reports on the dismantling of gas diffusion facilities (UDG) and the last operations in the diffusion building before permanent shutdown of operations.

SAFETY OF DEFENSE-RELATED MILITARY OR CIVILIAN NUCLEAR ACTIVITIES

■ ***Transportation of radioactive materials***

Among the many files dealt with in 2006, IRSN appraised a new package model (IR800) designed for the dry transport of irradiated fuel elements in naval propulsion nuclear reactors. As a result of this appraisal, CEA improved the safety of this model.

IRSN also gave DSND its opinion on an incident that occurred at the CEA center in Cadarache, concerning a fuel transfer from the new generation reactor (RNG) to the experimental reactor (RES) by means of a BK15 packaging (unsuitable procedures implemented).

■ ***Internal emergency plans (PUI)***

IRSN's work in 2006 focused on the internal emergency plans for the Ile Longue site and nuclear-powered ballistic missile submarines (SNLE) of the Le Triomphant *type. The corresponding assessments were carried out simultaneously in order to check the consistency and satisfactory interlinking of the emergency organizations described in*

more details

Dismantling the UP1 plant at the Marcoule site (Gard)

The UP1 plant was France's first irradiated fuel treatment plant, in service from 1958 to 1997. Since its final shutdown, it has undergone decommissioning and dismantling operations.
In October 2006, IRSN presented its position on continuing these operations to the safety commissions responsible for laboratories, plants and waste.
The analysis showed that feedback was satisfactory: most of the radioactive material had been removed without any significant incident and the exposure of personnel was under proper control.
The position submitted by IRSN stressed the importance of organizational and human factors which are possible causes of incidents.
It also dealt with the definition of treatment and storage systems for radioactive waste containing high levels of alpha emitters.
IRSN also submitted a position on the targeted final radiological situation at the end of operations and on the continuation of those operations on the basis of an updated, validated safety standard.

The Marcoule facility.

these two plans which are likely to be implemented at the same time.
In addition, a three-party working group (DSND, French Navy and IRSN) was set up to conduct an overall assessment of the four internal emergency plans for the facilities and activities at the Toulon naval base.

Radioactive sources

About 25 facilities where radioactive sources are held or used have already been placed under DSND control. Some of them have received only provisional clearance at present.
IRSN increased its technical support to DSND in 2006 so that it could issue new permanent clearances. The transfer to this authority of the control of facilities having received clearance from the Interministerial Commission for Artificial Radioelements (CIREA) before 2002 is expected to continue.
In addition, IRSN monitors the movements of sources held at these facilities and records them in a national database.

A report is drawn up on radiological and geo-mechanical monitoring of the atolls every year.

The naval docks in Brest.

Other activities

In 2006, IRSN examined the 2004 annual report on the radiological and geo-mechanical monitoring of the Mururoa and Fangataufa atolls, presented by France's nuclear test center monitoring department (DSCEN). In particular, this assessment covered the results of measurements of radiological activity in the atmosphere and in ground water.

2

Preparing for the future

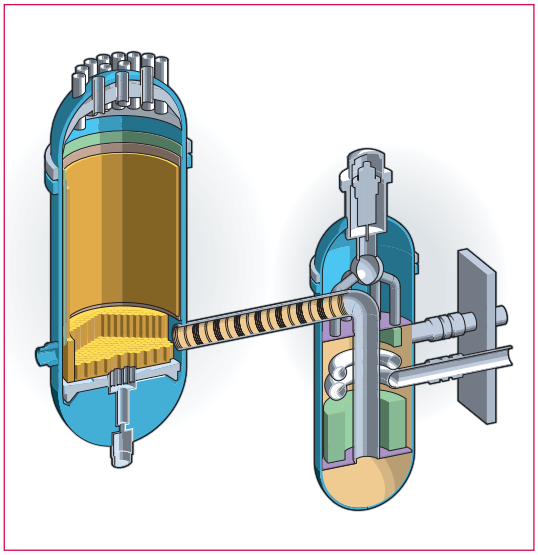
In order to provide the most appropriate expert appraisals concerning projects for future nuclear facilities, the Institute carries out research aimed at proposing safety objectives and developing, well in advance, the expertise required to perform detailed technical assessments on the safety of new reactors and nuclear waste disposal facilities.

Future reactors

IRSN identifies and assesses safety problems relative to industry plans for the facilities that will replace the current generations of reactors. This implies that the research topics to be investigated must be defined accurately enough to be able to conduct appropriate assessments.

SAFETY OF GENERATION IV REACTORS

At the beginning of 2006, the President of France announced the commissioning of a prototype reactor before the end of 2020, and this announcement was reflected in the Planning Act of June 2006 on sustainable management of radioactive waste materials. In 2006, IRSN drew up a report on safety and radiation protection issues raised by the six types of reactor studied within the framework of the Generation IV International Forum (GIF). The six types of reactor have not all reached the same level of maturity. The only ones for which significant industrial experience has so far been developed are helium-cooled high or very high temperature thermal neutron reactors and sodium-cooled fast neutron reactors.



HTR/VHTR reactors are capable of producing high temperatures (800 to 1,000°C).

The Institute has started to examine the issues which may require research and the skills to be maintained, reactivated or acquired.

in the words of

Didier PERRAULT, in charge of safety monitoring for the ITER project

"The ITER project is a special case in many respects. First of all, it involves nuclear fusion, a field in which IRSN has little expertise. What is more, it calls for the use of rather unusual equipment (such as a ring shaped vacuum chamber and a complex magnetic system). All this knowledge has to be acquired before we can assess the facility's safety.

There are seven partners in the international ITER project (Europe, Japan, the United States, South Korea, China, Russia and India), and each will supply part of the equipment. Technical discussions were initiated with the operator, well before the release of the preliminary safety analysis report which is scheduled for the end of 2007. These discussions will probably be lengthy and complex.

This is a growing field of activity for IRSN and it should last a long time, so we are considering research actions to prepare future safety assessments."

SETTING UP A NEUTRONICS CENTER

IRSN has launched a new project involving the neutronics of cores and systems containing fissile materials. The aim is to develop the tools and skills required to conduct critical analysis of the most credible designs for Generation IV reactors and the corresponding fuel cycle facilities.

These tools and skills will also enrich expertise on nuclear facilities currently in service or under construction. The scientific scope of this project includes:

- the means of creating and managing nuclear data libraries;
- computer codes and tools to process results;
- methods of analyzing the impact of various types of uncertainty;
- expertise regarding qualification of the tools.

STUDY PROGRAM ON REACTIVITY ACCIDENTS

This program, launched in 2005 and continued in 2006, is aimed at assessing the consequences of an explosive Borax reactivity accident for French experimental reactors and, notably, for the Jules Horowitz reactor project. For these reactors, fast reactivity insertion causes a rapid power increase and then practically instantaneous meltdown of the fuel, followed by a steam explosion.

SIMMER software, initially used to model a rapid power change in fast neutron reactors, underwent major adaptations to its neutronics module in 2006. A cooperation agreement was signed on this subject with the German research center, FzK, which is responsible for this software. Furthermore, certain neutronics parameters calculated by SIMMER software were validated by comparison with those determined using APOLLO 2 software, with a view to using SIMMER software for experimental thermal neutron reactors.

In addition, so as to be able to assess the safety file for the Jules Horowitz reactor project, IRSN undertook analysis of the thermal-hydraulic processes occurring during rapid power change and steam explosion, using MC3D simulation software developed by IRSN with CEA.

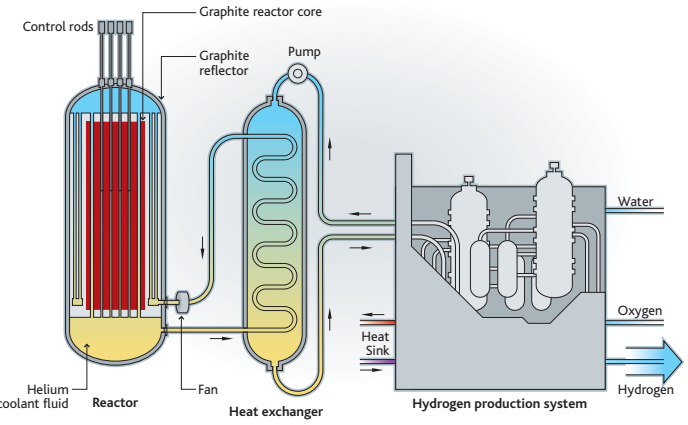
international

RAPHAEL: developing European research on very high temperature gas reactors

The aim of the RAPHAEL project, within the framework of the FP6, is to carry out important R&D actions at European level to demonstrate the feasibility of an industrial prototype of a very high-temperature gas reactor. It involves around 30 industrial firms, universities and research bodies.

IRSN's contribution, initially focused on analysis of the reactor's behavior in an accident situation, has been extended to include the study of the behavior of its fuel in various irradiation conditions.

A number of studies and calculations have been performed in order to assess the release of fission products under irradiation and their physicochemical interactions with the fuel coating. The results obtained will be compared with those obtained by experimental measurements scheduled for 2007 on irradiated fuel samples in the HFR reactor at Petten (Netherlands).



Block diagram of a 600 MWth VHTR reactor.

Deep disposal facilities

IRSN is developing modeling tools and carrying out studies and research work in order to extend its expertise regarding the safety of future radioactive waste disposal facilities in deep geological formations.

ORGANIZING RESEARCH IN THE FIELD OF DEEP DISPOSAL FACILITIES

The French Act of June 28, 2006 relative to sustainable management of radioactive waste materials set the date of 2015 for the assessment of the application to develop a reversible geological disposal facility for high-activity, long-life waste. In 2006, IRSN surveyed the actions it will be required to take in order to be able to draw up a relevant technical notice on the application to develop the facility, which Andra is expected to submit by the specified deadline. These actions include the following in particular:

- develop a better understanding of the major safety-related phenomena for which there are or will be few sources of information;
- develop the capability to model these phenomena, taking account of the experimental results obtained;

Simulation of radionuclide flows in deep disposal projects.

- carry out analysis and simulations using models in order to independently assess whether the containment performances that the disposal facility may be expected to provide are well founded.

In constructing its program, IRSN relied on its own experience in this field including, notably, the assessment of the feasibility of repositories in an argillaceous medium. A detailed multi-year program will be defined in 2007. It is already apparent that there should be two successive study phases:

- the first will aim to produce a notice, in 2010, on the likely site for the disposal facility and on the appropriateness of the design options retained by Andra;
- the second will entail assessment of the application for authorization to develop the disposal facility.

IRSN will examine the research work notably carried out at the Bure underground laboratory (Meuse) by Andra. Further more IRSN's scientific board will examine the research carried out by IRSN in Tournemire experimental center (Aveyron).

TOURNEMIRE: WORKING TOWARD AN INTERNATIONAL RESEARCH PLATFORM

In order to conduct its research work on the safety of storing radioactive waste in an argillaceous formation, IRSN relies, in particular, on the Tournemire experimental center. Indeed, the similarities between the argillite at the Bure and Tournemire sites mean that there is a high probability that their behavior will be similar and, therefore, the Tournemire site's access facilities (a railway tunnel) can be used to study the following points at a limited cost:

- damage related to the excavation of underground structures;
- the efficiency of tight sealing and supporting structures;
- the effects of thermal-hydromechanical disturbances on radioactivity containment properties;
- chemical interactions between the main components of the disposal facility;
- detection of fractures in the geological environment of the disposal facility and their possible role with regard to the transfer of radionuclides.

These programs will be conducted within the framework of cooperation with institutions concerned with the disposal of radioactive waste and the properties of argillites. For this purpose, IRSN organized several visits to the Tournemire site in 2006 and established con-

Research on the deep disposal of high-activity, long-life waste carried out at Tournemire was presented to the IRSN Scientific Board on February 22, 2006 during a visit to the facility.

tact with many scientists in the various disciplines concerned. Cooperation has been arranged, in France, with the CNRS, the universities of Montpellier (Hérault) and Orsay (Essonne), INERIS, the Laboratoire Central des Ponts et Chaussées and the Institut Français du Pétrole, and, abroad, with CEN-SCK (Belgium) and the universities of Berne (Switzerland), Minneapolis (USA) and Clausthal (Germany).

IRSN's intention is now to make the Tournemire site a research center for disposal in geological formations that is open to the international community.

opening up to society

Seminar on governance of nuclear waste and analysis of public debate

IRSN and Ancli conducted various actions regarding the governance of nuclear waste in 2006, including the joint organization of a seminar on international feedback on this issue. The topics presented at this seminar included work on the European COWAM program, in which Ancli and IRSN are involved.
More than 50 participants (IRSN, Cli, and interested government departments and businesses) attended this one-day event. It was followed by an Ancli/IRSN working meeting focused on shared expertise in waste management.

IRSN and Ancli also launched the joint production of a CD-ROM covering the main points of the public debate concerning nuclear waste, from the angles of governance and participation of local players in decision-making processes.

J. REPUSSARD, J. LABROYE (INERIS MD) and M.-C. DUPUIS (ANDRA MD) at Tournemire on February 22, 2006.

3

Knowing the radiological status of the environment and worker exposure levels at all times

Continuous monitoring in the field of radiological protection is one of the Institute's public service missions. It entails monitoring radioactivity in the environment in France and assessing the exposure of workers and members of the public to ionizing radiation. This assessment relies on a cutting-edge range of technical resources for the analysis of radioactive substances and radiation measurement, and on expert knowledge of doses and environmental contamination levels.

210 radiation monitoring beacons make up the country's remote monitoring network *(213 in 2005)*

1,000 ambient dose rate **measuring points** *(1,000 in 2005)*

600 sampling points across the country *(500 in 2005)*

31,500 environmental samples taken per year *(30,000 in 2005)*

100,000 radiological analyses conducted *(100,000 in 2005)*

Radiological monitoring of French territory and contributing to public information

IRSN maintains radiological surveillance of the environment in France so that it is constantly aware of the levels of radioactivity to which the population is exposed and to ensure early detection of any abnormal increase in radioactivity in different types of environment. The Institute has to provide the public with information on the radiological status of the environment in response to public concern over this matter.

PUBLISHING THE FIRST ANNUAL RADIOLOGICAL REPORT ON MONITORING OF THE ENVIRONMENT

To optimize the provision of information on the radiological monitoring of the national environment, the Institute opted for continuous publication of its results on the Internet, backed up by an annual summary published on paper and CD-ROM. The first radiological report of this type was issued in June 2006 on the database for 2004. It was sent to about 400 recipients (French *préfectures*, DRASS, DDASS, CLI and associations, etc.). Readers were asked to complete accompanying questionnaires in order to gauge their preferences for the 2005 report, which was produced in the second half of 2006 with, in particular, the addition of national or local maps.

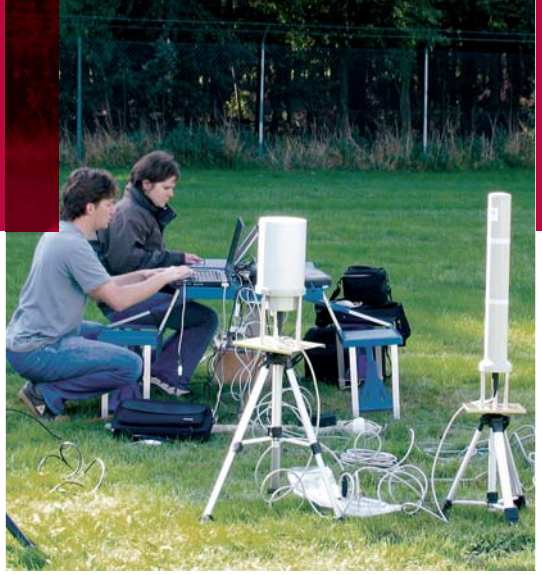
www.irsn.org – IRSN website: "Radioactivité dans l'environnement"

opening up to society

Cooperation between IRSN and CLIs of the Loire basin

The survey conducted in 2004, for ANCLI and IRSN, questioning local information commissions (CLI) and the Institute's personnel, showed that there was a shared interest in cooperating in the field of environmental monitoring. As a result, the Institute soon launched a pilot project in conjunct with some CLIs in the Loire basin to specify their requirements in terms of issuing the results of environment monitoring and the possible uses of these results.

In 2006, IRSN drew up an inventory of the existing data and identified organizations which could produce environmental radioactivity measurement results in the areas concerned. An initial summary report regarding Saint-Laurent-des-Eaux (Loir-et-Cher) was presented to the CLIs in July 2006 in Orléans (Loiret). This study will be extended to the whole Loire basin in 2007.



The unit in charge of remote monitoring at IRSN is currently testing several types of beacon.

Filter used to collect aerosols.

MONITORING IN FRENCH POLYNESIA

As it has done every year since 1962, IRSN carried out radiological monitoring in French Polynesia, excluding the experimental nuclear sites of Mururoa and Fangataufa which are covered under Challenge 1 (*see page 47*).
The results of the measurements performed on representative samples of Polynesian foodstuffs and the related estimated effective doses were included in a report available on the Institute's website which, above all, is intended for local elected representatives and the French authorities.
www.irsn.org – IRSN website: "Radioactivité dans l'environnement"

MODERNIZING AND IMPROVING RADIOLOGICAL MONITORING OF THE AIR

The first studies on the technical modernization of the Teleray remote monitoring network and the design of a new automated aerosol monitoring network were launched in 2006. Their purpose is to improve the capability of detecting and assessing any accidental radioactive air pollution which could originate from a facility in France or abroad.

These studies are being conducted with a wide scope under the ARGOS project, the aim of which is to use a test platform to establish the appropriateness of future choices as regards measuring devices, analysis software, transmission systems and database structures for IRSN's remote radiological monitoring networks.

A study of the existing situation, needs and potential solutions was conducted in combination with a technical study of remote monitoring in other European countries. This revealed that few existing operating systems were capable of satisfying IRSN's requirements, i.e. to supervise all monitoring networks with a single supervisory software package. IRSN therefore opted for a software package used in industry which can easily be adapted for its purposes. A full technical assessment is required, however, regarding the choice of radioactivity measuring sensors. Various measuring sensors were acquired with a view to intercomparison and assessment. The first stage of this assessment was carried out in Germany in September 2006 as part of the European EURADOS dose rate measurement exercise.
In parallel, work on setting up a special test room for the ARGOS platform, physically separate from the IRSN computer network and existing remote monitoring networks, was started at the Vésinet site (Yvelines). The platform will be used to create the interface between the sensors or prototypes and the supervision software already acquired.

MANAGING THE NATIONAL NETWORK OF ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS

IRSN is in charge of technical management for the French national network for environmental radioactivity measurements and provides secretarial services for its steering committee.
In accordance with Article 5 of the Order dated June 27, 2005, IRSN issued the first report on management of this network in 2006. This report assesses the work of the steering committee and the approval commission, as well as summarizing the state of progress on the various projects being developed. It is intended for parties involved in this network, professionals and members of the public who wish, firstly, to understand the procedures for obtaining laboratory approval and organizing inter-laboratory tests and, secondly, to know more about the development of tools for the centralization, management and public distribution of environmental radioactivity data.

National network portal: www.mesure-radioactivite.fr

This initiative to improve public information also resulted, in June 2006, in setting up the network's own web portal, which will be followed by a website providing access to all the results of environmental radioactivity measurements covered by the Order of June 27, 2005. To this end, IRSN consulted the relevant data producers (EDF, Areva, CEA, etc.) in 2006 to draw up the functional specifications for the national network's information system. On the basis of these specifications, IRSN conducted a technico-economic study of two solutions for the system's computer architecture and management, and the results were presented to the steering committee in October 2006. In the last quarter, the solution that will be implemented was chosen by IRSN, ASN and the data providers.

ORGANIZING INTER-LABORATORY COMPARISONS

IRSN's division for sample processing and environmental metrology organizes an annual test campaign for the intercomparison of environmental radioactivity measurements with laboratories seeking approval to join the national network. In November 2006, it obtained COFRAC certification as "organizer of inter-laboratory comparisons" (CIL). As a result, this division became the first and, so far, only French laboratory to receive CIL certification for the analysis of radionuclides in the environment.

Improving and consolidating expertise in radioecology

Knowledge of the mechanisms governing the behavior of radionuclides and their effects on ecosystems, together with the spatial and temporal development of radioactivity in the environment, have always been of major concern to the Institute which is conducting many research programs in the field of radioecology.

RECOGNITION AND FINANCING OF RADIOECOLOGY RESEARCH

In 2006, the Institute sought to win recognition of the relevancy and quality of its radioecology projects by submitting them to the selection processes of competitiveness clusters and the French national research agency (ANR). As a result, by the begining of the year, five radioecology projects had been approved.

Two projects were officially recognized by the "Mer PACA" competitiveness cluster:

- MERLUMED (pollution of a food chain in the Mediterranean),
- EXTREMA (transfers of masses and associated pollutants).

