RADIOACTIVE WASTE MANAGEMENT PROGRAMMES IN OECD/NEA MEMBER COUNTRIES

ITALY
[2011]

NATIONAL NUCLEAR ENERGY CONTEXT

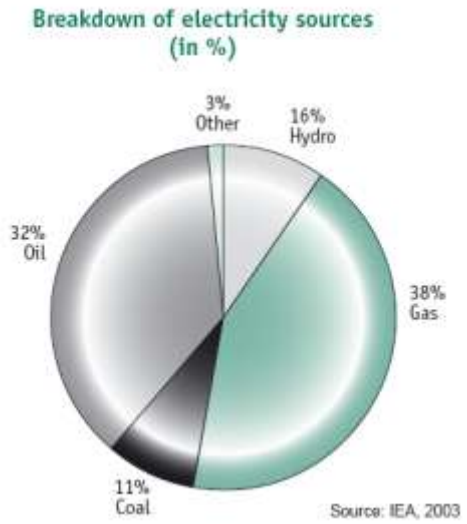
Commercial utilization of nuclear power in Italy started in 1962 and by 1981 four nuclear power plants (NPPs) had been commissioned. During that period, related nuclear fuel-cycle activities such as uranium and plutonium fuel fabrication and fuel reprocessing were developed at industrial or experimental pilot scale by the Nuclear Energy Research Agency (CNEN), now the Agency for New Technologies, Energy and Sustainable Economic Development (ENEA).

After the Chernobyl accident in 1986, however, there was a general public debate in Italy on the implications of using nuclear power and, following a referendum in November 1987, the Italian Government required the definitive closure of all NPP's operating or under construction and a 5 years moratorium on the construction of new NPP's. Consequently, Latina, Trino and Caorso NPPs were permanently stopped in addition to the Garigliano NPP, which had already been shut down in 1978 for economic reasons.

At the same time, the interministerial Committee for Economic Planning (CIPE) required the National Electricity Company (ENEL) to start the decommissioning of these NPPs.

Since 1999, the decommissioning of the four nuclear power plants has been taken in charge by SOGIN (*Società Gestione Impianti Nucleari*). Since 2003 SOGIN took in charge also the facilities of the nuclear fuel cycle owned by ENEA.

In 2009 the Italian Government, with the aim to restart a new nuclear programme, promulgated a new Law (Law 99/2009) establishing the necessary legislative provisions, including the institution of the ASN (Agency for the Nuclear Safety). Other Legislative Decrees have been issued or were in preparation but, after the Fukushima accident, a public debate brought to another popular referendum on June 2011 that sanctioned again the abandon of the nuclear programme in Italy.



SOURCES, TYPES AND QUANTITIES OF WASTE

Waste sources and categories

In addition to the radioactive waste that have been generated by NPPs and the associated experimental nuclear fuel-cycle facilities, radioactive waste also arises from use of radioisotopes in medical, research and industrial applications.

In Italy, radioactive waste is classified into three categories according to the characteristics and concentrations of the radioisotopes that they contain, having regard to the possible options for their disposal. Guidance on this waste classification and on the technical requirements for waste forms and waste packages is given in the reference document Technical Guide no. 26 issued by ENEA-DISP (now ISPRA). The three categories of radioactive waste are as follows:

Category I: Waste whose activity decays in a few months to below a level at which there is any concern about safety. Such waste may be disposed of as ordinary waste under general waste regulations. It is generally described as very low-level waste (VLLW) and is mainly generated by hospitals and research establishments.

Category II: Waste whose activity decays to the level of a few hundred Bq/g within a few centuries. The activity of several specified radionuclides must not exceed prescribed values. Such waste is suitable for near surface disposal. It is usually described as short-lived, low- or intermediate-level waste (LLW).

Category III: Long-lived waste not included in categories I and II, high-level waste from reprocessing of spent fuel, and alpha-bearing waste from nuclear fuel cycle and R&D activities. Such waste will require deep geological disposal. This waste is described generally as long-lived and/or high-level waste (ILW/HLW).

For Category II waste, the ISPRA reference document lists waste-conditioning requirements and other specific acceptance criteria for shallow land disposal. It defines two subcategories as follows:

1. Solid waste whose activity concentration is below the prescribed limits and which may be disposed of without further conditioning.
2. Waste whose activity concentration is above the prescribed limits and which needs to be conditioned and must fulfil further requirements to be accepted for final disposal.

