National Programme

for the management of radioactive waste and spent fuel

drafted pursuant to Legislative Decree 45/2014 implementing Directive 2011/70/EURATOM which establishes a Community framework for the responsible and safe management of nuclear spent fuel and radioactive waste*

Ministero dello Sviluppo Economico

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

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Preamble

Directive 2011/70/EURATOM issued by the European Council on 19 July 2011 establishing a community framework for responsible and safe management of nuclear spent fuel and radioactive waste requires member states of the European Union to draft a National Programme for the implementation of the policy for the management of spent fuel and radioactive waste, from generation to disposal, when these arise from civilian activities. This directive was transposed with Legislative Decree 45 of 4 March 2014.

This document contains an overview of the Italian policy for the management of radioactive waste and spent nuclear fuel and was prepared pursuant to Legislative Decree 45 of 4 March 2014.
The Programme also constitutes the original document on which the strategic environmental assessment, including the public consultation and government consultation, as provided by national law, will be based.

The National Programme must be submitted to the European Commission together with any significant amendments thereto.

The Ministry of the Environment and the Protection of Land and Sea

The Ministry of Economic Development

Introduction

This document contains seven chapters.

Chapter 1 contains a description of the legislative, regulatory and organizational framework, the main definitions of the technical terms used for the drafting of the National Programme, a description of the origin of spent fuel and radioactive waste with the relative classification and an overview of the national operators and government agreements referring to the sector with Member States and Third Countries.

In chapter 2, we describe the national policy from the 1960s to date for the management of spent fuel and radioactive waste and we illustrate the future objectives set by the national policy.

Chapter 3 contains the significant milestones and time limits for the implementation of these milestones in light of the future objectives of the National Programme.

Chapter 4 contains an inventory of the spent fuel and radioactive waste and estimates of future quantities.

Chapter 5 describes the management, from generation to disposal, of spent nuclear fuel and radioactive waste from the decommissioning of nuclear plants and those originating from research activities and usage of radioisotopes for medical and industrial activities and a summary description is provided of the National Repository and its post closure stage.

Chapter 6 contains indications on the responsibility for implementation of the National Programme and the procedures to be applied to ensure transparency and participation by the public in the decision-making processes concerning the management of spent nuclear fuel and radioactive waste.

Chapter 7 contains indications of the National Programme costs associated with the decommissioning activities, the construction of the National Repository and the Technological Park, the management of radioactive waste from usage of radioisotopes for medical and industrial activities and research and development activities focused on solutions for the management of spent fuel and radioactive waste.

CHAPTER 1: Management of spent fuel and radioactive waste: principles and objectives

1.1. Legislative, regulatory and organizational framework

Specifically regarding the management of radioactive waste at the **international level**, Italy is a signatory to the Convention on Nuclear Safety signed in Vienna on 20 September 1994 and ratified with Law 10 of 19 January 1998, and the Joint Convention on the safety of spent fuel and radioactive waste management, signed in Vienna on 5 September 1997 and ratified with law 282 of 16 December 2005.

a) The first of the above Conventions aims to improve nuclear safety worldwide and has three main objectives:

1. to achieve and maintain a high level of nuclear safety worldwide through the enhancement of national measures and technical co-operation;
2. to establish and maintain effective defences in nuclear installations against potential radiological hazards in order to protect individuals, etc;
3. to prevent accidents with radiological consequences and to mitigate such consequences should they occur.

This Convention – which does not define specific security standards, but represents a commitment to apply the fundamental principles of safety to plants – is applicable to the safety of nuclear plants used for peaceful purposes, including storage facilities, radioactive material processing facilities in the same location and which are directly connected to the operation of the plant and requires the contracting parties to create a legislative, regulatory and administrative framework to ensure the safety of the plants that provides for i) the establishment of applicable national safety requirements and regulations; ii) a system of licensing with regard to nuclear facilities and the prohibition of the operation of a nuclear facility without a licence; iii) a system of regulatory inspections and assessment. The systemic assessments must take place prior to construction and deployment of a nuclear facility and for the entire duration of its life; iv) the enforcement of applicable regulation and license restrictions, including suspension, modification or revocation.

The contracting parties shall designate a regulatory body entrusted with the issuing of the licenses and ensuring the correct application of the regulations. The functions of this organisation must be appropriately distinguished from the functions of every other organism in charge of the promotion or usage of nuclear energy. The plant managers must design a strategy that gives priority to safety and a quality program that will ensure compliance with the responsibilities. Measures for emergency situations must also be implemented, containing plans for informing the concerned authorities such as hospitals.

During periodic revision meetings, each contracting party must present to the other parties a report on the actions taken to comply with the obligations of the convention. These meetings must be held at least every three years. The parties shall examine the reports on the measures adopted by each of them for fulfilment of the convention obligations. The International Atomic Energy Agency (IAEA) will act as the secretariat.

b) The Joint Convention of 5 September 1997 sets the following objectives for the contracting parties:

- to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management, through the enhancement of national measures and international co-operation, including where appropriate, safety-related technical co-operation;
- to ensure that during all stages of spent fuel and radioactive waste management there are effective defences against potential hazards so that individuals, society and the environment are protected from the harmful effects of ionizing radiation, now and in the future, in such a way that the needs and aspirations of the present generation are met without compromising the ability of future generations to meet their needs and aspirations;
- to prevent accidents with radiological consequences and to mitigate their consequences, should they occur during any stage of spent fuel or radioactive waste management.

Furthermore, this Convention establishes that each contracting party shall take appropriate measures so that, throughout all the phases of managing the spent fuel and radioactive waste, individuals, companies and the environment are adequately protected against radiological risks. Every three years, each contracting party must submit a report on the provisions adopted to satisfy the obligations set by the Convention. This report will be submitted for examination by the other Contracting States and discussed in a review conference that will be held in Vienna several months after the date the report is submitted. The International Atomic Energy Agency (IAEA) will act as the secretariat.

Additional commitments arising from Italy's participation in the IAEA – International Atomic Energy Agency of Vienna. Indeed, this international organization issues, in the form of guidance, standards and technical reports concerning nuclear safety and radiation protection to be applied to nuclear installations and management of radioactive waste and spent fuel. These standards and technical reports are recognized and adopted internationally.

European regulations in the nuclear field, developed as a part of EURATOM, are well structured and continuously evolving. It is appropriate here to mention directive 2009/71/Euratom issued by the Council on 25 June 2009, which establishes a community framework for nuclear safety of nuclear installations and was transposed into Italian law with Legislative Decree 185 of 19 October 2011, subsequently amended by directive 2014/87/Euratom issued by the Council on 8 July 2014 which must be transposed by 15 August 2017, directive 2011/70/Euratom issued by the Council on 19 July 2011, which establishes a community framework for responsible and safe management of spent nuclear fuel and radioactive waste, transposed into Italian law with Legislative Decree 45 of 4 March 2014; directive 2013/59/Euratom issued by the Council on 5 December 2013, to be transposed into the national laws by 6 February 2018, laying down basic safety standards for protection against the dangers arising from exposure to ionising radiations and abrogating directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom.

In the Italian regulatory system, the source of binding rules traces back to an act of Parliament (the law) or an act of Government, the latter being delegated to carry out this function directly by the Parliament (the Legislative Decree). It is within the Government's authority to also issue ministerial or government decrees to regulate specific issues. The practice of regulating nuclear issues, particularly in technical terms, through the issuing of ministerial or government decrees is very frequent, especially in the sector relative to protection from ionizing radiation. Violating such binding laws exposes the operators concerned to criminal penalties.
As explained above, we note that the management of radioactive waste is currently regulated by national law by:

- ✓ Law 1860 of 31 December 1962 and subsequent amendments and supplements concerning the peaceful usage of nuclear energy;
- ✓ Legislative Decree 230 of 17 March 1995, containing the implementation of directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 2006/117/Euratom on ionizing radiations and 2009/71/Euratom on nuclear safety of nuclear installations and 2011/70/Euratom on the safe management of spent fuel and radioactive waste from civilian activities (hereinafter "Legislative Decree 230/95 and subsequent amendments and supplements");
- ✓ Law Decree 314 of 14 November 2003, converted with amendments into law 368 of 24 December 2003 containing "Urgent provisions for the collection, disposal and storage of radioactive waste under conditions of maximum safety";
- ✓ Legislative Decree 152 of 3 April 2006 and subsequent amendments and supplements, containing regulations on the environment and defining also the procedures applicable to the *Valutazione Ambientale Strategica* (VAS) [Strategic Environmental Assessment] and the *Valutazione di Impatto Ambientale* (VIA) [Environmental Impact Assessment];
- ✓ Legislative Decree 23 of 20 February 2009 containing the “Implementation of directive 2006/117/Euratom, on the supervision and control of the shipping of radioactive waste and spent nuclear fuel”; this legislative decree amended the pertinent administrative provisions included in Legislative Decree 230/95 and subsequent amendments and supplements concerning cross-border shipments of radioactive waste;
- ✓ Law 99 of 23 July 2009 and subsequent amendments and supplements “Provisions for the development and internationalisation of companies, including in terms of energy” and, in particularly article 29 pursuant to which the nuclear safety agency was established and subsequently abrogated by Legislative Decree 45 of 4 March 2014;
- ✓ Legislative Decree 31 of 15 February 2010, containing the discipline on the storage systems for irradiated fuels and radioactive waste, as well as the economic benefits thereof, pursuant to article 25 of Law 99 of 23 July 2009, amended by Legislative Decree 41 of 23 March 2011, Law Decree 34 of 31 March 2011 converted with amendments into Law 75 of 26 May 2011 and Law Decree 1 of 24 January 2012 converted with amendments into Law 27 of 24 March 2012 (hereinafter Legislative Decree 31/2010 and subsequent amendments and supplements). This decree contains criteria for the selection of locations with involvement of local administrations and the approval and determination of the compensation payable to the local entities. The decree also contains provisions for approval and the selection procedure for the location that will host the national repository of radioactive waste, attributing to Sogin S.p.A. certain specific operating responsibilities;

- ✓ Law 75 of 26 May 2011, which amended the provisions of law 99/2009 and Legislative Decree 31/2010, as amended by Legislative Decree 41/2011, ratifying abandonment of nuclear development in Italy, following the outcome of the referendum held in June 2011. This legislative act nevertheless did not alter Legislative Decree 31/2010 insofar as its regulatory portion which provides for a joint approach (with the scientific world, the population and the territorial entities) in research and identification of the most appropriate site for the National Repository for final disposal of low and medium activity radioactive waste and for the temporary to long-term storage of high activity waste. Furthermore, Law 75/2011, abrogating article 9 of Legislative Decree 230/1995 and subsequent amendments and supplements, amended the regulatory process by eliminating de facto the "Technical commission on nuclear safety and the protection of ionizing radiation";
- ✓ Law 27 of 24 March 2012 which, in order to accelerate the decommissioning of nuclear sites, provided for a single authorization procedure (disciplined by article 24) which also takes into due account the position of the local authorities involved;
- ✓ Legislative Decree 45 of 4 March 2014, with which directive 2011/70/Euratom issued by the European Council on 19 July 2011 was transposed into Italian law, establishing a community framework for responsible and safe management of spent nuclear fuel and radioactive waste. In addition to disciplining the procedures for definition, assessment and updating of the National Programme for the management of spent fuel and radioactive waste (see §1.1.V herein), this law provides, in terms of overall reorganization of this issue, under article 6, for the establishment of a new regulatory authority in the field of nuclear safety and protection from risks arising from ionizing radiation: ISIN (the national inspectorate for nuclear safety and protection from radiation). This Inspectorate is dedicated solely to regulation and control of the nuclear sector and, since additional legislative initiatives will be required for its full operation, this standard provides that the functions of ISIN, until such time as it becomes fully operative, will be carried out by the National Centre for Nuclear Safety and Radioprotection (formerly the Nuclear, Technological and Industrial Risks Department) of ISPRA;
- ✓ The Decree issued on 7 August 2015, by the Ministry of the Environment and the Protection of Land and Sea and the Ministry of Economic Development "Classification of radioactive waste, pursuant to article 5 of Legislative Decree 45 of 4 March 2014" which established a new classification for radioactive waste, replacing the one provided under the ISPRA Technical Guide number 26.

The issuing of **Technical Guides** is the responsibility of ISPRA pursuant to article 153 of Legislative Decree 230/1995 and subsequent amendments and supplements.
The Technical Guides are used as references during the authorization procedure. They are not binding but if they are not observed, the applicant or license holder is required to prove that equivalent alternative protection measures have been taken.

The Technical Guides established technical criteria that operators must take under consideration for the siting of the nuclear facilities, presentation and approval of specific projects, conducting operations, and the rules of good practice. Compliance with the Technical Guides is assessed during the authorization and inspection processes. ISPRA has issued 29 Technical Guides on safety and radioprotection regarding licensing procedures, which also include detailed technical information.
Existing international recommendations are also widely used in the Italian system, such as those set forth in the publications of the IAEA (International Atomic Energy Agency) and ICRP (International Commission on Radiological Protection).
A program is underway for updating of the Technical Guides, which is essentially based on the national action plan established within the framework of the WENRA activities connected to the development of the safety reference levels.
The Technical Guides projects required within the context of decommissioning the plants and storage of the waste have been processed with account taken of past regulatory experience and have been issued pursuant to the procedure set forth under Legislative Decree 230/1995. They also reflect the recent experience in licensing activities relative to decommissioning and management of waste.
There are two reference technical guides for the management of radioactive waste:

1) ENEA DISP Technical Guide no. 26 “Management of radioactive waste” – 1987
This Guidance provides elements for classification and management of radioactive waste into three categories: category I, category II and category III in relation to the characteristics and the concentration of radioisotopes. Different types of management are envisaged for each category and, in particular the disposal solutions are different for each. The Guidance currently under review is applied to radioactive waste produced as part of activities which are governed by the rules of law applicable on the peaceful use of nuclear energy and do not apply to airborne waste and liquid waste that are disposed of in the environment in the form of effluents.
The Guidance defines the management criteria as follows:

- Radioprotection and protection of the environment
- Reduction in the quantity of waste produced and reduction of volume
- Classification of radioactive waste and the relative management systems
- The characteristics of conditioned waste packages and containers and traceability thereof
- General characteristics of the disposal site for Category II radioactive waste

2) ISPRA Technical Guide no. 29 "Criteria for the siting of a superficial disposal facility for low to medium activity radioactive waste" – 2014
This guidance defines, as required by Legislative Decree 31/2010, the criteria for identification of the areas that are potentially suitable for hosting the National Repository for waste.

The **Technical Standards** are mainly published by UNI (the Italian National Unification Entity) Other Technical Standards that are often used in the nuclear sector are those published by the CEI (Italian Electro-Technical Committee) and ISO (International Organization for Standardization).
The documents concerning the Technical Standards are elaborated by a group of experts and approved by UNI and/or the CEI Technical Committee and are intended to reflect the broad consent of the industry and research experts in the specific centres.

Furthermore, in the design, construction and management of nuclear installations, other rules apply such as those which concern the prevention of fire, integrity of components under pressure, occupational safety and health. Among other things, and based on the individual circumstances, the use and application of foreign technical standards is often adopted or recommended.
The Technical Standards applicable to the decommissioning of the Italian nuclear installations are indicated in a single document issued by UNI (the Italian National Unification Entity): this document is named UNI 9498.
This document contains eight sections that cover different issues, the contents of which are summarized below.
In general, the standards of the document in question are applicable specifically to the following types of installations:

i) Nuclear reactors
ii) Nuclear sub-critical units;
iii) Electro-nuclear power stations;
iv) Nuclear research installations;
v) Nuclear installations for reprocessing spent fuel;
vi) Installations for the preparation and fabrication of special fissile materials and nuclear fuel;
vii) Storage of special fissile materials and nuclear fuel;
viii) Installations for reprocessing, conditioning or temporary storage of radioactive waste.