As a result of these approvals, regional financing was obtained for MERLUMED and inter-regional and European financing was secured for the marine section of EXTREMA, pending overall financing by ANR.

more details

IRSN's contribution in the 20th anniversary of the Chernobyl accident

IRSN has been closely involved in work conducted on the occasion of the 20th anniversary of Chernobyl accident, through action focused on both scientific aspects and public information. On the scientific side, IRSN completed a study to improve knowledge of and quantify radioactive fallout in France caused by the accident and to analyze the consistency of the various approaches to reconstitute the deposits that occurred and ascertain their significance in terms of dosimetric impact on people.

The Institute's recent work, along with its work over the last 10 years, was examined by its scientific board, which validated the Institute's approach and suggested various areas of improvement in assessing the consequences of a possible future accident. In association with this work, IRSN used the air contamination measurements conducted in Europe at the time of the accident to test the long-distance atmospheric dispersion model that is currently developing. As a result of this test, the propagation throughout Europe of the radioactive discharges resulting from the accident were illustrated in an animated simulation, which was widely circulated in the media in France and abroad owing to its extremely graphic nature. In the field of public information, IRSN placed a detailed pedagogical study of the accident and its consequences on line in April and organized a public conference in October to review its most recent work.

www.irsn.org/net-science et www.irsn.org

As part of the EXTREME project, IRSN took part in an exercise for the inter-comparison of measurements of flows and stocks of suspended materials in the Rhone river in September 2006.

Three projects were approved by the competitiveness cluster for "French territory risk and vulnerability management":

- PRISMES (risks associated with all pollution for aquatic organisms);
- PRIME, which is a research project concerning radioecological sensitivity indicators and multi-criteria methods applied to the environment in an industrial area;
- CLARA II (marine section of the SENSIB project, aimed at classifying territories with regard to their sensitivity to radioactive pollution) which is also financed by ARN.

DEVELOPING TOOLS TO SIMULATE RADIOACTIVITY TRANSFER IN THE ENVIRONMENT

Another current area of study for IRSN is the improvement of tools to assess the dosimetric impact on man resulting from the presence of radioactive contamination in the environment. Since 2003, the Institute has been working on the design of a platform to accommodate models and codes for various environmental compartments (atmospheric, land and aquatic) and to enable them to interact automatically, for any type of release (chronic or accidental releases). After constructing a prototype (2003-2005) which was used to validate the feasibility of the platform which was named SYMBIOSE, work in 2006 focused on industrializing the tool. This development is being conducted in cooperation with EDF, under a research agreement jointly financed by IRSN, EDF and CEA.

ASSUMING EUROPEAN LEADERSHIP IN THE FIELD OF RADIOECOLOGY

In 2006, IRSN took charge of the supervision of the European FUTURAE project comprising nine partners from eight different countries. The purpose of this project is to study the feasibility of a radioecology excellence network which could be set up within the framework of FP7. At its launch meeting in Vésinet on October 10 and 11, the partners defined a working program for the project's two-year period.

The first stage, consisting in assessing the situation of research in radioecology in Europe, was launched during the last quarter with a questionnaire sent out to more than 50 European radioecology teams.

Partners in the FUTURAE project at the project's launch meeting in Vésinet.

more details

Epidemiological studies on domestic radon

In 2006, IRSN conducted a methodological study to take into account uncertainties regarding the assessment of the risk posed by domestic radon and used the results of this study to re-assess this risk for the whole of France: between 2.2% and 12.4% of lung cancer cases could be blamed on radon.

This work follows the joint epidemiological study conducted in nine European countries with the participation of IRSN, which confirmed that there was a significant linear relation between domestic exposure to radon and the risk of death due to lung cancer. This risk increases by approximately 8% when the measured radon concentration increases by 100 Bq/m3, allowing for age, sex, region of residence and smoking habits.

A North American study obtained the same results. The European Alpha-Risk research program, coordinated by IRSN, will gather together all worldwide epidemiological data (United States, Europe and China).

Conducting assessments on uranium mining sites

Thanks to its experience in assessing the radiological impact of uranium mine sites on the environment, IRSN is regularly called upon as a third-party expert to conduct assessments of sites in France and abroad.

In 2006, two assessment reports were submitted to Areva NC. The first concerned the radiological situation in the area around the former mining works at Mounana, Gabon. This report was based on the study of files and observations made during a trip to the site. The assessment evaluated the appropriateness of the environmental radioactivity monitoring systems around the sites and identified areas of improvement for monitoring exposure of local inhabitants. In particular, two situations were studied: one was the result of the dispersion of treatment residues along a water course, and the other concerned the use of materials with a high level of radioactivity for building purposes. In the latter case, as a result of the findings, it was recommended that a strategy should be implemented to reduce exposure in homes partly built with such materials.

The second report concerns the first part of a third-party expert assessment requested of Areva NC by the Prefect of the Haute-Vienne, regarding operation of the mining residue storage facility at Bellezane (Limousin) and the impact of uranium works on the Ritord drainage basin. This work led to numerous exchanges with a pluralistic group of experts formed by the Ministries of Industry, Environment and Health, and placed under the chairmanship of Annie Sugier.

Monitoring the exposure of workers to ionizing radiation

IRSN has a duty to monitor the exposure of workers to ionizing radiation under the conditions laid down by the decree issued on March 31, 2003, relative to the protection of workers against ionizing radiation.

The Institute continued operational deployment of the SISERI system, set up in 2005 to centralize and store

international

Improvement of whole-body counting measurements

In the field of internal dosimetry, cooperation was developed between IRSN and IBPh of Moscow with the aim of achieving improvements in whole-body counting measurement methods, using the ŒDIPE software (tool for personalized internal dose assessment) developed by the Institute. Experimental validation based on human data represents an important step in this project.
A first validation study was conducted on animals contaminated with actinides in the lungs at IBPh.

The project continued in 2006 with whole-body counting measurements performed at IRSN on three Russian workers previously contaminated by plutonium.

Analysis of the results obtained using the ŒDIPE software is currently in progress and should soon be available for comparison with the measurements performed in Russia. Furthermore, there are plans to set up a French-Russian network of experts working in the field of internal dosimetry.

Whole-body counting measurement for Russian workers.

individual dosimetric data on workers. In this area, the Institute plans to improve analysis of the results for occupational exposure according to field of activity and trade. By the end of 2006, the SISERI system was receiving about 180,000 records each month from passive dosimetry laboratories and regularly retrieving active dosimetry data from 240 plants and hospitals for some 36,000 workers. These individual dosimetric results are available on an extranet and are accessible to occupational health doctors and the relevant radiation protection specialists (PCR) in order to optimize their medical monitoring and radiation protection for workers.

www.siseri.com

A report on the external exposure of workers in 2005 was drawn up using passive dosimetry data for 273,886 exposed workers. This report was based on statistics supplied by six laboratories approved for monitoring external exposure, including the IRSN dosimetry laboratory, and using the SISERI system.

The analysis conducted by IRSN revealed the following salient points:

- the number of workers monitored in 2005 was higher than in 2004 (+7%), covering practically all fields of activity;
- the decrease in collective doses that started at the end of the 1990s is continuing, especially in the nuclear industry and medical sector, whereas the corresponding number of workers monitored has tended to increase. However, in the sector of non-nuclear industries, collective doses have remained practically the same for about 10 years;
- the number of workers who received a dose exceeding the regulatory limit of 20 mSv in 2005 was, for the first time, less than 50.

www.irsn.org and www.net-science.irsn.org

STUDY OF WORKPLACES IN THE VICINITY OF MEDICAL ACCELERATORS

In 2006, upon a request from France's nuclear safety authority (ASN), IRSN conducted a measurement campaign on several high-energy medical accelerators representing the range of facilities in service in France. The aim of this campaign was to check the validity of protection systems implemented against parasite neutron radiation and to evaluate the consequences, in terms of radiation protection, of activating some of the equipment's component materials. The measurement results will allow ASN to draw up recommendations regarding the design of facilities and the dosimetric monitoring of workers.

Prototype RPL dosimeter.

Service in the field of external dosimetry of workers

IRSN currently equips more than half the dosimeter holders in France. In addition to the gradual phasing out of dosimetric film, the technology used has to keep pace with changing regulations. 2006 was marked by the launching of the project for change in passive dosimetry technique which will replace the photographic dosimeter with a radiophotoluminescent (RPL) dosimeter (*see box below*).

in the words of

Patrice FRABOULET,
Head of the "change of dosimetry technique" project

"The eventual phasing out of dosimetric film means to find another technique for the passive dosimetry.
With this in mind, IRSN decided to use a new dosimeter that offers better performance and features so that, in particular, a lower dose threshold can be obtained in accordance with changes in regulations. The Institute launched a call for tender and chose a dosimeter using radiophotoluminescence, proposed by the Japanese company, Chiyoda Technol.
This technique has proved that it provides very good dosimetric performance and will make it possible to modernize the operating process of dosimeters, which will be reusable. IRSN will be the first European organization to use this efficient technique on a large scale, and the cost will be very competitive.
This project represents an important investment for our Institute and provides it with the means of strengthening its commercial position and improving the quality of its service in the field of passive dosimetry."

137 test reports provided regarding inter-comparison exercises *(143 in 2005)*

152,028 workers monitored by external dosimetry *(150,000 in 2005)*

21,978 radiotoxicological analyses *(20,234 in 2005)*

247 whole-body counting measurements *(208 in 2005)*

4

Imperative vigilance in the field of Nuclear security

IRSN's activities in this area cover, first, the protection and control of nuclear and sensitive materials and, second, the protection of nuclear plants and radioactive and fissile material transports against malicious acts.

Protection and control of nuclear and sensitive materials

PHYSICAL PROTECTION OF NUCLEAR MATERIALS

The physical protection of nuclear materials is ensured by a series of concrete and organizational measures designed to provide an in-depth defense appropriate to the risk of theft from or sabotage of plants housing such materials. These measures include detection systems, delaying systems, access control systems and response resources.
Public authorities define the required objectives as regards physical protection and the Ministry of Industry (Minefi) checks that the measures implemented by nuclear operators and holders of nuclear materials ensure compliance with these objectives.

(1) For information, legislation distinguishes between plants subject to a prior authorization and plants subject to a prior declaration, depending on the nature and quantity of materials held.

Expert assessment and inspection activities

IRSN places its technical expertise at the disposal of public authorities to assess the efficiency of physical protection measures adopted or proposed by operators and holders of nuclear materials. When applicable, it proposes any corrective actions that may appear to be necessary. For example, in 2006, the IRSN conducted 156 case analyses, at the request of the Senior Defense representative at the Ministry in charge of Industry (HFD/Minefi)[(1)].

In addition, IRSN experts are appointed by a Minefi order, to carry out inspections under its authority, at facilities where nuclear materials are held. The aims of such inspections are to check that the baselines applicable to the possession of materials are complied with and to allow *on-site* checking for implementation and operational features of the protective measures. In 2006, the nuclear material inspectors conducted 52 inspections, including a specific inspection conducted at the Valduc CEA center (Côte-d'Or), prior to the commissioning of a new materials storage building.
One of the purposes of inspection is to assess the performance of physical protection systems. Throughout the year, the effort was especially focused on:

- electrical fencing;
- remote monitoring;
- access controls;
- nuclear material detection beacons.

Inspections cover compliance with technical instructions and checking that the selected equipment matches the desired objective, considering the plant layout (distance between buildings, location of the security control center, surface area of the zone to be monitored, etc.).

172 inspections related to the control of nuclear materials *(183 in 2005)*

45 support missions with international inspectors for controlling nuclear and sensitive materials *(56 in 2005)*

Physical protection.

Nuclear material measurement in a drum.

FOLLOW UP AND ACCOUNTING FOR NUCLEAR MATERIALS

Expert assessment and inspection activities

IRSN also places its technical expertise at the disposal of public authorities to assess the effectiveness of follow up and accounting measures adopted or proposed by operators and holders of nuclear materials. When applicable, it proposes any corrective actions that may appear to be necessary.

For this purpose, IRSN analyzes the reports required by the regulations and, especially, reviews the measures implemented by the operators in order to:

- have accurate, quantitative and qualitative information on all the nuclear materials that enter and leave the facilities;
- ensure materials follow up, i.e. always know where they are located and what they are used for;
- check that the actual stock of materials held corresponds to the accounting figures they are obliged to maintain.

In 2006, at the request of the HFD/Minefi, IRSN conducted 151 file analyses and 86 analyses of nuclear material inventory reports.

In addition, as above, IRSN experts are appointed by a Minefi order, to carry out inspections under its authority, at facilities where nuclear materials are held. The aims of such inspections are to check that the baselines applicable to the possession of materials are complied with and to allow *on-site* checking for implementation and operational features of the nuclear material follow up and accounting measures. In 2006, nuclear material inspectors conducted 68 inspections at operators' facilities, some of which included an accounting audit. It should be noted that the effort applied during the past three years to authorization and control files now allows operational application of these documents during inspections.

Finally, inspectors conducted 16 technical inspections at facilities subject to declaration.

Metrology of nuclear materials

During checks on nuclear material follow up and accounting, nuclear material inspectors apply measuring systems in order to specify the nuclear materials held by the operators and holders, both for quantity and quality. High-performance systems have to be operated in order to obtain unquestionable measurements.

Inspections involving measurements were conducted by the inspectors at about ten facilites operated by CEA and Areva NC. Measurements concerned various products: nuclear fuel sub-assemblies, plutonium waste, uranium oxide powder, etc.

The measuring systems are therefore constantly being improved in a bid to meet the requirements. In addition to the quality of measurements, efforts are especially focused on:

- developing easily transportable equipment;
- fast implementation (requirement resulting from the obviously short duration of inspections);
- reducing uncertainty for a necessarily short measuring time.

more details

Upgrading the accounting of nuclear materials

In 2006, IRSN initiated a project focused on restructuring national accounting of nuclear materials. The aim is to redesign the system, based on twenty years' of experience feedback.
This restructuring includes first, improvement of the coding system applied by operators when preparing their account statements and second, development of a tool for entering the account statements, which will now be e-mailed.
Data transfer via this procedure, associated with the implementation of an electronic signature system, will make it possible to reduce the circulation and archiving of a large amount of hardcopy.

more details

Cooperation with the DOE on metrology of nuclear materials

An agreement was signed in 2006 between IRSN and the US DOE, aimed at working together on topics associated with the protection of nuclear materials. Two cooperative actions in particular concern the metrology of nuclear materials:

- measurements of plutonium masses in different ways: the purpose is to assess new acquisition systems based on the analysis of neutron multiplicities;
- definition of the plutonium and uranium isotopic composition via spectrometry of gamma radiation emissions: the purpose of which is to validate spectrum analysis software.

In anticipation of these studies, experiments were conducted at the PERLA facility of the Ispra European common research center (Italy), which holds reference products: IRSN commissioned the center to create calibrated sources, both for mass and enrichment, in a wide range of uranium 235 enrichment.

TRANSPORT OF NUCLEAR MATERIALS

The regulation stipulates that the transportation of the most sensitive materials must be escorted, and that stops during transportation must be limited to approved areas. During the year 2006, in cooperation with the authorities in charge of escorts and approved stopping areas, and in relationship with transport safety experts, IRSN set up a system of "reflex sheets" specific to nuclear and sensitive material transports.

These sheets are designed on the basis of the radioactive material description sheets defined in the PSS-TMR ("radioactive material transport" special emergency plans set up in the various departments). They describe the features of the transported nuclear materials and specify a summary of risks in case of damage to the packages (radiological, thermal, chemical hazards, etc.). They also specify actions to be taken immediately and actions to be avoided, as well as the safety distances to be observed for the response teams and for the public (evacuation zone). These sheets were released at the end of 2006.

Irradiated fuel shipment container.

INTERNATIONAL CONTROLS ON NON-PROLIFERATION

In compliance with the application of treaties against nuclear and chemical proliferation in France, the French authorities asked IRSN to collect and/or draw up the activity declarations due under these treaties, to support inspectors from the international bodies visiting French territory, to analyze the justification documents thus produced, and to advise the operators.

In 2006, to support industrialists in drawing up their declarations, IRSN posted a new non-proliferation section on its website. This section describes the international agreements, the control bodies (Euratom, IAEA, OPCW), the obligations and rights of the organizations concerned and provides the required declaration media.

In parallel, IRSN conducted preliminary studies for converting declarations to electronic format, enabling faster processing of information by international bodies.

www.irsn.org/non-proliferation

Chemistry

During the past year, IRSN prepared and sent to the Ministry for Foreign Affairs, for the OPCW:

- the declaration on activities conducted in 2005 by the 144 chemical sites in France;
- the declaration of activities planned by 23 of these sites in 2007.

IRSN mobile laboratory.

Furthermore, IRSN provided support for all six inspections requested by the OPCW at French civil facilities. On these occasions, the OPCW did not issue any comment relative to compliance with the provisions of the Convention in France.

Within the scope of its advice activities with industrialists, the Institute has written a manual on declaring chemical products listed in Table 1 (most sensitive products), and implemented various initiatives designed to prepare the industrialists concerned for the new sampling procedure followed with *on-site* analyses, a procedure that the OPCW wishes to implement starting from 2007.
Consequently:

- bilateral exchanges were initiated with the OPCW, in order to negotiate agreements protecting the industrialist interests: for example, on-site analyses might be carried out in the mobile laboratory developed by IRSN;
- an awareness-raising and information meeting for industrialists, together with advisory assignments to the most concerned sites, were organized.

Nuclear

In 2006, insofar as regards nuclear materials, IRSN centralized over 600,000 lines of declarations received from French operators, before transmitting them to the European Commission. The Institute also prepared and forwarded to the French authorities 39 declarations required by the IAEA under nuclear non-proliferation safeguards. In total, 1,400 notices of transfer of materials were analyzed and forwarded to the authorities in charge of checking application of the various international agreements.

Changes to European Commission controls in France had a major impact for IRSN, which provided support for 55 inspections, including two audits at the La Hague (Manche) and Melox (Gard) sites. IRSN also took an active part in the ESARDA working group on the audit method as a tool for Euratom controls, and in the negotiations over transmission to the Commission of certain documents associated with the inspected facilities.

Furthermore, in relation to the future application of the Euratom/Japan agreement, IRSN supported the French authorities in negotiations over the technical provisions for application of the agreement.

Finally, IRSN and the authorities in charge of applying the additional protocol to the nuclear non-proliferation safeguard agreements, developed procedures that allow national management of the so-called additional access procedure, which may now be applied by the IAEA with 24 hours notice.

international

Ten years of application of the Convention prohibiting chemical weapons

The Convention prohibiting chemical weapons was enforced on April 29, 1997. Insofar as regards its application in France, the Government relies on IRSN, which provides technical support relative to the civil sector. Consequently, since 1997, the Institute collects the annual declarations issued by about 250 plants and its experts have provided support for 48 inspections, as representatives of the French authorities.

IRSN published a statement on these activities during the information meeting intended for industrialists jointly organized by the Ministry of Industry and the Chemical Industry Union, on September 27, 2006.

This meeting provided an opportunity to raise awareness among the French chemical industry representatives of current changes in the application of the Convention.

Protection against malicious acts

IMPROVING REGULATORY TEXTS

In 2006, IRSN continued the work undertaken during previous years on reinforcing and harmonizing defense code legislation relative to the protection of nuclear materials against theft or diversion, and that relative to the protection of nuclear materials and facilities against sabotage. In particular, at the request of the HFD/Minefi, IRSN was involved in writing the draft decree to apply Articles L.1333-1 and following of the French Defense Code. IRSN also proposed a number of draft orders on specific topics, such as the procedures for nuclear material holding authorization, material follow up and accounting, general provisions for transportation, as well as the case of small holders of nuclear materials. IRSN also participated in the preparation of the National Security Directive (DNS) for nuclear activities, in application of the new decree relating to the protection of activities of vital importance. Finally, IRSN was involved in work conducted by the General Secretariat for National Defense (SGDN) regarding changes in legislation on nuclear materials dedicated to the deterrent force.

These tasks will be pursued in 2007, especially with the preparation of draft orders relating to protection studies, physical protection provisions, and the various modes of transportation for nuclear materials.

SECURITY OF RADIOACTIVE SOURCES

The study program aimed at tightening up security for radioactive sources that are potential targets of malicious acts, initiated by IRSN in 2004, was continued in 2005 and 2006. In particular, protection measures designed to prevent or limit the consequences of a malicious act perpetrated using a radioactive source were proposed for operating, storage, movement and transportation phases. A progress report was sent to the various authorities that may be involved in this activity. Furthermore, calculations were initiated with a view to specifying the consequences of malicious acts involving radioactive sources.

