ISPRA
Istituto Superiore per la Protezione
e la Ricerca Ambientale

Unofficial translation

Technical Guide N. 29

Siting criteria for a near surface disposal facility for low and intermediate level radioactive waste

EXPLANATORY NOTES

2014

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

TECHNICAL GUIDE N. 29

Siting criteria for a near surface disposal facility for low and intermediate level radioactive waste

EXPLANATORY NOTE

Radioactive waste in Italy

Radioactive waste in Italy arises from past nuclear activities and from applications in industry, medicine and research. In the first case waste is stored at the production sites (former nuclear power plants and research facilities for which a decommissioning program is in place), while in the other cases waste is located in specific facilities authorised for collection, treatment and storage.

According to the data provided by the operators to ISPRA, in Italy today there are around 27,000 m^3 of low and intermediate level radioactive waste (first and second category)[1] of which approximately 5000 m^3 derives from activities not related to energy production (i.e. medical, industrial applications, etc.), and about 1700 m^3 of the highest level (third category), in large part still to be conditioned.

Other waste to be added to the above mentioned quantities is that one generated from the dismantling of nuclear installations, of an estimated amount of some tens of thousands of m^3 (approximately 30,000), mainly of low and intermediate level, as well as high level conditioned waste resulting from the reprocessing of irradiated fuel to be returned to Italy from UK (about 20 m^3 of third category vitrified waste) and from France (about 50 m^3 of the third category waste).

In addition an amount of about 200-300 m^3 of low and intermediate level waste, not related to energy production, has also to be considered.

The safe management of radioactive waste requires the definition of a clear national strategy with an associated action plan that identifies an appropriate solution for all types of radioactive waste, as foreseen by the Directive 2011/70/Euratom, setting up a community framework for the

[1] According to radioactive waste classification provided by Technical Guide n. 26 the following categories are defined: first category waste which decays in a period of a few months to a maximum of a few years; second category waste which decays in a period of a few decades to a few hundreds of years; third category wastes which decays in a period of more than thousands years and beyond.

responsible and safe management of spent nuclear fuel and radioactive waste, transposed into the Italian legislation by the Legislative Decree n. 45 of 4 March 2014.

There are also international obligations, stemming from the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*[2]. It is to be noted that as part of the periodic peer review conferences of the Joint Convention undertaken under IAEA's (International Atomic Energy Agency) auspices, the need for Italy to realize and operate a national radioactive waste disposal facility has been always highlighted.

We should also mention that an intergovernmental agreement with France, signed in 2006 on the reprocessing of spent fuel, defines clear deadlines for the return to Italy of the conditioned high level waste resulting from the reprocessing activities, therefore requiring a suitable structure for its interim storage.

Legislative Decree n. 31/2010 and subsequent amendments establishes a policy for the management of radioactive waste based on the disposal of low and intermediate level waste and on the long term interim storage of high level waste and spent fuel.

The unavailability of a national repository for radioactive waste requires to build new storage facilities at the nuclear sites or to refurbish the existing ones (as already done at some sites), either to improve the present waste storage conditions (in many cases waste is stored in already obsolete facilities, whose design doesn't comply with the actual requirements for interim storage), and to allow decommissioning operations through the availability of suitable facilities for the storage of the produced waste.

In the case that the national disposal facility would not be constructed, all operators, responsible for the pertaining radioactive waste, will therefore have to ensure the safe storage of their own waste at their sites in proper long-term storage facilities. It should be considered in this regard that the siting criteria of a NPP differ in several aspects from those of a disposal facility for radioactive waste. Just think about to one of the guiding criterion for the siting of a NPP, which is the availability of water, while the main guiding principle for the siting of a disposal facility of radioactive waste is certainly the isolation from water, which is the main factor influencing the radionuclides transfer into the biosphere.

We must than highlight the importance of the availability of a disposal facility for low and medium level radioactive waste also to ensure proper management of waste resulting from medical,

2 The Joint Convention entered into force in June 2001, and in October 2013 had 69 Contracting States. Italy has ratified the Joint Convention with the Law n. 282 of 16 December 2005.

industrial and research activities, which are presently stored at facilities not suitable for a long-term management. It has to be considered that this type of waste, differently from those deriving from the past nuclear program, will continue to be generated in the future.

A facility for the long term storage is needed to ensure the safe storage of high level wastes, in particular the vitrified waste that will be returned to Italy as result of the reprocessing of spent fuel in UK and France, and the small amount of spent fuel, not interested by the reprocessing campaign and still present in Italy.