However, the Technical Standards in question are not applicable to the following types of facilities:

i) Uranium mines;
ii) Definitive storage or warehousing of radioactive waste;
iii) Installations in which no radioactivity was produced during operations;
iv) Installations that were converted for a new nuclear related usage.

UNI 9498/1 – General Criteria
This standard provides a general framework that includes the principles and factors that must be taken under consideration for decommissioning of a nuclear plant. This includes the general requirements that all procedures, whether they involve management, accounting, administration or are of a technical nature, must be programmed and set up in a controlled and documented manner.
This standard is targeted to managers of nuclear installations to be decommissioned and managers in charge of planning and executing the decommissioning operations; it provides indications and recommendations regarding the methods and technical options that are convenient for adequately protecting the health of the workers, the public and the environment and, finally, for reducing as much as possible the radiation risk associated with the facility.
This standard is applied from the time that the owner/operator decides to definitively close the facility until a situation without any radiation related restrictions is reached. The status of the facility taken as a reference in this standard is the existing configuration at the time that of the final decision to close it. The radioactive substances considered are those associated with normal operation of the facility itself. This standard does not address decommissioning following a serious incident.

Aspects relative to the treatment, conditioning, transport and disposal of radioactive waste are not included in the field of application of this standard. Furthermore, consideration is not taken of the numerical definition of the radioactivity limits for materials that are free of radiation restrictions nor of the management, accounting and administrative aspects. This standard does not exempt users from complying with the rules and procedures in effect.

UNI 9498/2 – Decontamination techniques
This standard describes the principles and methodologies that must be taken under consideration for planning and executing the restoration of a nuclear plant in the decommissioning phase, in the case of an immediate or deferred decommissioning. It provides technical information and recommendations required for the owner/manager of the facility and the persons in charge of planning and executing all the decontamination procedures that are useful for improving the radioprotection conditions within the facility and also for optimal management of the waste.
It is not applicable to facilities of which the components, structures and buildings have been generally contaminated following an accident. In this case, the specific decontamination techniques will be different than those set forth in this standard.

UNI 9498/3 – Conservation and monitoring
This standard identifies the fundamental activities that must be conducted in a nuclear plant at the end of its operation: this is so as to leave this station under safe conditions for an adequate period of time. It refers in particular to facilities in which existing radioactivity, after complete removal of all the fissile materials, is mainly due to radioisotopes with degradation times that justify placement of the facility in a state of conservation and maintenance (C&M) for an adequate period of time in order to allow for complete decommissioning of the facility with a very reduced level of radioactivity.

UNI 9498/4 – Decommissioning of structures and components
This standard describes the principles and factors that must be taken under consideration for decommissioning and removal of the structures and components that were contaminated and/or activated while the facility was operational.

UNI 9498/5 – Radioactive inventory
This section specifies the methodology to follow in assessing residual radioactivity and the radiation fields associated with it in order to radiologically characterize the nuclear installations to be decommissioned. These methods must be planned and executed in a controlled and documented manner.

UNI 9498/6 – Radiological characterization and classification of the materials
This section discusses factors that must be taken under consideration for characterizing and classifying the materials produced during the deactivation of nuclear stations. It provides criteria based on which the most appropriate method for characterization and classification of the materials should be selected based on their type, as provided by a guideline for the selection of the appropriate measurement instruments for defining the radiological status of the materials.

UNI 9498/7 – Criteria for the partial release of an installation or nuclear facility
This section refers to the nuclear installations to be decommissioned for which a decision has been made to postpone final dismantling for a sufficiently long period of time, so as to enable them to be placed under C&M status.
The decision to place a portion of a nuclear installation under C&M status depends on the need to release certain zones where other non-nuclear type activities may continue to be carried out.
Usually, the portion of the plant that will be placed under C&M status will be that part in which the radioactivity can no longer be easily removed but can be restricted to well defined and sealed areas for long periods of time. Usually, these are sectors in which most of the radioactivity comes from neutron activation.

UNI 9498/8 – Requirements for temporary storage of radioactive waste and materials
This section provides the criteria to follow in planning a temporary deposit for the storage of radioactive waste from the operation and dismantling of nuclear installations. It also provides general technical requirements that must be satisfied whether in the planning or the management of the new temporary deposit as well as for the modification of already existing facilities.
Furthermore, this standard provides criteria for the protection of the environment from pollution resulting from the management of radioactive waste, in order to reduce as much as possible the individual and collective doses affecting the population and the workers and to ensure the quality of the environment for current and future uses of the site.
The radioactive waste above includes waste from the reprocessing and/or conditioning activities provided that these activities satisfy the concentration limits for radioactivity based on current standards for temporary storage or disposal in an appropriate site.

UNI Standards connected to the management of radioactive waste
The framework of UNI activities also included development of the following standards that aim to standardize the procedures for management of radioactive wastes:
UNI 10621 (2004): "Containers of characterized radioactive waste";
UNI 10704 (2004) "Classification of radioactive waste";
UNI 10755 (2004) "Registration and labelling of RW packages";
UNICEN 189 (2001) "Solid materials from nuclear plants – radiological methods and procedures for liquidation";
UNI11193 (2006) "Qualification of conditioning processes for cat. 2 packages", which establishes the general requirements for qualification of the conditioning process and specific testing with which the form and/or packages of waste should be verified (chemical, mechanical and physical properties by form of homogenous and heterogeneous waste and for High Integrity Containers);
UNI 11194 (2006) " Radiological characterization of Cat. 2 packages", which establishes the methods and requirements for radiological characterization of containers of radioactive waste prior to their disposal (for example, the measurement system services, typical radionuclides for the waste to be measured, the preparation of the sample, the correlation coefficients);

UNI 11195 (2006) "System for the management of information for the disposal of Cat. 2 packages", which establishes the requirements and methods for the management of the Source Information Management System disposal (that is, the acquisition of data, waste collection plan, control and monitoring of databases, long-term management of the information system);
UNI 11196 (2006) "Containers for the final deposit of Cat. 2 packages" which defines the requirements (dimensions, mechanical characteristics) of containers identified for LLW packages and the qualification process;
UNI 11197 (2006) "Procedure for identification and traceability of information for Cat. 2 packages" which defines the requirements for implementation of an appropriate database and for organization of the necessary information for appropriate management of the radioactive waste packages near the structures;
UNICEN 214-1 (2003) "Deposit for category 2 waste" which is structured as follows
Part 1: fundamental planning criteria;
Part 2: basic qualification requirements for artificial barriers;
Part 3: basic supervision and monitoring criteria.

1.2. Definitions

For the purposes of this Programme, all the definitions contained in the national nuclear safety and radioprotection laws apply, in particular the following:

competent regulatory authority: the entity which, pursuant to article 6 of Legislative Decree 45/2014, is designated to carry out the functions and duties of national authority for nuclear safety and radioprotection established by applicable laws, which is the national inspectorate for nuclear safety and radioprotection (ISIN). Pending the entry into effect of the ISIN regulation, the ISPRA National Centre for Nuclear Safety and Radioprotection (formerly the Nuclear, Technological and Industrial Risks Department) is attributed the functions and duties of the regulatory authority in charge of nuclear safety and radioprotection of nuclear installations and usage of ionizing radiation sources as well as controlling the process for siting of the National Repository;

closure: the completion of all operations at some time after the emplacement of spent fuel or radioactive waste in a disposal facility. This includes the final engineering or other work required to bring the facility to a condition that will be safe in the long term;

nuclear fuel: the fissile materials which are used or intended to be used in a facility including uranium in metal, alloy or chemical compound form (including natural uranium), plutonium in metal, alloy or chemical compound form and any other fissile material that will be qualified as a fuel pursuant to the decision Executive Committee of the Agency for Nuclear Energy of the Organization for Economic Co-operation and Development (OECD);

spent fuel: nuclear fuel that has been irradiated and permanently removed from a reactor core; spent fuel may be considered as a usable resource to be retreated, or it may be intended for final disposal, without any other usage envisaged, and treated as radioactive waste;

decommissioning: all the steps planned, whether technical or executive, to be carried out on a nuclear facility following its final shut down and definitive termination of operation, in compliance with requirements concerning the safety of the workers, the population and the environment, until final disposal or the release of the site without any radioactive restrictions.

management of radioactive waste: all the activities involved in collecting, sorting, manipulating, pre-treating, treating, conditioning, storing or disposal of radioactive waste, but not including transport outside the site;

period of institutional control: the period during which, after the closure of a disposal plant, controls continue to be carried out by the competent authorities. This period depends on the radiation load, expressed in terms of activity concentration as well as halving of the principal radionuclides present in the warehouse. For superficial disposal facilities for low and medium activity radioactive waste, this period generally ranges from 50 to several hundred years.

radioactive waste: any radioactive material in gaseous, liquid or solid form, even if contained in equipment or devices in general, for which no recycling or additional usage is anticipated or taken under consideration by the competent regulatory authority or by a legal or natural person whose decision is accepted by the competent regulatory authority and which is regulated as radioactive waste by the competent regulatory authority;

reprocessing of the fuel: technique for the treatment of irradiated fuel (elements of fuel which are irradiated in nuclear reactors) which consists of separating its constituent elements: the products from the uranium fission, i.e. the actual waste, the residual fissile uranium, which may be reused in another plant, and plutonium;

integrated service: a technical-operational instrument able to take on all the phases of the management cycle for sources which are no longer used such as the preparation for transportation, transportation, characterization, eventual conditioning treatment and temporary storage. All recognized plants that carry out the activity of collecting and temporarily storing radioactive sources which are not destined for further usage can be included under the integrated service definition.

disposal: the placement of spent fuel or radioactive waste, following appropriate methods, in an appropriate facility without the intention of retrieval after disposal; the storage of radioactive waste or spent fuel in an authorized facility, without the intention of retrieval thereof;

disposal in the environment: the planned emission of radioactive waste in the environment under controlled conditions, within the limits authorised or established by this decree;

orphan source: a sealed source the activity of which, at the time of discovery, is above the threshold established in table VII-I of attachment VII of the aforementioned Legislative Decree 230 of 1995, and which is not subject to controls by the authorities either because it never was in the past or because it was abandoned, lost, placed in an incorrect location, illegally removed from the holder or transferred to another unauthorised holder pursuant to this decree or without the recipient being informed.

storage: the holding of spent fuel or of radioactive waste in a facility that provides for its confinement, with the intention of retrieval.

1.3. Origin of spent fuel and radioactive waste

The radioactive waste originates from all those activities which are connected to the production of electronuclear energy (nuclear plants and fuel cycle), including research and development activities. Lower quantities are produced by other activities, such as medical diagnosis and treatment, certain production controls and scientific research.
Radioactive waste currently present in Italy mainly originates from the previously existing nuclear programme, and they are found in the installations managed by Sogin S.p.A. – the nuclear plants of Trino, Garigliano, Latina and Caorso, definitively shut down in the 1980s, the EUREX facilities of Saluggia and the ITREC facility at Trisaia (MT) the former ENEA, the Plutonium and OPEC plants at Casaccia Centre (Rome), the Avogadro Depot of Saluggia (VC) of Deposito Avogadro S.p.A. and the facilities of the Ispra (VA) Joint Research Centre of the European Commission, which are in turn no longer operative and therefore subject to the respective decommissioning programmes.

Waste of a medical, industrial and research origin are added to these wastes above, for which there is a non-negligible production of several hundred m^3 per year. This waste is placed at the facilities of certain national operators, the most significant of which is NUCLECO S.p.A., at the ENEA Centre of Casaccia in Rome.

While they were in operation, the four Italian nuclear plants used a total of approximately 1862 tons of fuel, which became irradiated fuel.

Modest quantities of irradiated fuel, equal to approximately 0.7 tons, are managed today in the nuclear reactor sites used for research.

1.4. Classification of radioactive waste

Radioactive waste from various uses of nuclear energy has qualitative and quantitative characteristics that fluctuate within a rather broad range. It is therefore necessary to classify them in relation to:

- the damage or inconvenience that the waste may cause to human beings and environments;
- the type of provisions to adopt for their disposal.

Disposal of radioactive waste normally refers to packaged waste. Indeed, after production, the radioactive waste is subjected to chemical and physical treatments, which differ depending on the type of waste, the main objective of which is their "conditioning", that is their conversion to a solid, stable and durable form, which allows for manipulation, storage, transport and finally disposal. The conditioned waste is therefore a waste package which consists of solidified material (e.g. cement or glass) encapsulating the original radioactive material and the external container, which is usually a steel drum.

Classification of the radioactive waste in Italy, up to 20 August 2015 when the Decree of 7 August 2015 entered into effect, referred to Technical Guide no. 26 "Radioactive Waste Management" issued by the ENEA – DISP of 1987 (T.G. no. 26). This classification is based in particular on the radioactive properties of waste and their handling requirements. T.G. no. 26 provides for the following three categories:

1) the first category includes all the radioactive waste which requires time measurable in months, up to a maximum of several years, until the values of the radioactive concentrations are lower than the values established under paragraphs b) and c) of point 2 in article 6 of the ministerial decree of 14 July 1970 and those which contain radionuclides with long half-lives, provided they are in concentrations that are lower than those values. This waste originates essentially from medical and scientific research uses, where the radionuclides used (except in certain specific cases such as ^{3}H and ^{14}C) are characterized by relatively short half-lives (less than a year) and, in most cases, less than two months.

2) the second category includes the waste that requires times that vary from few decades to several hundred years to reach concentrations along the order of several hundred Bq/g, and the waste which contains radionuclides with a long life provided the concentrations are along these lines. This waste is in particularly characterized by a concentration of radioactivity such that, following any treatment and conditioning processes they may be subjected to, upon disposal the values indicated in the table contained in T.G. no. 26 are not exceeded. This category includes most of the waste originating from particular production cycles of nuclear plants and above all electro-nuclear power plants, and particular medical, industrial and scientific research uses. Furthermore, certain parts or components of plants arising from "decommissioning" operations of nuclear plants also fall under this category.

3) the third category includes radioactive waste that does not belong to the two previous categories. This is waste that requires thousands of years to reach concentrations along the order of several hundred Bq/g.

This category includes, in particular,

- specific high activity liquid waste arising from the first extraction cycle of the reprocessing plants (or equivalent liquids) and the solids into which these liquids may be converted;
- the waste containing alpha emitters and neutrons arising essentially from research laboratories, medical and industrial uses, manufacturing plants of mixed oxide fuel elements and reprocessing plants.

For the first category waste, T.G. no. 26 provides for conservation (until reaching concentration values below those established under paragraphs b) and c) of point 2 of article 6 of the ministerial decree of 14 July 1970) in depots that are appropriate for guaranteeing protection thereof from meteoric agents as well as from events such as flooding, fire, unauthorized access by persons to the depot.

For the second category waste, in particular, the Technical Guide provides for appropriate treatment and packaging and provides general indications on the procedures for temporary depot and disposal in superficial plants with engineering barriers.

In the last few years, international recommendations issued by the IAEA have oriented the classification criteria for radioactive waste, as compared to those indicated previously, to focus mainly on the disposal procedures considered to be appropriate and identified for each category.

With the issuing of Legislative Decree 230/1995 and subsequent amendments and supplements the radioprotection rules were adjusted to match those established by the Euratom directives and in particular, the conditions regarding exemption from application of the provisions of the aforementioned Legislative Decree were updated.

Also in consideration of Legislative Decree 45/2014, with which directive 2011/70/Euratom was implemented, the latter establishing a community framework for the responsible and safe management of irradiated fuel and radioactive waste, which requires the drafting of the national programme for the management of radioactive waste, for all the phases from generation until disposal, the need was identified to update the classification indicated in T.G. no. 26 making it a priority to establish a more direct correlation between the various types of waste and the disposal solutions considered to be the most appropriate for each and to align, inasmuch as possible, the classification procedures with those adopted internationally.