INTERNATIONAL ACTIVITIES

In 2006, at the request of the IAEA, IRSN participated, as an instructor or speaker, in international courses covering design basis threats (Tunisia), physical protection of research reactors (Australia), and basis for physical protection of nuclear materials and facilities (Algeria). The Institute also took part in two IPPAS missions (International Physical Protection Advisory Service) in Serbia-Montenegro and in Mexico.

IRSN took part in various working groups implemented by the IAEA, with a view to drawing up guidelines that basically cover: the fundamentals of nuclear security, the principles of protection against the threat of sabotage, the protection of transport, the protection of radioactive sources, the definition of design basis threats, the identi-

in the words of

Gérard Charneau, Head of the Economic and Nuclear Infrastructure Security Department at the Ministry of Industry, Economy and Finance (HFD/Minefi)

"**What are the latest changes made to the regulations?**
The first change concerned the protection and control of nuclear materials, for which it was necessary to update the application decrees of the 1980 Act, by explicitly integrating facilities, which were not integrated until now, thus allowing improved reporting on the protection of nuclear materials.
The second concerned vital activity sectors. A national security directive, especially dedicated to nuclear activities, was drafted in 2006, aimed at tightening security for nuclear sites and facilities.
Finally, we implemented the provisions of the Convention on the physical protection of nuclear materials (CPPMN), adopted in 2005 by the IAEA.

What was IRSN 's contribution to these works
IRSN was deeply involved in preparing the documents related to these regulations.
It supported the Minefi and the Ministry of Foreign Affairs during the CPPMN drafting process, initiated in 1999 and adopted in 2005.
In 2006, it provided its expertise in restructuring the regulatory framework relative to security in the nuclear sector and was partly in charge of document drafting."

International Atomic Energy Agency in Vienna.

more information

Security of radioactive sources

As from 2004, a working group was set up within the Institute, with a view to producing a review of radioactive source security in France, and propose measures to deal with the risk of malicious acts. The hazard thresholds defined by the IAEA provided a frame of reference for determining the sources to be included in the scope of the study. These were grouped into various families having similar characteristics (design, use, mobility, etc.) and the operating conditions of the most sensitive sources were thoroughly reviewed in order to propose, if necessary, appropriate protection-improving measures. A progress report was sent to the relevant authorities at the beginning of 2006. A further report will be submitted in 2007.

fication of vital zones in nuclear facilities and protection principles for the fourth generation reactors.

The Institute also took part in a working group, sponsored by the ESARDA European Association, concerning the new inspection procedures to be implemented by the European Commission. It involved representatives of the European operators and of national and international control bodies. On this occasion, IRSN was able to demonstrate its extensive experience in this activity.

Finally, cooperation established since 2004 with the US Department Of Energy (US DOE) resulted in the development of a method for assessing the internal threat to security, which was adopted by the IAEA and is due to be published in 2007.

in the words of

Roger BRUNT,

Director of the Office for Civil Nuclear Security (OCNS, Great-Britain)

"I consider the European Nuclear Security Regulators Association (ENSRA) as a most interesting place to discuss the issues involved in nuclear security regulations in Europe. All ten member countries maintain a deep mutual confidence, and can thus discuss such problems as the terrorist threat, beyond the scope of information that is accessible to the public.

Due to their involvement in the ENSRA, regulatory authorities such as the British OCNS, and technical bodies supporting the authorities, like IRSN, can learn from the experience of other member countries and promote consistent security levels in the civil nuclear industry in Europe. Finally, the ENSRA members, signatories of the IAEA Convention on the physical protection of nuclear materials and facilities, share the objective of encouraging best practices, not only in Europe but worldwide, proposing common approaches at international meetings."

5

Ensure operational and technical support in an emergency

In the event of a major radiological emergency, IRSN would provide the public authorities with operational technical support, based on its monitoring and alert networks, its emergency response center, its mobile response and measurement resources and its know-how in physical and biological dosimetry. The Institute ensures the relevancy of this expertise by constantly upgrading its tools and response resources.

Renovating IRSN's mobile radiological response resources

Since 2005, IRSN has been implementing a modernization scheme for its mobile response resources in case of radiological emergency, in the bid to fulfil its duty to provide technical support to the Public Authority.

The scheme reflects a new strategy for resource deployment in the field: the vehicles and equipment dedicated to the measurement of samples collected in the environment, are now separate from the resources assigned to population radiological monitoring. Specific resources are also provided for managing the entire system. Various vehicles and equipment were purchased in 2006.

VEHICLES FOR ENVIRONMENT CHARACTERIZATION

Two kinds of vehicle are involved. Four emergency reponse vehicles have been operational since the first quarter of 2006, designed to transportthe measurement coordination team in the event of an accident. They are fitted with measuring and sampling equipment used to meet first-degree emergency assistance requirements, and include office space. To shorten journey times, these vehicles are located across France: in Agen (Lot-et-Garonne), Fontenay-aux-Roses (Hauts-de-Seine), Les Angles (Vaucluse) and Le Vésinet (Yvelines). The Institute is also purchasing laboratory-vehicles, designed for mass measurements of samples collected in the environment (earth, plants, liquids, sediments, foodstuffs, etc.). The year 2006 saw confirmation of the manufacturer's proposal selected

0 actual action taken by the emergency response center *(2 in 2005)*

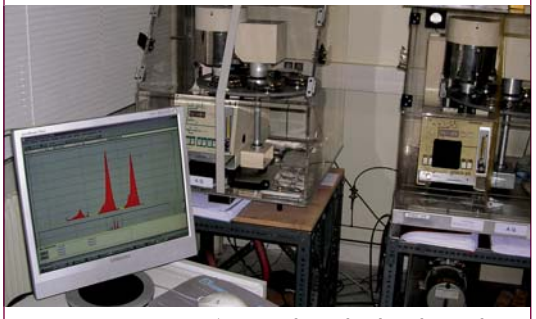
10 national nuclear emergency exercises (excluding defense-related activities) *(9 in 2005)*

77 dose assessments by biological dosimetry *(8 in 2005)*

more details

IRSN expert appraisal in the polonium 210 case

In November 2006, the poisoning of the former Russian secret agent, Viktor Litvinenko, with polonium 210, and the detection of traces of this radionuclide in various places in London, resulted in the IRSN becoming involved in an assessment of this type of contamination for French citizens present in these places.
To this end, a urine analysis protocol for polonium 210 was validated by the Institute.
At the beginning of December, the Health Protection Agency (Great Britain) requested the Institute to communicate its operational capability in terms of polonium 210 analysis resources, with a view to making use of them if necessary. Furthermore, the British authorities communicated to the French Nuclear Safety Authority a list of French citizens identified as being present in the contaminated places around November 1, 2006. 24 analyses were performed, but no contamination was detected.



A protocol was developed to analyze polonium in urine.

Prototype satellite communications unit onboard all new generation mobile resources.

New generation laboratory vehicle for measuring environment samples.

and the development of the first vehicle, for which the acceptance procedure was conducted in December; after testing and operational qualification of this first mobile laboratory, two other vehicles of this type will be purchased in 2007 and 2008.

VEHICLES FOR PERSONAL EXAMINATION

In 2006, IRSN completed the RFQ procedure for delivery of two expertise vehicles dedicated to whole-body measurements and intended for mobilization in order to treat individuals exposed to an internal contamination hazard. Delivery of the first vehicle is planned for the first half of 2007. The second vehicle will be ordered when tests conducted on the first vehicle are considered successful. For this purpose, it will scour the country to monitor workers in nuclear medicine departments.

TEAM COORDINATION AND COMMUNICATION IN THE FIELD

The IRSN crisis management system involves the deployment of teams and equipment in the field.
Communication with the Crisis Technical Center (CTC) and among the different teams sent to the site should be fast, efficient and permanent. In order to meet these requirements, satellite communications equipment has been specially developed for facility onboard each IRSN vehicle. The prototype has been tested since the Autumn of 2006, during emergency exercises in which the Institute is involved.

To make the overall system more robust and ensure timely crisis management, a so-called "command vehicle" project was decided in 2006. This vehicle will be the CP of the mobile cell officer in charge of coordinating all the Institute resources deployed in the field. It will also allow data and information collected locally to be centralized as well as communications and interchange with the CTC management cell. The equipment is designed for 24/24 operation.

Organization of environmental radioactivity measurements in the event of an emergency

The interministerial directive of November 29, 2005, on performing and processing environmental radioactivity measurements specifies

in the words of

Henri MASSE,
Préfet, Defense and Civil Security Officer,
Senior Defense representative

"The DDSC relies on the IRSN in managing nuclear or radiological hazards. Thus, in the event of an emergency or an emergency exercise, the Institute provides technical and educational support to the Prefectures and response teams in the field, both for the purposes of assessment to be performed and for assessing the potential impact on the population and environment.
From the health point of view, it provides whole-body checks and dosimetric assessment resources.
IRSN is also involved in feedback on emergency response exercises and supports the Prefectures in the preparation ad revision of PPI (specific response schemes) and their ORSEC systems relative to the transportation of radioactive material.
Finally, the Institute also provides its expertise in post-accident activities, as in 2006 during the exercise conducted that same year at the Chinon faciliity (Indre-et-Loire)."

that, in the event of a radiological emergency, the organization of measurements must be detailed for each specific action scheme, in a measurement master scheme (PDM) approved by the *Préfet*.

In addition, the directive includes the development by IRSN, under DDSC control, of support guidelines on drawing up the PDM, intended for the Prefectures. In 2006, IRSN defined a PDM draft structure and drew up an initial version of the support guidelines, based on its experience in emergency exercises.

The Institute also provides practical illustration of application of these guidelines with a draft master measurement program (PDM) for the Paluel CNPE (Seine-Maritime), mainly based on information provided by the Seine-Maritime Prefecture.

The PDM will eventually provide an operational baseline for crisis management, shared by all involved in measurement, and organized around four main points:

- availability of basic information about the site and the environment;
- assignment of responsibilities to each player, described in specific action sheets for each phase of the crisis situation;
- description of the organization and interfaces between players;
- reminder of the principles and strategies used in preparing measurement and sample schedules.

Developing a national policy on the management of post-accident situations

The main purpose of the Executive Committee for management of the post-accident phase in the event of a nuclear accident or radiological emergency situation (CODIR-PA), implemented by the Safety Authority in June 2005, is to establish the policy governing the organization and action of the Public Authority in a post-accident situation.

Throughout the year, IRSN was deeply involved in the related tasks, and took part in six out of seven working groups set up.

The Institute drew up two accident scenarios to support the working group's studies, and led the group in charge of assessing the radiological and dosimetric consequences for the environment and people; in 2006, the work of this group basically concerned action to be taken immediately after the end of the emergency phase, i.e. once radioactive releases are over or very low.

The key results of this work on the post-accident phase in the event of a nuclear accident include:

- the IRSN proposal for the initial basis of a policy on the lifting of sheltering after a short radioactive release (a few hours); this study proposes a set of references to help the Public Authority decide whether to let people stay in the area or to move them temporarily, bearing in mind the amount of time required to perform radioactivity measurements in the field and take decisions;

more details

Raising awareness of IRSN's expertise capabilities in emergency situations

In the event a radiological emergency situation, whether or not this requires initiating an emergency plan, IRSN provides technical support to public authorities.
It provides them with expertise and advice, especially for the emergency response center, together with response teams and resources.

In a bid to raise awareness of the different kinds of situation for which IRSN may intervene and the various components of the "technical platform" that may be mobilized in such situations, the Institute published a brochure aimed at the public authorities and risk managers describing the variety and capabilities of the resources available and specifying the provisions for mobilization.
A second brochure, intended for hospital units that may have to treat people who may have been exposed accidentally, has also been designed. Both will be released in 2007.

Environmental radioactivity measurements in the event of an emergency are essential.

opening up to society

Guidelines for agricultural environment management in the event of a nuclear accident

Under an agreement signed on December 27, 2005 between IRSN, the agricultural technical coordination association (ACTA), the ASN and the Ministry of Agriculture and Fisheries (General Directorate for Food), IRSN and ACTA were asked, in 2006, to prepare decision-aid guidelines for agricultural environment management in the event of a nuclear accident.

These guidelines should provide an overview of how to manage a nuclear accident in France and of the environmental contamination phenomena involved, as well as methodological support intended for Government agencies and agricultural businesses concerning livestock and crops, in order to mitigate the impact on production.

This support consists of "reflex" sheets describing action to be taken in the agricultural environment, during the release threat phase or at the beginning of the post-accident phase.

- a comparative analysis of predictive assessment methods, based on models and measurement techniques used to characterize deposits in the soil quickly, in order to determine the doses to people who may be exposed and the contamination of agricultural production;
- drawing up management guidelines for agricultural environments (*see box above*).

international

The urban environment: a major challenge in the post-accident phase

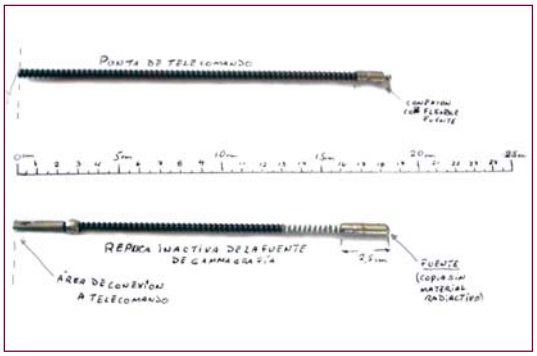
With over 70% of the population in developed countries living in urban areas, the radiological impact of contamination in such areas is a major issue in preparedness for a possible post-accident situation.

In 2006, IRSN conducted two actions related to this area. Its involvement in the Urban Remediation working group of the EMRAS program, controlled by the IAEA, consisted, firstly, in drawing up a list of computational software designed for assessing exposure levels of the people living in urban areas contaminated due to an accident, and secondly, in a review of the effectiveness of rehabilitation operations in these areas. By the end of 2007, the EMRAS program should result in recommendations on the best operational software and most effective operations.

Under the EURANOS European project, IRSN reviewed a European guide concerning management of contaminated built-up areas, which included the issue of drinking water supplies in post-accident situations.
This relied on a group of local players (elected representatives, association members, representatives of Government decentralized agencies and department technical agencies), involved in the Belleville-sur-Loire post-accident exercise in March 2005. Descriptive sheets were produced on decontamination techniques for the urban environment, specifying the relevant operational requirements and their effectiveness.

IRSN, an international expert in irradiation accident management

The Institute's skills in assessing and mapping received doses, diagnosing radiation-induced injuries, and therapeutic strategy, were put into practice in response to a number of accidents.



Source used in a gammagraph.

In 2006, the results of research work carried out by IRSN on the subject of radiopathology were applied in actual accident situations: local irradiation of individuals in Chile, Senegal and Ivory Coast, whole-body irradiation of a worker in Belgium and the consequences of radiotherapy in Epinal (*see Challenge 7 on page 75*).

www. irsn.org

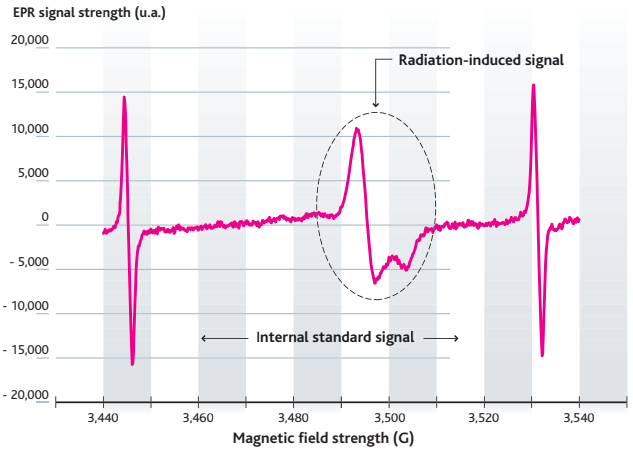
Insofar as concerns the accident in Chile, the doses received by the victim were reproduced through physical dosimetry, as a surface and in-depth mapping of injuries. This helped guide the surgery needed to eliminating tissue that received more than 20 Gray (Gy). The therapeutic strategy, organized in close cooperation with the Percy Hospital, used the injection of mesenchymal stem cells, a technique developed during IRSN experimental research into the treatment of radiation-induced burns.

more details

Operational EPR in the event of an irradiation accident

Dosimetry based on the electronic paramagnetic resonance (EPR) spectrometry is operational for many years at IRSN for various interesting materials, such as tooth enamel, dentine, bone tissue and sugars located in the environment close to an irradiated individual. In 2006, it was successfully applied on tooth enamel and bone biopsies during irradiation accidents that occurred in Chile and in Africa. The R&D work covers the decrease in detection limits, the reduction of uncertainty and also the dosimetric characterization of other materials to perform population screening in the event of a major radiological accident. For population triage, nails are extremely interesting because the analysis can be performed rapidly and even several days after exposure, provided however, they are stored at low temperature. Furthermore, the signal is linear up to 100 Gy, with a detection limit being estimated at 2 Gy. A protocol describing the steps involved in preparation, measurement and analysis of the signal and dose assessment has been already drawn up.

Other promising materials are also under study, such as plastic materials and glasses materials that may be recovered from an irradiated individual (mobile phone, glasses, watches,.).



EPR spectrum of a tooth enamel biopsy.

This world-first application of cell therapy for treating local irradiation is a major step forward in the highly complex treatment of this type of radiation-induced pathology. Insofar as regards the accident in Belgium, the biological dosimetric analysis of radiation-induced chromosomal anomalies was used to confirm the radiological origin of clinical symptoms observed in the irradiated individual and the exposure scenario. At the same time, the accident was reproduced using digital simulation to validate the received dose and this, in particular, made it possible to assess its heterogeneity. This last factor was essential in deciding the therapeutic strategy, in which a cytokine treatment was preferred to a bone marrow transplant.

Biological dosimetry was also used in screening people for exposure during the Dakar and Abidjan accident, in which 63 individuals were involved. This expert assessment involved the Institute's entire biological dosimetry laboratory: several weeks were required for microscope counting of radiation-induced chromosomal anomalies (over one million chromosomes were observed). Irradiation heterogeneity can also be confirmed through measurements performed using electronic paramagnetic resonance (EPR) spectrometry. This technique, operational at IRSN (*see box on page 68*), was successfully applied in 2006 during the Chile and Africa accidents.

in the words of

Thierry de REVEL,
Hematology Department Manager, Percy Hospital

"Cooperation between IRSN and the Percy Hospital proved its efficiency in 2006. During the accidents that occurred in the course of the year (in Chile, Belgium and Africa), IRSN provided its skills in physical and biological dosimetry, and we were then able, quickly and jointly, to plan the therapeutic protocols appropriate for each specific situation. The medical treatment of the young Chilean man was only possible thanks to the accurate assessment of the irradiation.

This assessment, performed by IRSN laboratories, allowed us to define an appropriate therapeutic strategy. Discussions with IRSN also covered the research work carried out at the Institute on mesenchymal stem cells, and the transplant we were able to perform on this patient was a world first."

ABOUT DEFENSE

CRISIS SITUATION EXERCISES INVOLVING INVENTORY OF NUCLEAR MATERIALS

Every year, the IRSN prepares and conducts, on behalf of the HFD/Minefi, a crisis situation exercise involving the inventory of nuclear materials. The basic purpose of this type of exercise is to test both the organization implemented and the methods applied to check, as early as possible, whether nuclear materials have been stolen or diverted.

In 2006, two exercises were carried out. One concerned the Eurodif and Cogema plants in Pierrelatte, the second concerned the Valduc CEA center. The first exercise tested a scenario highlighting the synergy between nuclear safety and monitoring and accounting methods.
The second exercise was based on the assumption of theft in relation with a malicious act. Each exercise involved up to one hundred people, and lasted six hours. A new exercise is already being planned; it is due to be carried out during the first half of 2007, at one or more EDF nuclear power plants.

FACILITY PROTECTION EXERCISES

At the request of the HFD/Minefi, IRSN prepares, conducts and assesses security exercises in the area of nuclear facilities physical protection. These exercises aim to test the decision-making system, the coordination and interfaces between participants (operators, public authorities, etc.).
Therefore, preparations for a national security exercise, the third of its kind, were initiated in June 2006. Working groups, consisting of representatives from the administrative and legal authorities, gendarmerie, police force, EDF and IRSN, worked out a "malicious" crisis scenario involving approximately 200 people. The exercise, planned for 2007 at an EDF plant, will be conducted by IRSN agents and the Institute will be in charge of supervising the assessments required.