It has to be considered that high level wastes have a decay period of hundreds of thousands years and a surface disposal is not suitable for such a waste while, a deep geological disposal is recognized as the most appropriate solution at international level. It has however to be considered that, according to Directive 2011/70/Euratom, recently transposed into the national legislation, Italy shall have to identify in its National programme a solution for the disposal of high level wastes.

It must be said that over the years, the Parliament and the Government have undertaken several initiatives to address the problem of radioactive waste management. In this regard it is worth to recall the work of the Bicameral Commission of inquiry on waste cycle in the years 1995-1999, which provided the basis of the document of the Ministry of Economic Development, *"Strategic guidelines for the management of the Nuclear heritage"* of 1999, the work of the Working Group set up under the Agreement between the Government, Regions and Autonomous Provinces for the safe management of radioactive waste in 2001[3] and the conclusions of the Working Group set up in 2008 by the Ministry of economic development[4].

Key legislative provisions

Title III of the Legislative Decree n. 31/2010 establishes the siting process as well as the construction and operation process of a National Disposal Facility, to be realized in a Technology Park, including also a research and study centre.

It must be highlighted that the National Disposal Facility, as defined at point e) of paragraph 1 of article 2 of Legislative Decree n. 31/2010, is intended for the disposal of low and intermediate level radioactive waste resulting from industrial, research and medical applications or from the

3 Final Report of the Working Group on the conditions for the safe management of radioactive waste (State-Regions Agreement of 4 November 1999) – 25 May 2001

4 Final Report of the Working Group established with Decree of the Minister of Economic Development dated 25 February 2008, *"Identification of procedures and methodology for the selection of a national site for the location of a radioactive material repository and a high standard technology research facilities"*

past operation of nuclear facilities, as well as for long-term interim storage of high level waste and spent fuel deriving from the past operation of nuclear installations.

In particular, paragraph 1 of article 26 of the aforementioned legislative Decree establishes that SO.G.I.N S.p.A. is the subject responsible for construction and operation of the National Disposal Facility and the associated Technology Park.

As far as the definition of siting criteria for the national disposal facility and related authorization and control, the same Decree refers to the Agency for Nuclear Safety[5], established by Article 29 of Law n. 99/2009 and subsequent amendments. In this regard it has to be noted that, following the abrogation of the same Agency, pursuant to Article 21 of Decree-Law n. 201 of 6 December 2011, as amended by law n. 214 of 22 December 2011, its tasks and functions have been temporally assigned to ISPRA, pursuant to paragraph 20-bis of the same article.

The Legislative Decree n. 45/2014 establishes the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN) as the competent authority, whose functions and duties however continue to be carried out by ISPRA until ISIN will become fully operative.

With regard to the siting process, paragraph 1 of Article 27 of Legislative Decree n. 31/2010 establishes that SO.G.I.N S.pA, taking into account the criteria set up by the IAEA and by the Agency for nuclear safety, has to propose a National Chart of potentially eligible areas, suitable to host the National Disposal Facility and the Technology Park, proposing at the same time also an order of suitability on the basis of the technical characteristics of the areas and socio-environmental aspects, as well as a preliminary design of the facility.

It can be summarized that, in relation to the siting of the National Disposal Facility, the Legislative Decree n. 31/2010 provides that the proposed National Chart of the potentially eligible areas together with a related order of suitability as well as the preliminary design of the facility have to be published on the website of SO.G.I.N. S.p.A. to allow Regions, local authorities and qualified stakeholders to formulate observations and technical proposals within sixty days from the publication. This publication can be done after the approval of the Ministry for the environment and protection of land and sea and the Ministry of economic development, issued on the basis of the technical assessment conducted by ISIN (now ISPRA).

Within 60 days SO.G.I.N. S.p.A. will promote a National Seminar to which the relevant Ministries and the Agency, the Regions, the Provinces and the Municipalities on whose territory the areas proposed in the National Chart fall, as well as the Union of the Provinces, the National

5 As established by Legislative Decree n. 45/2014, any reference to the Agency for Nuclear Safety is presently referred to ISPRA and, once operational, to ISIN

Association of the Italian Municipalities, the industry Associations of the concerned Provinces, and the most representative Trade Unions, Universities and Research institutions of the concerned areas will be invited. The Seminar will give the opportunity to discuss in detail all technical aspects related to the Technology Park, with particular reference to the full and timely compliance of the identified areas with the siting criteria established by the IAEA and the Agency as well as aspects related to the safety of workers, public and the environment.