To this end, the procedure for the definition of the new classification of the radioactive waste was concluded, also in relation to international standards, taking account of their properties and specific typologies, pursuant to article 5 of Legislative Decree 45/2014. This new classification was adopted with the Decree of 7 August 2015 issued by the Ministry of the Environment and the Protection of Land and Sea and the Ministry of Economic Development, replacing the applicable classification in Italy provided by Technical Guide no. 26 issued by ENEA-DISP.

With this interministerial decree, the radioactive waste was classified in the following 5 new categories:

- Very short-lived radioactive waste;
- Very low activity radioactive waste;
- Low activity radioactive waste;
- Medium activity radioactive waste;
- High activity radioactive waste.

The types and requirements for the management of each category will be the subject of specific Technical Guides that will be subsequently issued by ISIN, pursuant to article 153 of Legislative Decree 230/1995 and subsequent amendments and supplements. While awaiting their issuing, for those cases which are not addressed in T.G. no. 26, the specific procedures and management requirements will be assessed in the investigation phase on a case by case basis.

The interministerial decree classifying the radioactive waste is in effect from 20 August 2015. Beginning from that date, all the entities that produce or handle radioactive waste must adopt the new classification and, within six months thereof, must update the registrations and their accounting of the radioactive waste.

Pursuant to the new classification of the radioactive waste established by the aforementioned interministerial decree, all high activity radioactive waste and part of the medium activity radioactive waste with radionuclides in concentrations that do not respect the radioprotection objectives established for the superficial disposal plants will be sent to a temporary storage plant held by the National Repository. Therefore, regarding the terminology used in this Programme, in relation to the management of radioactive waste in the National Repository, when reference is made to high activity radioactive waste we also mean a portion of the medium activity waste pursuant to the aforementioned interministerial Decree of 7 August 2015.

1.5. Operators present on the national territory

The main national operators in the field of radioactive waste management are:

Sogin S.p.A.

Sogin S.p.A. is the state company in charge of the decommissioning of the Italian nuclear plants and the management of radioactive waste including the waste produced by industrial, research and nuclear medicine activities. For the latter Sogin S.p.A. is in charge only of the disposal phase in the National Repository. The closure of the nuclear fuel cycle and the activities connected to and ensuing from it, including in cooperation with other public entities or companies which, if public, may also acquire ownership thereof, was established with Legislative Decree 79 of 16 March 1999 which ordered the transformation of ENEL into a holding company composed of various independent companies, one of these companies being in charge of dismantling the decommissioned electro-nuclear plants.

Sogin S.p.A., which is the fully subsidiary of the Ministry of Economy and Finance and operates based on the strategic guidelines issued by the Italian Government, inherited all the nuclear installations belonging to ENEL with the duty of managing the “post operation” activities of the four Italian nuclear plants which have been shut down for some time (Garigliano, Latina, Trino and Caorso), managing the deactivation of the plants themselves,

the closure of the nuclear fuel cycle and the release without restrictions of a radiological nature of the sites on which the decommissioned plants were located.
From August 2003, pursuant to the directives of the Ministerial Decree of 7 May 2001, issued by the Ministry of Industry (now the Ministry of Economic Development), Sogin S.p.A. undertook also the activities of the former nuclear fuel cycle research plants of the ENEA of Saluggia (VC), Casaccia (RM) and Rotondella (MT) and the Bosco Marengo (AL) nuclear fuel plant (formerly Fabbricazioni Nucleari – FN).
In 2004 Sogin S.p.A. took over the majority share (60%) of NUCLECO S.p.A., the national operator qualified to collect, treat, condition and temporarily store waste and radioactive sources that derive from nuclear medicine and scientific and technological research.
Pursuant to article 26 of Legislative Decree 31/2010 Sogin S.p.A. is the entity in charge of constructing and operating the National Repository, an environmental surface infrastructure in which all radioactive waste is to be safely stored.
Pursuant to article 17, paragraph 2 of Legislative Decree 52/2007, Sogin S.p.A. is also the national operator in charge of long-term containment of sealed high-level sources that have been decommissioned, in view of their future disposal.

Deposito Avogadro S.p.A.
This is a company that belongs to the FIAT group which manages the Avogadro RS-1 plant, a nuclear reactor for experimental research located within the Saluggia (VC) site. This was the first reactor to be constructed in Italy in 1959, which was shut down in 1971 and then decommissioned. Since 1981, inside its pool the temporary depot of irradiated fuel elements originating from the electro-nuclear plants owned by ENEL was authorized. These irradiated fuel elements are currently being transported to France in order to be reprocessed (see § 1.6. herein for more information).

ENEA
ENEA is the National Agency for New Technologies, Energy and Sustainable Economic Development and it is a national institution for research.
Since 1950s, ENEA has been carrying out research and development activities in the **nuclear fusion** centre at the Frascati Centre. These activities were initially dedicated to experimentation on plasma and then evolved toward a complex system of physics, technology and engineering.
Since its establishment, ENEA also carries out research and development activities in the **nuclear fission** sector. Currently its activities are mainly focused on research and development of advanced nuclear systems for innovative production plants and for the resolution of medium-long term problems relating to the availability of fuel resources and the minimization of long lived radioactive waste.
Again as part of its activity relating to fission, it carries out a role that is important for qualification of components and nuclear systems, for metrology of ionizing radiations and radiation protection.
ENEA is moreover the Integrated Service Operator that can be entrusted by the operator for managing high level sealed sources which are no longer used, pursuant to article 17, paragraph 4 of Legislative Decree 52/2007.

NUCLECO S.p.A.
Established on 5 May 1981, the shareholders of NUCLECO S.p.A. (NUCLeare ECOlogia) are Sogin S.p.A. which owns 60% and ENEA which owns 40%. NUCLECO S.p.A. is involved in the integrated management of waste and radioactive sources, decommissioning of nuclear facilities, nuclear and/or asbestos decontamination of industrial sites.
As part of the "Integrated Service" of managing radioactive waste, coordinated by ENEA, NUCLECO S.p.A. is the national operator for the collection, treatment, conditioning and temporary storage of low and medium activity radioactive waste and decommissioned radioactive sources produced in the country by medical-health related activities, scientific and technological research and other non-electric activities.
The company is active in the international market particularly in Eastern Europe, where it provides design and consulting services.

JOINT RESEARCH CENTRE (Ispra-VA)
It began as an exclusively nuclear research centre, but over time it extended its activities to diversified sectors, such as renewable energy, the environment, cutting edge technologies, to the point that, currently, nuclear operations are practically stopped, except for the "safeguarding" sector (methodologies for controlling fissile and fertile materials, in application of the Non-proliferation Treaty), in which the CCR of Ispra has a leading position internationally. Nuclear plants which are no longer used (Ispra 1 reactor, ESSOR reactor and the plants connected to it, radiochemical laboratories, LMA hot cells, collection, deposit and radioactive waste treatment structures and structures for decommissioned nuclear material) are currently the object of a decommissioning programme, initiated by the European Commission. The relative activities are subject to the regulation system established by Italian laws.

Other Operators
Other operators are also present in Italy, mainly universities, which operate small reactors for research and private companies that collect and temporarily store low activity radioactive waste originating from research, industrial and medical-hospital activities.

1.6. Government agreements with other member states of the European Union

With the Intergovernmental Agreements of Lucca and Nice, the Italian and French Governments defined the forms of corporation regarding the processing of fuel and radioactive waste originating from Italian plants, between the authorities and the management companies of the two countries.

On 24 November 2006, the **Intergovernmental Agreement** between the government of the Republic of Italy and the government of the Republic of France was signed in Lucca for the treatment in France of 235 tons of nuclear fuel used at Italian nuclear plants.
By 2025, the waste produced from the reprocessing of spent fuel is expected to be returned to Italy, this constituting a specific commitment of the Italian Government.

For the implementation of this Agreement, on 27 April 2007, Sogin S.p.A. stipulated with AREVA NC (F) an onerous contract for the transportation and reprocessing at the French plants of La Hague, of approximately 235 tons of irradiated nuclear fuel from the plants operated by Sogin S.p.A. at Caorso (PC), Trino (VC) and Garigliano at Sessa Aurunca (CE) and stored partially at the plants of Caorso (PC) and Trino (VC) and partially by Deposito Avogadro S.p.A. of Saluggia (VC).
Furthermore, on 30 November 2007, an Intergovernmental Agreement between the Government of the Republic of Italy and the Government of the Republic of France was signed in Nice for enhancing and developing, among other things, consultation on issues connected to the containment and management of radioactive waste and scientific cooperation in the nuclear field. The two parties also established with this agreement to consolidate implementation of the Lucca Agreement.

CHAPTER 2: General objectives of the national policy regarding the management of spent fuel and radioactive waste

The administrative functions on the management of spent fuel and radioactive waste are attributed exclusively to the State pursuant to article 29, paragraph 2 letter i) of Legislative Decree 112 of 31 March 1998, removing this area from regional, provincial and municipal governance.

2.1. The national policy beginning from the 1960s until the current time

After the abandonment of the use of nuclear fission for electricity following the first abrogative referendum in 1987, a decade passed during which, without deviating from the conditions ensuring the safety of human beings and the environment, not much was done for the final containment of the radioactive waste and the decommissioning of the previously constructed nuclear plants.

It was necessary to concretely and effectively initiate decommissioning of the plants and the facilities, aiming for an unconditional release of the relative sites.

At the end of the 1980s, ENEL and ENEA conducted together a series of actions focused on waste management and decommissioning, which nevertheless remained isolated instances and were not part of a single and coordinated strategy at the national level.

The problem of a global strategy was formally discussed at the first National Conference on radioactive waste held by ANPA (the National Agency for Protection of the Environment) in July 1995, and it was then discussed again at a similar Conference in November 1997.

This latter one, in particular, shed light on the need and urgency to identify a solution for a problem which had by now gained the attention of the public opinion, the media, the political forces and the institutions, through a political initiative by government authorities, together with the regions and all interested parties, for definition of a national policy for management of radioactive waste, irradiated fuel, nuclear materials, and the subsequent decommissioning of nuclear plants within our country, founded on the availability of a national site for disposal and storage.

By implementing these indications, the Ministers of Industry and the Environment at the time announced, in the same Conference held in November 1997, the establishment of a “National table for the management of nuclear consequences” attended by all the players involved in decommissioning nuclear plants in Italy, for the definition of an Action plan in the sector.

Subsequently, a specific State-Regional Programme Agreement was defined and approved regarding the definition and establishment of certain measures aimed at promoting the safe management of radioactive waste produced in Italy. Among other things, a participatory, transparent and conceptual process was envisaged in order to identify and select a location for the construction of the national repository for radioactive waste.

Based on this agreement and, following the initial conclusions of the “National table”, the technical-programme document presented at the National Conference on Energy and the Environment with the title “Proposal for a plan for the decommissioning of nuclear plants in Italy and the containment of radioactive waste” the Ministry of Industry prepared the strategic guidelines document for the management of the consequences of nuclear use in Italy. Three major objectives were established.

First objective: treatment and conditioning of all the liquid and solid radioactive waste stored in the sites, a large portion of which was still untreated, in order to transform it into certified waste packages, temporarily stored on the production site but ready to be transferred to the national repository.

Second objective: (concurrently with the previous objective, given the long times involved): selection of the location and preparation of the national repository both for definitive disposal of packaged category II waste[1], and the temporary medium-term storage, within an engineering structure, of category III waste, in particular the waste originating from the retreatment and the irradiated fuel which was not sent for retreatment.

Third objective: accelerated deactivation of nuclear plants overall. Reaching this objective was dependent, among other things, on the following actions:
- management of irradiated fuel whether through retreatment abroad, only for the small quantity already provided for, or through dry storage on site in specific “dual purpose” containers, while awaiting its transfer to the national repository;
- removal of nuclear materials and fresh fuel to qualified and authorized operators abroad.

It was clear that the deactivation of the nuclear plants, given the volumes of waste produced (which have nevertheless to be minimized with a careful study and usage of optimal techniques), would have required the availability of the national repository. This meant that the pursuit of the third objective was strictly dependent on the pursuit of the second.
Numerous studies and researches were conducted regarding the second priority objective in the 1970s and up to the beginning of the 1980s, on the geological disposal of high activity radioactive waste. These studies, which were promoted and developed within ENEA, with the participation of qualified universities, and added to the Research programmes of the European Commission, placed Italy in an advanced technical-scientific position internationally, especially insofar as the study of clay formations and the investigations on “similar natural” sites (examples of biosphere isolation existing in nature for millions of years).
The Italian ratification of the “Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management” with law 282 of 16 December 2005 and the commitment to implement the obligations deriving therefrom, constituted, and still constitutes today, a key factor for the pursuit of the radioactive waste management objectives.
Among other things, the Ministerial Decree of 7 May 2001 gave Sogin S.p.A. mandates to store irradiated fuel in appropriate dry containers within the sites of the plants where they were located while awaiting transfer to the national repository and to provide for accelerated deactivation of all the decommissioned nuclear power facilities within twenty years, preceding directly to the decommissioning until the unconditional release of the locations where these facilities were located.

[1] Classification of radioactive waste in category I, II and III pursuant to Technical Guide no. 26 issued by ENEA-DISP in 1987.

The pursuit of this objective would have depended on the siting and realization of the national repository for radioactive waste in due time.
This strategy revealed itself to be difficult to implement, especially due to the opposition of the local communities, which considered the presence of dry storage as an obstacle to releasing the sites.
This led the Government to reopen the option of reprocessing the irradiated fuel and, with ministerial decree issued on 2 December 2004, instructed Sogin S.p.A. to carry out the feasibility study for the transfer abroad of the irradiated fuel, carrying out the reprocessing and providing for the repatriations of the conditioned waste.
In the same period, during the administrative management of the activity arising from defining an emergency state (14 February 2003 - 31 December 2006) the Government put through Legislative Decree 314/2003 which provided for the siting of a geological type national repository for the definitive disposal of high activity radioactive waste in Scanzano Jonico (MT).
The emergency solution was considered not to be feasible by the Government itself, and therefore the idea of a geological deposit was rejected: following the decision made by the Conference of Regional Presidents, in the subsequent conversion of the Legislative Decree into law 368/2003 there was a provision for construction of “a national repository restricted to only category III waste”, which Sogin S.p.A. had to construct by and no later than 31 December 2008 and the location of which was to be identified within one year by an Extraordinary commissioner who was thereafter never appointed.
Subsequently, law 239/2004 provided that, using the same procedure adopted for realization of the category III radioactive waste repository, “a location for final placement of category II waste” was also to be identified.
It is appropriate to remember that Law 368/2003 also established that, until the national repository became available, offsetting measures would be implemented for the local communities hosting the plants and the radioactive waste through the provision of annual funds proportional to the inventory of fuel and the radioactive waste stored. This part of the law was implemented and contributed to constructing a more aware and open attitude by the local communities themselves, though within the framework of specific medium-long-term guarantees.
It is also useful to remember that while they were in operation, the four ENEL’s nuclear plants used a total of approximately 1862 tons of fuel, which became irradiated fuel. Of this, approximately 950 tons were sent abroad to be reprocessed based on contracts concluded prior to 1977 with British Nuclear Fuel Ltd (BNFL), which did not provide for the respective radioactive waste to be returned to Italy. Subsequently, based on contracts stipulated by ENEL with BNFL after 1977 (Latina 1979 Contract and the Service Agreement 1980 Contract), another 678 tons were sent to the United Kingdom up to 2005 for reprocessing in the Sellafield site. These last contracts provided for the radioactive waste produced to be returned to Italy.
The state of emergency of the radioactive waste was concluded by the pro tempore Government on 31 December 2006, the year in which the intergovernmental agreement between Italy and France for reprocessing of approximately 235 tons of irradiated fuel was signed in Lucca.
Concurrently, the Government defined a national “road map” for construction of a national repository so as to allow France and the United Kingdom to return the category II and III radioactive waste between 2020 and 2025.

