Radioactive waste Repository in Italy and annexed Technology Park

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Summary. — Radioactive waste is produced, in advanced industrial countries, by many activities, including medical, industrial and research fields. In Italy such waste, increasing year after year, has to be added to those deriving from nuclear activities. Italy operated Nuclear Power Plants (NPPs) until 1987, when they were shutdown after a referendum. After a ten year stand-by, in 1999 the Italian Government created SOGIN, a public company charged for NPPs decommissioning and for the safe and responsible management of the Italian radioactive waste, acting as a Waste Management Organisation (WMO). Such management, following international guidelines and best-practice, is framed and implemented in a holistic approach, Radioactive Waste Management (RWM), that aims to guarantee safety "from cradle to grave", from the moment when a radioactive waste is produced to the moment when it can be disposed of accordingly to safety standards, that include a classification of radioactive waste, assigning specifical requirements for disposal of each category of waste. The overall amount of radioactive waste is described and analysed, in each country, in a National Inventory. The Italian National Inventory is composed of many and different waste streams. This situation was originated from a pioneering nuclear programme started in the early '60s, from a spread and diversified industrial installations, and from publicly enhanced research and medical activities. Following international best practices, Italy has adopted and is implementing a National Programme for RWM, that provides the disposal of some $78\,000\,\mathrm{m}^3$ of radioactive waste in a near-surface repository, the National Repository (NR). A smaller amount of radioactive waste, some $17\,000\,\mathrm{m}^3$, will be hosted in the NR for a long-term interim storage (50 to 100 years), waiting for its final disposal in a Geological Disposal Facility (GDF), that is required to be built deeply underground.

The siting procedure for the NR is designed following a "mixed-mode approach", that combines technical and engineering criteria with others referred to societal and economic aspects, in order to draw a National Map of Potentially Suitable Areas. SOGIN drafted this Map in 2014, and held a Public Consultation and a National Workshop (2021) to discuss, with a wide range of stakeholders, modifications to be applied in a National Map of Suitable Areas, that is currently waiting for green light from the government for its publication. After the publication of the National Map of Suitable Areas, Regions and local communities concerned will be asked to issue an expression of interest, aimed to start consultation with SOGIN (Project's Implementer) to define an agreement that includes the research of a suitable site in the territory to host the NR. Together with the NR, a Technology Park will be built to carry out activities related to the NR operations, and other activities to be developed in various branches, from radiological and environmental protection to research laboratories. The choice of activities to be developed will be agreed with hosting communities.

1. – Radioactive waste: origins, classification and management

The origin of radioactive waste is related to several human activities, and can be split in two main areas. The first one is the nuclear sector, that includes NPPs, fuel-cycle installations, research reactors, military activities. The second one is the "institutional sector", that is not assoc iated to nuclear activities but nevertheless produces radioactive waste, through the use of sources for diagnostic and therapeutic activities in medicine, for the sterilisation of medical equipment and food products, for welding verification and other industrial activities. Figure 1 shows the origin of the Italian radioactive waste, to be disposed of in the National Repository.

Whatever could be the origin of radioactive waste, they need to be early identified and safely managed to avoid hazard for human kind and for the environment. In order to improve this task, the United Nations-based International Atomic Energy Agency (IAEA) provides a classification of radioactive waste designed taking into account the level of activity in the radioactive material and the half-life of radionuclides concerned, calculated as the time required for each radionuclide to decay to halve its level of radioactivity. Figure 2 shows IAEA's classification of radioactive waste with disposal and storage provisions.

As a consequence, depending on the decay periods, IAEA radioactive waste classification is directly linked to the appropriated disposal facility type for each waste.

Such classification is based on the following categories of radioactive waste, and each category is associated to a specific solution required for storage and disposal needs:

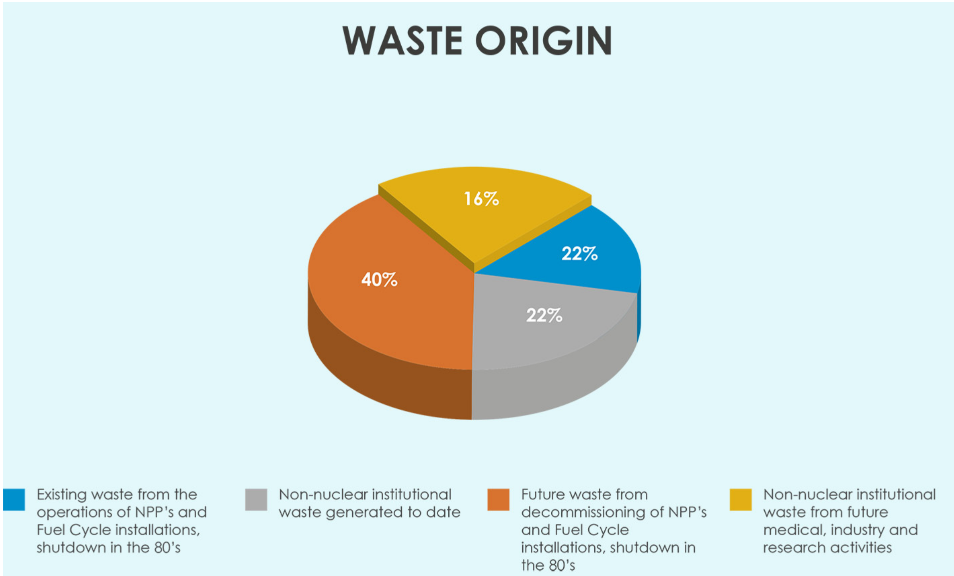

Fig. 1. – Origin of the radioactive waste.