1 emergency exercise related to the security of facilities
(1 in 2005)

4 emergency exercises related to the safety of defense-related facilities
(4 in 2005)

6

Low level chronic exposure: more thorough analysis required

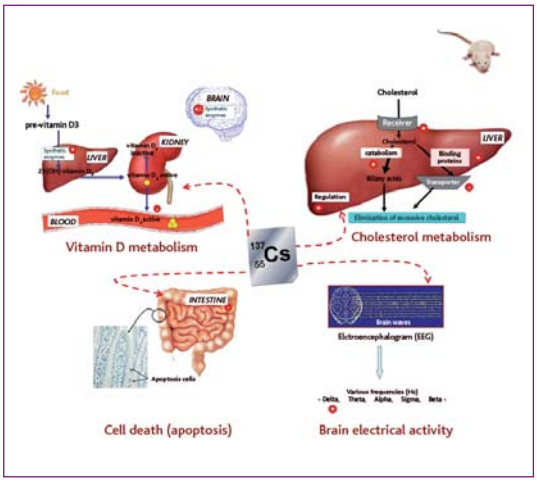
Current radiation protection guidelines are based on long-term observations performed on exposure levels following the Hiroshima and Nagasaki explosions. Extrapolation to low dose rates is the subject of much scientific debate. The aim of IRSN's activities related to low level chronic exposure is basically to acquire data and develop knowledge in this area, which is yet to be fully explored.

ENVIRHOM

The purpose of the ENVIRHOM program is to assess the impact of chronic exposure to low-dose radionuclides on human beings and the environment.

IMPACT ON HUMAN BEINGS

The first years of the program were devoted to studying the feasibility of an innovating experimental approach, based on observation of the effects of uranium administered in the drinking water of rodents, with conclusive results. In 2006, a new research line was opened up to gain a better understanding of the biological and health consequences of long-term exposure to cesium 137. The initial studies were performed on rodents, in order to develop our



Effects of chronic contamination (three months) via 137Cs ingestion (150 Bq/day) in rats.

international

First results of the EPICE program

The EPICE program, launched in October 2005, is aimed at improving our knowledge of pathologies showed by children living in contaminated area as a result of Chernobyl accident. The first phase of the program involved 49 children living in contaminated areas, in the south-west of Russia, and presenting specific cesium 137 activity ranging from 0 to 80 Bq/kg.

Analysis of the results shows that no link can be found between contamination by cesium 137 and the existence of cardiac arrhythmia, which is evenly distributed regardless of the specific cesium activity for children. Insofar as concerning cataracts, eight out of nine cases are found in the group of children showing a specific cesium 137 activity of less than 10 Bq/kg.

Furthermore, no evidence of cesium 137 activity in excess was found in heart, thyroid or stomach for 42 out of 49 children. However, it is interesting to note that, among the seven children showing higher activity in the thyroid, five suffer from a cataract, a pathology that will be studied in the second phase of the program.

The *Daphnia Magna* crustacean was selected to conduct experiments covering several generations.

knowledge of cesium behavior in the body and its effects on large physiological systems. Cesium toxicity was thus analyzed in the intestine, central nervous system and in the metabolism of vitamin D and cholesterol.

Most of the results have been published in international scientific journals. Following ingestion of cesium in the same quantities as are likely to be received in post-accident situations, there was little evidence of effects on intestine (in terms of morphology, inflammatory status or secretory functions) not on central nervous system (locomotor activity or quantity of certain chemical substances synthesized in the brain (neurotransmitters). Nonetheless, after 30 days' contamination, cesium significantly modified the wake-sleep cycle of the contaminated animals. Concerning results about metabolisms, it appears that cesium added to drinking water modifies the level of vitamin D in blood, and induces changes in the liver and central nervous system, to the expression of genes involved in the metabolism of this hormone. Similarly, changes in the expression of genes involved in cholesterol metabolism were observed in the liver. All these results suggest that in vivo metabolism of vitamin D and cholesterol may be modified by the ingestion of cesium 137. Most of the changes observed are specific to biological effects, but do not systematically result in pathological consequences.

Also, the experimental model used claims to represent healthy adults and cannot simulate the behaviour of more sensitive and more fragile individuals, such as young children or individuals predisposed to certain pathologies. Research will thus continue, both in order to obtain results in areas still to be explored (immunology, reproduction, cardiovascular and endocrine systems), and for other categories of population.

EFFECTS ON ECOSYSTEMS

Implementing an environmental radiation protection approach requires knowing the levels of chronic exposure to radionuclides which are likely to cause damage in ecosystems.

This implies considering the environment as a set of ecosystems hat must be protected rather than as a simple food chain for human beings. The practical implementation of such a change in perception comes up against a lack of knowledge, especially insofar as regards the biological effects due to chronic exposure to low doses and in a multiple contamination context.

In practice, defining ecosystem protection criteria requires a number of extrapolations, especially for predicting the incidence of effects observed on the biological functions of individuals at the higher ecological organization level represented by populations. The approach consists in determining, for various exposure conditions (internal or external), the relative sensitivity of individual functions (survival, reproduction age, fecundity), in order to model the impact on population dynamics. These developments require fine measurements of the energy consumed in major processes (maintenance, growth, reproduction)

opening up to society

Presentation of epidemiological studies to the Cli

Some population groups living in the vicinity of nuclear facilities are worried about the increase in the number of child leukemia cases, and of cancers in general. For this reason, the Cli are querying the IRSN on this topic more and more frequently. In June 2006, the Institute presented a statement on the studies carried out, especially in conjunction with the Inserm, on child leukemia to the Cli at the Bugey (Ain) plant.
It is now possible to conclude that no overall increase in the risk for leukemia is reported in the vicinity of nuclear facilities. Furthermore, the Cli of the Tricastin (Drôme) and Gravelines (Nord) plants questioned the Institute about the impact on health of chronic exposure resulting from the operation of nuclear plants. As a result, IRSN and the Ancli decided in December 2006 to set up a working group in charge of analyzing the Cli requests and jointly establishing a procedure to respond to them.

more details

Assessment of the radiological risk for ecosystems

A tool for computing radiological hazards for natural ecosystems (CARREN tool) was developed in 2006 by IRSN, under the EDF/IRSN/CEA research tripartite agreement. This tool is designed to assess chronic risks for ground and aquatic ecosystems (continental and marine) associated with the normal operation of electricity-producing nuclear plants, which involve controlled releases of liquid and gaseous radioactive effluents.
Risk assessment is based on the method typically applied for chemical materials released to the environment, recommended by the partners of the European ERICA project (FP6). Based on cautious assumptions, the first step provides a simplified assessment: for the receiver ecosystem, a risk index is calculated according to the ratio between the concentrations in the medium and the concentrations considered as ineffective for the same medium. This approach is based on the assumption of the additivity of risks associated with the various radionuclides present in releases, which is consistent with the assumption applied in chemical activities when various substances are present.
IRSN extended the use of the CARREN software to assess the acute risk associated with incidental releases.

CARREN software is used to assess risks for ground and aquatic ecosystems, for normal or incidental operation of nuclear electric power plants.

governing population dynamics. In particular, the amount and quality of energy dedicated to producing the next generation seem to provide a clue about the renewal capacity of a population, as shown by studies conducted in the short term (resistance of young people in a fasting situation) and in the medium term (impact over several generations).

A small water crustacean called *Daphnia Magna*, characterized by a short lifetime of about one month, was selected by IRSN to carry out the experiments.
This organism, which is widely used in ecotoxicology, was selected for the fact that it is easy to control and has a fast reproductive cycle, thus saving time and cutting the workload and the cost of data acquisition.

The research carried out in 2006 on this organism showed a decrease by approximately 15% in the growth of individuals chronically exposed to americium 241 (23 days), as from a 110 µGy/hr dose rate (UNSCEAR considers that effects are observed on aquatic organisms as from 400 µGy/hr). Female fertility remained unchanged for one generation, but the ovum and larva numbers produced were reduced as compared with a non exposed control group. The additional energy consumption induced by the stress associated with chronic internal exposure to an α emitter is passed on to the next generation. This is suggested by lower resistance to fasting observed in young individuals born from irradiated mothers as compared with those born from non-irradiated mothers. Other studies on external exposure γ (up to 31 mGy/hr) concluded that the energy delivered by a γ emitter was 30 times less efficient than the same energy delivered by an α emitter for the survival of second generation young individuals. Finally, contamination by americium 241 continued over three generations (10 weeks) with an internal dose rate varying from 0.4 to 40 µGy/hr resulted in a net effect on the survival of the second and third generation individuals.

Chronic risks

PECTIN: FIRST STATEMENT OF ACTION TAKEN BY IRSN

At the request of the French Ambassador in Belarus, IRSN analyzed the interest of administering pectin to reduce contamination by cesium 137 of children living in contaminated areas in Belarus. A review of the literature, published in February 2006 by the Institute, also helped identify the studies that would be required to answer

Research on the Envirhom program: making progress due to the many lab experiments carried out by PhD students and Post-doctorate students.

unresolved questions. This analysis was presented at a meeting with the parties involved in May. A clinical study protocol was then defined, in liaison with the Minsk Belrad Institute, and proposed to the members of the CORE program approval committee. A recommendation concerning the purposes and implementation of this study will be delivered in 2007.

NEW ENVIRONMENTAL RADIATION PROTECTION CONCEPT

In July 2006, IRSN published a document entitled "*Environmental radiation protection: summary and prospects*", in the Policies and Summaries collection. This document describes the state of international knowledge regarding the assessment of environmental risks associated with the contamination of ecosystems by radionuclides and follows on from the document entitled *Environmental protection, IRSN's position*. IRSN policy and summary documents provide all the parties concerned with information on which to base the develpment of their own opinions.

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in the words of

François BRÉCHIGNAC,
Scientific Activity and Assessment Manager

"CIPR's fifth committee in charge of environmental protection against ionizing radiation has been set up. This is a key step in the history of this organization. Founded by doctors, it was, until now, dedicated to human protection, based on the assumption that, as mankind is one of the most radiation sensitive species, everything contributing to human protection systematically contributes to the protection of other living beings present in the environment.
This assumption was challenged, as it relies on a logic that has not been scientifically demonstrated, as explained by IRSN in the notice published in 2005.
At present, CIPR's Committee 5 is in charge of developing an environmental radiation protection system (plants and animals), that will be consistent not only with human radiation protection, but also with protection against other toxic products, especially toxic chemicals. IRSN's involvement in this committee reflects the Institute's desire to contribute to efforts to maintain a sustainable environment."

7

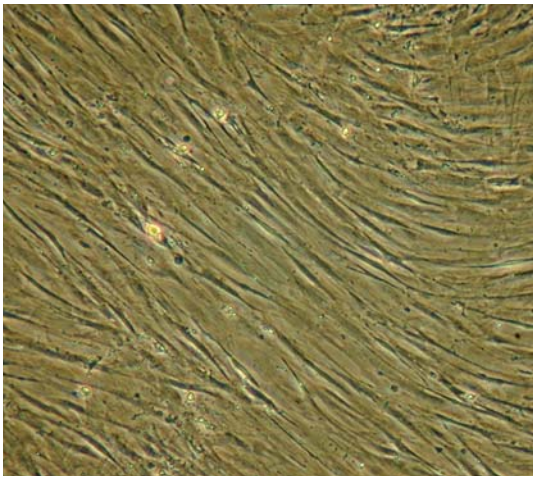
Optimizing professional practice

IRSN activities in the area of protection against ionizing radiation in the medical sector concern both health professionals and patients. Above all, they are aimed at optimizing professional practice in order to reduce exposure without diminishing the medical benefits. With this in mind, the Institute has developed cooperative partnerships with various organizations in the medical sector.

DEVELOPING PROTECTION AGAINST IONIZING RADIATION IN THE MEDICAL SECTOR

Research carried out by IRSN, in partnership with the Institut Gustave Roussy, in preventing and reducing early and late side effects of radiotherapy, aims to optimize the use of ionizing radiation in medical treatment and to improve assessment of the risks associated with such treatments.

A survey conducted in 2006, based on samples from patients undergoing radiotherapy treatment for prostate cancer and suffering from radiation-induced fibrosis of the rectum, revealed the extent of damage to blood vessels in the development of these side effects. The involvement of specific growth factors , such as the TGF, was demonstrated. Furthermore, significant progress was achieved in



Use of mesenchymal stem cells in the treatment of radiation induced injuries.

opening up to society

Cooperation to improve radiation protection for Hospital patients

IRSN launched a cooperative project with the managers of Belfort-Montbéliard Hospital, within the framework of the "radiation protection" pilot project embarked upon in 2004 by the Montbéliard region urban consortium.
In 2006, this cooperation dealt with two aspects:

- support in setting up a new radiation physics and radiation protection unit encompassing activities associated with the protection of patients and workers and applying its skills across the board for the benefit of all departments concerned;
- radiation protection of radiology patients in which IRSN was involved in justification for and optimization of treatment. Concerning the justification of treatment, the Institute provided advice on the position of the radiologist as the preferred contact for treatment prescribers and the only person responsible for the final decision. Insofar as concerns optimizing treatment, the Institute contributed to drawing up the specifications for centralized image management software, with a view to integrating all relevant information on radiological exposure due to examinations performed into patient records.

The use of mesenchymal stem cells affords real hope in the treatment of radiation induced damage.

the development of new therapeutic approaches aimed at treating such radiotherapy toxicity.
IRSN's results, mainly obtained through animal experimentation, demonstrate the interest of a therapeutic strategy based on the use of mesenchymal stem cells in the reconstruction of healthy tissue lesions. These results are still to be confirmed, but afford real hope for improving treatment of radiotherapy toxicity.

APPLICATION OF IRSN EXPERTISE FOLLOWING THE EPINAL RADIOTHERAPY ACCIDENT

Thanks to this research, together with the Institute's expertise in radiopathology and the treatment of highly irradiated tissue, IRSN was in a position to respond to the request for assistance issued by the Health Minister in October 2006, following the radiotherapy accident that occurred at Jean Monnet Hospital in Epinal (Vosges). This accident involved 24 patients treated for prostate cancer. An error in operating the software that controls the radiotherapy equipment resulted in excessive exposure of the rectum and bladder. This excessive exposure generated very severe complications for several of the patients, which could, in some cases, develop into a rectal perforation. IRSN performed a comprehensive and accurate re-assessment of the doses received by each victim and the consequences. The medical treatment of the victims, intended to provide the best treatment, resulted from a joint decision based on research conducted by the Institute in this area.

MICADO, A TOOL FOR RADIOLOGISTS

In December 2006, IRSN posted the MICADO dose computing software on its website. Reserved for radiology professionals, this software enables the entrance surface dose to patient during conventional radiology examinations to be estimated. MICADO software is designed to support application of the Order of February 12, 2004, relative to diagnostic reference levels (DRLs) in radiology and nuclear medicine, requiring radiology and nuclear medicine departments to submit each year to IRSN the doses received by 20 patients undergoing key examinations. The data collected by IRSN are used to update the diagnostic DRL. The progress report shows that, after three years, application of this regulation remains inadequate in radiology (only 430 sites out of approximately 6,000 in France sent data to IRSN), and is quite satisfactory in nuclear medicine (over 50% of sites complied). MICADO software should help to improve the situation in radiology.
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more details

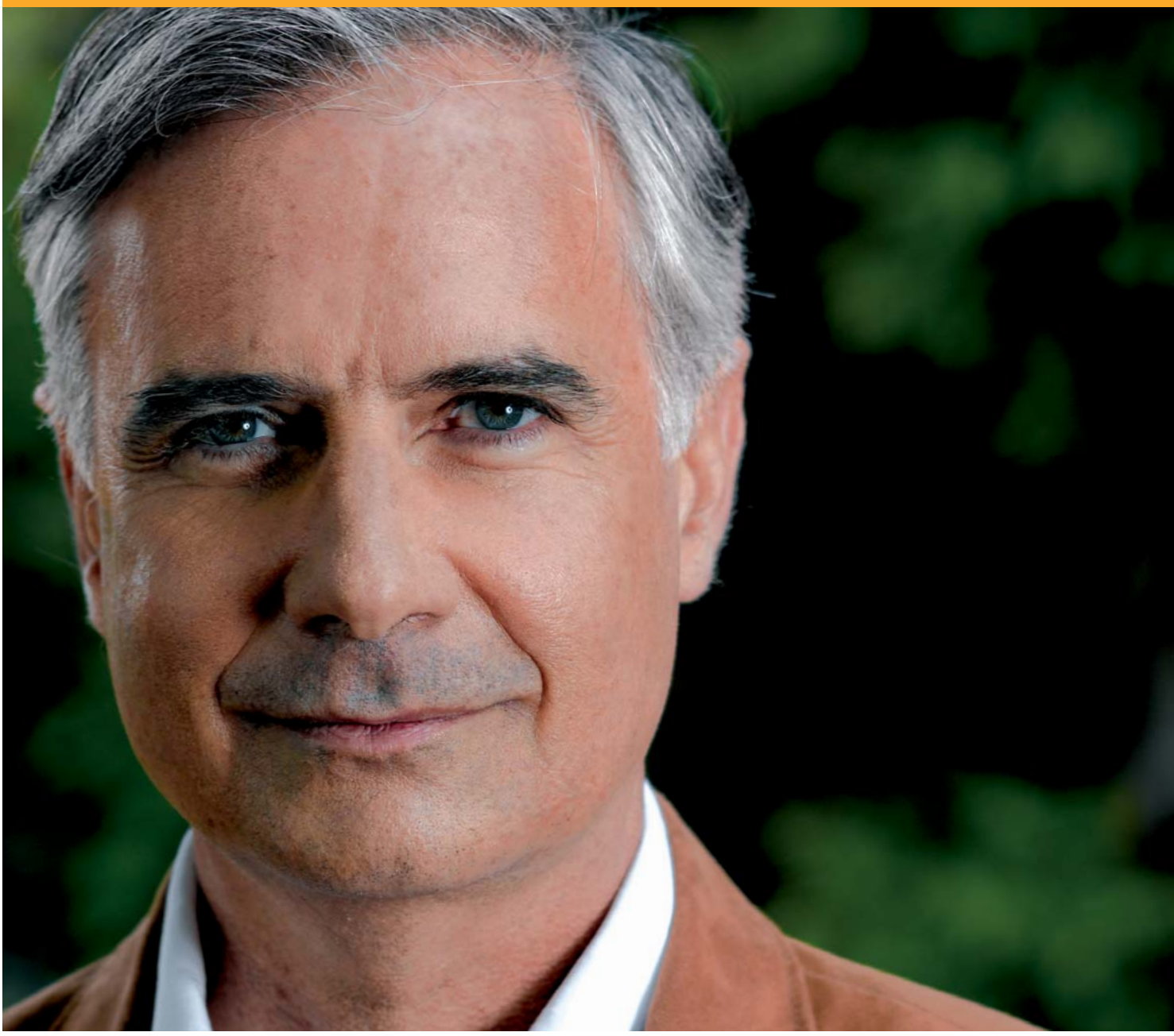
Analysis of a radiation protection incident

In 2006, IRSN analyzed the incident that occurred in March 2005 at Frédéric Joliot Hospital in Orsay (Essonne), during the synthesis of a radioactive pharmaceutical preparation. After the detection of a disfunction in the manufacturing process, the agents opened the shielded enclosure containing the preparation, in order to correct the situation. During this action, an agent was contaminated.

Following the incident, the manufacturing device was transferred to a new shielded enclosure, equipped with an interlocking door system that only the system controller can neutralize.

The IRSN analysis demonstrated the importance of limiting the situations in which an action inside the shielded enclosure may be required: in particular, the agents should be provided with facilities that enable them to identify a malfunction and take appropriate action from outside the enclosure. It also emphasized the importance of not leaving it up to the technician alone to decide whether to stop production or not in the event of a malfunction and of formalizing the decision-making process.

Ensure efficiency



“To guarantee the highest levels of excellence and efficiency, we must integrate a continuous improvement and progress program. We must also maintain a vital link with our environment at all times.“

François BRÉCHIGNAC – Scientific Activity and Assessment Manager


Preparation
As
Supervision note
Mission letter
Assessment file
IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

In order to fulfill the expert assessment and research missions entrusted to it, IRSN implements cross-divisional initiatives, focused especially on human resources, quality, scientific excellence and communications. These initiatives are designed to enable IRSN to enhance the quality, relevancy and understanding of its daily activities.

The real estate master plan

The principle of a master plan for IRSN sites was enacted in 2006 with the Supervisory Ministries. This master plan provides for the Institute's Head Office to move back to the Fontenay-aux-Roses site and for the possible set up of a new site in one of the provinces, to replace the Le Vésinet site.

MOVING BACK TO FONTENAY-AUX-ROSES

IRSN's Head Office was temporarily relocated to Clamart (Hauts-de-Seine) in 1996 when fire destroyed the building that previously housed the Head Office, i.e. the CEA center in Fontenay-aux-Roses (Hauts-de-Seine). The operation to move back to the former Head Office site started in 2005. This involved the purchase, on August 5, 2005, of a building adjoining the CEA Center in Fontenay-aux-Roses, redevelopment of this building and construction of another building at the center. These buildings will house the general management teams and staff departments currently located in Clamart. The building permit was applied for on July 13, 2006 and granted on January 15, 2007.