In March 2008, the Ministry of Economic Development established a Committee consisting of representatives of Ministries, Regions, ISPRA and ENEA who had the task of discussing and proposing the most appropriate procedures for identifying adequate areas and for selecting a national site for storage of radioactive waste. The conclusive report on the work of this committee which was also transmitted by the Minister at the time to the State-Regional Conference, was published in September 2008.
The procedure for identification of the appropriate site on which to construct the national repository for the disposal of low and medium activity radioactive waste and storage over the medium term of high activity radioactive waste while awaiting a definitive solution for its disposal was made official with Legislative Decree 31/2010. The abovementioned national repository was conceived in order to be constructed and managed as part of a technology park with common structures for the services and the functions required for the management of an integrated system of operations, scientific research and technological development, of technological infrastructures for the pursuit of activities connected to the management of radioactive waste and irradiated fuel.
In March 2014, Legislative Decree 45/2014 was issued implementing Council Directive 2011/70/Euratom which provides for the establishment of a National Programme clearly illustrating the general objectives of the national policies of the member states regarding the management of radioactive waste and spent fuel.
As regards the nuclear reactors used for research, the national policy regarding fuel is to return the spent fuel to its country of origin.
The last significant delivery abroad of spent fuel from nuclear reactors used for research took place in July 1999, when 140 elements of TRIGA RC-1 fuel, located in ENEA Casaccia Research Centre were sent to the US Department of Energy as part of the US policy of repatriating spent fuel produced by the United States.
Regarding the Italian research reactors, the only ones which currently hold spent fuel on site are the TRIGA Mark II, located in the L.E.N.A. (Laboratory of Applied Nuclear Energy) of the university of Pavia, and the TRIGA RC-1, located in ENEA Casaccia Research Centre.

2.2. Future national policy objectives

The fundamental principle underlying the national policy on radioactive waste and spent fuel management is to protect the population, the workers and the environment from the risk of exposure to ionizing radiation and, in particular, to avoid undue transfer to future generations of the onerous duty of managing radioactive waste present today, ensuring adoption of the necessary solutions, without delay.
National policy is also based on the general **principles** indicated in article 4 of directive 2011/70/Euratom, which are provided below:

a) the generation of radioactive waste shall be kept to the minimum which is reasonably practicable, both in terms of activity and volume, by means of appropriate design measures and of operating and decommissioning practices, including the recycling and reuse of materials;
b) the interdependencies between all steps in spent fuel and radioactive waste generation and management shall be taken into account;
c) spent fuel and radioactive waste shall be safely managed, including in the long term with passive safety features;
d) implementation of measures shall follow a graded approach;
e) the costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials;
f) an evidence-based and documented decision-making process shall be applied with regard to all stages of the management of spent fuel and radioactive waste.

The following assumptions constitute the **GENERAL OBJECTIVES** of the national policy:

1. implementing the decommissioning of nuclear installations, until the release of the sites without restrictions of a radiological nature and, consequently, securely treat and condition all the liquid and solid radioactive waste located on site, in order to transform it into certified waste packages, temporarily stored at the production site, ready for transfer to the National Repository;
2. update the national inventory of radioactive waste and spent fuel yearly;
3. safely dispose of the radioactive waste generated in Italy, as priority, on the national territory, as established by Directive 2011/70/Euratom;
4. define the location, construct and operate the National Repository for radioactive waste generated in the country, originating from industrial, research and medical-health related activities and from the previous management of nuclear plants, when these arise from civilian activities, including within a Technology Park that will include a study and experimentation centre, as specifically defined in article 27 of Legislative Decree 31 of 15 February 2010;
5. dispose of low and medium activity radioactive waste from industrial, research and medical - health related activities and previous management of nuclear plants in the National Repository, when these originate from civilian activities;
6. in a long-term provisional capacity, store within this National Repository the high activity radioactive waste and spent fuel from the previous operation of nuclear plants, when originating from civilian activities.

For the disposal of the latter, the solution which most specialists agree with internationally is disposal in geological formations. In the case of Italy, considering that the quantity of high activity radioactive waste (including spent fuel) to be disposed of is of a modest entity, the solution of creating a geological deposit within the country appeared to be excessive and not financially expedient. Therefore, during the transitional period while the high activity radioactive waste remains in the National Repository, the most appropriate disposal solution within a geological site for this waste will be identified, also taking into account the opportunities provided within the context of any international agreements that could be concluded within the same period;

7. transport abroad the spent nuclear fuel generated by the operation of decommissioned nuclear power plants, still present in the country, to be treated and reprocessed, pursuant to specific government directives/agreements, except for particular cases in which management will nevertheless follow the aforementioned principles of the 2011/70/Euratom directive. Upon completion of the treatment, the radioactive waste originating from specific contracts/agreements for reprocessing of spent nuclear fuel will be returned to Italy;
8. ensure respect for the commitments between the Republic of Italy and EURATOM on the management of radioactive waste in the Joint Research Centre located in the municipality of Ispra (VA);
9. establish a programme for research and development activities which is exclusively aimed at the secure management of spent fuel and radioactive waste in line with the contents of the National Programme.
10. as a priority aimed at reaching the aforementioned objectives, implement a correct, objective and accurate disclosure process, to ensure transparency and actual participation by the public in the decision-making processes concerning the management of spent fuel and radioactive waste.

Based on the commitments following the aforementioned objectives, the National Repository will ensure, on the one hand, the (final) disposal of the low and medium activity radioactive waste originating from civilian usages, arising from industrial, research and medical-health related activities and the prior management of nuclear plants and on the other hand, safely store the spent fuel and the high activity radioactive waste originating from civilian activities, which are already packaged and transformed into stable and inert solids of high durability, for an adequately long period (up to 50 years). It is significant to specify that, in relation to the new classification of the radioactive waste, medium activity waste will also be stored on a long-term provisional basis in the National Repository which, in relation to the content of the long-life radionuclides, cannot be placed in the medium and low-level disposal facility, as the radioprotection objectives set for this facility would not be fulfilled.

Implementation of the programme to confer all the types of radioactive waste and spent fuel to the National Repository will also allow the closure of the temporary storage depots currently present within the sites of the nuclear plants currently being decommissioned.

When the provisional storage period of the high activity radioactive waste and spent fuel in the National Repository will be considered to have been completed, a structure will be provided in which this waste can be disposed of so that isolation from the biosphere is maintained for the very long term.
In principle, a geological depot for the final disposal of high activity radioactive waste (including spent fuel) should be constructed in Italy as well, but in the case of Italy, the quantity of such wastes to be disposed of is modest and the solution of creating a geological depot within the country appears to be excessive and not expedient financially. During the transitional period when the high activity radioactive waste remains in the National Repository, the most appropriate disposal solution within a geological site for this waste will be identified, also taking into account the opportunities provided within the context of possible international agreements that could be concluded within the same period.

2.3. Implementation of general objectives

In order to implement the general objectives of the national policy on management of radioactive waste and spent fuel, in relation to waste treatment and conditioning projects, implementation of the decommissioning of nuclear installations and the operation of the National Repository, the objectives concerning the radioprotection of the must be respected, in particular:

- for decommissioning operations, including the treatment and conditioning of waste, compliance with the non-radiological (up to a dose of 10microSv per year), as established by Legislative Decree 230/1995, must be ensured under normal operating conditions. The objective for accident conditions is a dose of 1 mSv/event;

- for the National Repository, ISPRA's T.G. no. 29 has established the objectives for radioprotection under normal conditions in the operating phase of the Repository and in the subsequent phases, in compliance with the above mentioned non-radiological criterion and, for accident conditions, the radioprotection objectives are established in such a way that the radiation impact on individuals of the population arising from such situations is low enough to exclude adoption of any intervention for protection of the population itself, including in the case of more severe accident scenarios.

Furthermore, in relation to the decommissioning of the nuclear installations, up to the release of the sites without any radiation restrictions, it is hereby noted that the projects related to the treatment and conditioning of waste have nevertheless been initiated for some time now on the basis of guidelines provided to the implementing entity by the Ministry of Economic Development and are currently partially either already concluded, in process or scheduled for the near future. Furthermore, the procedures for assessment of the environmental impact have already been carried out for the decommissioning of nuclear plants.

One element of fundamental knowledge refers to the updating of the national inventory of radioactive waste and spent fuel, which will be carried out annually, using ISIN skills and services. To this end, we hereby specify that the ISPRA National Centre for Nuclear Safety and Radioprotection, which is currently performing the functions of ISIN, has already been assigned similar duties, such as conducting assessments of the radiometric inventory present on the sites, pursuant to article 4 of Law 368/2003 or preparing the national inventory of radioactive waste to support its own preliminary and monitoring activities and also for use as part of the national contribution to the “IAEA Waste Management Database” within the context of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and for the three year report on the state of implementation of directive 2011/70/Euratom.

For the safe disposal of radioactive waste generated in Italy, by way of a priority on national territory, and as established by directive 2011/70/Euratom, it will be processed and conditioned and, at the same time, action will continue with a view to identifying a suitable area for the construction and operation of the National Repository.

To define the location, construct and operate the National Repository for radioactive waste generated in the country from industrial, research and medical-health related activities and from the previous operation of nuclear plants, when these arise from civilian activities, to be situated within a Technology Park that will include a study and experimentation centre, the instructions specifically defined in article 27 of Legislative Decree 31 of 15 February 2010 will be followed, with particular attention to the transparency and participation obligations established by directive 2011/70/Euratom.

As concerns the disposal in the National Repository of low and medium activity radioactive waste from industrial, research and medical-health related activities and previous operation of nuclear plants, when these originate from civilian activities, the instructions set forth in Legislative Decree 31 of 15 February 2010 will be followed.

High activity radioactive waste and spent fuel originating from the previous operation of nuclear plants, when originating from civilian activities will be stored long-term provisionally within this National Repository. For disposal of the latter, during the transitional period when the high activity radioactive waste remains in the National Repository, the most appropriate disposal solution within a geological site for this waste will be identified, also taking into account the opportunities provided within the context of any international agreements that could be concluded within the same period.

Spent nuclear fuel generated by the operation of decommissioned nuclear plants still present in the country will be transferred abroad to be treated and reprocessed pursuant to specific government directives/agreements, except for particular cases in which management will nevertheless follow the aforementioned principles of the 2011/70/Euratom directive. Upon completion of the treatment, the radioactive waste from the reprocessing of the spent nuclear fuel will be returned to Italy pursuant to specific contracts/bilateral international agreements.

To ensure respect for the commitments between the Republic of Italy and the European Atomic Energy Community (EURATOM) on the management of radioactive waste in the Joint Research Centre (CCR) located in the municipality of Ispra (VA), Parliament will issue a specific law ratifying the agreement concluded between the parties on 27 November 2009.

As regards the research and development activities, the exclusive purpose of which is the safe management of spent fuel and radioactive waste in line with the contents of the National Programme, the operator of the Technology Park, which may collaborate with the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) and other research entities, will present a programme to be submitted for approval to the Ministry of Economic Development and the Ministry of the Environment and the Protection of Land and Sea.

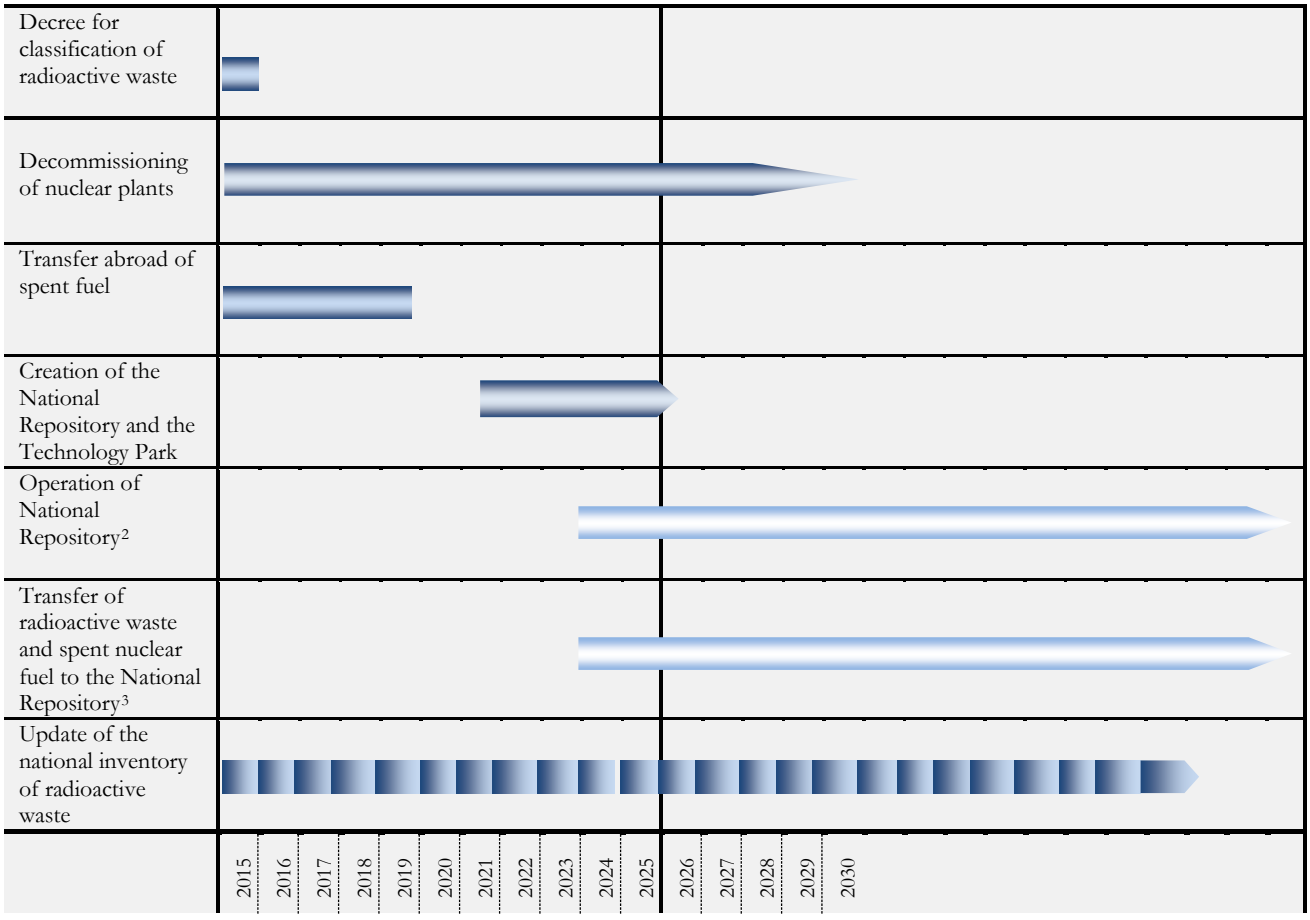
For achievement of these objectives, a correct, objective and accurate disclosure will be made to ensure transparency and actual participation by the public in the decision-making processes concerning the management of spent fuel and radioactive waste, initially through communications posted on the websites of the Ministry of Economic Development and the Ministry of the Environment and the Protection of Land and Sea.

CHAPTER 3: Significant milestones for implementation of the National Programme

Following are the milestones for the implementation of the National Programme:

a. issuing of the decree for classification of radioactive waste (issued via Ministerial Decree of 7 August 2015);
b. pursuit of the decommissioning activity of nuclear plants (in compliance with the times indicated in the authorizing decrees);
c. completion of the transfer abroad of spent fuel for reprocessing;
d. siting, construction and operation of the National Repository and the Technology Park;
e. transfer of radioactive waste and spent nuclear fuel to the National Repository;
f. annual updating of the national inventory of radioactive waste.