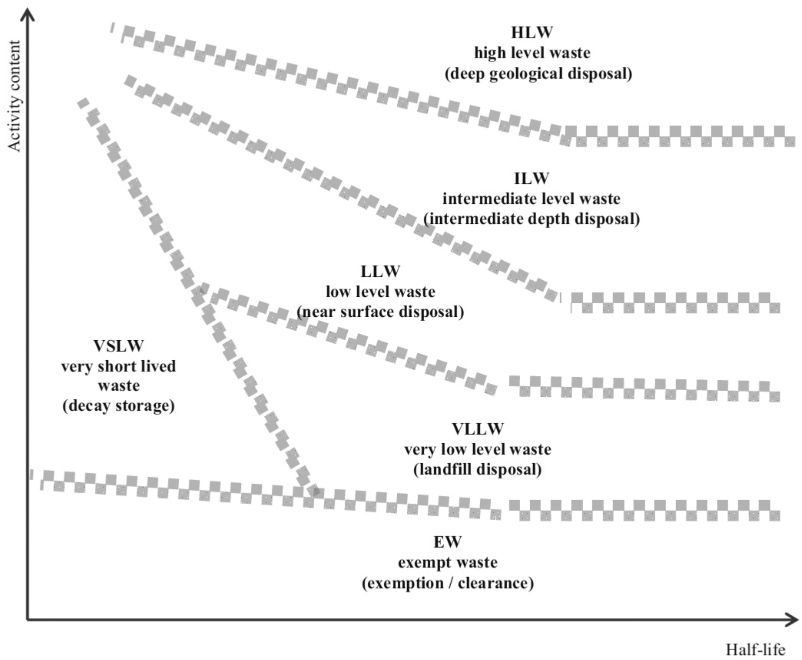

Fig. 2. – Schematic illustration of the IAEA Safety Guide No. GSG-1 "Classification of Radioactive Waste", 2009.

- Exempt Waste (EW): can be cleared as its radioactivity level is negligible;
- Very short-lived waste (VSLW): can be stored until its decay to a conventional waste;
- Very Low Level Waste (VLLW): can be disposed of in a landfill;
- Intermediate Level Waste (ILW): can be disposed of at an intermediate depth;
- High Level Waste (HLW): requires a deep geological disposal facility.

Some differences arise in the selected solutions in different countries: some of them (Sweden, Finland, South Korea) have an "open fuel-cycle policy", implying that a bar of fuel is immediately defined as waste after its usage, while the majority of countries have a "closed fuel-cycle policy", with fuel reprocessing; some countries have a huge amount of particular categories of waste, like LLW-LL (Low Level Waste - Long Lived) and plan to realise specific disposal facilities for them; some countries (Switzerland) plan to realise a single disposal facility for all of waste categories, or plan (Italy) to dispose of VLLW together with LLW; almost all European countries are considering whether or not including NORM (Naturally Occurring Radioactive Materials) and TE-NORM (Technologically Enhanced Naturally Occurring Radioactive Materials) among radioactive waste, with the alternative option of finding more suitable solutions.

An early identification of the final solution in terms of storage and disposal (by far the most crucial part of the RWM) is a good driver for all of the activities to be scheduled and implemented in the previous stages, so that it is possible to refer to them as "pre-disposal activities". Pre-disposal activities are mainly the following:

- Pre-treatment

  It is the group of preliminary activities that must be performed before the waste's treatment can be started. Pre-treatment activities include *collection* of waste (that sometimes can be spread in a site or in a facility); *segregation* of waste (that is often in a compound form to be changed in order to allow the treatment); *chemical treatment* (a phase planned and performed to address chemical issues separately from radiological ones); *decontamination* (that can be also perfomed in multiple phases).

- Treatment

  Waste treatment is a general category that is applied with different techniques for various materials and waste streams. The most important among them are the following:

  - *Waste reduction – Super compaction*: with a hydraulic press an effective volume reduction can be performed, reaching a factor of reduction from 2 to 10 times the previous volume of waste. The compacted pellets are then placed in overpacks for subsequent conditioning.

- *Thermal treatment – Fusion*: This is a technology widely used in the nuclear sector and allows for the recycling of more than 95% of the initial material. Radioactivity is concentrated in the melt slag (< 5% of initial volume).
- *Decontamination*: A part of the decontamination process may be performed during the treatment stage. Abrasive materials (metal balls or sand) are used to remove the surface contamination in order to reduce the final amount of waste. The removed surface material and the abrasive are collected and managed as radioactive waste, the recirculation of the abrasives allows secondary waste to be minimised. It is applicable to most materials except those that may be crushed from the abrasive (*e.g.* glass or plexiglass). It is most effective on flat surfaces and because the abrasive is sprayed, it is also applicable to areas difficult to reach.