A general criterion is in force in Italy for unrestricted release. Radioactive materials can be unconditionally released from regulatory control if the concerned radionuclides comply with both a concentration and a radioactive half-life threshold:

- activity concentration $\leq$1 Bq/g; and
- half-life < 75 days.

If both conditions above are not complied with, a specific authorisation is required for releases, reuse and recycle of the materials concerned. The authorisation can be given provided that the following criteria are complied with:

a) Effective dose $\leq$ 10 μSv/year, and

b) either Effective collective dose $\leq$ 1 man·Sv/year or the analysis demonstrates that exemption is the optimum option.

and with the additional condition of activity concentration < 1 Bq/g, general threshold of the Italian Law.

In order to implement the above criteria, derived concentration values are established, making reference to EU documents.

Specific clearance levels for conditional and unconditional releases have been issued for Latina NPP, Eurex and Itrec reprocessing plants according to European Union directives and recommendations.

Waste inventory

ISPRA maintains an overall national inventory of the radioactive waste, spent sources and spent fuel currently stored in the 21 nuclear installations in Italy. Information on volumes and activity of radioactive waste in store is given in the tables below by category and by source.

As far as the spent fuel is concerned, in may 2007, SOGIN signed an agreement with AREVA for the reprocessing of 235 t of spent fuel still present in Italy. As result of the implementation of the contract between SOGIN and AREVA in the past three years all the spent fuel stored in the pool of the Caorso NPP has been transferred to France. The transfer of the spent fuel stored in the Avogadro AFR storage pool and in the Trino NPP will be completed by 2012. Residual wastes will be returned to Italy starting by 2020.

At present the only fuel that will not be reprocessed is the 1,7 tHM of Uranium/Thorium spent fuel, which is stored at the ITREC experimental reprocessing facility. For this fuel the transfer into dual purpose dry cask storage is planned.

The amount of spent fuel from research reactors is less than 1 tHM and this is stored at various other sites.

As regards future amounts of waste, some 20 m^3 of vitrified HLW arising from reprocessing of spent fuel will be returned from Sellafield in the UK. Other similar amount of radioactive waste will have to return in Italy from the reprocessing of the 235 t of spent fuel in France. In addition, about 30.000 m^3 of Category II will arise from decommissioning of nuclear facilities.

Category GT 26	International classification	Volume (Activity)
Category I	VLLW	3900 m^3 (0,2 TBq)
Category II	LLW short lived	22700 m^3 (700 TBq)
Category III	ILW and HLW	1700 m^3 (2454 TBq)

Source (Category)	Volume (Activity)
Industry, Hospital, etc..(I and II)	4370 m^3 (5 TBq)
Reactors (II)	8400 m^3 (443 TBq)
Fuel Cycle facilities (II and III)	6530 m^3 (2580 TBq)
Research	9000 m^3 (126 TBq)

RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

Waste management policies

There is currently no LLW disposal facility in Italy, and radioactive waste from NPPs and experimental fuel cycle facilities are stored at their sites of origin. Radioactive waste from medical, industry and research activities is collected by private operators for interim storage. Most of this waste is stored in untreated form, awaiting appropriate treatment and/or conditioning.

By the end of 1999, the Ministry of Industry, Commerce and Crafts, now named Ministry for Economic Development (MSE), issued strategic guidelines for the management of liabilities resulting from past national nuclear activities.

According to this new policy all the nuclear installations should be completely decommissioned by 2024.

Programmes and projects

LLW repository project and site selection process

As far as the availability of a national site for the LLW disposal and for the long term storage of ILW-HLW is concerned, a policy has been issued in connection with the recent Agreement for the reprocessing of the 235 t of spent fuel still stored in Italy, where to the Italian Government was committed to make a national site available in due time.

In fact, this Agreement establishes a national road map for enacting all the modifications and integrations to existing legislative provisions as necessary to rule the implied matter (e.g. selection of a national site for a waste storage facility) and to execute all the construction works in order to have facilities ready and operational according to a time schedule to be established for the re-entry of the high and intermediate level waste packages.