Figure 1: Significant milestones and time limits for implementation of the National Programme

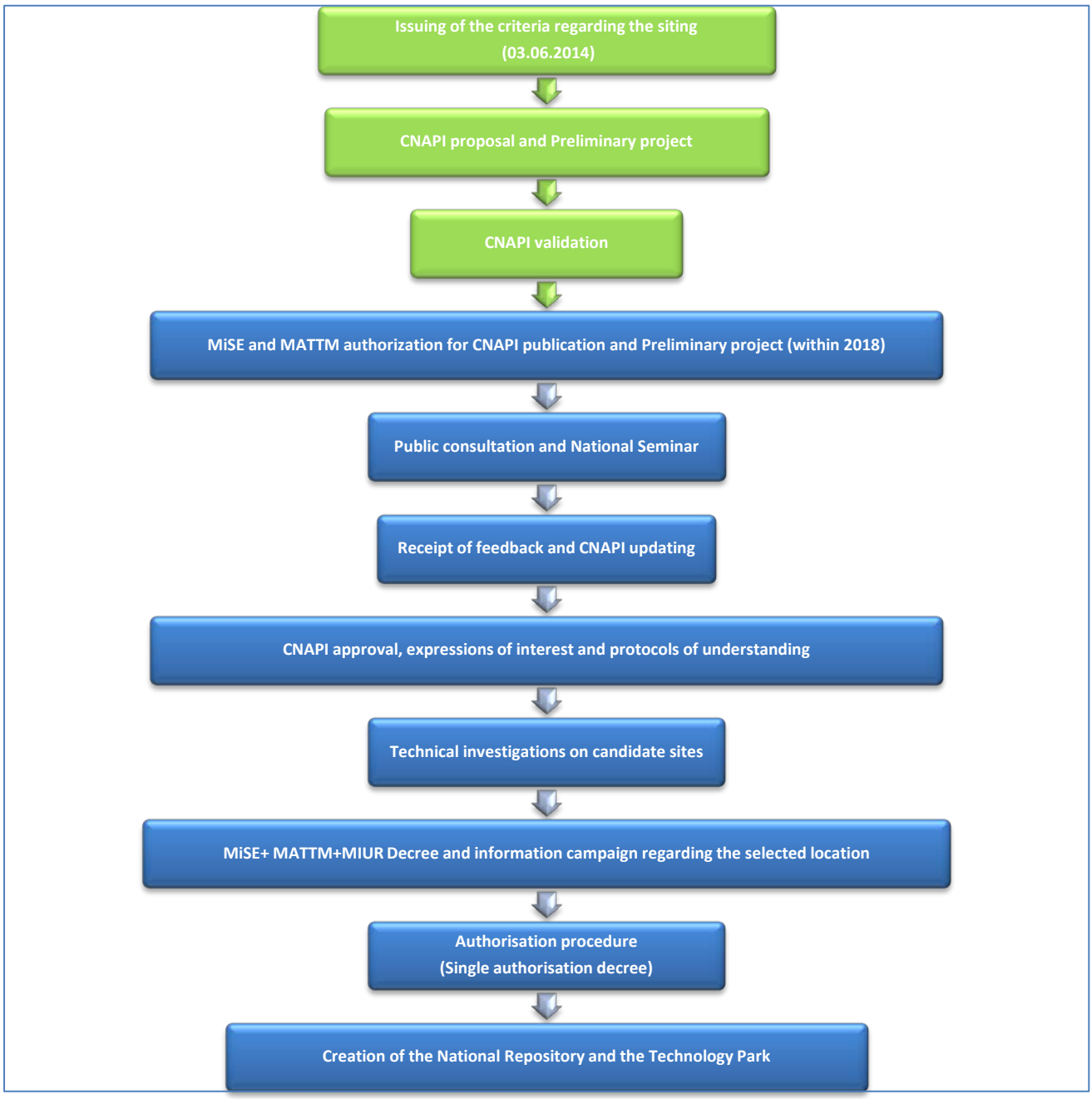


One of the most significant of the milestones above refers to the procedure that will lead to the siting of the National Repository within the Technology Park. In figure 2, below, we

[2] Though the finalization of the National Repository and the relative Technology Park is set for the end of 2025, the operation of the interim storage (high level activity area) within the National Repository is scheduled for the beginning of 2024.
[3] The return of only high activity waste, reprocessed abroad, is set to begin in January 2024.

summarized schematically the activities that have already been completed and those which remain to be completed.

Figure 2: Significant milestones for the creation of the National Repository and the Technology Park (concluded actions are in green, while pending actions are in blue).



CHAPTER 4: Inventory of the spent fuel and radioactive waste and estimates of future quantities

4.1. Spent fuel and radioactive waste

The radioactive waste currently present in Italy originates from the operation of four nuclear installations (Caorso, Garigliano, Latina, Trino) and research activities focused on the nuclear fuel cycle. To these are added the waste of a medical-industrial origin of several hundred cubic meters per year.

Compared to other types of waste, radioactive waste has two characteristics in its favour:

1. the rather small quantity produced from the exploitation of nuclear energy;
2. due to the radioactive decay, over time the waste tends to lose its radioactivity and therefore the danger associated with it.

As regards this latter point, the times depend on the type of waste, but nevertheless its danger tends to decrease progressively over time, which is not the case for the other types of waste.

Concerning the first point, the overall volume of radioactive waste produced in Italy from the beginning of the nuclear age to date which is present in the Italian installations includes:

- radioactive waste produced by the four nuclear power plants;
- radioactive waste produced by research reactors, experimental installations run by ENEA and other operators;
- the radioactive sources used in the industry, for research and above all in the medical field, for diagnostic purposes and for treatments.

In particular, the total quantity, as at 31 December 2015, of the radioactive waste present in Italy totalled **29,724.94 m^3**.

Table 1 illustrates the locations of the radioactive waste and decommissioned radioactive sources present in Italian plants.

Table 2 illustrates the volume, expressed in m^3, of the inventory of radioactive waste distributed in compliance with its classification pursuant to the Ministerial Decree of 7 August 2015.

Table 3 illustrates the activity expressed in gigabecquerel (GBq), of the inventory of radioactive waste distributed in compliance with its classification pursuant to the Ministerial Decree of 7 August 2015.

The national inventory of radioactive waste is prepared by ISIN on the basis of data that is submitted to the inspectorate annually by various operators, who are in turn responsible for holding and management the waste itself in a safe manner.

The inventory of radioactive waste present as at 31 December of each year on the national territory is kept by ISIN, considering all the categories of waste and reporting the volumes at the time of recognition and therefore in a form that is partially already conditioned for definitive disposal, and partially not yet conditioned.

The regulatory indication regarding the preparation of the inventory is shown under point c) of paragraph 1, article 8 of Legislative Decree 45/2014.

Table 1 – Summary by Plant – Radioactive waste and decommissioned sources (updated as at 31 December 2015).

Plant	Location	Volume	Activities	Decommissioned sources
		m^3	GBq	GBq
Caorso Power Plant	**Caorso (PC)**	2,456.57	2,204.53	0.02
Garigliano Power Plant	**Sessa Aurunca (CE)**	2,790.82	375,244.12	0.00
Latina Power Plant	**Latina**	1,686.34	20,993.53	0.00
Trino Power Plant	**Trino (VC)**	1,178.71	11,604.20	0.00
EUREX Plant	**Saluggia (VC)**	2,842.13	2,299,545.00	8.94
ITREC Plant	**Rotondella (MT)**	3,059.60	279,446.19	0.02
Plutonium Plant	**Casaccia, Rome**	149.86	20,969.70	0.00
OPEC	**Casaccia, Rome**	9.23	3,666.59	1305.01
Bosco Marengo	**Bosco Marengo (AL)**	477.73	33.58	0.00
TAPIRO Reactor	**Casaccia, Rome**	0.00	0.00	0.00
TRIGA Reactor	**Casaccia, Rome**	0.00	0.00	0.00
NUCLECO Plant	**Casaccia, Rome**	6,791.09	8,476.86	1075409.40
CCR Ispra EURATOM	**Ispra (VA)**	4,770.00	97,035.78	261.00
Avogadro Depot	**Saluggia (VC)**	80.31	443.44	0.00
Campoverde Tortona	**Tortona (AL)**	326.64	84.93	209.00
Campoverde Milan	**Milan**	383.96	104.31	3036.88
LivaNova Depot	**Saluggia (VC)**	668.72	310.54	3439.90
Protex Depot	**Forlì**	901.00	70.74	167.13
Cemerad Depot	**Statte (TA)**	1,139.30	92.80	1.46
CESNEF Reactor	**Milan**	9.56	11.09	0.00
LENA Reactor	**Pavia**	3.38	0.98	1.00
AGN-1 Reactor	**Palermo**	0.00	0.00	0.00
Total		**29,724.9**	**3,120,338.9**	**1,083,839.7**

Table 2 – Volume of inventories of radioactive waste, expressed in m^3, by category (updated as at 31 December 2015)

Plant	Location	VSLW (1)	VLLW (2)	LLW (3)	ILW (4)	HLW (5)	Totals
		m^3	m^3	m^3	m^3	m^3	m^3
Caorso Power Plant	**Caorso (PC)**	0.00	733.75	1722.82	0.00	0.00	2456.57
Garigliano Power Plant	**Sessa Aurunca (CE)**	0.00	1269.24	1431.58	90.00	0.00	2790.82
Latina Power Plant	**Latina**	0.00	595.78	1076.54	14.02	0.00	1686.34
Trino Power Plant	**Trino (VC)**	0.00	599.90	506.54	72.28	0.00	1178.71
EUREX Plant	**Saluggia (VC)**	0.00	1402.92	908.79	530.43	0.00	2842.13
ITREC Plant	**Rotondella (MT)**	0.00	2553.66	284.30	221.64	0.00	3059.60
Plutonium Plant	**Casaccia, Rome**	0.00	0.00	0.00	149.86	0.00	149.86
OPEC	**Casaccia, Rome**	0.00	0.00	2.73	6.50	0.00	9.23
Bosco Marengo	**Bosco Marengo (AL)**	0.00	132.73	343.52	1.47	0.00	477.73
TAPIRO Reactor	**Casaccia, Rome**	0.00	0.00	0.00	0.00	0.00	0.00
TRIGA Reactor	**Casaccia, Rome**	0.00	0.00	0.00	0.00	0.00	0.00
NUCLECO Plant	**Casaccia, Rome**	157.60	806.96	5619.23	207.30	0.00	6791.09
CCR Ispra EURATOM	**Ispra (VA)**	0.00	797.00	2845.00	1128.00	0.00	4770.00
Avogadro Depot	**Saluggia (VC)**	0.00	76.01	4.30	0.00	0.00	80.31
Campoverde Tortona	**Tortona (AL)**	92.07	4.46	226.14	3.96	0.00	326.64
Campoverde Milan	**Milan**	132.81	23.97	219.62	7.56	0.00	383.96
LivaNova Depot	**Saluggia (VC)**	0.00	558.52	102.40	7.80	0.00	668.72
Protex Depot	**Forlì**	720.00	0.00	180.00	1.00	0.00	901.00
Cemerad Depot	**Statte (TA)**	776.52	249.45	92.96	20.37	0.00	1139.30
CESNEF Reactor	**Milan**	0.00	6.34	0.00	3.22	0.00	9.56
LENA Reactor	**Pavia**	0.00	2.50	0.00	0.88	0.00	3.38
AGN-1 Reactor	**Palermo**	0.00	0.00	0.00	0.00	0.00	0.00
Total		**1879.00**	**9813.18**	**15566.48**	**2466.29**	**0.00**	**29724.94**

(1) VSLW: very short-lived radioactive waste

(2) VLLW: very low activity radioactive waste

(3) LLW: low activity radioactive waste

(4) ILW: medium activity radioactive waste

(5) HLW: high activity radioactive waste

Table 3 – Activity of the inventory of radioactive waste, expressed in GBq, by category (updated as at 31 December 2015)

Plant	Location	VSLW (1)	VLLW (2)	LLW (3)	ILW (4)	HLW (5)	Totals
		GBq	GBq	GBq	GBq	GBq	GBq
Caorso Power Plant	**Caorso (PC)**	0.00	18.87	2185.66	0.00	0.00	2204.53
Garigliano Power Plant	**Sessa Aurunca (CE)**	0.00	12.76	22329.65	352901.70	0.00	375244.12
Latina Power Plant	**Latina**	0.00	1.47	15206.43	5785.62	0.00	20993.53
Trino Power Plant	**Trino (VC)**	0.00	10.07	1058.29	10535.83	0.00	11604.20
EUREX Plant	**Saluggia (VC)**	0.00	7.62	266.20	2299271.18	0.00	2299545.00
ITREC Plant	**Rotondella (MT)**	0.00	71.22	3085.34	276289.63	0.00	279446.19
Plutonium Plant	**Casaccia, Rome**	0.00	0.00	0.00	20969.70	0.00	20969.70
OPEC	**Casaccia, Rome**	0.00	0.00	54.46	3612.12	0.00	3666.59
Bosco Marengo	**Bosco Marengo (AL)**	0.00	0.32	33.13	0.12	0.00	33.58
TAPIRO Reactor	**Casaccia, Rome**	0.00	0.00	0.00	0.00	0.00	0.00
TRIGA Reactor	**Casaccia, Rome**	0.00	0.00	0.00	0.00	0.00	0.00
NUCLECO Plant	**Casaccia, Rome**	396.53	312.52	7351.31	416.50	0.00	8476.86
CCR Ispra EURATOM	**Ispra (VA)**	0.00	1.66	447.37	96586.76	0.00	97035.78
Avogadro Depot	**Saluggia (VC)**	0.00	6.85	436.58	0.00	0.00	443.44
Campoverde Tortona	**Tortona (AL)**	0.03	0.00	84.61	0.29	0.00	84.93
Campoverde Milan	**Milan**	0.42	0.04	98.57	5.28	0.00	104.31
LivaNova Depot	**Saluggia (VC)**	0.00	0.67	43.53	266.35	0.00	310.54
Protex Depot	**Forlì**	0.44	0.00	29.30	41.00	0.00	70.74
Cemerad Depot	**Statte (TA)**	0.00	21.02	53.56	18.22	0.00	92.80
CESNEF Reactor	**Milan**	0.00	0.00	0.00	11.09	0.00	11.09
LENA Reactor	**Pavia**	0.00	0.05	0.00	0.93	0.00	0.98
AGN-1 Reactor	**Palermo**					0.00	
Total		**397.41**	**465.15**	**52764.02**	**3066712.33**	**0.00**	**3120338.90**

(1) VSLW: very short-lived radioactive waste
(2) VLLW: very low activity radioactive waste
(3) LLW: low activity radioactive waste
(4) ILW: medium activity radioactive waste
(5) HLW: high activity radioactive waste

The total quantity of irradiated nuclear fuel present in Italy as at 31 December 2015 was approximately 15 tHM.

Table 4 shows the location of irradiated nuclear fuel present in Italian nuclear installations.