– Conditioning

Conditioning activities are crucial in making the waste package much closer to the form it will have when stored and/or disposed of. The most relevant techniques are the following:

- *Encapsulation*: it is the process of immobilising solid waste by applying a fluid matrix (often cement-based) that completely penetrates the waste to form a solid monolith;
- *Embedding*: it is a typical solid waste immobilisation process, where the waste is incorporated into clay, mortar, sand, cement, etc. Generally, the elements (or additives) are inserted in the form of a fluid matrix together with the waste in a container, so that the voids can be filled and form a solid monolith. This process is generally used to immobilise waste in cylindrical and/or prismatic containers ("large containers");
- *Solidification*: is the immobilisation process of non-solid waste (generally liquid or semi-liquid waste) which is generally applied by mixing the waste with cement, additives and water. A disposable stirrer is used to homogenize the mixture. The cement is then dried as for the "encapsulation process" to form a solid monolith;
- *Vitrification*: High level liquid radioactive waste (fission products obtained from the reprocessing phases of the irradiated fuel) is mixed with molten glass and poured into stainless steel containers (canisters) in order to obtain a solid matrix (vitrified waste). Glass guarantees chemical/physical stability for long periods and is characterised by high resistance to leaching, radioactivity and heat; it therefore constitutes an excellent matrix for the containment of radioactive waste.

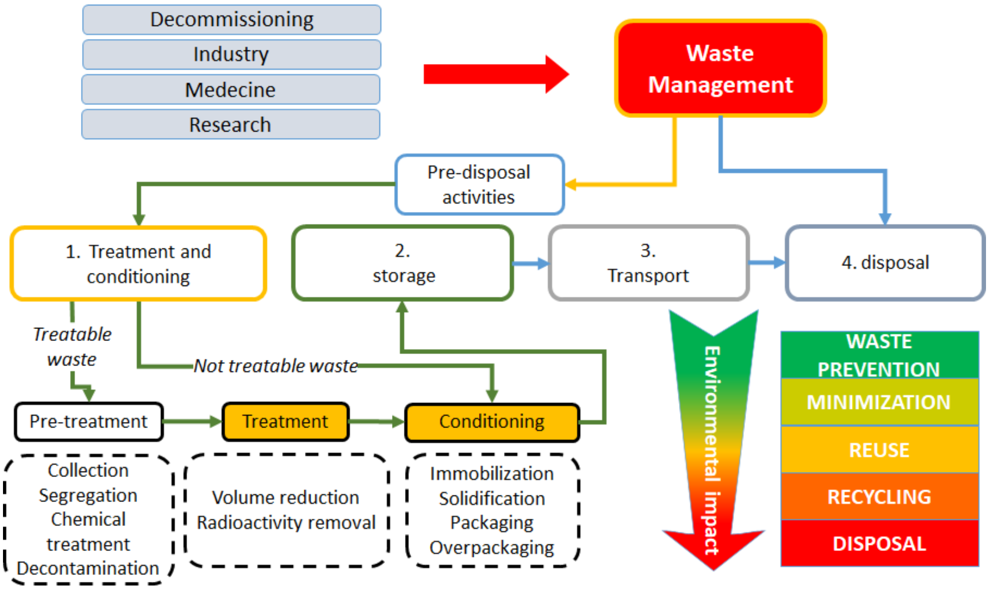

Fig. 3. – Waste management overall strategy.

Predisposal activities are always designed and implemented following the paramount principles of RWM, that aim to: 1) Avoid the generation of waste; 2) Minimise the spread of radioactivity; 3) Minimise the amount of radioactive waste; 4) Optimise possibilities for recycling and reuse. In fig. 3 the overall strategy for the waste management is shown.

2. – Radioactive waste in Italy

2˙1. *Italian nuclear power programme (NPP) until 1987*. – Italy was a pioneer in nuclear energy, starting with research in the late ’40s and with industrial settlement and research reactors in the ’50s. The economical and political relations fostered a diverse development of NPPs: the first unit to be commissioned, in 1958, was a British Magnox with gas-cooled reactor (GCR) at Latina, followed in a couple of years (1959–1961) by US General Electric’s boiling water reactor (BWR) at Garigliano and Westinghouse’s pressurized water reactor (PWR) at Trino Vercellese. In the mid ’60s the three units were transferred to ENEL, the public company built with the nationalisation of the electricity sector. In the ’60s and in the ’70s ENEL promoted the realisation of new NPPs, but the only one approved was a second BWR unit, from a General Electric/Ansaldo partnership, at Caorso, entering the commercial phase in 1981. Meanwhile, in 1978 Garigliano NPP was temporarily shutdown. Although two more units were commissioned (Trino-2; Montalto di Castro), in 1987 a referendum was held on three topics regarding the support to the nuclear programme, intending to make the commissioning of new units more difficult.

The result of the referendum was interpreted by politicians as a message to shutdown the operating NPPs, far beyond the topics, and this decision was ultimately taken in 1990. In 1999 a new company, SOGIN (Società Gestione Impianti Nucleari), was set up as a state-owned enterprise to take over ENEL's NPPs. In the following years ENEA's research reactors and fuel-cycle facilities were also transferred to SOGIN, that with its subsidiary NUCLECO is responsible for decommissioning the Italian nuclear facilities and, as waste managemant, for the global radioactive waste managing.