In connection with the mentioned road map, the Legislative Decree 31/2010 establishes the new procedure for the localization and the construction of a national repository for the LLW disposal and the ILW-HLW long term storage, and assigns to SOGIN the role of the Implementer responsible for the construction and operation of the national repository. Legislative Decree 31/2010 also assigns SOGIN the role to propose areas suitable for the localization of the facility based upon criteria established by the IAEA and the new national Agency for Nuclear Safety and taking into account results of Strategic

Environmental Evaluation. The steps to be made in order to realize a national storage facility foresees public consultations and involvement of the interested Regions and Local Authority in the decisional process.

However, even if the SOGIN activity is in an advanced stage of development, due to the delays in the establishment of the new Safety Authority the time schedule foreseen by the Legislative Decree has been postponed.

Waiting for the implementation of this new procedure and for the availability of a national facility, radioactive waste are being stored in the nuclear installations of origin. Action plans are in progress to enhance the safety level of waste by implementing specific treatment and conditioning projects, by refurbishing existing buildings or by realizing new storage facilities on the sites. New facilities will also be used to ensure temporary storage capacity for waste resulting from decommissioning activities.

Conditioning and decommissioning

Preliminary dismantling activities as well as the conditioning of the radioactive waste are on going at the shutdown SOGIN nuclear power plants and fuel cycle facilities.

The **Garigliano** 150 net MWe BWR was operated from 1963 to 1978. The plant has been totally defuelled and several activities have been performed such as a light decontamination and drainage of the vessel, primary circuit and spent fuel pit; dry low-level operational wastes compaction, cementation of liquid and semiliquid (sludge) radioactive waste.

The **Latina** 153 net MWe GCR was operated since 1962 up to 1987. The plant has been totally defuelled; the primary circuit has been filled with dry air, and blowers and portions of the primary circuit outside the reactor building have been dismantled.

The **Trino** 260 net MWe PWR was operated from 1965 to 1987 for the equivalent of about eleven full power years; a limited quantity of spent fuel is still present in the spent fuel pool; no major decommissioning activities have been performed. Decontamination of the primary circuit is in progress.

The **Caorso** 860 net MWe BWR was operated from 1981 to 1986. Decontamination of the circulation loops and clean-up have been completed in 2003. Dismantling activities on the turbine building, RHR tower and off-gas system are in progress.

As far as the fuel cycle facilities are concerned, all of them are at present shut down and managing their nuclear materials and/or radioactive waste, before starting decontamination and dismantling operations.

Bosco Marengo *(former Fabbricazioni Nucleari)*, an industrial scale plant for LWR fuel fabrication located at Boscomarengo, was operated from 1973 to 1995.

EUREX pilot reprocessing facility, located at Saluggia, operated from 1970 to 1974 (MTR fuels) and from 1980 to 1983 (Candu fuels). Its main present task is to treat and condition the liquid reprocessing waste (some 120 m^3 ILW and some 100 m^3 LLW).

ITREC pilot reprocessing facility, located in the southern part of Italy (Trisaia), was operated in the seventies (uranium-thorium cycle fuels from the US Elk River reactor). After the solidification (by cementation) of its liquid reprocessing waste, its present task is to manage many other different solid and liquid waste streams.

IPU plutonium pilot MOX fuel fabrication facility, located at Casaccia Centre, was operated from 1968 to the early eighties (MOX fuel fabrication experimental campaigns). After treatment of many radioactive waste streams (mostly high plutonium-bearing liquids), the dismantling of glove boxes is going to start using a special remotely handled installation.

RESEARCH AND DEVELOPMENT

Functions

R&D is conducted by several agencies, institutions and universities, mainly at laboratory scale. Main activities are performed by ENEA within its Research Centres (CR) of Casaccia (near Rome), Bologna, and Saluggia (near Vercelli). ENEA is the name for the Italian National Agency for New Technologies, Energy and Sustainable Economic Development. Pursuant to art. 37 of Law no. 99 of July 23rd, 2009, the Agency's activities are targeted to research, innovation technology and advanced services in the fields of energy - including nuclear.

All nuclear research is carried out within the framework of: national R&D programmes funded by the Italian Ministry for Economic Development and the Ministry of Universities and Research; EU projects funded by EURATOM; other important international initiatives.