Table 4 – Inventory of irradiated fuel present as at 31 December 2015

Plant	Type of fuel	N° of elements	Mass (tHM)	Activity (TBq)
AVOGADRO	PWR - TRINO UO_2	1	0.31 (*)	1,650
	BWR - GARIGLIANO MOX	63	12.88 (*)	44,400
	Garigliano rods	1 (**)	0.00132	n.a.
	CIRENE rods	4 (**)	0.00588	n.a.
ITREC	ELK RIVER U-Th	64	1.68 (*)	3,160
OPEC-1		581 (**)	0.116	88.94
CCR ISPRA			0.68	4,271.60 (***)
TRIGA LENA Pavia		9	0.0017	6.00
TRIGA RC1 Casaccia		12	0.0023	8.04
Total			**15.677**	**53,584.58**

(*) fuel mass prior to irradiation
(**) no. of rods, sections of rods, etc.
(***) estimate of the activity regarding the discharge, not updated for radioactive decay

A nuclear installation which belongs to the Defence Administration is also present on Italian Territory, at San Piero a Grado (PI). This is the research nuclear reactor RTS-1 “Galileo Galilei” of the Joint Force Centre for Military Applications Studies (CISAM) which was definitively shut down in 1980 and is currently in the decommissioning phase. The radioactive waste, the decommissioned sealed sources and the irradiated fuel from the operation of this installation are not included in this National Programme, since directive 2011/70/Euratom which sets the obligation for implementing national programs by Member States, applies exclusively to the management of spent fuel and radioactive waste from civilian uses.

4.2. Estimates of future quantities of radioactive waste

In the near future, the waste generated by the decommissioning of nuclear power stations and installations and the pursuit of medical, industrial and research activities will be added to the radioactive waste present in Italy.

Pursuant to article 27 of Legislative Decree 31/2010, Sogin S.p.A. estimates the volumes and the radiation spectrum of the national radioactive waste exclusively for the purposes of determining the size of the National Repository and the execution of the safety analyses thereof. To this end, Sogin S.p.A. uses the inventory of waste existing as at 31 December of each year which is kept on file by ISIN and the latter's estimates of future waste based on its knowledge and/or derived from contacts with producers.

The decommissioning portion constitutes the major component of the waste volumes that will be generated in the future. Of this, the largest portion is from power plants and the nuclear fuel cycle under the responsibility of Sogin S.p.A.

Table 5 contains the estimates up to 2040 of the total volumes, expressed in m^3, of radioactive waste included in the national inventory, based on data as at 31 December 2015, of radioactive waste produced by decommissioning of plants and radioactive waste from reprocessing.

The radioactive waste that will be generated from the dismantling of nuclear installations is estimated to be several tens of thousands of cubic meters of conditioned waste mainly of intermediate and low level. Furthermore, consideration must be taken of the high level conditioned waste to be repatriated to Italy from England and France, from reprocessing of irradiated fuel of an estimated several dozen cubic meters.

Table 5 – Estimates of total volumes, expressed in m^3, of packaged waste for the years 2020, 2030 and 2040 by category (ISPRA estimate)

YEAR	VLLW (m^3)	LLW (m^3)	ILW (m^3)	HLW (m^3)
2020	10,036	38,087	5,911	
2030	17,870	48,927	11,463	38.1
2040	22,467	54,579	13,713	38.1

Finally, consideration must be taken of the production of waste which does not originate from the production of energy. Currently, the rhythm of production of medical waste only, which represents the majority by far of waste of “non energy” origin, is in the area of thousands of cubic meters per year, the majority of which managed as non-radioactive waste after appropriate decay, whether by the production structures themselves or by the Integrated Service operators. On the other hand, the waste volumes with longer life, once treated and conditioned total a few dozen cubic meters per year.

Estimating future production of radioactive waste of medical origin is not a simple matter.

Account must be taken of various factors: on the one hand, the expected increase of medical practices whether for diagnostic or treatment purposes connected to the nevertheless increasing trend focused on welfare, and on the other hand the progressive replacement of “nuclear” practices with more “simple” methods that use non-radioactive materials.

Having made this observation, the forecasts, though with a significant level of uncertainty, can be made on a macroscopic scale by comparing the trends of countries that belong to the same “health category” as Italy.

Based on certain valuations made by UNSCEAR (the United Nations Scientific Committee on the Effects of Atomic Radiation), appropriately scaled to Italian reality, and notwithstanding the concurrently applicable factors indicated above, a progressive increase in annual production in the next few years is a possibility.

4.3. Radioactive waste originating from remediation activities

Radioactive waste produced by interventions for remediation of industrial installations (for example steelworks for the production of steel from metal scraps) contaminated accidentally by radioactive substances following the fusion of radioactive sources are also present on the national territory.

Table 6 shows the quantities (expressed in units of mass and of volume) and the activity, expressed in gigabecquerels (GBq), of the aforementioned radioactive waste. The values indicated regarding the quantities and the activity have been estimated roughly by ISPRA's National Centre for Nuclear Safety and Radioprotection, based on preliminary data as at December 2015 provided by ARPA/APPA and should therefore be considered as provisional. For the most part, this radioactive waste can be better defined and consequently classified, only after the completion of the characterization activity that will be carried out after the industrial installation is removed and the final remediation is performed.

Consequently, specific actions cannot be forecasted at the present time until completion of the aforementioned characterization, notwithstanding that pursuant to article 1, paragraph 104 of Law 239/2004, the operators and holders of radioactive waste are required to storage, also in compliance with the national and European laws, in relation to the technical developments and the indications provided by the European Union on the containment and storage within the National Repository pursuant to article 2, paragraph 1 e) of Legislative Decree 31 of 15 January 2010.

Table 6 – Estimates of radioactive waste originating from restoration activities (ISPRA)

Location		Type of waste	Activities GBq	Mass (t)	Volume (m3)	Radionuclides
Alfa Acciai	Brescia	Gas dusts and contaminated material (1997)	100	370	240	Cs137
		Metal bar plating (1997)	10	280	190	Co60
		Gas dusts (2011)	0.25	50	35	Co60
Acciaierie Venete	Sarezzo (BS)	Contaminated gas dusts	3	270	470	Cs137
Acciaierie Beltrame	Vicenza	Contaminated dusts and ashes	1.2	252	224	Cs137
Luigi Premoli e figli SpA	Rovello Porro (CO)	Demolitions (asphalt and cement) – Salts (fusion additives) from restoration – Salts (fusion additives) already present in the warehouse upon discovery of the accident – no.162 UN drums, capacity 220	100	370	250	Cs137
Service Metal Company Srl	Mazzano (BS)	Furnace slag, gas dusts	0.02	40	30	Am241
Astra SpA	Gerenzano (VA)	Soil cement and floor coverings, iron oxide, aluminium dust	10	320	210	Cs137
ECO-BAT SpA	Paderno Dugnano (MI)	Lead furnace slag	15	370	130	Ra226
INTALS SpA	Parona (PV)	Furnace slag (aluminium shielding) (originating from Somet SpA)	0.5	130	90	Ra226
Fonderie Rivadossi	Lumezzane (BS)	Gas dusts, brass wires, remediation material	2	140	100	Cs137
Raffineria Metalli Capra	Castelmella (BS)	Furnace slag, gas dusts	0.015	20	15	Cs137
formerly Fermeco Brescia 80	Montirone (BS)	Furnace slag, gas dusts				
Formerly CAGIMETAL (formerly Cava Piccinelli)	Brescia	Slag from casting and earth	10	1,800	1,000	Cs137
Capra Landfill	Capriano del Colle(BS)	Salt slag from aluminium casting and earth	1,000	82,500	55,000	Cs137
Borgo Hospital Trento	Verona	Material contaminated by radium needles	1		50	Ra226

CHAPTER 5: Management of spent fuel and radioactive waste from generation to disposal

5.1. The spent nuclear fuel and radioactive waste from the decommissioning of nuclear plants

The process of deactivating nuclear installations consists of a set of planned actions to be carried out, in compliance with the requirements for the safety and protection of the workers, the population and the environment, until final dismantling or, nevertheless, the release of the site without radiation restrictions.

In relation to the final objective of releasing the site without radiation restrictions, the following actions are required: removal of the irradiated fuel in order to reprocess it, containment, through appropriate conditioning of the existing waste in the nuclear installation and the waste produced from the dismantling activity, the dismantling and the removal of the aforementioned packaged waste to the National Repository, the availability of which is therefore an essential condition for the pursuit of this objective.

Prior to the more complex decommissioning operations, the spent nuclear fuel must be removed from the plant in order to be reprocessed.

The reprocessing of the fuel makes it possible to separate the reusable materials from the final waste and to package the latter in a form that considerably reduces the volume and guarantees safe conservation over the long term during their radioactive decay. This process makes it possible to reduce the volume of higher activity waste to 5% of the original volume of the fuel.

Almost all of the spent fuel produced during the operation of Italian nuclear stations was sent abroad for reprocessing. Operations for the transfer of the remaining portion, which is lower than 1%, are under way.

The spent fuel from the research activity (CCR Ispra, ITREC, OPEC1) remains securely stored within the sites while awaiting transfer to the National Repository and there are no current plans for reprocessing.

Radioactive waste, is treated, packaged and stored in every nuclear plant, in temporary depots, which exclusively contain the waste present in each site, while awaiting transfer to the National Repository.

Upon completion of the decommissioning operations, the temporary depots within the nuclear plants will be dismantled.

5.2. Radioactive waste from research activities and from the usage of radioisotopes for medical and industrial activities

In addition to the so-called “energetic” radioactive waste, i.e. which derives from the previously existing nuclear programme, the production of radioactive waste continues from medical-health related, industrial, scientific and technological research applications.

This radioactive waste is managed and stored temporarily in authorized plants, under secure conditions as established by the law and under the control of the competent National Authority.

This type of radioactive waste arises from activities that can be defined as routine for a developed country, generating an increasing annual quantity.

The highest production of radioactive waste, which is among other things usually widespread throughout the country, is from the healthcare sector where there is a widespread and growing use of radiopharmaceutical both for diagnostic and treatment purposes.
In the non-energy waste area, we must also mention the issue of orphan radioactive sources which are found within metal scraps imported from abroad relatively frequently.
Radioactive waste generated from medical, industrial and research applications is currently managed by authorized operators while awaiting its transfer to the National Repository.
The national policy regarding fuel from nuclear reactors used for research is to return the spent fuel to its country of origin.
For Italian research reactors, the periodic review is every 5 years, but mainly focuses on their monitoring with analysis carried out on a case by case basis.
In application of the Code of conduct for research reactors, the Authority is currently examining whether to extend the reviews in direct conjunction with a gradual approach.
Over 90% of this type of radioactive waste, in terms of activity, is stored and managed within the NUCLECO S.p.A. depot at the ENEA research centre in Casaccia (Rome). NUCLECO S.p.A. is a Sogin Group company held by Sogin S.p.A., which holds the majority share of 60%, and by ENEA with 40%.
As part of the "Integrated Service" for the management of this radioactive waste, coordinated by ENEA, NUCLECO S.p.A. takes on the role of national operator for the collection, treatment, conditioning and temporary storage of the radioactive waste produced in the country, with coverage of costs by the holder.
Pursuant to Legislative Decree 52/2007, the duties of the "Integrated Service" cover all the phases of the management cycle of the high level sealed sources which are no longer used. These phases include preparation for transport, shipment, characterization, any treatment and conditioning and the temporary storage, which can pose a threat as they have the potential to cause damage to the population and the environment through improper or malicious use.
As established under paragraph 104 of article 1 of law 239/2004, all producers and holders of radioactive waste must transfer [radioactive waste] to the National Repository "*within the times and according to the technical procedures defined by the Decree issued by the Ministry of Economic Development, jointly with the Ministry of the Environment and the Protection of Land and Sea, which may also enlist the assistance of the organization for nuclear safety…*", in compliance with the applicable laws.

5.3. Plans and projects for the management of spent nuclear fuel and radioactive waste from nuclear power stations

The policy guidelines for the management of spent nuclear fuel were issued by the Italian Government with:

- the directive of the Minister of Production Activities issued on 28.03.2006, which provides for transfer abroad of irradiated nuclear fuel which is still present on the national territory at decommissioned nuclear power plants, for reprocessing;
- the directive of the Minister of Economic Development issued on 10.08.2009, which provides for the return to Italy of radioactive waste from the reprocessing contract stipulated by Enel after 1977 with British Nuclear Fuels Limited (BNFL) now renamed Nuclear Decommissioning Authority (NDA), pursuant to art. 1, paragraph 2 letter b) of the Decree issued by the Minister of Production Activities on 02.12.2004.

The Italian Government has adopted the strategy of “accelerated deactivation” of all the power stations and other nuclear reactors and decommissioned nuclear fuel cycle plants which provides for the release of the sites on which the Italian nuclear power plants are located without radiation restrictions (so-called “green fields”).
The implementation of the strategy, the most recent version of which was issued with MiSE [Ministry of Economic Development] Decree of 2 December 2004, which provides the following operating guidelines for Sogin S.p.A.:

- the management of the decommissioning and maintenance of the stations/plants under secure conditions;
- the management of radioactive waste from the prior operation of the stations/plants as well as the relative decommissioning activities, with construction of temporary depots on the sites;
- the management of the agreements for reprocessing abroad of irradiated fuel and the subsequent return to Italy of the reprocessed products;
- construction of the National Repository.

As part of the strategy adopted by the Government, the activity connected to the reprocessing of the fuel is one of the most complex operations of the decommissioning process. As already indicated under paragraph 5.1, almost all the spent fuel produced during the operation of the Italian nuclear power stations was sent abroad for reprocessing.
Additionally, the aforementioned 2004 guidelines were supplemented with the directive issued by the Ministry of Production Activities on 28 March 2006.

Finally, an additional directive issued by the Minister of Economic Development on 10 August 2008 refers to the return to Italy of the radioactive waste, packaged and ready to be warehoused within the National Repository for radioactive waste, from reprocessing in Great Britain of irradiated fuel which had been sent by Italy to the Sellafield establishment.
In particular, this directive assigned to Sogin S.p.A. the task of defining an agreement with the NDA (Nuclear Decommissioning Authority) for the replacement of intermediate and low activity waste with a lower volume of radiologically equivalent high activity waste. Furthermore, the same directive required the Company to conclude the necessary agreements in order to adjust the re-entry times to the availability of the National Repository.
The operations for the transfer of the last elements of spent fuel to France are currently under way, pursuant to the Intergovernmental Agreement signed in Lucca.
Once the National Repository is operative, the waste produced from the reprocessing abroad of spent Italian fuel will be able to be returned to Italy from 2024.

With the entry into effect of Law Decree 1/2012, particularly pursuant to article 24 therein, the authorization procedures for the deactivation and dismantling procedures were redefined and the maximum times allowed for the assessment and intervention instruments were set, these being the service conferences convoked by the Ministry of Economic Development to ensure conclusion of the assessment.
To address the aforementioned administrative fragmentation which required numerous authorizations to be secured at the central and local levels, the “single authorization” instrument was introduced for the nuclear sector as well, with the participation of Municipalities and Regions in the authorization process. The latter participate in the process and are called upon to provide a mandatory but not binding opinion.