2˙2. *Decommissioning activities*. – Decommissioning (dismantling) is the last stage of a nuclear power plant lifecycle, after its building and operation stage. The decommissioning process generally involves removing fuel, carrying out the facility radiological characterisation, the decontamination of structures and, lastly, the site radiological characterisation. Any of these operations is carried out in a safe working place. This process also involves managing the radioactive waste stored in specific interim storage facilities, and all other materials resulting from dismantling operations such as iron, copper or concrete, which will be then reused or removed from the site to be recovered and recycled. The demolition of the power plant structures, the conditioning of radioactive waste and its storage in interim facilities ready to be transferred to the National Repository, allows the place to be defines as "brown field".

After the gradual transfer of radioactive waste to the National Repository, the interim storage facilities are also dismantled. At this stage, after having verified that no radiological risks are present, the brown field becomes a "green field" and the site can be reused by the community.

Decommissioning is a challenge for engineers, because Italian nuclear power plants were designed without considering their possible future dismantling. An accurate planning is necessary for the implementation of decommissioning programmes, which must be carried out in parallel with the development of specific technological solutions, often prototypes, that cannot be produced on a large scale.

"Safe enclosure" is the process to shut down a nuclear power plant which involves all the steps for the implementation of a "deferred dismantling". This approach implies that the facility decontamination and dismantling are carried out after several decades from its closure; on the one hand, this period allows the natural decay of greater part of radioactivity in the site, and, on the other hand, it helps fixing a financial framework and evaluating the costs for the disposal of radioactive waste.

In Italy, in 1990 the Italian Government opted for a deferred decommissioning (or "Safstor") strategy, with the goal of waiting for better conditions for implementing decommissioning. In 1999 this decision was reversed, deciding to adopt the accelerated decommissioning strategy. SOGIN is currently implementing decommissioning activities aimed to reach the status of "brown field", when spent nuclear fuel is removed from the site, and that of "green field", when the site can be released and its use is no more restricted by radiological constraints. The schedule of such states is the following:

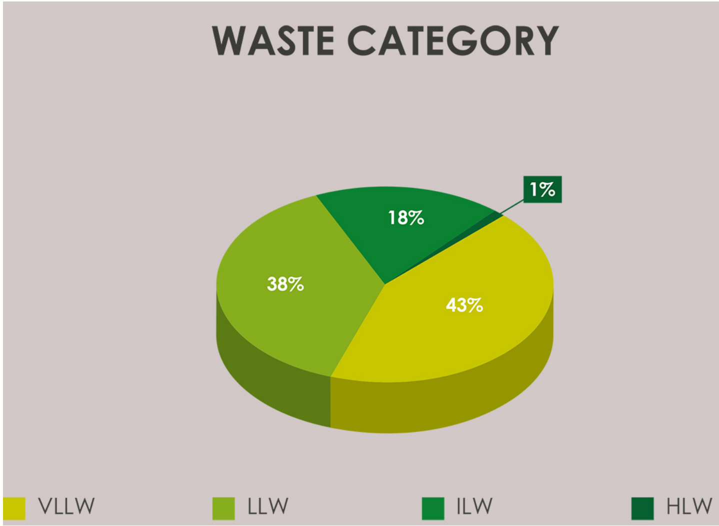

Fig. 4. – National inventory of radioactive waste categories. VLLW = Very Low Level Waste, LLW = Low Level Waste, ILW = Intermediate Level Waste, HLW = High Level Waste.

– Trino Vercellese NPP, brown field 2030, green field 2040

– Caorso NPP, brown field 2031, green field 2039

– Latina NPP, brown field 2042, green field 2043

– Garigliano NPP, brown field 2028, green field 2042

– Bosco Marengo fuel fabrication plant, brown field reached, green field 2036

– Saluggia fuel-cycle facility, brown field 2037, green field 2041

– Casaccia fuel-cycle facility, brown field 2030, green field 2042

– Trisaia fuel-cycle facility, brown field 2038, green field 2040

2˙3. *National inventory of radioactive waste*. – The forecast amount of radioactive waste to be disposed of (VLLW/LLW) in the National Repository is about 78 000 m^3, and includes existing waste (40%) originated from operation of NPPs and fuel-cycle facilities; waste to be generated (22%) through decommissioning activities of the aforementioned installations; existing institutional waste (22%) from medicine, industry and research activities; institutional waste to be generated in the future (16%). The forecast amount of radioactive waste to be stored (ILW/HLW) is about 17 000 m^3 (see fig. 4).

2˙4. *Italy's national programme for radioactive waste managenent.* – Duties of issuing and implementing a programme in RWM, already in force by national and international commitments, had a major enhancement with the 2011/70/Euratom, a Directive from European Commission that makes a National Programme mandatory for all Member States, to be updated every five years, for the safe and responsible management of radioactive waste and spent fuel. The word "responsible" implies that final solutions must be addressed and implemented, in order to avoid undue burdens to future generations.