Furthermore, when IRSN was founded, the public authorities decided to assign the "Annexe" of the CEA Center in Fontenay-aux-Roses to IRSN and leave the other part of the Center, known as the "Fort", to CEA. This means that the operation to relocate to the new IRSN Head Office also involves conversion of part of the "Annexe". This publicly-owned property was returned to the State by CEA and assigned to IRSN by an Order dated November 29, 2006, published in the Official Journal on December 29, 2006.

Illustration of the new Head Office.

POSSIBLE SET UP OF A NEW IRSN SITE IN THE PROVINCES

In response to requests from the public authorities, IRSN studied the possibility of setting up a new scientific and technical center outside the Île-de-France region to replace the site in Le Vésinet (Yvelines). The project, focused on radiation protection of man and the environment, was presented to the interministerial committee for regional planning and development (CIACT) chaired by the prime Minister on March 6, 2006. The CIACT has taken note of the project and asked the Environment and Sustainable Development Minister to study its financial feasibility and its location in liaison with the Institute. At the meeting held on March 28, 2006, IRSN's Board of Directors took note of CIACT's decision and approved the Institute's choice of site location criteria, notably the scientific criteria.

A call for proposals was issued and seven strongly-supported proposals were received by October 15, the closing date set by the public authorities. The proposed sites include Aix-en-Provence (Bouches-du-Rhône), Avignon (Vaucluse), Bordeaux (Gironde), Caen (Calvados), Nîmes (Gard), Valence (Drôme) and Villeurbanne (Rhône).

IRSN presented an examination report on these proposals to its Board of Directors at the meeting on December 5, 2006. As requested by the Board of Directors, the Institute sent recommendations on this project together with a financing plan to its Government Commissioner on December 21, 2006.

A dynamic human resources management policy

The quality of human resources is vital to implementation of IRSN's strategic policy. The Institute has therefore adopted a dynamic human resources management policy. In 2006, several major initiatives concerning employment, training, personnel management and industrial relations were successfully concluded.

71% engineers, researchers and managerial staff *(68% in 2005)*

29% technicians and technical and administrative support staff *(32% in 2005)*

76 employees recruited on permanent contracts *(122 in 2005)*

€1,364 million spent on training *(€1.33 million in 2005)*

45,947 training hours *(42,000 in 2005)*

2,922 people took training courses *(2,100 in 2005)*

OBJECTIVES:

- anticipate the Institute's skills requirements and deal with them in a context of strong competition related to renewed dynamism in the nuclear industry;
- encourage individual skills development and pool skills to promote collective action;
- ensure quality discussions between management and labor;
- stay in contact with the 69 members of staff who have been seconded or leased to other organizations (*see table page 91*).

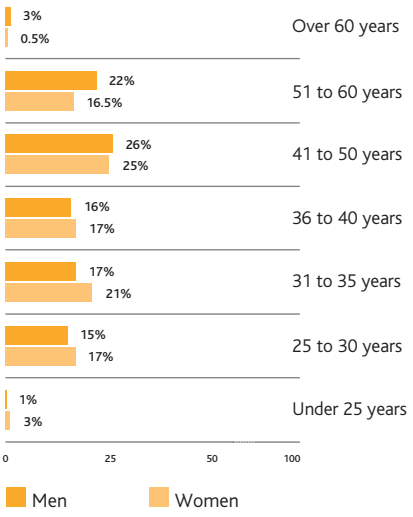
Insofar as training is concerned, in 2006, management and labor negotiated and then signed an agreement on the individual right to training. This mutually-consented agreement provided an opportunity to update and extend all the measures implemented to maintain levels of professional training. The Institute devotes about 5% of its payroll to training and this represents more than 45,000 hours of activity.
As far as recruitment is concerned, the human resources division systematically interviewed and assessed applicants, in accordance with the procedure introduced in 2005. Changes were made to the induction course for new employees in 2006 and thus the whole process of selecting applicants and integrating new employees at IRSN has been adapted over a period of two years. In 2006, about one hundred new employees attended the four induction courses.

Moreover, two operational divisions initiated a process involving the forward planning of jobs and skills. This entailed more than thirty working meetings, mainly with the different laboratory heads, to analyze all the positions in their unit and start drawing up job profiles. This process will be prolonged and extended in 2007.
As for career development, extremely open discussions continued with CEA: in 2006, employees were seconded within the framework of the mobility agreement signed by the two organizations and one IRSN unit manager followed CEA's higher training course.

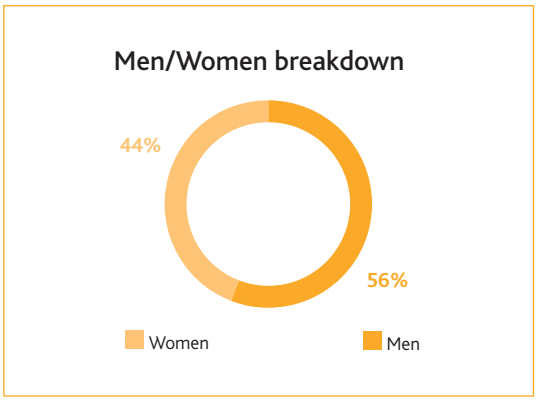
Personnel management also saw the introduction of an intranet portal which simplifies formalities related to outside assignments, holidays, RTT (reduction of working time), etc. for employees while at the same time limiting the issue and circulation of paper documents.

Insofar as regards social welfare, an agreement led to improved benefits from the mandatory mutual insurance

Age pyramid



Signing the DIF agreement (individual right to training) with all the trade unions.



BREAKDOWN OF TRAINING BY DISCIPLINE

Discipline	Breakdown of hours
Economics, management	1.50%
IT	10.30%
Foreign languages	20.51%
Quality, methodology	6.66%
Relations, communication, management	10.28 %
Science and Technology	31.88%
Safety, prevention	18.88%

company chosen by IRSN, with employee contributions remaining low.
Finally, as part of its policy on training through research and taking on trainees, IRSN received 77 thesis writers and 120 trainees in 2006, mainly in fields related to the environment, experimentation and studies.

SUMMARY

13 WORKS COMMITTEE MEETINGS WERE ORGANIZED AS WELL AS 33 PERSONNEL REPRESENTATIVE MEETINGS, ABOUT TWENTY NEGOTIATION MEETINGS, THREE INFORMATION GENERAL ASSEMBLIES FOR PERSONNEL, SEVEN INFORMATION MEETINGS FOR DIVISIONS; NEARLY 1,700 PAY SLIPS WERE ISSUED EACH MONTH; OVER 130 RECRUITMENT INTERVIEWS AND APTITUDE TESTS WERE CONDUCTED; 12,000 ASSIGNMENT STATEMENTS WERE REGISTERED.

in the words of

Patricia de la MORLAIS, Director of Human Resources

"Insofar as human resources are concerned, we are going through a consolidation phase, following the setting up of IRSN. Thus, in 2006 two operational divisions volunteered to initiate forward planning for jobs and skills. Training is very important in our area of activity and 2006 saw the implementation of the individual right to negotiated training (by unanimous consent); professionalization should follow in 2007. In addition, multidisciplinary training for directors was set up. As for tools, progress was made in enabling staff to carry out administrative formalities online and the Institute's pay software was adapted to meet the new declaration requirements. Now that the period of change, following set up of the Institute, is over, staff seem to have developed a sense of belonging to IRSN. Therefore, we now need to work with the different IRSN players to fulfill the Institute's goals as described in the contract of objectives. Building a human resources policy is a long-term process.
It is built gradually, step by step, and must be interactive to motivate all the employees around the same goals."

Total quality management

As part of IRSN's certification process, a mock audit was carried out in 2006 on the Institute's total quality management system. It was carried out by the certifying organization LRQA, prior to the certification audit scheduled for the summer of 2007.

OBJECTIVES:

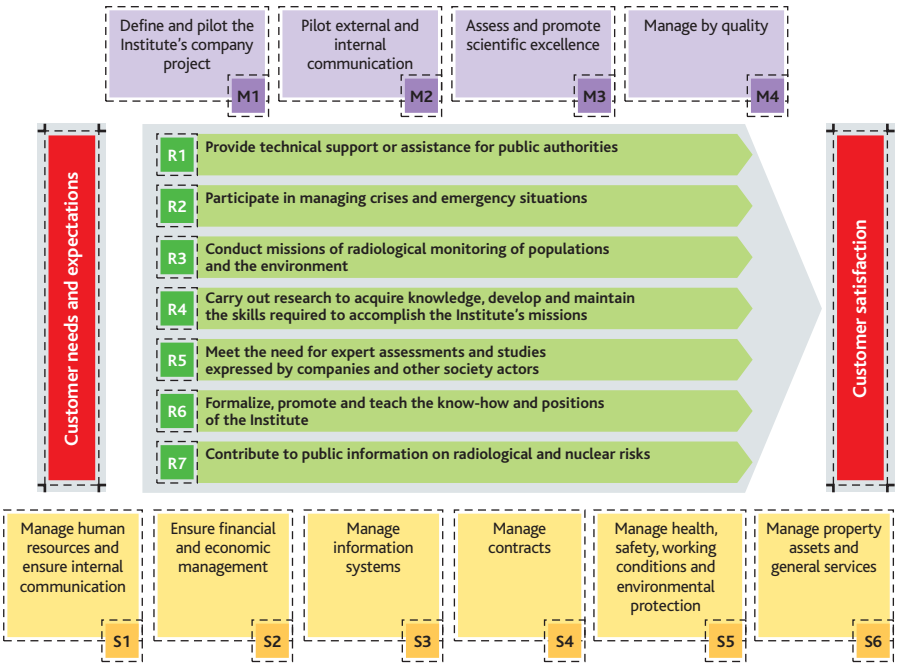
- implement the quality policy by focusing on three main lines of improvement: customer satisfaction, professionalism and the benefits that the whole of society will reap from IRSN actions;
- for each macro-process corresponding to the Institute's different types of activity, (*see mapping of macro-processes*), identify, quantify and monitor the most appropriate objectives and indicators.

The first eight months of 2006 were mainly devoted to preparing the mock audit, with:

- the construction of 80% of the Institute's macro-processes being completed in the summer of 2006;
- training courses to prepare staff for the audit - followed by about 450 employees from November 2005 to September 2006;
- three half-day seminars to inform personnel on progress made on the certification project and the launch of a periodic newsletter on the same subject (the third issue was mainly devoted to preparations for the mock audit);

6 laboratories approved in accordance with ISO 17025 standard *(6 in 2005)*

2 laboratories certified in accordance with ISO 9001standard, version 2000 *(2 in 2005)*



IRSN process mapping.

The auditors day (July 2006).

- the implementation in the summer of 2006 of the first version of ISIMAN, the IT tool that manages the Institute's quality-based system (SMQ).

The audit is a kind of final rehearsal mainly aimed at:
- comparing IRSN's QMS with ISO 9001 standard;
- identifying improvements to be made to this QMS to ensure that it will be granted certification in 2007, i.e. checking that it complies with the standard's requirements (well designed, efficient and capable of running a continuous improvement loop).

The actual mock audit was carried out in three stages:
- June 20: LRQA examined IRSN's documented QMS and audit plans were drawn up at the sites of Fontenay-aux-Roses (Hauts-de-Seine), Cadarache (Bouches-du-Rhône), Le Vésinet (Yvelines) and Clamart (Hauts-de-Seine);
- from September 13 to 29: audit performed;
- October 9: the results were presented to IRSN's Quality Managment Committee and this committee validated the Institute's version of the action plan drawn up after the audit. Meetings to present these results to the personnel were also held in November in Fontenay-aux-Roses, Cadarache and Le Vésinet; 150 employees attended.

The auditors' main conclusions were:
- IRSN's QMS is well designed and appropriate to the Institute's activities;
- personnel involvement is satisfactory;
- however, to receive certification, the system still requires substantial changes to be made - it should be possible to make these changes in a little over six months, which means we should be able to meet the certification deadline.

SUMMARY

IN 2006, THE DEPARTMENT OF SAMPLE PROCESSING AND METROLOGY FOR THE ENVIRONMENT (STEME) OBTAINED COFRAC APPROVAL AS AN ORGANIZER OF INTER-LABORATORY COMPARISONS.

Consolidate scientific and technical excellence

The Institute's scientific and technical excellence policy, pursued since IRSN was set up, is based on promoting the excellence of its teams and activities both within the Institute and among partners. In 2006, the second in-house seminar on scientific excellence provided an opportunity to assess the action taken and commit to new projects.

79 doctorate students
(72 in 2005)

26 post-doctorate students
(24 in 2005)

14 theses vivaed
(17 in 2005)

39 holders of doctorates qualified to direct research
(42 in 2005)

122 publications in scientific journals, with review committees
(144 in 2005)

350 communications at conferences
(350 in 2005)

OBJECTIVES:

Achieve the highest level scientific and technical expertise possible in all IRSN's research and assessment activities, based on three major criteria of excellence:

- the scientific and technical quality of the teams and results;
- the relevancy of the subjects dealt with;
- the efficient organization of scientific and technical activities (methods, cooperation, etc.).

THE SECOND IN-HOUSE SEMINAR ON SCIENTIFIC AND TECHNICAL EXCELLENCE WAS HELD IN APRIL 2006

This aimed to assess the results achieved since the last seminar in 2004 and continue studying ways of making progress in fields that were not discussed at the first seminar.

Several important decisions were taken after this seminar. More specifically, these concern:

- the Institute's scientific and technical assessment system; the seminar highlighted the need to complete implementation of a long-term program of targeted assessments, with the setting up of theme-based scientific councils on some of the Plan's mid- and long-term research projects;
- sustained efforts in continuous professional training and researcher training (doctorate and post-doctorate students), in the Institute's areas of expertise;
- the need to put more effort into scientific communications; as well as encouraging researchers to systematically publish their work, IRSN's work should also be promoted via public media (scientific websites, scientific and technical reports, books).

THE EXPERTS: SETTING UP THE COLLEGE OF EXPERTS

In 2006, the Institute's College of Experts was set up. During its first seminar, at the end of August, the operational rules were set out and a few topics for study were defined, such as: selecting exploratory research projects, identifying subjects for cross-divisional scientific events and helping to develop the medium- and long-term plan (PMLT).

TARGETED SCIENTIFIC AND TECHNICAL ASSESSMENT

Several summary reports on pilot assessments, mainly conducted by outside experts at IRSN's request, were circulated in 2006. These included proposals by the units assessed on how they intended to take the recommendations into account.

The proposals concerned:

- working together with Eastern European countries on radioecology, thermohydraulics and the release of fission products;
- the CHIP program (chemistry of iodine);
- the Biological Dosimetry Laboratory;
- IRSN's safety analysis of the ATALANTE facility.

EXPLORATORY RESEARCH

On the recommendation of a special workshop, the Committee for Scientific and Technical Excellence suggested that the Director General should encourage research project initiatives that showed creativity: the projects chosen should be potential forerunners of new practices and methods, or new programs. As an experiment, a call for proposals was sent out at the beginning of March and four projects were chosen for 2007.

SCIENTIFIC ACTIVITIES

IRSN was involved in developing the ECCOREV research pooling project (continental ecosystems and environmental risks), conducted by the CEREGE (European research hub of L'Arbois), which groups together several partners (INRA, CNRS, CEA, Cemagref and the University of Aix-Marseille, etc.). This research pool should eventually become an important instrument for the "risk management and territorial vulnerability" competitive cluster, set up in the Provence-Alpes-Côte d'Azur region. 57 researchers belonging to four IRSN laboratories are involved.

KNOWLEDGE SHARING

In 2006, IRSN developed a new software tool to manage its scientific publications - MINERVE. Eventually, all IRSN articles published in journals or books, presentations given at conferences and some research reports will be grouped together in a database.

The project on "capitalizing on scientific and technical knowledge" (CCST), aimed at making all documents produced by the Institute available to IRSN employees, was pursued, with the identification of databases that could be grouped together in a global, pooling system and the proposal for an interfacing scheme for the different databases.

Presenting the RST to the BNF.

SUMMARY

IN ITS "*LIGNES DIRECTRICES*" COLLECTION (Guidelines Collection), IRSN PUBLISHED THE FRENCH TRANSLATION OF ICRP PUBLICATION No. 85 "AVOIDANCE OF RADIATION INJURIES FROM MEDICAL INTERVENTIONAL PROCEDURES".

IRSN'S FIRST SCIENTIFIC AND TECHNICAL REPORT (*RST 2005*) SINCE IT WAS SET UP WAS RELEASED IN JUNE 2006. INTENDED FOR THE SCIENTIFIC COMMUNITY, THIS REPORT PRESENTS THE RESULTS OF PROGRAMS THAT REACHED A KEY STAGE IN THEIR PROGRESS IN 2005.

THREE AND A HALF TIMES MORE VISITORS CONNECTED TO IRSN'S SCIENTIFIC WEBSITE BETWEEN 2005 AND 2006 (440,000 VISITORS COMPARED WITH 67,000 VISITS IN 2006).

www.irsn.org/net-science

in the words of

Joseph LEWI,

Director of Scientific, Technical and Quality Assessment

"The seminar held in April 2006 on scientific and technical excellence at IRSN underlined just how much progress had been made since 2004 when a policy on this subject was implemented. Our links with academic research have been strengthened through a substantial increase in the number of doctorate and post-doctorate students; in the future, researchers at IRSN who supervise thesis writers must be "qualified to direct research".
Almost all the results of our scientific work are now systematically published in recognized journals. In the field of scientific assessment, a process that is specific to the Institute has been developed through test assessments. This will now be implemented at all the laboratories.
Finally, a College Experts was set up.
For the future, we plan to specify the Institute's training programs in more detail, in line with the training mission, improve scientific communications and work to improve cross-divisional scientific pooling.
Of course, the teams are expected to work very hard but we have a duty to provide excellence as this ranks us among France's top research and expertise organizations."

Health, safety and environmental protection

In line with the Director General's May 2005 safety policy declaration, IRSN implemented a prevention program in 2006 based on the assessment of occupational risks at workstations in accordance with the quality management process.

OBJECTIVE:
Everyone, whether they are employees at the Institute, or from co-contracting companies or temporary employment contractors, must be able to work at IRSN sites in total safety and in conditions that protect their health.

ASSESSING OCCUPATIONAL RISKS

The identification of occupational hazards and the results of workstation risk assessments are now presented in a single document for each IRSN site. Unit managers use this document to set up prevention initiatives focusing on training, studies or the purchase of personal protective equipment.

In 2006, this assessment was supplemented by the initial assessment of risks related to exposure to substances that are carcinogenic, mutagenic and toxic to reproduction (CMR) and by an in-house guide assessing the ignition hazards of explosive atmospheres.
The occupational risk assessment process is now systematically used to draw up safety files for high-risk facilities. At the end of 2006, there were files of this type for almost half of the high-risk facilities.

REVISING ADMINISTRATIVE FORMALITIES FOR REGULATED FACILITIES

For the Fontenay-aux-Roses site (Hauts-de-Seine), the Institute drafted the impact and hazard studies required by the regulations relative to facilities classified for environmental protection (ICPE). In addition, as part of the project to assign the CEA Center's "Annexe" building in Fontenay-aux-Roses to IRSN (*see text on the Real Estate Master Plan on page 79*), a convention specifying CEA's and IRSN's respective responsibilities with regard to safety was drafted and a working group defined the action to be taken to enable IRSN to acquire the appropriate resources for managing a site of over 1,000 employees.

For Cadarache (Bouches-du-Rhône), the internal emergency plan for facilities classified for environmental protection was drafted, studies on pollution prevention for water supply systems and studies on loading and unloading areas were conducted, in accordance with the requirements of the Prefectorial Order of August 12, 2005.

For Le Vésinet (Yvelines), the Institute declared a new classified facility to the Prefect, covering the uses and storage of all the site's radioactive sources.

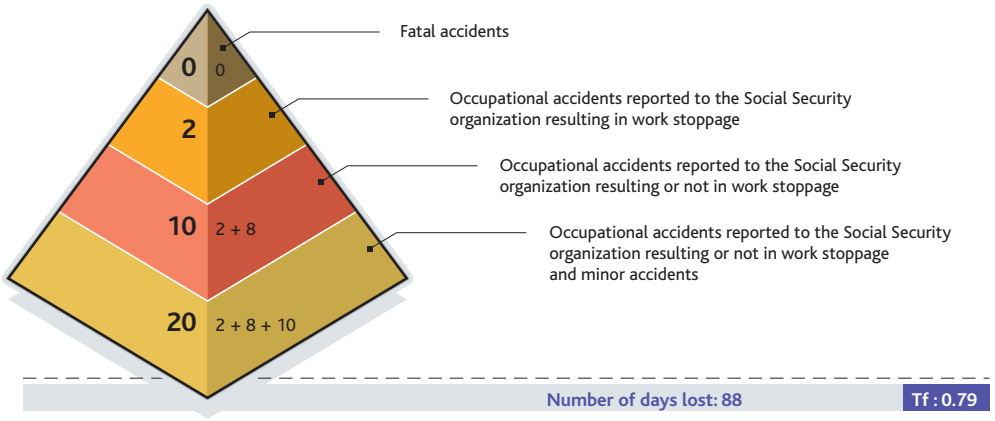
UPGRADING FACILITIES: INVESTMENT OF €2.9 MILLION IN 2006

Work on upgrading facilities in terms of technical and regulatory standards was carried out at facilities which did not comply with current regulations. At Le Vésinet in particular, the conformity of electrical and ventilation systems in laboratories monitoring the environment was upgraded.