Based on the new law, on 2 August 2012, 28 September 2012 and 10 February 2014 the Ministry of Economic Development was able to issue the authorization decrees for deactivation of the nuclear power stations of Trino (VC), Sessa Aurunca (CE) and Caorso (PC), respectively.
The administrative process for the issuing of the authorization for the deactivation of the nuclear power station of Latina is still underway.
The activities are scheduled for the management of radioactive waste consisting of spent ion exchange resins, used for the purification of the process fluids of the plants, from the past operation of the Trino and Caorso stations:
- in Trino (VC), for the conditioning of the resins extracted also during the decontamination operations of the vapour generators, there is a provision for the construction of an experimental treatment plant based on Wet Oxidation Technology (or WOT) and a cementing plant named SiCoMoR (Modular conditioning system for radioactive waste) for the conditioning of the waste produced from the treatment process.
- for Caorso (PC), in June 2015, Sogin S.p.A. concluded a contract with the temporary consortium Javys-Consorzio Ansaldo NewClear for the recovery, transport, treatment for incineration and conditioning at a facility for such resins in Slovakia, since one is not available in Italy. The packaged resins, together with the sludge from the treatment, will be returned to the Caorso site.
Regarding the EUREX plant of Saluggia, at the end of 2015 the construction of a treatment and conditioning plant for high level liquid radioactive waste named CEMEX began. This waste is currently stored at the Nuovo Parco Serbatoi.
For the ITREC plant at Trisaia, there are plans for the dry storage of the irradiated fuel and solidification of the so-called “Finished Product” (a U-Th mixture) through cementing. The construction of the Cementazione del Prodotto Finito (ICPF) Plant began in 2014. Other activities for the characterization, treatment and conditioning of previous solid low activity waste (the SiRiS project) also began.
On the date, this National Programme was defined, there was no national repository in Italy for the disposal of low and medium activity radioactive waste and for the long-term storage of high activity waste.
The radioactive waste already produced and the waste that continues to be produced in activities for the secure maintenance of the plants, or prior to dismantling thereof, therefore continues to be temporarily stored within those same sites.
This solution requires maintenance of the depots in optimal conditions and monitoring of the various sites located on Italian Territory for safe conservation of the waste therein.
Furthermore, while awaiting the deployment of the National Repository, it is necessary to construct certain temporary depots which are compliant with more advanced security requirements, both in order to fulfil the requirements of improving the current storage conditions of the waste (which are in certain cases placed in storage structures which are older and designed in a manner that is not compliant with the current requirements for temporary depots), and to enable the pursuit of the deactivation activities, through the availability of appropriate storage structures for the waste they typically produce.
Only waste already present in each site and the waste from the decommissioning activities of the plant itself will be temporarily stored in the abovementioned temporary depots; the depots themselves will be dismantled immediately upon transfer to the National Repository of the radioactive wastes temporarily stored within them.

5.4. Technical solutions for the management of radioactive waste and spent nuclear fuel

The principles set forth under §2.2 and the objectives arising from these principles will be pursued in the everyday management of the radioactive waste through a series of actions which consist of:

- the collection, exact characterization of physical-chemical-radiological properties and confinement of the waste;
- the separation of the waste containing only short-lived radionuclides that can be maintained in the depot, for the time required until the levels fall below the limits set for exemption/removal for unconditional release;
- the classification of the waste based on the radioactive content and the decay times and therefore the necessary type of disposal;
- the treatment of the waste to be followed in order to facilitate the conditioning operations;
- the conditioning of the waste in order to produce waste packages that are appropriate for secure movement, transportation, storage and disposal;
- the storage of the waste until it reaches release levels (decay in storage) or storage of waste during the treatment phases and prior to transport to a disposal installation (temporary depot);
- the scheduling of the disposal of various categories of waste in appropriate depots (subject to the availability of technological solutions which allow for optimum selection of treatment/conditioning processes as well as the availability of appropriate stationary or mobile treatment/conditioning plants on the national territory).

a) Management of irradiated fuel

From the beginning of its nuclear program, Italy pursued the option of retreatment (reprocessing) abroad of the spent fuel produced by its nuclear power stations. As indicated under §2.1, with the Decree of December 2004, not including the fuel that cannot be retreated (as specified below), Sogin S.p.A. was assigned the duty of establishing retreatment agreements for all the remaining irradiated fuel stored in Italy, including the Italian portion of the fuel from the joint operation of the Superphoenix reactor in France.
This decision became a part of the intergovernmental agreement signed with the French Government on 24 November 2006, followed by a contract that Sogin S.p.A. stipulated with Areva on 27 April 2007.
As already described, the agreement provides for the return to Italy of the waste from the retreatment activity. A “roadmap” was also outlined in connection with the agreement for the transfer operations of the spent fuel to France and the return of the waste to Italy, while the various actions to be implemented at the legislative level were identified and the decision was made to make available a depot structure for the waste returning from France.

While awaiting transfer abroad for retreatment, the spent fuel is stored safely in the pools of the plants. Regarding the nuclear power stations, the spent fuel was completely removed from the Garigliano and Latina power stations many years ago. The campaign for the transfer of the Caorso fuel to France for retreatment was completed in June 2010. At the time that this National Programme was prepared, there remained for transfer to France for retreatment approximately 13 tons stored within the pool of the Avogadro depot. The transfer abroad is expected to be concluded within 2018.
There is also a small quantity of irradiated fuel that cannot be re-treated, which is in particular comprised of:

- 64 elements of fuel from the US Elk River power station (currently stored at the ITREC plant at Rotondella (MT) originally intended for the experimental retreatment campaigns at the ITREC plant. This fuel will be placed in dry storage within a “dual purpose” cask TN24 ER (licensed both for transport and storage) in an appropriate temporary depot at the Rotondella (MT) site, while awaiting transportation and long-term provisional storage at the National Repository.
- lower quantities of irradiated fuel, of approximately 115 kilos, in the form of pellets, sections of rods, liquids, that are currently stored in various containers at the Casaccia site near Rome. This fuel will be recovered and repackaged for storage in “dual purpose” casks to then be transported and stored, on a long-term provisional basis at the National Repository.
- approximately 680 kilos of irradiated fuel in the form of pellets, sections of rods, elements of experimental fuel, liquids, currently stocked in various stations within the sites located in the Joint Research Centre at Ispra (VA). This fuel will be recovered and repackaged for storage in “dual purpose” casks to then be transported and stored on a long-term provisional basis at the National Repository.

b) Management and treatment of solid waste

Following we list the phases for the management of solid radioactive waste.
Radiological characterization and sorting. The phase consists of verifying the radiation characteristics and separating, in as much as possible, the waste into homogeneous lots for the preparation of subsequent campaigns. This phase includes the packaging in packages appropriate for temporary storage and transport to other sites.
Supercompaction. This phase aims to reduce the volume (reduction factors of approximately 3-8) and increase the stability of solid waste for transport, storage and disposal. The treatment takes place in stationary or mobile plants using hydraulic pressure equipment with pressure force from 1500 t to 2000 t. Currently, a centralized installation is available at NUCLECO S.p.A. in Casaccia near Rome and there is a mobile plant for contaminated waste from beta-gamma emitting radionuclides. Other super compaction installations are currently being studied for alpha-contaminated waste. These installations allow for remote manipulation of the compacted waste with packaging of final containers over which cement mortar qualified for encapsulating the waste is poured within a heterogeneous matrix which is compliant with the disposal requirements

Incineration. This phase is applicable to solid waste as well as liquid fuel and allows for a higher level of volume reduction (in excess of a factor of 10), resulting in a chemically stable form. No centralized and authorized plant is available in Italy that is able to implement this type of treatment, while there exist such plants within the EU, therefore implementation requires organizing transports and stipulating contractual agreements with the authorized foreign facilities. Pursuant to the applicable legislation, the required licenses require the Control Authorities involved to verify both the authorization conditions of the treatment plant as well as the definition of prescriptions on the manner in which the treated waste will be returned, in quantitative as well as radiation terms.

Fusion of metals. This phase applies to all contaminated metal components, achieving a high level of decontamination. In the case of contamination present in the superficial layers of the component, the possibility of separating contaminating radionuclides is much higher compared to mechanical or chemical type treatments. Fusion plants, which are authorized to handle radioactive components, do not exist in Italy and it is necessary, as in the case of incineration, to conclude contracts with European companies and to secure authorizations to transfer the waste abroad.

c) Management and treatment of liquid waste

The treatment processes for liquid radioactive waste aim to reduce the volume and remove the radionuclides from the mass of the waste. The result of the process consists of a flow of concentrated waste (which requires further packaging) and a supernatant/distillate which can often be released pursuant to regulatory controls either directly or immediately after additional treatment. In Italy various installations for the physical-chemical treatment of radioactive liquids either exist or will be constructed.
The sludge produced by the various treatment phases and mixed are then packaged within the cement matrix inside the containers, which are qualified for storage and transport, using the “disposable rotor” technology, based on the time that the mixing rotor remains in the conditioning matrix.

In general, the most common methods of treatment for liquid radioactive waste are:

i) **Chemical**: a precipitation process through the addition of chemical substances such as barium chloride, sodium sulphate, potassium ferrocyanide, copper sulphate, etc.
The resulting sludge that contains most of the radioactivity requires packaging. In Italy this method is applied within the installations of NUCLECO S.p.A.

ii) **Evaporation of aqueous solutions and organic concentrates:**
The result of this process features a very high-volume reduction factor as well as the high level of decontamination. The concentrate that results must be packaged further; in Italy the installations for the application of the treatment systems for liquid effluents are available in the Trino (VC) and Sessa Aurunca (CE) power stations.

iii) **Ion exchange**: process for the extraction with selective resins using ion exchange, whether organic or inorganic. This treatment was applied by the power stations in operation for the treatment of liquids and found an application in certain cases of decontamination of pools in which fuel was stored at installations such as EUREX Saluggia. This treatment is interesting because it allows for decontamination factors that are high and because of the availability on the international market of selective products as well as mobile installations;

iv) **Membrane methods**: processes such as inverse osmosis and electro-osmosis, nano and ultrafiltration in combination with other treatment methods (chemical treatment or ionic exchange processes) can be used to further improve the decontamination of the liquid waste. The membranes used and the concentrate sludge must be packaged further.

An installation for inverse osmosis membrane filtration for treatment of radioactive liquid is available at the NUCLECO S.p.A. installation at Casaccia near Rome the usage of this treatment is limited by the problems connected to the management of the membranes, whether in operation or used, and the low production efficiency of the decontamination process, in terms of the ratio between the volume filtered and the volume under treatment.

The conditioning produces a physical or chemical form that is more stable and sometimes applied directly, such as cementing, to the treatment of aqueous liquids with high concentrations of beta emitters (tritium) or alpha emitters (uranium and plutonium), where the concentration of the activity is nevertheless compatible with a homogeneous qualified matrix and acceptable for disposal in a surface site.

Packaging in matrices other than cement, such as bitumen embedment (used at the CCR of Ispra – VA) or the process of urea formaldehyde on ion exchange resins (used at the Caorso – PC station), is more difficult because in the past their results were not acceptable or because they are currently in an experimentation phase.

d) Management of spent ion exchange resins

The technological processes considered at the international level for the treatment of ion exchange resins refer to:

1. Incineration and subsequent conditioning of the ashes
2. Thermal treatments that destroy the organic chains, alternative to incineration, with production of a substance that can be packaged in a cement matrix.
3. Direct encapsulation into polymeric and/or silicon matrices.

The first two technologies have reached a sufficient degree of maturity while the third still requires a development phase due in particular to the incomplete verification of the resistance of the matrix to irradiation over the long term.

For ion exchange resins produced by the Caorso (PC) power station (950 t, of which 90 t are not encapsulated in urea-formaldehyde with a total activity of approximately 3 TBq) the solution which has been defined for some time now consists of the incineration process and subsequent conditioning of the ashes.

Application of the above-mentioned process was not possible for the resins at the Trino (VC) power station (82 t with content having a total activity of approximately 74 TBq) due to the high radiation content. Further attempts to treat these resins by mixing them directly with cement did not yield positive results due to the high level of boron present.

A service contract for incineration of the Caorso resins in a foreign installation with re-importation in Italy of the packaged residues is currently in the process of being concluded.

e) Management and treatment of decommissioned radioactive sources

Since the 1960s, Italian legislation regarding radioprotection regulates the use of radioactive sources, from the time they are placed on the market until they are decommissioned, and Legislative Decree 52/2007 implementing directive 2003/122/Euratom, integrating the provisions of law 1860/1962 and Legislative Decree 230/1995, reinforces the control system for sealed high level radioactive sources as these are defined in the Legislative Decree itself. Ministry authorities issue authorizations for the usage of category A ionising radiation sources and prefectures issue the authorisations for usage of category B sources, while for activities involving the category B use of sources for medical exposures the authorization is issued by the authorities identified by the law in the regions and the autonomous provinces.

To receive the authorization to use the source, the law requires that the holder provide for the relative disposal procedures, just as for other radioactive waste.
Insofar as the treatment/conditioning and disposal phases, the decommissioned sources are managed on the basis of the following principles:

- there is no provision in Italy for the construction of a disposal site specifically for sources;
- decommissioned sources are included in the same classification scheme as all radioactive waste.

Even on the above basis, two groupings of decommissioned sources can be envisaged, classified as waste:

- short lived sources with radionuclides, the half-life and the starting activity of which allow for decay below the release values within times (typically 10 years) that are compatible with the authorizations for a temporary depot;
- sources which, due to the long decay time and a high concentration of level, require disposal within a geological depot.

For the second group, the operators involved will have to remove the sources from the container in which they are placed to transfer them to appropriate shielded and leak proof packaging which is compatible with the prescriptions for long-term provisional storage in the National Repository.

The scope of Legislative Decree 52/2007 regarding sealed high-level sources also includes compliance with the obligations set forth in the IAEA “Code of conduct on Security of Radioactive sources” which Italy formally endorsed in 2005 and the “Guidance on import and export of Radioactive sources” which Italy endorsed in 2006.
The management of this type of decommissioned sources, which are not returned to the supplier, is entrusted by the holder the following operators:

- recognized installations which are authorized as temporary depots for the sources;
- National operator, in charge of the long-term preservation of decommissioned sources, ensuring the safety thereof for at least 50 years;
- Integrated Service, in charge of managing the decommissioned sources, including packaging for transport, transport, characterization, treatment and conditioning and storage.

The holder of the sealed high-level source shall also provide a financial guarantee for the funds required for management of the source until disposal or stipulate an agreement for the return to the supplier of the source upon completed usage, or the Integrated Service for treatment and disposal.
Once management of the decommissioned source is carried out by the Integrated Service or the National Operator, “ownership is transferred” and the necessary funds are provided until disposal, releasing the holder from any future responsibility.

5.5. National Repository for radioactive waste disposal

With regard to the need for a National Repository we hereby reiterate that, over the next few years, packaged waste from reprocessing of the irradiated fuel is expected to be repatriated to Italy from the United Kingdom and France. There are also commitments at the international level that our country is required to respect, as these arise from the Joint convention on the safety of irradiated fuel and radioactive waste management.
With transposal of directive 2011/70/Euratom, through the drafting of this strategic national programme for the safe management of radioactive waste, we therefore outline the appropriate solution for all types of waste present in the territory.
Therefore, for Italy, the availability of the repository within a reasonable period of time will satisfy a triple requirement:

- to honour the deadline set forth in the agreement stipulated by Italy for the return to Italy of radioactive waste from reprocessing of fuel;
- to release without radiation restrictions the sites that hosted the plants of the former nuclear programme;
- to provide a long-term solution for non-electronuclear radioactive waste (i.e. medical - hospital related, industrial and the waste from research).

The construction of the National Repository also has a functional character insofar as the intention of rapidly concluding the definitive dismantling of the nuclear power stations and complying with the objective of rendering the decommissioning of the nuclear power stations swifter and more effective, thereby allowing for reduction of the item listed in the bills payable by Italian citizens labelled as “other system expenses”.

Over the years the Parliament and Government have taken various initiatives aimed at providing a solution to the problem of radioactive waste management.
Legislative Decree 31/2010 on the “*discipline of irradiated fuel and radioactive waste storage systems, and economic benefits, pursuant to article 25 of law 99 of 23 July 2009”*, in Title III establishes the procedures for the siting, construction and operation of the National Repository within the Technology Park, the latter being a research centre open to international collaborations and specialized in the waste treatment sector.

Currently the Government is implementing the articulated procedure which is regulated by article 27 of the Legislative Decree 31/2010 to identify the location that will host the National Repository, following a transparent procedure which is as open as possible to the involvement of citizens and local institutions, acknowledging that this is a choice that involves many aspects, and not just of a technical nature.

The transfer of radioactive waste may begin concurrently with the operation of the repository.