The main aspects of the italian nuclear programme, in line with the 2011/70/Euratom Directive's requirements, are the following:

- Guaranteeing adequate funds for the safe and responsible management of spent nuclear fuel and radioactive waste for all of the envisaged phases, until final disposal.
- Treatment and conditioning of waste to be stored or disposed of in the national repository to be realised.
- Transport abroad of the spent nuclear fuel to be reprocessed.
- Receiving back, from France and United Kingdom, the residues foreseen by the reprocessing contracts.
- Temporary storage of waste at the production sites.
- Siting and realisation of the National Repository, for Disposal of Very Low and Low Level Waste and long-term interim storage of Intermediate and High Level Waste.
- Active evaluation of opportunities to realise a European Geological Repository with other countries interested in this project, with a back-up solution of implementing a national Geological Repository.
- Implementing RD&D aimed at the safe management of Spent Nuclear Fuel and Radioactive Waste.
- Guaranteeing transparency and effective participation in the relevant decision-making processes related to the spent nuclear fule and radioactive waste management.
- Guaranteeing awareness about radioactive waste and preservation of technical competences for the future, a challenging aspect for a country that no longer has a Nuclear Programme.

3. – National Repository for Radioactive Waste

3˙1. *Disposal Programme.* – A Disposal Programme for disposal of Italian radioactive waste began in the '70s, with the first attempts of drawing maps of potentially suitable areas, taking into account general principles on geological and technical aspects that were available by date.

Between the late '90s and the early 2000s a series of evaluations (Commissione Cenerini, Conferenza Stato-Regioni) produced different ideas about the opportunity of realising a single repository for all-category wastes, or two different repositories. In 2003 the Government tried to jump directly to the conclusion, providing by law the decision of realising a single repository at Scanzano Jonico, in Southern Italy, but the project was soon halted by lack of political support and protests of local communities.

In 2010 a new law was passed (Decreto Legislativo 31), relaunching a nuclear programme in Italy and providing a series of Articles about designing, siting, realising and operating a National Repository for the disposal of VLLW and LLW and for the long-term interim storage of ILW and HLW, together with a Technology Park, tasks assigned to SOGIN with definitions about preliminary design, siting procedure and decision-making process. The part of the Decree related to the nuclear energy option was cancelled due to a referendum, while the part regarding the National Repository is still in force.

The phases of National Repository and Technology Park

There are four main phases in the life of the National Repository: pre operation, operation, closure and post-closure

- *Pre-operation phase* (about 20 years): siting, design, licensing and construction activities.
- *Operation phase* (about 40 years): the repository receives VLLW/LLW packages to be disposed of in the surface repository and ILW/HLW packages/casks to be temporarily stored in the Interim Storage Facility.
- *Closure phase* (about 10 years): the repository is closed and sealed, ready for the institutional control period.
- *Post closure phase* (about 300 years)
  - *Institutional control period*: the repository is monitored both in active and passive way to guarantee the actual isolation of the waste from the environment.
  - *Site release*: the repository is released from radiological constraints; dose constraint to be agreed with the Regulator.

3˙2. *Preliminary Design.* – The Preliminary Design of the National Repository and Technology Park includes three different areas:

- the area dedicated to VLLW-LLW surface disposal.
- the area which hosts the Complex for centralized long-term storage of ILW-HLW.
- the Technology Park, with common facilities and R&D labs devoted to D&WM as well as sustainable development activities to be agreed with the local communities.

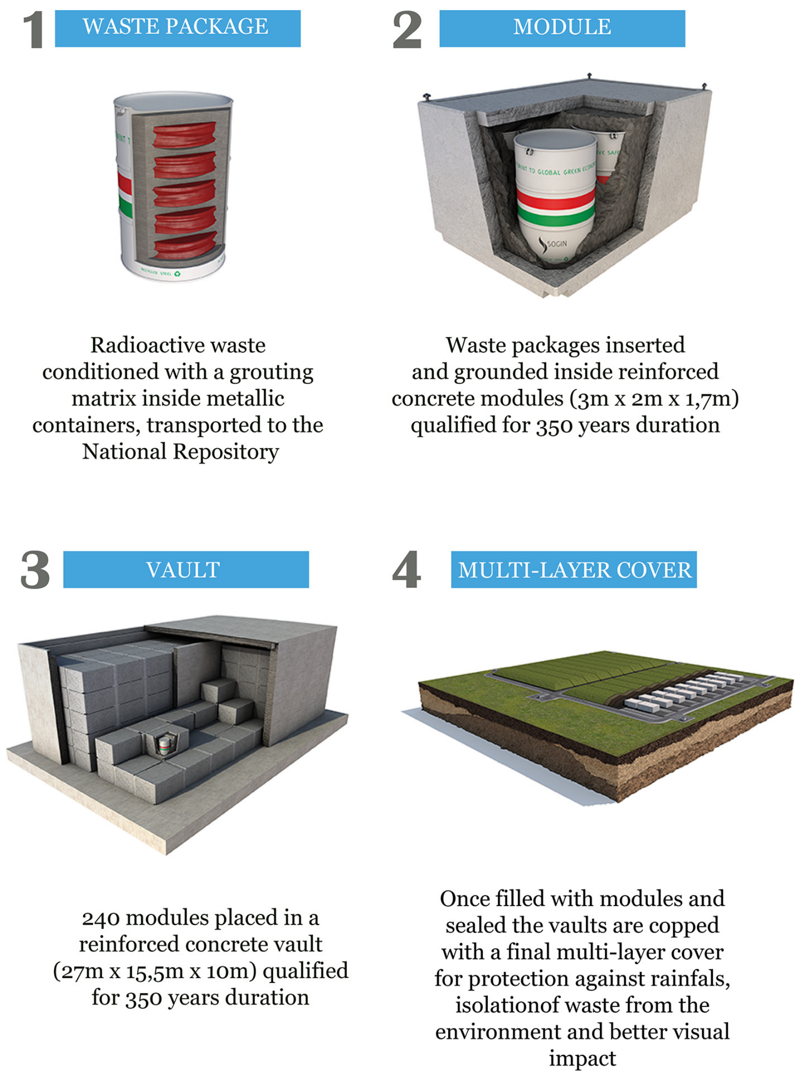

Fig. 5. – Schematic illustration of the multibarrier concept.