ENEA collaborates with the major national and international institutions, universities and research bodies. It is active part of agreements signed with the most important international nuclear organizations (International Atomic Energy Agency, Nuclear Energy Agency, EURATOM), and participates in the main EU research programmes (SNETP, EERA, ESNII, etc.). It also collaborates and exchanges researchers with the two major French nuclear research bodies (Commissariat à l'Énergie Atomique and Institut de Radioprotection et de Sûreté Nucléaire) as well as with US-DOE labs.

A three-year Nuclear Fission R&D national programme has received support by the Minister of Economic Development, based on "strategic funding devoted to the National Electric System R&D" and focused on participation to international initiatives like INTD (International Near Term Deployment) and Generation IV nuclear systems and on studies and research on Near Surface Disposal of LLW, Long Term Storage and Geological Disposal of HLW. Total fund for the first three years amounts to about 20 MEuro (1,2 for R&D on radioactive waste management) and comparable funds are expected for the next three-years programme.

Content of R&D plans

Since its foundation, ENEA performs R&D on nuclear fission. Within the government programme re-launching nuclear energy as electric power source (before Fukushima), the Agency intensified its participation in the most important international research programmes by supporting the national industry's growth in know-how and skills. The technical and scientific activities are mainly R&D on advanced and innovative nuclear systems and medium-, long-term problem solving associated with the availability of fuel resources and minimization of long-life radioactive waste.

Main R&D activities are:

- New-generation nuclear systems (advanced LWRs, Generation IV reactors) and on small and medium nuclear fission reactors (SMR).
- Development of test facilities for qualifying prototypical components and systems of innovative Nuclear Power Plants (SMR, LFR, etc.).

- Diagnosis and medical therapy techniques by using modular neutron flow-channels of nuclear research reactors; characterization of materials under irradiation; neutronic codes validation.
- Development of engineering models and reactor processes simulation for safety and design studies on current and future nuclear systems and their fuel cycle; simulation of advanced control and protection systems; decision support models for plant operators; innovative man-machine interface systems.

For the **Radioactive Waste Management** the last R&D Plan has been focused on following main issues:

- support politic's decision making;
- critical review of the national inventory of radioactive waste to identify shortcomings, especially in terms of characterization, and needs for studies and R&D on radioactive waste;
- radioactive waste characterization;
- safe transport of radioactive waste;
- communication, information and training;
- site characterization procedures, performance assessment codes and transport phenomena modeling of radionuclides in the repository;
- environmental monitoring during the institutional surveillance phase;
- geological disposal of radioactive waste of high activity and long life: ENEA and CIRTEN are partners in IGD-TP;
- innovative processes for the treatment and conditioning of radioactive waste coming from advanced fuel cycles).

DECOMMISSIONING AND DISMANTLING POLICIES AND PROJECTS

By the end of 1999, the Ministry of Industry, Commerce and Crafts, now named Ministry of Economic Development (MSE), issued strategic guidelines for the management of liabilities resulting from past national nuclear activities. According this new policy all the nuclear installations should be completely decommissioned by 2024.

In this respect, in 1999 all the ENEL's liabilities connected to nuclear power were assigned to a newly established company, named SOGIN. The mission of SOGIN covers the implementation of a prompt decommissioning of the four national power stations until an unconditional release of the respective sites within twenty years, as well as the safe management of radioactive waste and spent fuel associated with the power stations.

The new policy was implemented by a Ministerial Decree of 26 January 2001 which established the plans and procedures for funding the activities associated with decommissioning of NPPs and nuclear fuel-cycle facilities. The strategy defined in this Decree was further detailed by another Ministerial Decree of 7 May 2001 which directed SOGIN to implement prompt decommissioning of the four national NPPs with a view to unconditional release of their respective sites within twenty years. The Decree also charged SOGIN with the safe management of radioactive waste and spent fuel from these NPPs using funds provided by the levy on electricity sales.

Comprehensive plans for prompt decommissioning of the Garigliano, Caorso, Trino and Latina NPPs have been presented by SOGIN to the Ministry of Economic Development, and they are currently under review by ISPRA.

Following the directives included in the Ministerial Decrees of 2001, in 2003, SOGIN also took under its responsibility the ENEA fuel cycle facilities, with the main objective to manage the activities related to their decommissioning.