At Fontenay-aux-Roses, a safety audit was carried out on Building 02 to decide on its future. Over 200 employees work in this building. Indeed, it is an old building and no longer complies with fire risk or electrical risk protection standards.

Decontamination operations were carried out in the premises formerly used for the storage of radium 226 sources at Le Vésinet and in a disused research laboratory at Cadarache.

27 ICPE under the French Environmental Code *(25 in 2005)*

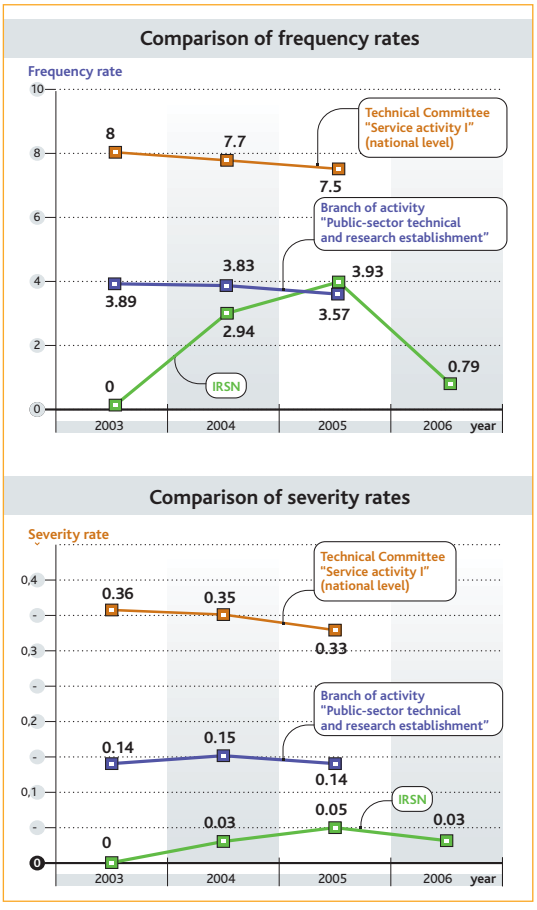


The National Health Insurance Fund defined two national indicators:
- **the frequency rate (Tf):** number of occupational accidents with work stoppage per one million of hours worked
- **the severity rate (Tg):** number of days lost per one thousand of hours worked

Pyramid of accidents occurring in the workplace at IRSN in 2005.

IMPLEMENTING AN IN-HOUSE RADIATION PROTECTION ORGANIZATION

IRSN set up a department specializing in radiation protection, in accordance with regulations, and appointed two radiation protection specialists in charge of conducting workstation studies and monitoring work environments at the Fontenay-aux-Roses and Cadarache sites. This has led to a new distribution of tasks with the host sites' radiation protection departments, which will continue to provide services related to environmental monitoring and incident response.



SUMMARY

THE PROGRAM OF INITIATIVES UNDERTAKEN IN 2005 HAS HELPED MAINTAIN A LOW LEVEL OF OCCUPATIONAL ACCIDENTS (*SEE DIAGRAM*). OVERALL, RESULTS HAVE REMAINED STABLE OVER THE PAST THREE YEARS. TO ACHIEVE THIS, THE PEOPLE IN CHARGE OF SAFETY AND, GENERALLY SPEAKING, ALL THE INSTITUTE'S EMPLOYEES AND EMPLOYEES FROM OUTSIDE COMPANIES WHO COME TO WORK WITH IRSN MADE A HUGE EFFORT TO IMPLEMENT RISK PREVENTION INITIATIVES.

THE INSTITUTE CONTINUED TO PROVIDE ITS STAFF WITH SAFETY TRAINING (1,742 PEOPLE WERE TRAINED) AND STEPPED UP FIRST AID AND FIRE RESPONSE TRAINING. AT LEAST ONE EMPLOYEE IN TEN IS NOW AN INDUSTRIAL RESCUER / FIRST AID ATTENDANT AND ONE THIRD OF STAFF HAVE BEEN TRAINED IN HOW TO HANDLE FIRE EXTINGUISHERS. THIS GENERAL TRAINING WAS ACCOMPANIED BY SPECIFIC TRAINING SESSIONS, SUCH AS AWARENESS RAISING FOR MANAGERIAL STAFF, ON ISSUES OF HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION WHICH CONCERNED 37 HEADS OF DEPARTMENT.

IRSN SET UP A "HIGH-RISK FACILITY OPERATORS CLUB" WHICH BRINGS TOGETHER REPRESENTATIVES OF OPERATIONAL DIVISIONS THAT OPERATE THE MOST SENSITIVE FACILITIES. THIS CLUB'S OBJECTIVES ARE TO IDENTIFY THE PROBLEMS THAT FACILITY OPERATORS HAVE IN COMMON, TO PROPOSE AND SHARE SOLUTIONS AND TO TRY TO HARMONIZE PRACTICES. A REPRESENTATIVE FROM THIS CLUB NOW TAKES PART IN THE INSTITUTE'S ENVIRONMENTAL SAFETY COMMITTEE MEETINGS, WHICH MAKES SUGGESTIONS TO THE DIRECTOR GENERAL ON INITIATIVES THAT COULD BE IMPLEMENTED TO APPLY THE SAFETY POLICY.

Making knowledge and expertise on nuclear and radiological risks accessible

Contributing to public information on nuclear and radiological risks is one of IRSN's missions. In 2006, as part of its goal to obtain ISO 9001 certification in 2007, the Institute formalized the information and communication processes designed to take account of the public's expectations more effectively. Two important information initiatives were also launched in 2006 - one for the 20th anniversary of the Chernobyl accident and the other within the framework of the Act on radioactive waste.

OBJECTIVES:

- contribute to information and meet public demands;
- enhance IRSN's status as a public authority expert on the prevention of nuclear and radiological risks;
- develop a shared culture within the Institute, taking account of the diversity of its activities and strengthen in-house awareness and dialogue.

Road show

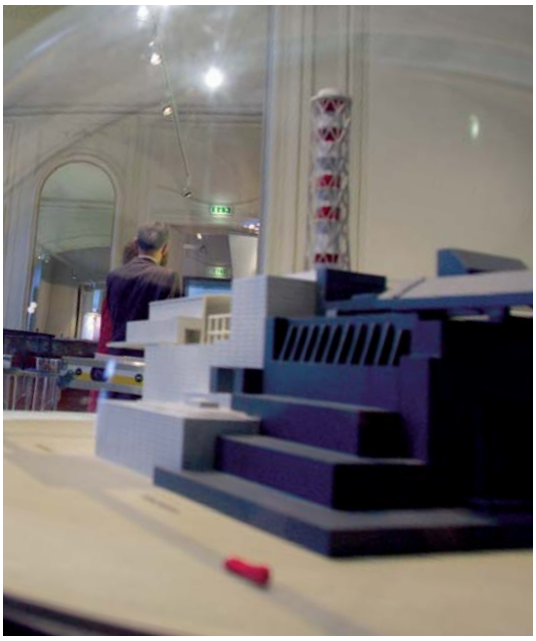
4,500 visitors
(3,360 in 2005)

2 towns visited
(2 in 2005)

5 conferences organized
(5 in 2005)

761 requests for information processed *via* the contact box on IRSN's website "contact@irsn.fr"
(831 in 2005)

1,400,000 hits on IRSN's website
(864,996 in 2005)



The Road Show.

THE CHERNOBYL ACCIDENT

Information initiatives were taken to mark the twentieth anniversary of the Chernobyl accident. A press trip to the Chernobyl site was organized, a booklet on the subject was updated, as was the module devoted to Chernobyl in the IRSN-ASN road show, i.e. "*Nucléaire et société : de la connaissance au contrôle*".

The Institute made a large information file available on the Net listing its entire scientific output over the last twenty years and the lessons to be learnt from this accident. Moreover, on October 11, it organized a conference on the mapping of fallout in France from the accident; this was attended by 85 people from government and administrative departments, health and safety agencies, learned societies and associations.

GEOLOGICAL DISPOSAL OF RADIOACTIVE WASTE

One of the major events for IRSN in 2006 was the Institute's examination of the Andra file on the feasibility of geological disposal of radioactive waste in clay formations. Its opinion was posted online on the Institute's website. In addition, the discussions and studies on radioactive waste management that took place within the framework of the 1991 Act also led to a complete rewriting of IRSN's file on radioactive waste. This is available on the Institute's website.

The MEDEC medical exhibition.

The IRPA Congress.

SUMMARY

MRS NELLY OLIN VISITED IRSN ON FEBRUARY 14. FRANCE'S ENVIRONMENT AND SUSTAINABLE DEVELOPMENT MINISTER WAS IMPRESSED BY THE INSTITUTE'S ASSESSMENT AND RESEARCH CAPABILITIES.

PRESENTATION OF THE IRSN-ASN "*NUCLÉAIRE ET SOCIÉTÉ : DE LA CONNAISSANCE AU CONTRÔLE*" ROAD SHOW FIRST IN FONTENAY-AUX-ROSES, FROM MARCH 18 TO APRIL 14, AND THEN IN MARSEILLE, FROM MAY 9 TO JULY 15. IN MARSEILLE, IT WAS ALSO ACCOMPANIED BY THREE CONFERENCES ON REACTORS OF THE FUTURE, RADIOACTIVITY AND HEALTH, AND THE ENVIRONMENT.

IRSN PARTICIPATION IN THE IRPA CONGRESS FROM MAY 15 TO 19. THE INSTITUTE CONTRIBUTED TO THIS EVENT THROUGH TALKS GIVEN BY ITS EXPERTS AND ITS STAND WHICH PRESENTED THE ENVIRHOM PROGRAM AND ITS WORK ON MESENCHYMAL STEM CELLS, THE NEW THERAPEUTIC STRATEGY FOR THE TREATMENT OF RADIOLOGICAL BURNS.

IRSN HAD A STAND AT THE MEDEC MEDICAL EXHIBITION FROM MARCH 14 TO 17 AT WHICH IT PRESENTED THREE SUBJECTS: RADIOLOGICAL ACCIDENTS, WORKERS' EXPOSURE TO IONIZING RADIATION AND TRAINING IN RADIATION PROTECTION. THE 19 EXPERTS FROM IRSN WHO ATTENDED THE MEDEC WELCOMED OVER 1,000 VISITORS TO THE INSTITUTE'S STAND.

ON JUNE 12, IRSN'S FIRST SCIENTIFIC AND TECHNICAL REPORT WAS PRESENTED AT THE FRANÇOIS MITTERRAND LIBRARY (PARIS).

IRSN AND ITS PARTNERS, GRS AND AVN, HELD THE EIGHTH EUROSAFE FORUM ON NOVEMBER 13 AND 14. THE MAIN THEME CHOSEN WAS "RADIOACTIVE WASTE MANAGEMENT: LONG-TERM SAFETY REQUIREMENTS AND SOCIETY'S EXPECTATIONS". THIS CONFERENCE WAS ATTENDED BY OVER 400 EXPERTS IN NUCLEAR SAFETY FROM VARIOUS COUNTRIES.

in the words of

Marie-Pierre BIGOT,
Communications Director

"What did the Communications team get out of formalizing its work processes?

IRSN is making progress insofar as concerns quality and hopes to obtain ISO 9001 certification in 2007. For the Communications Department, this goal has led to the formalization of processes and procedures that govern its initiatives, whether they involve organizing national or international events, producing information materials, or organizing visits to our facilities. We see it as an opportunity to step back from our day-to-day activities in a bid to improve how we make information available. Our procedures will be audited sometime in 2007.

What is the most commonly used means of communication these days?

The Net! It is the most efficient and responsive way of reaching all our audiences: journalists can find press packs and press releases online, the general public can find files providing more detailed information on subjects presented at exhibitions, and professionals in the nuclear sector can find technical files, etc. It isn't just a communication tool, it is also becoming a tool for professionals.
For example, it allows radiologists to make their dosimetry declarations online.
In a similar vein, IRSN redesigned its intranet site to improve the functions available to employees, thereby enhancing the Institute's efficiency."

(*) Since 2006, IRSN has encouraged people to read and download documents on the Net

4,700 information booklets distributed* *(24,500 in 2005)*

5,500 copies of the Annual Report* *(5,000 in 2005)*

Participated in 3 professional trade fairs or public events *(5 in 2005)*

230 press requests processed

600 mentions in the press *(250 in 2005)*

Appendices

STANDING ADVISORY GROUP MEETINGS IN 2006

The expert assessments conducted by IRSN gave rise to discussions with the following standing advisory groups in 2006: Standing Advisory Group for Nuclear Reactors; Standing Advisory Group for Basic Nuclear Facilities other than nuclear reactors and excluding facilities designed for long-term storage of radioactive waste; Standing Advisory Group for Facilities designed for long-term storage of radioactive waste.

Subjects	Date of meetings
Continuation of safety assessment of ERP nuclear reactor project	01/26/2006
Examination of proposed guidelines on the seismic design of civil engineering works at all BNI	02/02/2006
Containment of radioactive materials awareness days	02/08 and 09/2006
Information meeting on the revision of statutory regulations drawn up within the WENRA framework	02/16/2006
Re-examination of the safety of the MASURCA reactor and examination of the directions taken by the operator with regard to renovation works	03/09 and 16/2006
Examination of operating staff skills management at pressurized water reactors	03/14/2006
Examination of the qualification of equipment to accidental conditions at pressurized water reactors	03/23/2006
Examination of ageing management of pressurized water reactors	05/11/2006
Visit to the Aube disposal centre in preparation for the meeting on June 20, 2006	06/12/2006
Examination of the revision to the Aube disposal center's safety report	06/20/2006
Examination of the assessment of the radiological consequences of accidents on pressurized water reactors and the EPR project	06/29/2006 and 07/11/2006
Examination of the request to increase production capacity of the MOX (Melox) fuel manufacturing plant at Marcoule	05/07/2006
Examination of the preliminary safety report for the EPR project	07/06 and 11/2006
Examination of proposed new ALCADE fuel management system for 1450 MWe reactors	09/28/2006
Information meeting on "severe accident" R&D	10/12/2006
Visit to the French-Belgian fuel manufacturer (FBFC) at Romans-sur-Isère in preparation for the meeting on November 29, 2006	11/22/2006
Re-examination of safety at the facility that manufactures nuclear fuel for research reactors – French-Belgian fuel manufacturer (FBFC) in Romans-sur-Isère	11/29/2006
Examination of strategy to clean up and dismantle CEA's civilian facilities	12/06/2006

IRSN PERSONNEL MADE AVAILABLE OR SECONDED TO PARTNER ORGANIZATIONS

Organization	IRSN personnel seconded	IRSN personnel made available	Total
IAEA	7		7
NUCLEAR SAFETY AUTHORITY		53	53
CEA	1		1
COGEMA	1	1	2
IRSN WORKS COMMITTEE	2		2
EUROPEAN COMMUNITY COMMISSION	1	2	3
EDF		1	1
INSERM		2	2
InVS	1		1
MINISTRIES	1	3	4
RISKAUDIT		6	6
SFRP		1	1
SGDN	1		1
Total	**15**	**69**	**84**

Glossary

A

ADEME
French environment and energy management agency

AECL
Atomic Energy of Canada Limited – Canadian research organization

AFSSA
French food safety agency

AFSSAPS
French agency for the safety of health products

AFSSET
French agency for environmental and occupational health safety

Alcade
Name of a fuel management method used at French power plants

Alpha (α symbol)
Radiation composed of helium 4 nuclei, highly ionizing but not very penetrating; a sheet of paper is sufficient to stop alpha radiation

ALPS
Japanese experimental research program on reactivity injection accidents

ANCLI
French association of local information commissions

ANDRA
French national agency for radioactive waste management

ANR
French national research agency

APOLLO 2
Neutron calculation code used to calculate the conditions governing the nuclear reaction in a fissile medium

ARGOS
Project for developing a scientific and technical assessment platform for the renovation of the radiological remote monitoring network for the environment

ASN
French nuclear safety authority

ASTEC
Accident Source Term Evaluation Code

ATALANTE
Alpha workshop and laboratories for transuranics analyses and reprocessing studies, CEA's R&D facility on reprocessing and waste

AVN
Belgian Vinçotte nuclear association

B

BARC
Bhabha Atomic Research Center (India)

Becquerel (Bq)
Official and international unit for radioactivity measurement; the Becquerel corresponds to one disintegration per second

Beta (β symbol)
Radiation composed of electrons of negative or positive charge; a few-millimeter air screen or a simple sheet of aluminum can stop this type of radiation

BNF
Basic Nuclear Facility

Borax
Boiling Water Reactor Experiment

BSR
Basic safety rule

C

CABRI
Test reactor for fuel safety used by IRSN (CEA)

CABRI-CIP
CABRI International Program with pressurized water loop

Caesium (Cs, atomic number 55)
Noble, toxic metal whose characteristics are comparable to those of potassium

CARREN
Calculation of the radiological hazard for natural ecosystems; dosimetric design code for organisms (fauna, flora) from natural ecosystems

CEMAGREF
French Institute for Agricultural and Environmental Engineering Research

CEN-SCK
Studiecentrum voor Kernenergie – Belgian nuclear research center

CEPN
French nuclear protection evaluation center

CETMEF
French maritime and river technical studies center

CHIP
Study program on iodine chemistry in gaseous phase in the primary system of a PWR during a core meltdown accident

CLARA II
Calculations related to accidental releases to sea, prediction and assessment aid system in case of accidental pollution in Mediterranean

CLI
Local information commission

CNDP
National public debate commission

CNNC
China National Nuclear Corporation (China)

CNPE
French nuclear power generation site

CNR
Compagnie Nationale du Rhône – French electricity utility

CNRS
French National Center for Scientific Research

COB
IRSN-Government contract of agreed objectives

Containment building or reactor building
Leaktight concrete building housing the reactor pressure vessel, primary system, steam generators and main auxiliaries ensuring the safety of a pressurized water reactor

CORE
Cooperation for the rehabilitation of living conditions in contaminated areas

COWAM
Community Waste Management – European program

Criticality (risks)
Risk associated with uncontrolled fission phenomena in fissile materials

CSN
Consejo de Seguridad Nuclear (Spain)

CTC
IRSN's emergency response center

D

DDSC
Directorate of Civil Defense and Security

DGA
French Defense procurement agency

DGS
Directorate-General for Health

DGT
Directorate-General for Labor

DIVA
System used to study fire, ventilation and air contamination

DMP
Interim provision and means

DOE
Department of Energy (USA)

Dosimetry
Detection, by assessment or measurement, of the dose of radiation (radioactivity) absorbed by a substance or a person

DPPR
Division for the prevention of pollution and risks (IRSN)

DSND
Nuclear safety and radiological protection representative for activities and facilities relating to defence

E

EADS
European Aeronautic Defense and Space Company

EBRD
European Bank for Reconstruction and Development

ECCOREV
Continental ecosystems and environmental risks – research federation project including several organizations from the Provence-Alpes-Côte d'Azur (PACA) region

EMRAS
Environmental Modeling for Radiation Safety

ENSRA
European Nuclear Security Regulators' Association

ENVIRHOM
Research program aimed at studying radionuclide accumulation processes and the biological effects, during such accumulation, induced in the living organisms of plants, animals and humans subject to chronic exposure

EPICE
Assessment of the pathologies induced by chronic caesium contamination

EPICUR
Cobalt-60 irradiator used to study the behavior of iodine under radiation (Cadarache)

EPR
European Pressurised Water Reactor

ERCF
Containment for recovering and conditioning drums

ESARDA
European Safeguards Research and Development Association

EURADOS
European Radiation Dosimetry Group

EURATOM
European Atomic Energy Community

EXTREMA
Research program studying extreme climatic events and to the redistribution of sedimentary masses and associated pollutants within a coastal system

F

FPRD
Framework Program for Research and Development (European union)

Fuel assembly
Cluster of fuel rods, connected with a metallic structure, used in nuclear reactors