The Preliminary Design of the disposal is in line with international guidelines and European best practices and the so-called "multi-barriers system". The concept is based on a series of three technical engineered barriers: the waste package, a conditioned grouting matrix that contains the waste; the module, a reinforced concrete structure that hosts many waste packages; the vault, a reinfored concrete construction that may host up to 240 modules. A fourth engineered barrier is the multy-layers cover that will be posed on the vaults after the loading operations. There is one more barrier for the radioactivity, the natural one: the site where the repository is inplaced. Figure 5 shows the series of engineered barriers of the National Repository.

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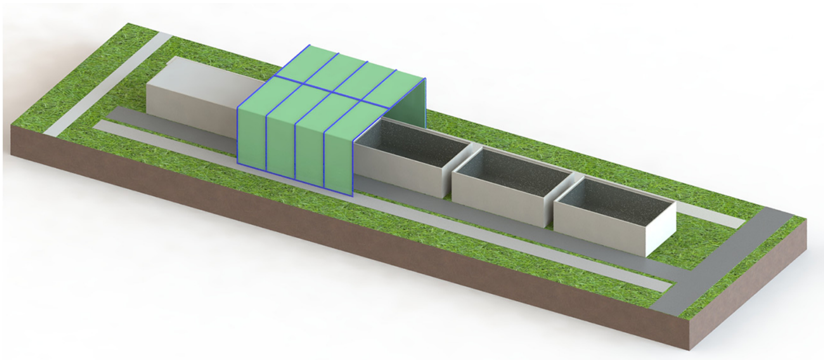

Fig. 6. – Mobile gantry crane/cover system on the operating vaults.

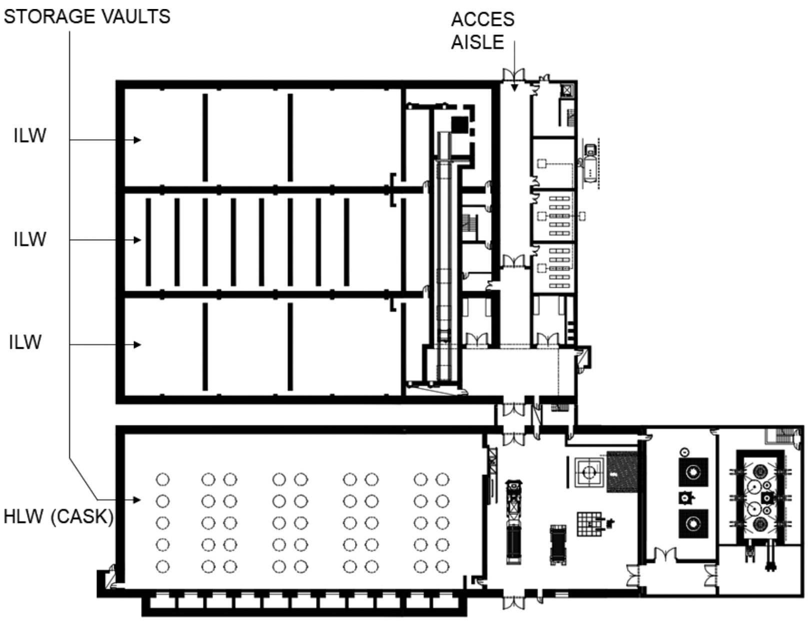

Fig. 7. – Long-term centralized storage building with casks area.

During the loading process the vaults are protected from weather agents by a mobile cover as shown in fig. 6. The movement of the modules inside the vault takes place via a gantry crane designed to prevent the loads from falling. The spaces between the modules are filled with inert material to allow the possible recovery of the module itself, if needed.

Containment and isolation of the waste are ensured by a combination of the engineered barriers in series and the natural geologic characteristics of the site. The engineered barriers system shall be designed and the host environment shall be selected so as to provide containment of the radionuclides until radioactive decay has significantly reduced the hazard posed by the waste.

