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IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

Nuclear safety, environment, and health: research at IRSN

IRSN FACT SHEETS

November 2022
www.irsn.fr

As a public expert in the assessment of nuclear and radiation risks, IRSN contributes, through its research and expertise, to the development and implementation of public policies on prevention and protection against ionizing radiation risks in the energy, environment, and health sectors. As such, the Institute relies on research programs directed towards the production of data and tools in support of public service missions, in particular in the field of nuclear safety, as well as on more fundamental research programs aimed at advancing knowledge, in particular as regards the effects of ionizing radiation on health and the environment. A particular feature of IRSN is the variety of sectors in which it operates and the wide spectrum of scientific disciplines it covers: nuclear science, engineering science, geoscience, environmental science, and life science, health and medical science... As such, IRSN has a rather unique role as an integrator of multidisciplinary knowledge.

Research at IRSN: budgetary resources, human resources, and production

39.1% of the budget allocated to research

450 full-time equivalents devoted to research and 102 PhD students and post-doctoral students

25 theses produced

271 scientific publications presented at congresses

269 publications listed in scientific journals indexed to the JCR (*Journal Citation Reports* - Thomson Reuters)

(2021 data)

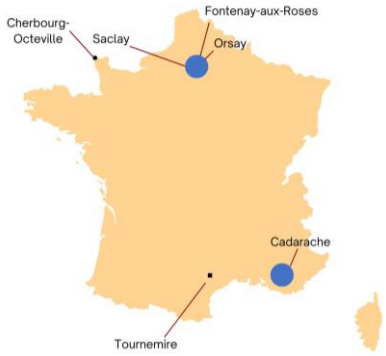
Resources and organization

Almost 40% of the budget devoted to research and an ambitious doctoral training program

- IRSN spends almost 40% (around €100 million) of its total annual budget on research.
- Research involves over 450 full-time equivalents, including around 150 permanent researchers.
- IRSN's scientific activity also benefits from an ambitious training program for and through research. This represents around a hundred PhD students and post-doctoral students. It also has the fundamental task of disseminating the knowledge and skills acquired within the Institute's laboratories.

Three research units covering safety, the environment, and health

- *The safety research unit* covers topics such as the behavior of nuclear fuel, neutronics and criticality, thermo-hydraulics, nuclear core meltdown accidents, aging of materials and structures, and the human and social aspects of safety and radiation protection;
- *The environmental research unit* works on, for example, the transfer of radioactivity to the environment and the effects of ionizing radiation on ecosystems, the assessment of natural hazards, and the geological storage of nuclear waste;
- *The health research unit* focuses on the effects of low doses of ionizing radiation on health, prevention of side effects of radiotherapy, the treatment of acute effects of radiation, and the assessment or reconstruction of radiation dose.



Experimental and digital modeling platforms essential for producing and leveraging knowledge

- To conduct its research, IRSN relies on experimental facilities and analytical instruments organized into around twenty scientific platforms. The Institute also develops digital modeling platforms that enable the complexity of the phenomena involved to be simulated and its prediction capabilities strengthened. Unique for some, these platforms support research activities and, at the same time, leverage the knowledge produced. They allow IRSN both to develop numerous partnerships and to have a great deal of independence in the way it conducts its work. As an important component of the Institute's scientific heritage, platforms are also an essential interface between nuclear research and expertise.
- The research platforms devoted to safety are grouped on two sites: Cadarache (south-east of France), for those devoted to studying accidents and the behavior of materials, and Saclay (Paris metropolitan area), for those devoted to studying the containment and air dispersion of pollutants.
- Those devoted to research in the field of health and the environment are divided between the Cadarache site, where work on transfers to the environment and the effects of radiation on ecosystems is hosted, as well as a platform allocated to neutron metrology, and the Fontenay-aux-Roses site (Paris metropolitan area), which hosts teams and platforms involved in the fields of health and geosciences. Research into geological disposal also relies on the underground research laboratory in Tournemire (southern France). The Orsay and Le Vésinet sites host metrology developments. Finally, a team of environmental researchers is located in Cherbourg-en-Cotentin (north-west of France), near the Orano plant in La Hague.

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IRSN is a French State-owned industrial and commercial establishment (EPIC) the missions, status, and operation of which are determined by Articles L592-45 to L592-49 and R592-39 to R592-61 of the French Environment Code. IRSN is under the joint supervision of the French Minister for the Environment, the French the Minister of Defense, and the French Ministers of Energy, Research, and Health.