FUTURAE
A Future for Radioecology in Europe

FzK
Forschungszentrum Karlsruhe – Karlsruhe study center in Germany

G

Gamma (γ symbol)
Highly penetrating but not very ionizing electromagnetic radiation, emitted by the disintegration of radionuclides – shielding of concrete or lead is necessary to protect persons

GRS
Gesellschaft für Anlagen- und Reaktorsicherheit (Germany)

GWd/t
Fuel burnup rate – Giga Watt Days per ton of fuel, customary unit for measuring fuel assembly irradiation, expressed as the energy extracted from the assembly in the reactor per ton of initial uranium

H

HFD
Senior defense representative at the French Ministry of Finance

HFR
High-flux research reactor at Petten (Netherlands)

HSE
Health and Safety Executive (United Kingdom)

I

IAEA
International Atomic Energy Agency

IBPh
Institute of Biophysics (Russia)

IBRAE
Nuclear Safety Institute of the Russian Academy of Sciences

ICRP
International Commission on Radiological Protection

IFEN
French Institute for the Environment

INERIS
French National Institute for the Industrial Environment and Risks

INRA
French National Institute for Agricultural Research

INRETS
French National Institute for Transport and Safety Research

INRS
French National Health and Safety Research Institute

InVS
French Health Watch Institute

IRPA
International Radiation Protection Association

ISAI
Irradiated fuel monitoring installation

ISIS
Calculation software that precisely simulates the progress of a fire, gas, smoke and structures in confined and ventilated premises laid out in any way

Isotopes
Elements whose atoms have the same number of electrons and protons, but a different number of neutrons: they have the same name and the same chemical properties. Around 325 natural isotopes and 1,200 artificially-created isotopes are currently listed

ISPRA
Euratom research center

ITER
International Thermonuclear Experimental Reactor

J

JAEA
Japan Atomic Energy Agency

JNES
Japan Nuclear Energy Safety Organization

K

kV
kiloVolt

L

LOLF
Organic law relating to finance acts

LRQA
Lloyd's Register Quality Assurance Ltd – certifying agency

M

M5™
Type of pressurized water reactor fuel cladding

MASURCA
Breeder model – research reactor (CEA)

MC3D
Multi Composants 3 Dimensions – software program which calculates the corium-water interaction or vapor explosion

MCCI
Melt Coolability and Concrete Interaction – OECD project

MEDD
French ministry for ecology and sustainable development

MEDEC
French health exhibition

MERLUMED
Research program dedicated to the study of pollutions within a food chain including the hake in the Mediterranean

Mesenchymal Stem Cells
Cells from the bone marrow able to proliferate and differentiate into many types of cells

mGy
milli-Gray – unit of absorbed radiation dose of the International System of Units

MICADO
Module Interactif de Calcul de Dose – ionizing radiation dose computer

MINEFI
French Ministry for the Economy, Finance and Industry

MINERVE
Tool used to manage IRSN's scientific publications, including a computerized authorization process and a database feeding

MOX
Fuel of uranium (natural or depleted) and plutonium oxides

MOZART
Analytic tests to study the oxidation kinetics of cladding in air

MRRC
Medical Radiological Research Center of the Russian Academy of Medical Sciences

mSv
milli Sievert – unit of dose equivalent of the international system of units

MULTISTRESS
Research project on the impact of stressor mixtures on the environment

MWe
MegaWatt electric

N

NNSA-NSC
National Nuclear Safety Administration (China)

NRC
Nuclear Regulatory Commission (USA)

NSRR
Nuclear Safety Research Reactor (Japan)

Nuclear fuel
Fissile material (capable of undergoing fission reactions) used in a reactor to develop a nuclear chain reaction ; after being used in a nuclear reactor, this is referred to as irradiated fuel

O

OCNS
Office for Civil Nuclear Security (United Kingdom)

OECD
Organization for Economic Cooperation and Development

OPCW
Organization for the Prohibition of Chemical Weapons

P

PDM
Measurement master program

PERLA
Performance Laboratory – research center set up at the Ispra site

PHEBUS
Experimental reactor

PHEBUS-PF
Experimental program on the degradation of a nuclear reactor core and the release of fission products (FP)

PHÉBUS FPT3
PHEBUS-FP program test

PICSEL
Propagation of fire in solid fuels in laboratory or industrial environments

Plutonium (Pu, atomic number 94)
Transuranic chemical element; the isotope 239 has a half life of 24,110 years

PMLT
IRSN's medium- and long-term plan

PRIME
Research project on the radioecology sensitivity indicators and multicriteria methods applied to the environment of an industrial territory

PRISME
Fire propagation during elementary multi-premises scenarios

PRISMES
Integrated consideration of risks associated with stressor mixtures on aquatic ecosystems and health

PSI
Paul Scherrer Institut, Villigen (Switzerland)

PUI
Internal emergency plan

R

Radiation protection
Set of measures intended to ensure protection of the population and workers using ionizing radiation sources

Radioactivity
Property of certain chemical elements whose nuclei spontaneously disintegrate into other elements emitting ionizing radiation

Radioelement
Natural or artificial radioactive element

Radionuclide
Radioactive isotope of an element

RAPHAEL
ReActor for Process Heat, Hydrogen And ELectricity generation

RBMK
Reactor Bolshoi Moschtnosti Kanalny – pressure tube nuclear reactor cooled by a water-vapor mixture and moderated by graphite (designed by the Soviets, this type of reactor, such as the one involved in the Chernobyl accident, only exists in Russia, Lithuania and the Ukraine)

RNM
National network of environmental radioactivity measurement

S

SARNET
Severe Accident Research NETwork of Excellence – European network of excellence on core meltdown accidents in water reactors (FPRTD 6)

SCANAIR
Software used to calculate an RIA-type transient

SENSIB
Research project on radioecological sensitivity

SHOM
French Naval Hydrographic and Oceanographic Service

SIMMER
Multiphase and multicomponent thermal hydraulics software, coupled to a space-dependent neutron model

SISERI
Ionising radiation exposure monitoring information system

SKI
Statens Kärnkraftinspektion – Swedish nuclear safety authority

SNLE
Nuclear-powered ballistic missile submarine

STEL
Liquid effluent treatment station

STUK
Stäteilyturvakeskus – Finnish nuclear safety authority

SYLVIA
IRSN's software system for the study of ventilation, fire and air contamination

SYMBIOSE
SYstemic approach for Modeling the fate of chemicals in BIOSphere and Ecosystems

T

Trustnet In Action
European and cross-disciplinary network aimed at developing the quality of decision-making processes related to the management of hazardous activities

U

UNSCEAR
United Nations Scientific Committee on the Effects of Atomic Radiations

UO_2
Uranium oxide

V

VAEC
Vietnam Atomic Energy Commission

VARANSAC
Vietnam Agency for Radiation and Nuclear Safety & Control

VTT
Valtion Teknillinen Tutkimuskeskus – Finnish technical research center

VVER or WWER
Vodo Vodianoï Energetitcheskyi Reactor ou Water Water Energetic Reactor – Russian-designed reactors, that operate along similar lines to Western european pressurized water reactors

W

WENRA
Western European Nuclear Regulators Association

WISE-Paris
World Information Service on Energy – agency for information and studies on energy and nuclear industry

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AUTHORS
IIRSN with the assistance of Camille JAUNET (La Clé des mots) and Jean-Christophe HEDOUIN (HIME)

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Sites coordinates,
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Clamart
(IRSN Head Office)
77-83, av. du Général-de-Gaulle
92140 Clamart
Tel.: +33 (0)1 58 35 88 88

Agen
B.P. 27
47002 Agen
Tel.: +33 (0)5 53 48 01 60

Cadarache
B.P. 3
13115 Saint-Paul-lez-Durance Cedex
Tel.: +33 (0)4 42 25 70 00

Cherbourg-Octeville
Rue Max-Paul Fouchet
B.P. 10
50130 Cherbourg-Octeville
Tel.: +33 (0)2 33 01 41 00

Fontenay-aux-Roses
B.P. 17
92262 Fontenay-aux-Roses Cedex
Tel.: +33 (0)1 58 35 88 88

La Seyne-sur-Mer
Centre Ifremer de Méditerranée
B.P. 330
83507 La Seyne-sur-Mer Cedex
Tel.: +33 (0)4 94 30 48 29

Le Vésinet
31 rue de l'écluse - BP 40035
78116 Le Vésinet Cedex
Tel.: +33 (0)1 30 15 52 00

Les Angles – Avignon
550, rue de la Tramontane – Les Angles
B.P. 70295
30402 Villeneuve-Avignon Cedex
Tel.: +33 (0)4 90 26 11 00

Mahina – Tahiti
B.P. 519
Tahiti Papeete, Polynésie française
Tel.: +689 54 00 25

Orsay
Bois-des-Rames (bât. 501)
91400 Orsay
Tel.: +33 (0)1 69 85 58 40

Pierrelatte
B.P. 166
26702 Pierrelatte Cedex
Tel.: +33 (0)4 75 50 40 00

Saclay
Centre CEA de Saclay
91191 Gif-sur-Yvette Cedex
Tel.: +33 (0)1 69 08 60 00

IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Head Office
77-83, avenue du Général-de-Gaulle
92140 Clamart
RCS Nanterre B 440 546 018

Telephone
+33 (0)1 58 35 88 88

Postal address
B.P. 17 - 92 262 Fontenay-aux-Roses Cedex

IRSN web site
www.irsn.org

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DE RADIOPROTECTION
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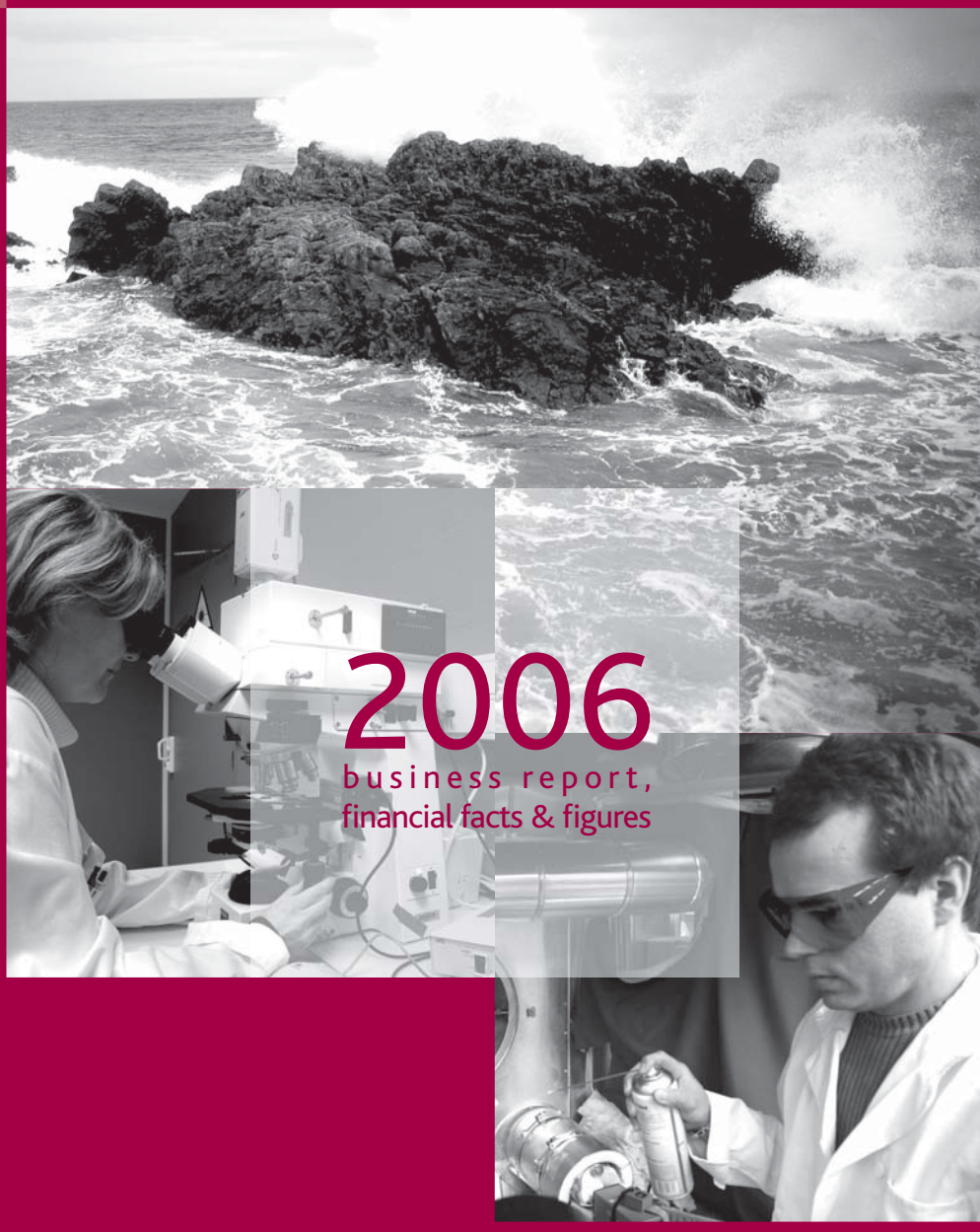


2006

business report, financial facts & figures

Didier DEMEILLERS,
Finance Director

Contents

Management report

1 | OVERVIEW

2006 was an eventful year for IRSN, due to:

- the adoption of the nuclear transparency and safety Act setting up ASN and consolidating the nature of the contractual relationship between ASN and IRSN;
- the signature on July 5 of the first Government-IRSN contract of agreed objectives for the period 2006-2009 and the launch of a medium-/long-term plan, enabling strategic objectives to be quantified;
- direct allocation to IRSN of part of the income from the tax on basic nuclear facilities (BNFs) to finance strategic investment and future dismantling costs, amounting to €4 M in 2006.

However, clarification of the Institute's tax base has yet to be finalized, due to lack of response from the Tax Legislation Directorate (DLF).

Moreover, amending decisions (DM 1 and 2), presented to the Board of Directors in March and June, integrated:

- frozen expenses of €10.6 M created by LOLF (Finance Reform Act);
- carry forward of €12.2 M uncompleted investments from the 2005 financial year, transferred to working capital on 2005 closure;
- an increase in costs and resources of €31 M, relative to the entries for dismantling assets and corresponding provision, pursuant to accounting regulations.

Items carried forward have almost all balanced during the financial year, apart from long-term projects (renovation of headquarters building, new technology dosimetry project).

Implementation of the 2006 budget included a major investment program, in particular:

- transfer of headquarters from Clamart to Fontenay-aux-Roses;
- change of technology in the worker dosimetry monitoring sector;
- launch of a priority investment plan, including renewal of mobile response equipment and improvements to radiological monitoring and radioactivity measurement networks;
- progressive creation of a dedicated fund to finance future dismantling costs assessed at €31 M.

The forecast overall initial investment was around €40 M, €6 M of which was cancelled by DM 2, by withdrawal from the loan reserve set up by LOLF.

It has not been possible fully to complete this ambitious plan during the financial year, €15.2 M of committed and uncompleted operations being carried forward to the 2007 financial year. Most of this sum relates to the three principal operations (transfer of headquarters, dosimetry and monitoring and measurement networks).

Budgetary balance

Year (in €M)	2004[1]	2005	2006 [2]	Change 2006/2005
Total assets	280.2	287.6	306.9	+6.7%
Total liabilities	281.0	268.1	301.7	+12.5%
Balance	**-0.8**	**+19.5**	**+5.2**	**NS**

[1] To enable financial years to be compared, the 2004 financial year is presented with a hypothetical integration of the Institute's new tax basis that only changed on January 1, 2005, resulting in an increase in revenue of €33 M and a corresponding debit of about €23 M. The difference of €10 M enables absorption of the budget deficit arising from the tax underestimate.
[2] The 2006 financial year integrates +€31 M in expenditure on dismantling assets, balanced in revenue by a corresponding provision.

Financial year 2006, like that of 2005, shows a balanced budget, in reality over-valued by the €15.2 M investment carried forward. Reprocessing would result in the following situation:

Reprocessed year (in €M)	2005	2006
Balance	+19.5	+5.2
2005 carry forward	-12.2	+12.2
2006 carry forward	-	-15.2
Net balance	**7.3**	**2.2**

2006 is therefore marked by:

- observance of balances in the EPRD (Interim Income & Expenses Statement) approved by the Management Board;
- a budget completion rate of 94.3% (95.7% in 2005), a variation of €19.5 M, €15.5 M of which is accounted for by deferral of certain investments. Ignoring such deferral, the expenditure completion rate would be 98.8%.

2 | INCOME STATEMENT ANALYSIS

2.1. Revenue

Financial Year (in €M)	2004[1]	2005	2006	Change 2006/2005
Turnover	35.2	36.1	35.1	-2.8%
Subsidies	206.7	240.2	233.4	-2.9%
Other operating income	3.7	2.2	3.3	+33.0%
S/T operations	245.6	278.5	271.8	-2.4%
Financial income	1.4	1.2	1.6	+25.0%
Extraordinary income	6.7	4.2	2.0	-52.4%
Total	**253.8**	**283.9**	**275.3**	**-3.0%**

[1] year not reprocessed; on a comparable tax basis, €33 M subsidies should be added

■ Operating income of €271.8 M, down by €6.7 M in comparison with the preceding financial year (-2.4%) includes:

- €226.2 M subsidy from the Ecology & Sustainable Development Ministry (MEDD), down by €10.6 M, a sum corresponding to cancellation of credit released at the end of 2006;
- €2.9 M under a Defense Ministry agreement, renewed at its 2005 level;
- €0.3 M in other subsidies, notably from local authorities, as against €0.5 M in 2005.
- €4 M partial allocation of income from the tax on BNFs, a provision voted under the 2005 Finance Act amendment, to enable financing of the Institute's priority investments and dismantling of facilities;
- €35.1 M own resources from IRSN expert consultancy activities, joint financing of research programs or other provision of services, down by €1 M in comparison with 2005;
- €3.3 M sundry income, as against €2.2 M in 2005; this income represents patent royalties (€0.1 M, stable), sundry current management income (€0.4 M, stable) and writebacks on depreciation and provisions (€2.8 M, an increase) representing early retirement costs (CAPRON agreement).

■ Financial income of €1.6 M rose as against that of 2005 (+€ 0.4 M, or +33%) due to cash released by deferral of the Institute's investments.

■ Extraordinary income fell to €2 M, against €4.2 M in 2005. This mainly comprises investment subsidies transferred to the Income statement. This accounting operation, inherited from CEA assets and having no impact on the operating balance, will continue to decrease until it disappears completely.

2.2. Expenses

Year (in €M)	2004[1]	2005	2006	Change 2006/2005
Purchases [1]	118.0	128.7	125.5	- 2.5%
Personnel	117.7	109.2	112.6	+3.1%
Tax & rates	1.3	1.2	8.1	+575%
Depreciation	13.6	13.4	15.3	+13.4%
Provisions	4.2	8.3	7.0	-15.7%
Other expenses	1.2	2.1	1.0	-52.4%
S/T operations	**246.0**	**262.9**	**269.5**	**+2.5%**
Financial expenses	NS	0.1	0.3	+200%
Extraordinary expenses	13.8	0.4	0.6	+ 50%
Total	**259.8**	**263.4**	**270.5**	**+2.7%**

[1] 2004 figures relate to the former tax basis, thereby reducing total purchases by about €23 M.

■ Financial year operating expenses rose by €6.5 M to €269.5 M (+2.5%). This moderate variation, reflecting that in prices, conceals significant disparities, broken down as follows:

- personnel expenses up by 3.1% to €112.6 M. This variation is split between a modest increase in salaries, growth in the average workforce and increase in certain welfare contributions (UNEDIC).
- Tax & rates, totaling €8.1 M, increased very sharply by €6.9 M, due to IRSN's subjection to payroll tax from January 1, 2006. This tax levy is however less than the DM 2 provision, insofar as part of the business tax, allocated to tax and rates under DM 2, was provisioned in the accounts while awaiting clarification from DLF of IRSN's tax basis on this point.
- Depreciation allowances (€15.3 M), increased by €1.9 M, to take account of the high level of investment in recent years. Provisions of €7 M relate mainly to taxation (cf. supra).
- Purchases of goods and services fell by €6.6 M to €125.5 M (-5%), as a result of a decrease in the volume of purchases pursuant to partial cancellation of credit (-€10.5 M). These decreased by 2.5% in comparison with 2005.
- "Other expenses" accounts for €1 M, against €2.1 M in 2005.

Year (in €M)	2004[1]	2005	2006	Change 2006/2005
60 - Purchases	58.3	69.1	68.0	-1.6%
61 - External services	42.3	41.1	39.3	- 4.4%
62 - Other external services	17.4	18.4	18.2	-1.1%
Total	**118.0**	**128.7**	**125.5**	**-2.5%**

[1] 2004 figures relate to the former tax basis, thereby reducing total purchases by about €23 M.