Based on the seminar's outcomes and in relation to the publication of the National Chart of potentially eligible areas and the presented preliminary project, SO.G.I.N. S.p.A will update its proposal of National Chart and will submit it to the Ministry of economic development. The Minister himself with his own decree, in consultation with the Minister for the environment and protection of land and sea and the Minister of infrastructure and transport, based upon the advice of the Agency, will adopt the National Chart of eligible areas.

Following a very structured process the Ministry of economic development, will define a proposal of those eligible areas on which a consensus by the interest regions have already been declared. In each of these areas and until the identification of the suitable site to host the Technology Park, SO.G.I.N S.p.A., within 15 months, shall perform the necessary technical investigations according to the procedures defined by the Agency. The Agency will supervise the performance of the technical examinations, will study the final results and express to the Ministry of economic development its binding advice on the suitability of the proposed site. As a result of the technical investigation, SO.G.I.N. S.p.A. will submit its proposal for the identified suitable site to the Ministry of economic development.

After having received the proposal, the Minister of economic development, based upon the Agency binding advice, and in consultation with the Minister for the environment and protection of land and sea and the Minister of infrastructure and transport, as well as the Minister for education, university and research for aspects related to research activities, will identify with a proper decree the site suitable for the construction of the Technology Park.

Key aspects of the Technical Guide's development process

In July 2012, the Ministry of economic development, with a specific note submitted to the Ministry of environment and protection of land and sea and to ISPRA, highlighting the importance of continuing the implementation of the decommissioning plan concerning existing nuclear installations, pursuant to article 24 of Law n. 27/2012 and the priority to be assigned to the

definition of the technical criteria for the siting procedure of the National Disposal Facility and of the related Technology Park, pinpointing the opportunity for ISPRA to begin the related activities. This in order to allow SO.G.I.N. S.p.A. to define the proposal of the National Chart of potentially suitable areas, as established by the provisions of the Legislative Decree n. 31/2010.

ISPRA has decided to proceed to the indication of these criteria by issuing a Technical Guide, pursuant to article 153 of the Legislative Decree n. 230/1995 and subsequent amendments. It should be noted that ISPRA's Technical Guides are documents aimed at disseminating good technical practices related to operational and technical procedures for implementing legislative provisions in the field of nuclear safety and radiation protection, and aimed at defining criteria and methodology of the related control activities to be performed by ISPRA. Requirements established in the technical guides are expected to be taken into account by the Operators during the process of site selection, development of projects to be approved and implementation of operational activities. Verification of compliance with requirements set up in Technical Guides is carried out by the technical assessment associated to the licensing procedure, and during the subsequent control activities.

In relation to the type of installations that have to be developed pursuant to Legislative Decree n. 31/2010 - a disposal facility for low and intermediate level radioactive waste and a long-term interim storage facility for high level radioactive waste and irradiated fuel – ISPRA, in defining the contents of the Technical Guide, has considered the following.

With regard to the disposal of low level radioactive waste – mostly containing short lived radionuclides, namely with a half-life of less than 30 years and low concentrations of long lived radionuclides - and for intermediate level radioactive waste which decay below certain concentration levels so as to comply with established radiation protection objectives within a period of some hundreds of years, international recommendations consider suitable a disposal in near surface facilities. The high safety and radiation protection standards required for this type of facilities are ensured by radionuclides isolation and containment achieved by the waste conditioning and by the characteristics of the engineering structures of the facility together with those related to the site, particularly over the period following the institutional control. It should be in particular noted that the same Legislative Decree n. 31/2010, with reference to the post-operation phases of the radioactive waste disposal facility, defines a closure phase, characterized by the completion of loading of the waste in the facility, including final engineering or other works required to make the installation safe in the long term, as well as a period of institutional control, which marks the phase following the closure, in which the controls continue to be exercised by the competent authorities.

For near surface disposal facilities of low and intermediate level radioactive waste this period generally ranges from 50 years to a few hundred years, depending on the radiological inventory of the facility and the decay period of the main radionuclides.

In this regard some construction and operation experiences already exist in Europe, consolidated throughout the years (for example in France and Spain), while in other countries the construction of such structures is planned for the near future (for example in Belgium and Slovenia) and the related licensing process is ongoing.