Considering that the disposal of the low and medium activity radioactive waste in the National Repository will be definitive, during the provisional period that the high activity radioactive waste will remain in the repository its disposal within a geological depot will be identified, with account taken also of the opportunities offered in the future as part of any international agreements for construction of a disposal structure.

5.6. Post closure phase of the disposal plant

Regarding the authorization for the closure of the radioactive waste disposal plant at the National Repository and the relative post closure phase thereof, we note that there are specific authorizations provided pursuant to article 28-bis of Legislative Decree 31/2010.
In particular, the execution of the operations connected to the closure of the National Repository is subject to the prior authorization of the Ministry of Economic Development with the Ministry of the Environment and the Protection of Land and the Sea after receiving the opinions of the Ministries of the interior, labour and social policies, health, the region or autonomous province in question and the competent regulatory authority, upon application of the license holder. This authorization is issued, where necessary, at individual intermediate phases with regard to the closure and post closure status.

The procedure for the issuing of the authorization to close the aforementioned depot is established by a Decree issued by the Ministry of Economic Development with the Ministry of the Environment and the Protection of Land and the Sea and the Ministries of the interior, labour and social policies, health, after receiving the opinions of the region or autonomous province in question and the competent regulatory authority. Upon completion of the closure operations, the authorization holder will submit to the competent regulatory authority one or more reports documenting the operations that were carried out and the status of the plant and the site.

Finally, the Ministry of Economic Development with the Ministry of the Environment and the Protection of Land and Sea, after having consulted with the involved administrations and the competent regulatory authority, will issue a decree indicating any prescriptions connected with the institutional control period.

CHAPTER 6: Responsibility for implementation of the National Programme, transparency and participation

6.1. Responsibility for implementation of the National Programme

The responsibility for implementation of the National Programme lies with the Ministry of Economic Development and the Ministry of the Environment and the Protection of Land and Sea which, each within their own competences, have the function of defining the contents and the relative milestones and carry out the activity of issuing guidelines and authorizations to the main national operators, after receiving the technical and independent opinion of ISIN (the ISPRA National Center for Nuclear Safety and Radioprotection pending the establishment of ISIN) and monitoring progress achieved. It is understood that the main responsibility for the safe management of spent fuel and radioactive waste lies with the license holders.

6.2. Transparency and participation

Pursuant to article 7, paragraph 4 of Legislative Decree 45/2014, the Ministry of the Environment and the Protection of Land and Sea and the Ministry of Economic Development provide the public with the opportunity to participate in the decision-making processes concerning the management of spent nuclear fuel and radioactive waste by publishing the National Programme framework on its own institutional websites.

They also ensure that within the sixty days subsequent to the publication, the public is able to provide its own observations and that these are taken into account by the National Programme.

When the scheduled strategic environment assessment procedure is executed, an evaluation will also be made of the impacts and the achievement of the present sustainability objectives. The results will be posted for public disclosure also on the website of the Ministry of the Environment and the Protection of Land and Sea.

Furthermore, in order to further ensure public participation, account will be taken of the unified Conference pursuant to article 7, paragraph 1 of Legislative Decree 45/2014.

Similarly, in order to make significant decisions regarding the management of spent fuel and radioactive waste, a policy of transparency and public participation to the decision-making processes will be implemented, as provided also for the siting of the National Repository within the Technology Park.

CHAPTER 7: National Programme costs

This chapter contains a description of the costs associated with implementation of the National Programme for the management of radioactive waste and spent fuel over its long-term development. In particular, the National Programme identifies and analyses costs relative to the siting and construction of the National Repository, as well as for the research activity to be carried out within the Technology Park within which the National Repository will be constructed.

It can be presumed as of now that the cost of the solution for the definitive disposal of high activity waste and spent fuel (as described in chapter 2, paragraph 2.2.) will be of a similar level to the costs for the National Repository and the Technology Park. However, the definitive and specific determination of these expenses will obviously be connected to the type of disposal that will finally be selected, and coverage thereof will be in line with the financing mechanisms provided by applicable laws.

7.1. Costs associated with the Sogin S.p.A. deactivation programme

The costs for the dismantling of the decommissioned nuclear power stations (Latina, Caorso, Trino, Garigliano), the nuclear plants (Saluggia Eurex, Casaccia IPU and OPEC, Trisaia ITREC) and which are in general relative to the closure of the nuclear fuel cycle and the activities connected and consequent to it (the so-called “nuclear expenses”) arising from the previous production of electro-nuclear power in Italy is covered by a specific component (A2) of the electricity rates, which falls under the general expenses of the electricity system.
The general expenses are applied as an increase over the distribution rate (and therefore as part of the network services), in a manner that is differentiated by type of usage – domestic, public lighting, other low, medium or high voltage usages – according to criteria that vary from component to component.

The revenue which is collected is transferred to the specific operating account established at the *Cassa per i servizi energetici e ambientali* [treasury for energy and environmental services].
Each year, based on a specific “regulatory system” resolved upon by the AEEGSI (Italian Regulatory Authority for Electricity, Gas and Water) an estimate of the annual costs to be incurred as well as the relative accounting of the actually incurred costs are approved. Financial regulation of Sogin S.p.A. operations (regarding the activities at issue here) by the Authority takes into account specific economic efficiency criteria, defined for the regulatory period 2013-2016 with resolution AEEGSI of 9 May 2013, 194/2013/R/eel.
Furthermore, for application of the economic efficiency criteria, the Authority has set performance milestones[4] following a discussion with the Ministry of Economic Development, Ispra and Sogin S.p.A. itself and the task drivers[5].
Based on requirements, this Authority updates the rates to be applied every quarter.
The average annual cost per domestic user is approximately 2-3 Euro/year.

[4] These are intermediate planning objectives, identified by AEEGSI and relative to the projects to be completed for each year of the regulatory period. The milestones measure achievement of interim results.

5 These are projects that AEEGSI considers to be of strategic value for the level of physical progress of the entire decommissioning programme.

The main regulatory references are: Legislative Decree 79/99; ministerial decree of 26 January 2000; Law 83/03; decree of 2 December 2004; Law 311/04 (Finance Law 2005); Law 266/05 (Finance Law 2006); ministerial decree of 3 April 2006; Law 99/09.

Pursuant to the finance laws of 2005 and 2006, a portion of the revenues from the A2 component, equal to 100 million Euro per year, is applied to the State budget.
The MCT (territorial compensation measures) component is also charged in the electricity bill. This finances the territorial compensation measures for the sites that host nuclear power stations and nuclear fuel cycle plants and, in the future, the national repository for slag. From 2005, approximately 70% of the revenue from the MCT component has been applied to the State budget.
The main regulatory references in this case are Law 368/03; law 311/04 (Finance Law 2005).

According to the planning documents produced by Sogin S.p.A., the estimate of the overall cost for the release of the sites without any radiation restrictions, making it possible for them to be reused, is approximately 6.5 billion Euro to be incurred between 2030/2035.
The cost includes the continuation of the physical dismantling, reprocessing of the fuel, secure maintenance of the plants and overheads.

From 2001 until the end of 2013, Sogin S.p.A. performed this activity against a total of 2.6 billion Euro.

The remaining 3.9 billion Euro are the costs which are planned for conclusion of the dismantling plan, set for 2035.
The estimate does not include the cost for the construction of the National Repository nor does it include the extra costs from possible slowdowns in the decommissioning activities and in the construction of the National Repository.
To date, the Company has reviewed the 2014 programming and the volumes of activity, with a reduction compared to forecasts, based on the actual performance of the activity, but maintaining the long-term timeline.
The ability to control compliance with the realization times, plan and efficiently manage the individual projects and, in general, the possibility of working concurrently on several dimensions, rather than in sequence, contribute to keeping the costs of the operation under control throughout its entire life.
The costs of reaching brown field status depend very much on the work realization times, given the need to incur additional costs each year for site management in the event of delays.
The cost of reaching green field status mainly depends on the construction times of the National Repository.

7.2. Costs associated with the construction of the National Repository and the Technology Park

The construction times for the National Repository are set forth in Legislative Decree 31/2010 and the commitments for the return to Italy of the waste from the reprocessing activities which were assumed by our country toward the United Kingdom and France.
The investments scheduled for the siting and construction of the Technology Park, including the National Repository, total 1.5 billion Euro, distributed as follows:

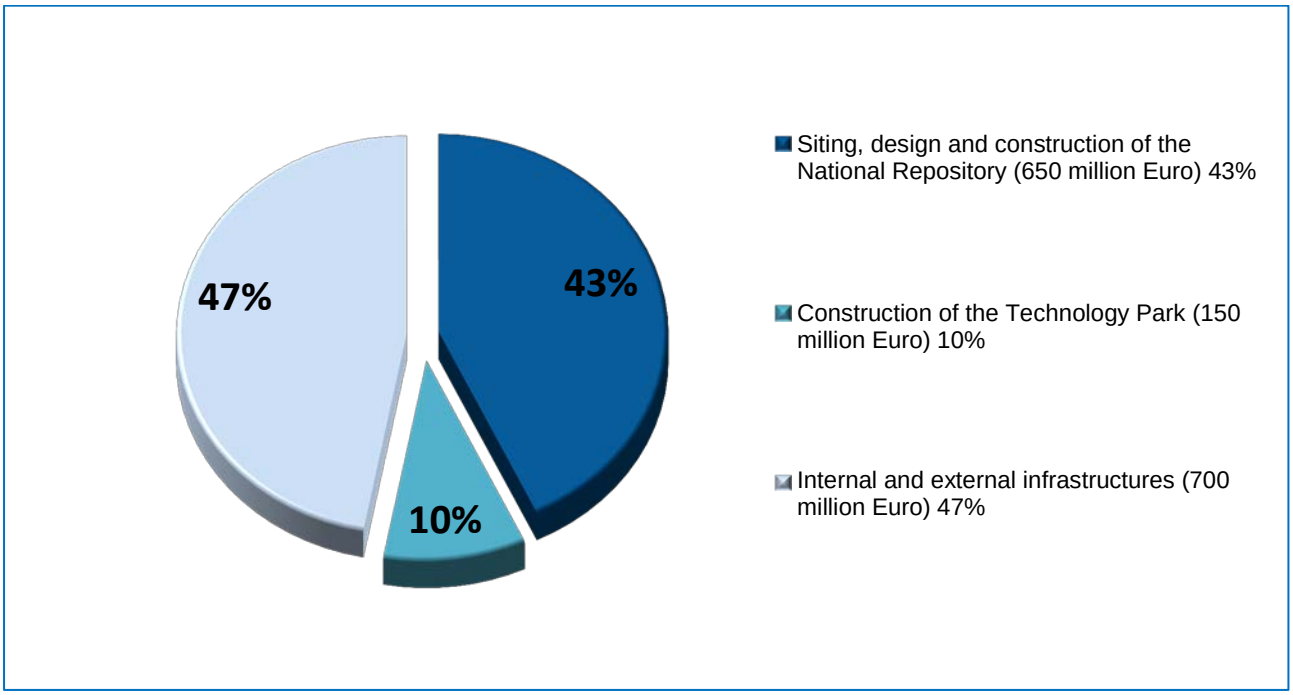
- 650 million Euro for the siting, design and construction of the National Repository,
- 700 million Euro for the internal and external infrastructures,
- 150 million Euro for the construction of the Technology Park.

This estimate was made on the basis of a preliminary analysis by Sogin S.p.A. which was assigned to construct the Technology Park with the National Repository annexed thereto pursuant to Legislative Decree 31/2010.

To these investments are added approximately 1 billion Euro for research projects. Pursuant to article 24, paragraph 4 of law decree 1/12, converted with amendments into Law 27/2012, the activities of identifying and constructing the Repository will be financed by the A2 component, including but only as an advance, the portion of the costs that refers to the sectors that lie outside the electricity “perimeter” (i.e. the industrial, health care and research sectors).
Indeed, article 24, paragraph 5 of law decree 1/2012 establishes that the producers and holders of radioactive waste that transfer this waste to the National Repository must pay a contribution for the usage of the Technology Park and National Repository structures. This contribution is determined in manners which have been established by the Ministry of Economic Development on the proposal of the Authority for electricity and gas, so as to offset the amount that will provisionally be placed on the electricity rate.

We note finally that pursuant to articles 1 and 30 of Legislative Decree 31/2010 the economic benefits relative to the operation of the National Repository are also included among the costs associated with the construction of the National Repository and Technology Park. These benefits shall be extended to residents, businesses operating in the territory surrounding the site and local entities interested in maximising the effects of social and economic, employment and culture impacts arising from the construction of the Technology Park.
Of this economic contribution 10 percent is earmarked for the province or the provinces where the site is located, 55 percent to the municipality or municipalities in which the site is located and 35 percent to the neighbouring communities, these being those of which the territory falls entirely or partially within an area included within a 25 km radius from the centre of the Repository building.

Figure 3: Total investment (component A2) 1.5 billion Euro (up to 1 billion to be added for research projects funded by other instruments)



7.3. Costs of handling radioactive waste from the usage of radioisotopes for medical and industrial activities

These are the costs incurred by the companies that operate in the national market for the management of radioactive waste

As regards radioactive waste belonging to ENEA, NUCLECO S.p.A. carries out the activities against costs reaching approximately 1 million Euro/year for the safekeeping and treatment of the waste produced by ENEA laboratories and plants.
This portion of ENEA waste could increase by approximately 5 percent per year until the construction and operation of the National Repository: when the approximately 5 year period of transfers to the Repository begins (the start date is to be established based on the general transfer programme), the safekeeping portion will gradually decrease.

The financial resources are assigned as part of the ordinary State contribution for the operation of ENEA and therefore they are State financial resources.

The costs connected to the management of radioactive waste which are incurred by the Integrated Service are approximately 1 billion Euro/per year including the collection and treatment of radioactive waste generated by biomedical activities and scientific research on the national territory.
Account should be taken of the fact that the estimate of the costs above is based on the NUCLECO S.p.A. Financial statements of the last 5 years, in which there is a subdivision between public and private financing of approximately 50 percent for each.
Furthermore, in particular for 2014, NUCLECO S.p.A. had a market share equal to approximately one third of the national market.

Consequently, the total connected costs nationally are estimated to be approximately 3 million Euro/year, an amount which can be considered constant over time even in the absence of the construction and operation of the National Repository.

7.4. Costs associated with the research and development activities for solutions for management of spent fuel and radioactive waste

The financial resources used for the management of spent fuel and radioactive waste produced by the research sector are provided by public institutions that operate the nuclear plants for research (universities and research centres).
The management of the radioactive waste that originates from the research plants takes place according to prescriptions connected to the operating licenses of the individual nuclear sites, including use of the Integrated Service.
An estimate of the resources used in the last decade for research and development activities on the management of spent fuel and radioactive waste is approximately 5 million Euro distributed between co-financed European projects for approximately 3 million Euro (personnel 50%, investments 30% and current expenses 20%) and national programmes for approximately 2 million Euro (personnel 50%, investments 12% and current expenses 38%).
A similar figure, with a very similar financing scheme, should be invested in research and development activities including in the period prior to the construction of the Technology Park, reinforcing where possible the national research programmes, which have a multiplier effect on the resources that can be acquired with European Projects.

Therefore, the research infrastructures for spent fuel and radioactive waste to be constructed within the Technology Park will have a commitment of resources that is certainly higher, contributing to forming the cost which is estimated at over one billion Euro (partially in a lump sum) between personnel, purchasing of instruments, design, construction and maintenance of the infrastructures in operation.

In any case, according to the provisions of the law, the operator of the Technology Park can use the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) and other research entities, which can submit for approval to the Ministry of Economic Development and the Ministry of the Environment and the Protection of Land and Sea a programme for research and development activities in the field of the management of spent fuel and radioactive waste. Therefore, the rough assessment made above must be verified and approved by the two competent Ministries, once the overall framework of the construction is clearer.

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