Issues that continue to hinder progress, however, are:

- Lack of a national site for the disposal of LLW.
- Lack of a centralised interim storage facility for spent fuel ILW and HLW.

TRANSPORT

Transport arrangements must comply with the provisions of specific Decrees issued by the Ministry of Infrastructure and Transport. These Decrees transpose the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material into national legislation for the different modes of transport.

Only carriers authorized by the Ministry for Economic Development may transport radioactive material. Authorization is granted on the basis of technical advice from ISPRA and from the Ministry of Interior.

Approval and validation of package design is carried out by ISPRA. For high-level sealed sources and fissile material transportation, however, further specific certification granted by ISPRA and Ministry of Infrastructure and Transport is required.

COMPETENT AUTHORITIES

The competent national bodies for radioactive waste management in Italy are as follows:

Ministry for Economic Development

The Ministry for Economic Development (formerly of Productive Activities) is the authority that issues the operating licence for all nuclear and radioactive installations, taking the technical advice of ISPRA into account. For installations related to radioactive waste storage and disposal, the concerted agreement of the Ministries of the Environment Land and Sea, Interior, and Labour Health and Social Affairs, is also required.

Institute for Environmental Protection and Research (ISPRA)

ISPRA, established in 2008 from the former APAT, is responsible for control and regulatory inspections of nuclear installations in matters of nuclear safety and radiation protection. Any licence granted by the Ministry for Economic Development incorporate the corresponding technical prescriptions and legally binding requirements formulated by ISPRA. Moreover, ISPRA approval is required for detailed designs of any structure, system and component relevant to safety in any nuclear installation.

ISPRA is a governmental Institute, with administrative and financial autonomy, under the supervision of the Ministry of the Environment.

In 2011, the regulatory framework has been modified with the abrogation of the "Technical Commission on Nuclear safety and Radiation Protection". This Commission was entitled to formulate an independent technical advice to ISPRA during the assessment process connected to the granting of licences, authorizations and approval of detailed designs. The Technical Commission was composed of experts designated by various Ministries (Interior, Health, Environment and Territory, Economic Development, Transport and Infrastructure), by ISPRA and ENEA and by the Regions where the nuclear activities are exploited.

FINANCING

Waste management costs

The cost of waste disposal is generally considered to be the most significant component of the cost of waste management, which in turn is one of the most significant components of the cost of nuclear facility decommissioning. Thus, it is important to have an early estimate of waste disposal costs for the purpose of calculating the long-term funding liabilities. These costs will depend on the charges for disposal of waste in the national repository. As this has not yet been designed the likely charges are unknown.

Financing long-term liabilities

Even before there was a legal requirement to do so, ENEL had created a fund to meet its long-term liabilities for decommissioning and spent fuel management. The accumulated fund was transferred to SOGIN at the time of its creation as an independent body, and amounted to about € 750 million at that time. This amount was judged sufficient to complete decommissioning activities by way of the deferred dismantling, "SAFSTOR" strategy.

Following the separation of SOGIN from ENEL, additional costs have arisen from changed economic conditions, additional company management costs, and a change of decommissioning strategy. These have been recognized, and arrangements have been made to finance them by way of a levy on electricity sales as described above.

Every year SOGIN is required to present its programme of future activities, with associated costs. On this basis, the national Authority for Electric Energy and Gas, the body that defines tariff policy, re-evaluates the levy on the price of electricity for the next three years.

A provisional figure equivalent to about 0.03 euro cents per kWh was defined, corresponding to an annual income for SOGIN of about € 75 million.

Subject to the necessary agreements, the same procedure is envisaged for meeting the additional costs to SOGIN arising from dismantling the nuclear fuel cycle facilities currently owned by ENEA.

PUBLIC INFORMATION

For more information, the websites of the relevant organisations are listed below.

Government

ISPRA (Institute for the Environmental Protection and Research)
Website: http://www.isprambiente.gov.it/site/it-IT/
E-mail: webispra@isprambiente.it (technical issues)
E-mail: urp@isprambiente.it (public relations)

SOGIN
Website: www.sogin.it
E-mail: friello@sogin.it

Research

ENEA (Agency for New Technologies, Energy and Sustainable Economic Development)
Rome (headquarters)
Website: http://www.enea.it/