It should be pointed out that, according to the IAEA classification, the intermediate level radioactive waste includes also wastes other than those mentioned above, whose concentrations and content of long-lived radionuclides require an isolation level higher than that typical of a near surface disposal facility. According to the international practice these wastes have to be disposed in medium-deep facilities (50-100 meters), to be distinguished from facilities in deep geological formations (100-1000 meters) required for the disposal of high-level radioactive waste and irradiated fuel.

The complexity of the deep geological waste disposal facilities, where the natural barriers are the only parameters that are considered in the long term safety analysis (for periods of hundreds of thousands of years), the site qualification takes a long time.

In fact, with the only exception of the transuranic radioactive waste disposal facility (TRU) of the Waste Isolation Pilot Plant (WIPP, the USDOE, repository in deep saline basin in operation since 1999), there are no other repositories worldwide for deep waste disposal. Their technical features are currently under study in major nuclear countries through underground laboratories. The operation of this type of disposal facility is not expected before 2030, and Sweden and Finland will probably be the first countries to implement such a strategy.

In the light of the above concerns, intermediate level radioactive waste containing high concentrations of long-lived radionuclides in Italy will be stored in the long term interim storage facility for the high level radioactive waste and for the limited quantity of residual spent fuel, as provided for by the Legislative Decree n. 31/2010, the latter of which will remain in Italy, not being involved in the reprocessing abroad.

For the interim storage facility, the compliance with the established safety and radiation protection objectives for normal operation and accident conditions can be ensured by an appropriate design of the engineering structures and waste conditioning, providing that the proposed facility is properly designed against the conceivable natural and human induced events

related to the site characteristics. Providing the positive outcome of the above mentioned assessments, a site that will be recognized to be suitable for the construction of a near surface disposal facility of low and intermediate level radioactive waste on the basis of the criteria identified in the Technical Guide, may be considered suitable also for the siting of a long term interim storage facility.

According to what said and taking into account international experiences and recommendations provided by international organizations, ISPRA has therefore issued a Technical Guide setting out the siting criteria for a near surface disposal facility for low and intermediate level radioactive waste. This Technical Guide has been issued also to support the procedures referred to in Legislative Decree n. 31/2010 in relation to the definition of a National Chart of potentially suitable areas and subsequent phases of investigation and assessments for the identification of the suitable site.

If in the suitable site selected according to the criteria defined in the Technical Guide it will be decided to realize, as envisaged in the Legislative Decree n. 31/2010, a long term interim storage facility for high level radioactive waste and for residual spent fuel, evidence shall be provided by the implementer during the pertaining licensing process on the overall compliance of this type of facility with the selected site.

For this purpose criteria defined in IAEA Guides for nuclear installations, as applicable, as well as specific criteria that will be defined in a specific ISPRA Technical Guide for radioactive waste interim storage facilities under preparation shall have to be taken into account.

In order to develop the Technical Guide n. 29 a specific Working Group was established at ISPRA, composed - due to the multidisciplinary nature of the subject - of experts from the Department of nuclear, technological and industrial risk, the Department of soil protection, the Department of nature protection and the Department on environment state.

The Working Group, using the studies performed in the past, with particular reference to the conclusions of the Working Group established in 2008 by the Ministry of Economic Development, as well as using IAEA recommendation, prepared a preliminary version of the Technical Guide n. 29 in December 2012.

Based on this preliminary version, and in order to take into account experiences gained in Europe in the definition of siting criteria, ISPRA deemed it necessary to exchange views with the nuclear safety authorities of European countries that already have similar structures - France (near surface facility) and Switzerland (interim storage facility for high level waste) - or countries that

are going to have them in the near future (Belgium and Slovenia), as well as to submit the Technical Guide to an international peer review by the international Atomic Energy Agency. The process was completed in October 2013.

Subsequently a consultation was performed involving the concerned relevant national technical bodies pursuant to the mentioned Article 153 of the Legislative Decree n. 230/1995. In particular the following administrations were consulted: Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA), Istituto Geografico Militare (IGM), Istituto Superiore di Sanità (ISS), Istituto Nazionale di Geofisica e Vulcanologia (INGV), Consiglio Nazionale delle Ricerche (CNR).

Following the evaluation of the received comments and motivated proposals of amendments the final version of the Technical Guide n. 29 -*"Siting criteria for a near surface disposal facility for low and intermediate level radioactive waste"* has been issued.

It should be considered that the compliance with the criteria set out in the Technical Guide shall have to be adequately demonstrated during the various phases of the licensing process as envisaged by the Legislative Decree n.31/2010.