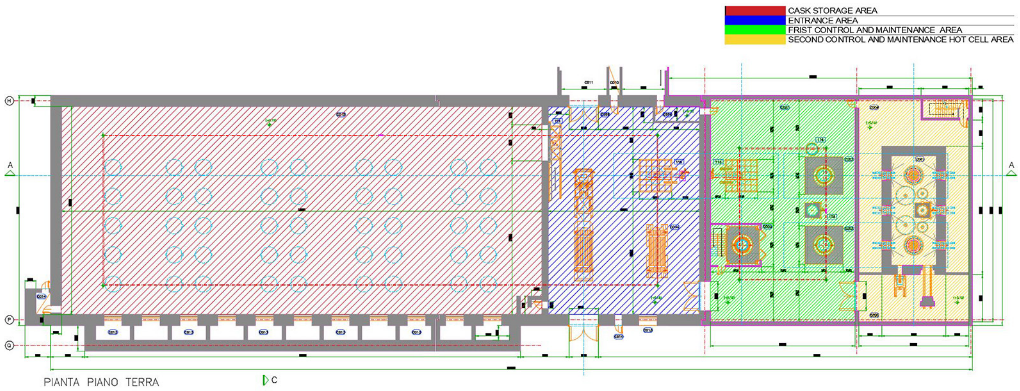

Fig. 8. – Casks management areas.

The structures for centralized long-term interim storage are also aligned to best international examples, in particular the Zwilag centralised storage facility (Switzerland) and the HABOG facility at Borssele (The Netherlands). The concept of the storage complex for the long-term storage of ILW-HLW includes 4 similar buildings, that will be realised to host waste with different features in separated halls. The halls are connected through an access aisle for the transfer of the ILW waste packages. One of the buildings (see fig. 7) will host the hall dedicated to HLW/ILW, vitrified and compacted residues from fuel reprocessing and non-reprocessable irradiated fuel that will be stored in "dual purpose" casks, high integrity and shielded containers qualified for safe transport and storage.

The area dedicated to the casks includes some control and maintenance rooms of the casks themselves (see fig. 8), throughout the entire storage period; in fact, there is a special area, shielded and instrumented by remote-controlled tools and devices, the so-called "hot cell", to carry out monitoring and/or maintenance operations on the internal part of the casks up to possibly their complete replacement.

3·3. *Siting.* – The Decree 31/2010 requested SOGIN to apply a set of siting criteria to be elaborated by ISPRA (now ISIN, Ispettorato Nazionale per la Sicurezza Nucleare e la Radioprotezione-, National Inspectorate for Nuclear Safety and Radiation Protection), the Nuclear Regulatory Authority. ISPRA provided (2014) a list of 15 exclusion criteria and 13 in-depth investigation criteria, on the basis of international guidelines acknowledged by IAEA.

The exclusion criteria comprehend the fundamental aspects about the geological and environmental features of italian territory (*e.g.* volcanic activities, seismic activity, hydraulic and naturalistic features), with human aspects (*e.g.* cities, roads, underground resources, industrial activities).

The investigation criteria were applied on a more detailed scale, taking into account peculiarities like lythotypes, endorheic river basins, chemical paraters of soil and groundwater, and many others.

SOGIN drafted within the 6 months assigned by law its Proposal of CNAPI (Carta Nazionale delle Aree Potenzialmente Idonee-, National Map of Potentially Suitable Areas). Such proposal remained freezed, though continuously updated by SOGIN and ISPRA/ISIN, waiting for the green light from the Government for its publication, that finally came in January 2021. With the publication of the proposals of CNAPI and of the Preliminary Design, SOGIN launched the Public Consultation provided by Decree 31 for collecting, from a wide range of stakeholders, observations and technical contributions on both proposals.

The Public Consultation had its momentum in a National Workshop that was planned and arranged in Autumn 2021. Due to the pandemic, SOGIN had to renounce holding public meetings, nevertheless a series of virtual and hybrid meetings enabled a wide range of stakeholders, mostly from Regions and local communities, to exchange their views, to increase the level of discussions and to have an impact on the decision-making, providing contributions that SOGIN had to take into account.

As provided by law, SOGIN has indeed drawn a new map, CNAI (Carta Nazionale delle Aree Idonee – National Map of Suitable Areas), that is currently under review by ISIN, and that will be published after green light from the Government is obtained.

3˙4. *Decision-making.* – Within 30 days after the publication of CNAI, SOGIN will send a formal invitation, to Region and local communities concerned, to issue in the following 60 days an expression of interest to host the National Repository and Technology Park.

Expressions of interest are not binding, and have the aim of discussing with Project's Implementer (SOGIN) several topics, to state the Agreement in a formal Protocol, and then to start the site investigation phase. This is a key aspect of a decision-making process that is founded on a semi-voluntaristic approach, that combines the application of a series of tecnical criteria with the goal of a shared decision with Regions and local communities.

In case of a lack of expressions of interest, SOGIN starts bilateral negotiations with the Regions concerned, in order to promote agreements to sign a Protocol. If more Protocols will be signed, through this negotiations or through the expressions of interest mentioned above, each of them will be dealt for the site investigation phase, taking into account a priority list made upon technical, environmental, social and economic aspects.

If an agreement is not reached, the Government will convene an inter-institutional Committee, with the advice of the Unified State-Regions Conference, to promote shared decisions in that organism. In case of further failure, a decision from the Government is envisaged.

4. – Technology Park

The idea of realising a Technology Park annexed to the National Repository is provided by the Decree 31/2010, but it was not a novelty nor a unique concept. The most similar idea was the Spanish "Parque Tecnologico Asociado" (Annexed Technology

Fig. 9. – A concept image of the Technology Park from the call for ideas.

Park) to the realisation of the “Almacén Temporal Centralizado” (Centralised Interim Storage), that Spain would need to implement in order to remove the spent nuclear fuel from temporary storage facilities in operating and decomissioning NPPs.