Detailed study of this table shows:

- a reduction in the volume of purchases, if account is taken of price increases;
- a very sharp reduction in Item 61 – External services, resulting in particular from the reduction in subcontracting;
- a significant reduction in Item 62 – Other external services.

Financial expenses increased from €0.1 M to €0.3 M, due to loans contracted (€7.2 M + €4.8 M) to finance the new headquarters.

Financial expenses also rose, from €0.4 M to €0.6 M, as a result of subsidies granted to Société Française de Radioprotection (SFRP) and Médecins du Monde, the balance having been paid in the dispute over the fuel leak at the Vésinet site.

3 | RESULTS AND FINANCING

Year (in €M)	2004	2005	2006	Change 2006/2005
Profit or Loss	-6.0	20.4	4.9	-75.9%
SFC	5.1	37.8	22.4	-40.7%
Working capital variation	**-10.8**	**19.5**	**5.2**	**-73.3%**

■ The financial year shows a profit of €4.9 M against €20.4 M in 2005, €3.4 M forecast in DM 2 and €6.9 M in the 2006 EPRD.

The variation of €1.5 M between the DM 2 forecast and the accounts is due to:

- improvement in financial income of €0.6 M;
- reduction in provision write back of €0.6 M;
- reduction in depreciation expenses of €0.3 M;
- reduction in operating expenses by transfer to depreciation of €1.2 M.

The variation of €2 M between the EPRD and the accounts is mainly due to depreciation on dismantling assets.

Year	EPRD	DM 2	Actual
Profit or Loss	6.9	3.4	4.9
SFC	15.6	13.3	22.4

■ The Institute's self-financing capacity (SFC), budgeted at €13.3 M in DM 2 and at €15.6 M in EPRD, is €22.4 M, or +€9.1 M over DM 2, due to:

- improvement in profit of €1.5 M;
- increase in provisions of €7 M;
- reduction in provision write back of €0.6 M.

This SFC of €22.4 M, increased by external resources of €5.3 M (including a €4.8 M loan to finance improvements to the Institute's new headquarters), enables financing of investment and financial debts up to €22.6 M, swelling working capital by €5.1 M.

60%, or €22.6 M, of total planned investments of €37.8 M, has been completed. The difference of €15.2 M is explained by a carry forward of the same amount to the 2007 financial year. A proposal to integrate it in the 2007 DM 1 was presented to the Management Board in March 2007.

4 | BALANCE SHEET ANALYSIS

4.1. Liabilities

■ The profit of €4.9 M has improved the net position (€59.9 M) by 8.9%. Taking account of the gradual decrease in investment subsidies (-€2 M) and the sharp increase in Contingency provisions (+€35 M), including, in particular, the creation of a €31 M dismantling provision, the Institute's investment capital stands at €122.1 M, against €83.8 M in 2005.

■ The increase in short and medium term debt to €94 M (€72.7 M in 2005) is due to the combined effect of subscription to the €4.8 M loan to finance improvements to the Institute's new headquarters, and the sharp increase in supplier debts (+€13.2 M). The remaining variation is caused by tax and welfare debts (+€3.5 M).

4.2. Assets

■ Fixed assets have sharply increased to €99.2 M, (+€36.7 M), mainly due to setting up dismantling assets of €31 M, balanced by a provision of the same amount entered under Liabilities (cf. supra). The net increase of €5.7 M in fixed assets confirms commencement of renewal of the Institute's facilities and equipment.

■ Current assets have also increased to €117 M, the result of an increase in cash of €19.8 M, following carry forward of part of the investments in the sum of €15.2 M, and transformation of a provision for part of the tax burden, while awaiting DLF's clarification of IRSN's tax status.

This healthy €90.2 M cash position is the principal component (77%) of current assets of €116.9 M that should be reconciled with short- and medium-term debts of €94 M. Moreover, the amount of committed but uncompleted investments of €15.2 M should also be covered by current assets. Uncommitted capital is therefore only €7.7 M, whereas contingency provisions, excluding dismantling and tax, amount to €9.4 M, a shortfall of €1.7 M.

The 2006 financial year ends with growth in working capital of €5.2 M, but with a charge of €15.2 M to be made in 2007 for sums carried forward.

CONCLUSION

The 2006 budget has been executed in observance of balances presented to the Board of Directors.

The accounts will henceforth integrate a €31 M provision to cover future dismantling and drainage costs. Financing for this provision will be provided gradually through the setting up of a dedicated fund, provisioned from 2006 by allocation of part of the BNF tax. The guarantee of long-term financing of these costs depends nonetheless on continued provisioning of the dedicated fund that for IRSN depends in turn on continued allocation to it of the portion of the BNF tax income.

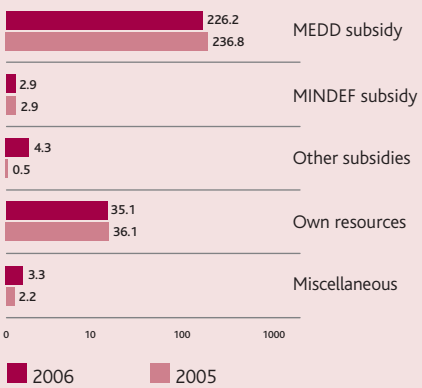
The Institute's tax status is still awaiting clarification from DLF.

Income statement

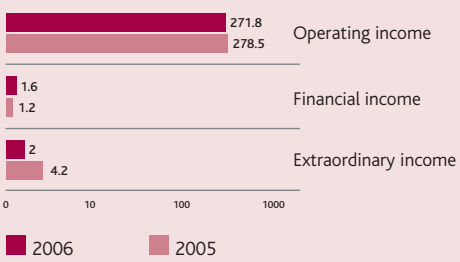
REVENUE

Euros, excl. VAT	2006	2005	2004	2003
Operating income	**271,761,730.22**	**278,533,129.53**	**245,598,908.63**	**235,482,280.96**
Net turnover	35,094,526.08	36,082,032.27	35,164,526.17	35,590,211.96
Operating subsidies	233,413,984.22	240,153,038.38	206,681,399.76	198,098,871.94
Write backs on depreciation & provisions	2,770,683.10	522,051.53	80,417.64	20,504.32
Transfer of expenses	24,721.71	54,410.88	36,839.37	25,349.47
Other income	457,815.11	1,721,596.47	3,635,725.69	1,747,343.27
Financial income	**1,571,625.06**	**1,190,690.45**	**1,446,579.93**	**1,018,763.58**
From holdings		104,780.21		
Other interest & similar income	52,762.66	19,690.46	8,710.77	
Positive currency variation	12,011.51	4,800.05	19,953.00	38,568.13
Net income from sale of investments	1,506,850.89	1,061,419.73	1,417,916.16	980,195.45
Extraordinary income	**2,013,326.86**	**4,146,552.62**	**6,721,564.71**	**25,211,622.50**
Income from asset sales		20,516.72		
Investment subsidies transferred to financial year income statement	1,958,340.98	3,791,414.60	6,554,482.13	18,742,326.22
Non-staggered investment subsidies	28,163.26	265,856.15		
Management operations	26,822.62	68,765.15	167,082.58	6,469,296.28
TOTAL REVENUE	**275,346,682.14**	**283,870,372.60**	**253,767,053.27**	**261,712,667.04**
Debit balance = loss			**6,045,350.60**	
OVERALL TOTAL	**275,346,682.14**	**283,870,372.60**	**259,812,403.87**	**261,712,667.04**

Operating income (in €M)



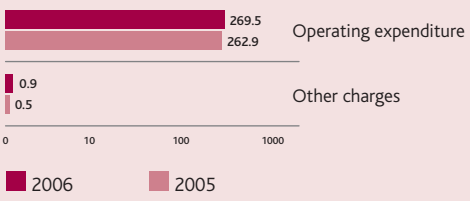
Details of income (in €M)



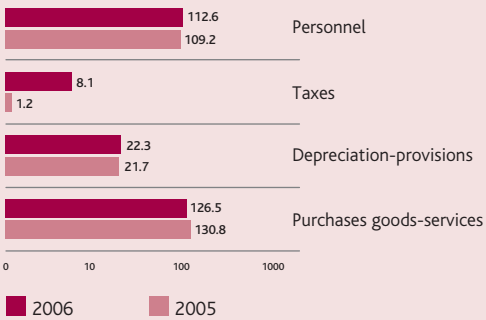
EXPENSES

Euros, excl. VAT	2006	2005	2004	2003
Operating expenses	**269,549,127.59**	**262,953,012.10**	**245,997,066.23**	**261,015,076.71**
External financial year OPEX	125,464,361.29	132,158,168.96	158,454,902.47	182,831,266.23
Tax, rates & similar payments	11,117,320.62	3,302,586.05	2,776,145.74	1,381,124.89
Personnel expenses	109,618,595.41	103,617,061.44	65,805,418.98	45,440,248.53
Depreciation & provisions	22,295,556.87	21,734,857.59	17,771,491.98	28,404,363.46
Other expenses	1,053,293.40	2,140,338.06	1,189,107.06	2,958,073.60
Financial expenses	**323,419.25**	**99,153.11**	**33,456.39**	**21,155.29**
Interest & similar expenses	319,792.03	88,837.44	9,805.48	1,881.88
Negative currency variation	3,627.22	10,315.67	13,650.91	19,199.31
Net expenses on sale of investments			10,000.00	74.10
Extraordinary expenses	**613,616.11**	**375,520.45**	**13,763,131.25**	**260,535.00**
On management operations	263,442.72	292,742.13	13,763,131.25	35.00
On capital operations	350,173.39	82,778.32		500.00
Depreciation & provisions				260,000.00
Tax on profit	**0.00**	**18,750.00**	**18,750.00**	**0.00**
Fixed annual taxation		18,750.00	18,750.00	
TOTAL EXPENSES	**270,486,162.95**	**263,446,435.66**	**259,812,403.87**	**261,296,767.00**
Credit balance = profit	**4,860,519.19**	**20,423,936.94**		**415,900.04**
OVERALL TOTAL	**275,346,682.14**	**283,870,372.60**	**259,812,403.87**	**261,712,667.04**

Details of charges (in €M)



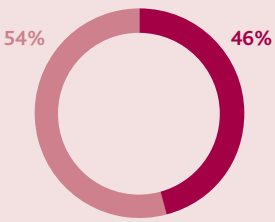
Operating charges (in €M)



Balance Sheet

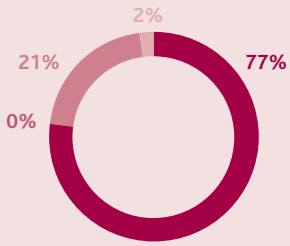
ASSETS

Euros			2006	2005	2004	2003
	Gross	Depreciation & provisions	Net	Net	Net	Net
Intangible fixed assets	10,969,097.47	8,350,866.07	2,618,231.40	1,597,325.37	1,742,147.10	1,845,335.08
Tangible fixed assets	153,110,332.52	58,705,072.59	94,405,259.93	59,558,191.36	47,190,404.05	45,435,018.48
Financial assets	2,139,011.49		2,139,011.49	1,314,180.01	1,196,078.27	635,212.81
Fixed assets	**166,218,441.48**	**67,055,938.66**	**99,162,502.82**	**62,469,696.74**	**50,128,629.42**	**47,915,566.37**
Current assets						
Inventories						34,943.08
Advances & deposits paid on orders	142,937.41		142,937.41	140,499.71	9,824,069.06	7,758,726.96
Operating receivables	26,482,769.80	4,555.79	26,478,214.01	26,716,089.71	48,360,217.79	108,077,954.31
client receivables	*24,551,355.83*	*4,555.79*	*24,546,800.04*	*24,984,581.97*	*29,826,904.94*	*28,178,006.45*
other receivables	*1,931,413.97*		*1,931,413.97*	*1,731,507.74*	*18,533,312.85*	*79,899,947.86*
Sundry receivables					1,069.28	1,069.28
Investments	85,092,342.32		85,092,342.32	65,313,646.29	10,938,217.44	33,680,806.20
Cash	5,254,892.15		5,254,892.15	1,905,219.84	2,565,411.71	10,370,525.94
Prepaid expenses	-			72,469.00	72,469.00	241,517.33
Current assets	**116,972,941.68**	**4,555.79**	**116,968,385.89**	**94,075,455.55**	**71,761,454.28**	**160,165,543.10**
OVERALL TOTAL	**283,191,383.16**	**67,060,494.45**	**216,130,888.71**	**156,545,152.29**	**121,890,083.70**	**208,081,109.47**



Details of assets

- Tied-up assets **€99.2 M**
- Current assets **€117 M**

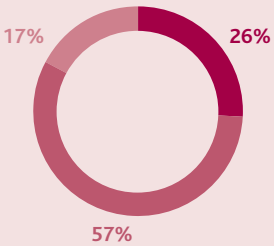


Current assets

- Treasury **€90.2 M**
- Advances **€0.2 M**
- Client receivables **€24.6 M**
- Sundry receivables **€2 M**

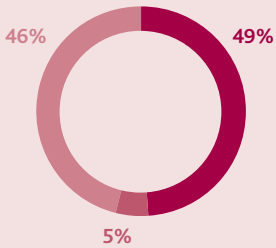
LIABILITIES

Euros	2006	2005	2004	2003
Allowances	8,782,859.59	8,782,859.59	8,782,859.59	8,782,859.59
Reserves	46,222,746.95	31,844,160.61	31,844,160.61	31,428,260.57
Carried forward	0.00	-6,045,350.60		
FY result (profit or loss)	4,860,519.19	20,423,936.94	-6,045,350.60	415,900.04
Net position	**59,866,125.73**	**55,005,606.54**	**34,581,669.60**	**40,627,020.20**
Investment subsidies	6,547,264.28	8,505,605.26	12,297,019.86	18,851,501.99
Equity	**66,413,390.01**	**63,511,211.80**	**46,878,689.46**	**59,478,522.19**
Risk provision	2,013,000.00	1,278,000.00	1,260,000.00	260,000.00
Tax provision	15,375,369.57	9,250,369.57	1,300,000.00	
Expenses provision	38,285,000.00	9,806,000.00	9,882,369.57	8,150,000.00
Contingency provision	**55,673,369.57**	**20,334,369.57**	**12,442,369.57**	**8,410,000.00**
Loans and debts to credit institutions	11,012,752.99	7,283,771.11		136,224.68
Sundry loans and financial debts	190.50	190.50	312.42	312.42
Advances and deposits received on current orders	2,432,850.45	2,468,724.45	2,426,504.71	2,426,504.71
Supplier debts & attached accounts	44,716,299.49	31,459,617.08	33,998,794.86	79,002,887.85
Tax & welfare debts	24,085,228.42	20,529,969.47	16,649,279.72	11,409,966.28
Other operating debts				39,514,301.48
Debts on fixed assets & attached accounts	9,042,920.05	9,306,807.42	6,583,920.72	5,386,816.45
Other debts	2,753,887.23	1,650,490.89	2,792,448.24	2,197,809.41
Accruals			117,764.00	117,764.00
Debts	**94,044,129.13**	**72,699,570.92**	**62,569,024.67**	**140,192,587.28**
OVERALL TOTAL	**216,130,888.71**	**156,545,152.29**	**121,890,083.70**	**208,081,109.47**



Analysis of debts

- Tax and social debts **€24.1 M**
- Debts to suppliers **€53.7 M**
- Sundry debts **€16.2 M**



Invested capital

- Net Assets **€59.9 M**
- Investment subsidies **€6.5 M**
- Provisions **€55.7 M**

Interim balances

ENTRIES	12/31/2006	%	12/31/2005	12/31/2004	12/31/2003
Turnover	35,094,526.08	13.07%	36,082,032.27	35,164,526.17	35,590,211.96
+ Operating subsidies	233,413,984.22	86.94%	240,153,038.38	206,681,399.76	198,098,871.94
FY PRODUCTION	**268,508,510.30**	**100%**	**276,235,070.65**	**241,845,925.93**	**233,689,083.90**
- External OPEX	125,464,361.29	46.73%	132,158,168.96	158,454,902.47	182,831,266.23
ADDED VALUE	**143,044,149.01**	**53.24%**	**144,076,901.69**	**83,391,023.46**	**50,857,817.67**
- Tax & rates	11,117,320.62	4.14 %	3,302,586.05	2,776,145.74	1,381,124.89
- Personnel expenses	109,618,595.41	40.82%	103,617,061.44	65,805,418.98	45,440,248.53
GROSS OPERATING SURPLUS	**22,308,232.98**	**8.31%**	**37,157,254.20**	**14,809,458.74**	**4,036,444.25**
+ Writeback, transfer of expenses	2,795,404.81	1.04%	576,462.41	117,257.01	45,853.79
+ Other income	457,815.11	0.17%	1,721,596.47	3,635,725.69	1,747,343.27
- Depreciation, provisions	22,295,556.87	8.30%	21,734,857.59	17,771,491.98	28,404,363.46
+ Writeback on equipment subsidies	1,986,504.24	0.74%	4,057,270.75	6,554,482.13	18,742,326.22
- Other expenses	1,053,293.40	0.39%	2,140,338.06	1,189,107.06	2,958,073.60
OPERATING RESULT	**4,199,106.87**	**1.56%**	**19,637,388.18**	**6,156,324.53**	**- 6,790,469.53**
+ Financial income	1,571,625.06	0.59%	1,190,690.45	1,446,579.93	1,018,763.58
- Financial expenses	323,419.25	0.12%	99,153.11	33,456.39	21,155.29
CURRENT PRE-TAX RESULT	**5,447,312.68**	**2.03%**	**20,728,925.52**	**7,569,448.07**	**-5,792,861.24**
+ Extraordinary income	26,822.62	0.01%	89,281.87	167,082.58	6,469,296.28
- Extraordinary expenses	613,616.11	0.23%	375,520.45	13,763,131.25	260,535.00
EXTRAORDINARY RESULT	**-586,793.49**	**-0.22%**	**-286,238.58**	**-13,596,048.67**	**6,208,761.28**
- Tax on profit			18,750.00	18,750.00	
FINANCIAL YEAR PROFIT/LOSS	**4,860,519.19**	**1.81%**	**20,423,936.94**	**- 6,045,350.60**	**415,900.04**

Forecasts-operations reconciliation

INCOME STATEMENT in Euros	2006 Budget	2006 - Actual
REVENUE		
Sales of services	39,079,470.00	35,094,526.08
State subsidies	243,320,400.00	233,413,984.22
Other operating income	1,813,930.00	2,109,147.76
Internal operations	5,657,320.00	4,729,024.08
TOTAL REVENUE	**289,871,120.00**	**275,346,682.14**
EXPENSES		
Personnel expenses	112,478,660.00	109,618,595.41
Other operating expenses	147,839,510.00	138,572,010.67
Internal operations	15,600,000.00	22,295,556.87
Emergency reserve	10,574,160.00	
TOTAL EXPENSES	**286,492,330.00**	**270,486,162.95**
RESULT (PROFIT)	**3,378,790.00**	**4,860,519.19**
RESULT (LOSS)	-	-
TOTAL INCOME STATEMENT BALANCE	**289,871,120.00**	**275,346,682.14**

TRANSFER OF RESULT TO SFC TABLE in euros	2006 Budget	2006 - Actual
RESULT	**3,378,790.00**	**4,860,519.19**
+ Depreciation and provisions	15,600,000.00	22,295,556.87
- Portion of subsidies transferred to result	2,200,000.00	1,958,340.98
- Writeback on depreciation & provisions	3,457,320.00	2,770,683.10
SELF-FINANCING CAPACITY	**13,321,470.00**	**22,427,051.98**

SUMMARY FINANCING TABLE in euros	2006 Budget	2006 - actual
SELF-FINANCING CAPACITY	**13,321,470.00**	**22,427,051.98**
Acquisitions of tangible & intangible fixed assets	34,169,010.00	20,180,971.60
Financial fixed assets	1,245,000.00	1,180,229.55
Reimbursement of financial debts	1,200,000.00	1,193,199.18
Dismantling assets	31,000,000.00	31,000,000.00
TOTAL APPLICATION OF FUNDS	**67,614,010.00**	**53,554,400.33**
State investment subsidies		
Other resources (excluding Internal operations)	4,930,000.00	5,277,579.13
Dismantling provision	31,000,000.00	31,000,000.00
TOTAL RESOURCES	**35,930,000.00**	**36,277,579.13**
CONTRIBUTION TO WORKING CAPITAL	**- 18,362,540.00**	**5,150,230.78**

IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Head Office
77-83, avenue du Général-de-Gaulle
92140 Clamart
RCS Nanterre B 440 546 018

Telephone
+ 33 (0)1 58 35 88 88

Correspondence
B.P. 17 - 92262 Fontenay-aux-Roses Cedex

IRSN website
www.irsn.org