As a public expert, IRSN advances scientific knowledge to manage all nuclear and radiation risks. Through its research, methods, and interactions with all stakeholders, IRSN assesses these risks and their consequences independently. It thus contributes to their prevention, detection, and the limitation of their possible effects, in order to protect the population and the environment.

Research serving strategic objectives, built on partnerships and backed by external bodies

A scientific strategy based on identifying priority issues

IRSN's broad scope requires a major effort in deciding on the direction of research programs. In 2015, it adopted a scientific strategy based on 18 priority scientific questions. These are broken down, for each of the major themes, into research roadmaps. The questions considered cover, for example, issues related to the aging of materials and facilities, the cooling of corium resulting from a core meltdown, the effects of exposure to low doses of ionizing radiation on the living environment, at different scales, and the side effects of their use for diagnostic and therapeutic purposes.

Deployment based on a multi-level partnership policy

IRSN's scientific partnership policy is an essential lever for improving the effectiveness of its research and positioning the Institute in higher education and research circles. It allows IRSN to benefit from additional national funding – *via* calls for projects set up by the French National Agency for Research (ANR), French Agency for Food, Environmental and Occupational Health & Safety (Anses), the French National Cancer Institute (INCa), etc. – as well as European and international funding.

The partnership policy involves cooperation with three types of stakeholder:

- *academia*: in recent years, IRSN has strengthened its ties with academia by refocusing its partnership strategy on a privileged relationship with the CNRS, on the one hand, and with Paris-Saclay and Aix-Marseille universities, on the other. These partnerships represent a very significant share of IRSN's scientific production: nearly 40% of the Institute's research publications are co-authored by researchers from the French National Centre for Scientific Research (CNRS) and almost half of its PhD students are enrolled in Paris-Saclay University or Aix-Marseille University (AMU) doctoral schools. Through its partnership with the CNRS, IRSN has privileged access to the most advanced fundamental knowledge in all the disciplines it covers. Its academic partnerships are based on a regional rationale. The objective is to establish privileged relationships with the major universities in the regions in which the Institute's teams are located: Paris-Saclay University for Fontenay-aux-Roses, Saclay, and Orsay research teams and Aix-Marseille University for Cadarache research teams. More targeted partnerships, with the Institut Gustave Roussy or the French National Institute of Health and Medical Research (Inserm) in the field of health, or with the French National Institute for Industrial Environment and Risks (Ineris) in the field of technological risk management, for example, complete this system;
- *nuclear power producers and stakeholders*: the multi-year framework cooperation agreements between IRSN and manufacturers, such as EDF, Framatome, Orano, and the CEA enable the Institute to conduct research programs as close as possible to operational realities and technological developments. They not only provide access to nuclear facilities and the materials used in them, but also provide a valuable insight into the research carried out by the nuclear industry. Finally, they contribute to the creation of a knowledge base shared by all the technical stakeholders in the sector;
- *its counterparts in Europe and abroad:* the Institute is strongly involved in European and international partnership research programs. It is an important contributor to the research programs financed by the European Commission, in particular under the Euratom program, and contributes to the development of the strategic agendas for European research platforms. It also participates in research projects conducted under the auspices of the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA). IRSN also maintains bilateral relationships covering research with its counterparts, including the German technical safety organization GRS, the U.S. Department of Energy (DOE), the U.S. Nuclear Safety Authority (NRC), the Nuclear Regulation Authority (NRA) of Japan, and the Japan Atomic Energy Research Institute (JAERI).

External bodies to ensure scientific relevance and excellence in programming and implementation

To guide the development and implementation of its scientific strategy and the deployment of its partnership policy with regard to its more general objectives, IRSN has set up two committees placed with its Board of Directors or its general management:

- *the Scientific Council,* which plays an advisory and support role in steering its scientific activities;
- *the Research Steering Committee*, which includes representatives of the Institute's various stakeholders and which contributes to ensuring that the research conducted meets the needs of the public authorities and the expectations of society at large.

As a research organization, IRSN is also subject to the assessments of the High Council for Evaluation of Research and Higher Education (Hcéres). As far as its research units are concerned, assessments are carried out by an external evaluation committee set up according to procedures validated by Hcéres.