There are many examples of diverse activities hosted in radioactive waste repositories and in their surroundings, in different countries. In Belgium a visiting centre (Tabloo) has been built by Belgian WMO and Project’s Implementer (ONDRAF-NIRAS) on the site that will host a near-surface repository for LLW, at Dessel for permanent exhibition on radioactivity, its human usage, radiological protection and radioactive waste, and for public meetings and other initiatives from local communities. Figure 9 shows an example for Technology Parx concept, collected in the competition (Concorso di Idee).

Implementing such activities is a part of a package of benefits for the hosting communities, together with direct benefits, job opportunities, and infrastructure improvements. It also helps creating a sense of community, reversing a paradigma that implies a stigma associated to “dead” radioactive waste, and realising instead a living centre in everyday life. It is a part of aknowledgment to local communities that, agreeing in hosting a national strategic infrastructure, helped solving a national relevant problem.

Such acknowledgment and guarantees for local communities must be designed for a very long time, since the National Repository will occupy a portion of soil for about three and a half centuries. For this reason the goal of a sustainable development must be assured by a set of activities that will survive the end of operational phase, and that will everlast during the long post-closure phase (Institutional Surveillance Period).

The peculiar Italian situation is that of a country that exited its nuclear programme decades ago, and that nevertheless needs to preserve its technical competences and expertise in the nuclear and radiological sector. For this reason, the role of the Technology Park is twofold: on the one hand, that of strenghtening the activities carried out in the National Repository, with the presence of services common to both areas, environmental analysis laboratories, training centres for the personnel employed in the infrastructure, research laboratories to improve radiation protection techniques, and so on.

On the other hand, the Technology Park will make it possible to develop a wider spectrum of research activities, which will be agreed with the local communities who will host the National Repository, also taking into account the specific features of the territory. In this sense it is worth considering that the siting of the National Repository is still running, and that many potentially suitable areas differ a lot from a socio-economic and environmental perspective.

The aforementioned activities will be developed with a financial system that will attract investments from both public and private sectors, thanks to the profitable situation guaranteed by the presence of the infrastructure itself, and National and International scientific communities will be engaged in the development of the research laboratories together with the local communities.

A list of the activities that may be among research and laboratories includes:

– Laboratories on new technologies for decommissioning and radioactive waste management, for new characterisation system, new treatment and conditioning solutions for special waste, new monitoring systems for environment and workers, research activities for implementing a geological disposal facility in Italy, use of nuclear science to exploit new solutions on other fields; modification of general solutions to be applied on nuclear field.

– Laboratories for environmental analyses, where analyses will be carried out on liquid environmental samples and solids (air, drinking water, vegetables, milk, etc.) both inside and outside the site, in order to confirm the absence of contamination.

– Research laboratories for sustainable development and for new solutions on renewable energies, to be agreed upon with hosting communities during the site selection phase.

– Visitors centre.

– Education and training structures, in a first phase to personnel assigned to National Repository, and subsequently, to foster the opportunities for young residents in the area which will host the National Repository, specific post-graduate courses will be organised, in order to make the Technology Park a unique centre of education and training at national level.

5. – Conclusion: where we stand

The reference solution adopted for National Repository & Technology Park, to be realised for disposing of the National Inventory of VLLW and LLW radioactive waste and for the centralized long-term interim storage of ILW and HLW, in a site that will be selected accordingly with the international guidelines, is ready and is safe, though safety measures will need to be stepwise confirmed by regulator's role and by monitoring.

This solution is to be implemented because its implementation is an essential element to achieve the "*green field*" status in the Italian nuclear installations, eliminating all constraints related to radiation and following new proposals for sites reuse as well as to manage all radioactive waste, including that produced by industrial, research and nuclear medicine activities.

Decommissioning activities are running year after year, they are getting closer to their final steps, but these steps are closely related to National Repository availability and to the safely disposing of radioactive waste pastly and currently generated.

SOGIN has been dealing for more than a decade with the necessity of raising awareness about radioactive waste and the National Repository solution, and the results at a national level are quite satisfying. Like many other countries, the major problem is to find a suitable site not only in terms of feasibility, but in terms of public acceptance, and the outcomes of Public Consultation and National Workshop show that there is still a lot of work to be done.

As a Project's Implementer, SOGIN has the competences and the resources to pursue this goal, following international guidelines and best practices, that in many cases (Belgium, Slovenia, Switzerland) showed the opportunities of finding shared solutions even recovering from previous failures. But the line between failure and success is made by responsibilities that involve a wide range of stakeholders, at both national and local level, and each of them is called to act in a clear and constructive way, to change the status quo.

Like other Project's Implementers, SOGIN has to respect the international safety guide lines as well as the legal framework and the decision-making process set at political level. In this narrow space, SOGIN is trying to improve its relationships with different stakeholders, through drivers like involvement, transparency and sustainability's respect, and is ready to restart dialogue with Regions and local communities, with the aim of building up partnerships as legal entities to find common ground.

In conclusion, solutions of implementing the National Repository and Technology Park exist, just to be applied with shared decisions in the sense of solving both a crucial *national challenge* and an opportunity in ways that reflect the *values* and *interests* of local communities and surrounding region.